American Urological Association Guideline: Management of Benign Prostatic Hyperplasia (BPH)

Revised, 2010

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Chapter 1: Guideline on the Management of Benign Prostatic Hyperplasia (BPH)

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Introduction

Benign prostatic hyperplasia (BPH) is a histologic diagnosis that refers to the proliferation of smooth muscle and epithelial cells within the prostatic transition zone.^{1, 2} The exact etiology is unknown; however, the similarity between BPH and the embryonic morphogenesis of the prostate has led to the hypothesis that BPH may result from a "reawakening" in adulthood of embryonic induction processes. The enlarged gland has been proposed to contribute to the overall lower urinary tract symptoms (LUTS) complex via at least two routes: (1) direct bladder outlet obstruction (BOO) from enlarged tissue (static component) and (2) from increased smooth muscle tone and resistance within the enlarged gland (dynamic component). Voiding symptoms have often been attributed to the physical presence of BOO. Detrusor overactivity is thought to be a contributor to the storage symptoms seen in LUTS.³ This Guideline attempts to globally encompass the concept of LUTS in a broad spectrum of etiologies, and focuses treatment (e.g., active surveillance, medical and surgical) on the management of such symptoms.

The prevalence and the severity of LUTS in the aging male can be progressive, and is an important diagnosis in the healthcare of our patients and the welfare of society. In assessing the burden of disease, the Urologic Diseases in America BPH Project examined the prevalence of moderate-to-severe LUTS reported in U.S. population-based studies that used the definition of an American Urological Association (AUA) Symptom Index (SI) score of ≥7.⁴ Results from the Olmsted County Study showed a progressive increase in the prevalence of moderate-to-severe LUTS, rising to nearly 50% by the eighth decade of life. The presence of moderate-to-severe LUTS was also associated with the development of acute urinary retention (AUR) as a symptom of BPH progression, increasing from a prevalence of 6.8 episodes per 1000 patient years of follow-up in the overall population to a high of 34.7 episodes in men aged 70 and older with moderate to severe LUTS. Another study has estimated that 90% of men between 45 and 80 years of age suffer some type of LUTS.⁵

Although LUTS secondary to BPH (LUTS/BPH) is not often a life-threatening condition, the impact of LUTS/BPH on quality of life (QoL) can be significant and should not be underestimated.⁴ When the effect of BPH-associated LUTS on QoL was studied in a number of community-based populations, for many, the most important motivations for seeking treatment were the severity and the degree of bother associated with the symptoms. These were also important considerations when assessing BPH and deciding when treatment is indicated.⁶

Traditionally, the primary goal of treatment has been to alleviate bothersome LUTS that result from prostatic enlargement. More recently, treatment has additionally been focused on the alteration of disease progression and prevention of complications that can be associated with BPH/LUTS. A variety of pharmacologic classes are employed including alpha-adrenergic antagonists (alpha-blockers), 5-alpha-reductase inhibitors (5-ARIs), anticholinergics and phytotherapeutics. Choosing the correct medical treatment for BPH is truly complex and ever-changing.

In the management of bothersome LUTS, it is important as healthcare providers that we recognize the complex dynamics of the bladder, bladder neck, prostate and urethra, and that symptoms may result from interactions of these organs as well as with the central nervous system. It is the hope that this revised clinical Guideline will provide a useful reference on the effective evidence-based management of male LUTS secondary to BPH. This 2010 Guideline reviews a number of important

aspects in the management of LUTS presumed secondary to BPH including available diagnostic tests to identify the underlying pathophysiology and to assist in symptom management. Pharmacotherapies-including complementary and alternative medications (CAM) and watchful waiting, as well as lifestyle issues-- are addressed. The current literature on the standard surgical options as well as on minimally invasive procedures was similarly reviewed. Despite the rigorous methodology and detail used in these various areas, supporting high-quality data (i.e., randomized controlled trials) could not be identified for some topics. In these situations, the Panel, not surprisingly, was forced to suggest best practices based on expert opinion.

In more recent years, the association between LUTS and erectile dysfunction (ED) has been clarified. Lifestyle factors – such as exercise, weight gain and obesity –appear to have an impact on LUTS. We expect these concerns to grow in importance with the aging of our nation and the obesity epidemic. Because prevalence of LUTS increases with age, the burden and number of men complaining of LUTS will rise with the increasing life expectancy and growth of our elderly population. This will place increased demands for treatment services, and necessitate the incorporation of evidence-based medicine in treatment therein.

Definitions and Terminology

For this Guideline, the **Index Patient** is a male aged 45 or older who is consulting a qualified healthcare provider for his LUTS. He does not have a history suggesting non-BPH causes of LUTS and his LUTS may or may not be associated with an enlarged prostate gland, BOO, or histological BPH. Although the Index Patient defined in the 2003 Guideline was aged 50 or older, the Panel has lowered the age for inclusion in this Guideline, as this lower age group can present with LUTS.

LUTS include storage and/or voiding disturbances common in aging men. Storage symptoms are experienced during the storage phase of the bladder and include daytime frequency and nocturia; voiding symptoms are experienced during the voiding phase. LUTS may be due to structural or functional abnormalities in one or more parts of the lower urinary tract that comprises the bladder, bladder neck, prostate, distal sphincter mechanism, and urethra. Of note, LUTS may result from abnormalities of the peripheral and/or central nervous systems that provide neural control to the lower urinary tract. LUTS may also be secondary to cardiovascular, respiratory or renal dysfunction or disease. Thus, this disease entity is particularly complex to evaluate, survey and treat. In men, enlargement of the prostate gland from hyperplasia can cause BOO and be a major cause of LUTS or mimicked by other issues, such as infection, malignancy, central-peripheral neurologic disease or overactivity/hypoactivity of detrusor muscles.

In the past, a number of terms have been used to describe these LUTS in the male. These have varied from BPH, clinical BPH, BOO, prostate enlargement, or prostatism. It is becoming widely accepted that the symptoms we relate in many older males may not have an etiology in prostate enlargement. For that reason, the term "LUTS independent of BPH" has been introduced and is gaining worldwide acceptance. Regardless, the concept of LUTS secondary to BPH (LUTS/BPH) is meaningful to clinicians. Less frequently, LUTS/BPH has been associated with other comorbidities including AUR, renal insufficiency, and the development of gross hematuria, bladder calculi, urinary incontinence and recurrent urinary tract infection (UTI).^{8,9}

The **overactive bladder syndrome** is defined as urgency with or without urge incontinence, usually with frequency and nocturia.

Detrusor overactivity is a urodynamic observation characterized by involuntary detrusor contractions during the filling phase. These contractions may be spontaneous or provoked.

The term "benign prostatic hyperplasia" is reserved for the histological pattern it describes. Benign prostatic enlargement is used when there is gland enlargement and is usually a presumptive diagnosis based on the size of the prostate. Benign prostatic obstruction (BPO) is used when obstruction has been proven by pressure flow studies, or is highly suspected from flow rates and if the gland is enlarged. Bladder outlet obstruction (BOO) is the generic term for all forms of obstruction to the bladder outlet (e.g., urethral stricture) including BPO.

The AUA-SI and the International Prostate Symptom Score (I-PSS) (Appendix A6)^{10, 11} are nearly identical, validated short, self-administered questionnaires, used to assess the severity of three storage symptoms (frequency, nocturia, urgency) and four voiding symptoms (feeling of incomplete emptying, intermittency, straining, and a weak stream). The I-PSS also assesses the degree of bother associated with the seven symptoms in the aforementioned symptom severity score with one additional QoL question: "If you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about that?" A three-point improvement in the AUA-SI is considered meaningful. For consistency in this Guideline, the term "AUA-SI" will be used when discussing the tools unless specifically differentiated in a study being cited. The BPH Impact Index (BII) (Appendix A5) is a questionnaire that assesses the effect of symptoms on everyday life and their interference with daily activities, thus capturing the impact of the condition. This questionnaire can be administered in conjunction with the AUA-SI and provides useful additional information to the single QoL question.

This Guideline does not apply when other disease pathologies are known to be responsible for LUTS, such as prostate cancer or other genitourinary tract malignancies, or when LUTS are due to significant comorbidities (e.g., severe diabetes mellitus or neurologic disease), concomitant medications, UTIs, prior pelvic surgery, or trauma. In addition to being responsible for the symptoms, these excluded clinical scenarios, diseases and/or conditions may affect treatment in a manner outside the purview of this Guideline.

Methodology

The clinical guideline statements presented in this document were based on a systematic review and synthesis of the clinical literature on current and emerging therapies for the treatment of BPH. The methodology followed the same process used in the development of the 2003 Guideline and, as such, did not include an evaluation of the strength of the body of evidence as will be instituted in future Guidelines produced by the AUA. The full description of the methodology presented in Chapter 2 can be accessed at http://www.auanet.org/content/guidelines-and-quality-care/clinical-guidelines.cfm.

The expert Panel examined three overarching key questions for pharmacotherapeutic, surgical and alternative medicine therapies: (1) What is the comparative efficacy (the extent to which an intervention produces a beneficial result under ideal conditions such as clinical trials) and effectiveness (the extent to which an intervention in ordinary conditions produces the intended result) of currently available and emerging treatments for BPH? What are the predictors of beneficial effects from

treatments? (2) What are the adverse events associated with each of the included treatments, and how do the adverse events compare across treatments? (3) Are there subpopulations in which the efficacy, effectiveness, and adverse event rates vary from those in general populations?

The guideline statements were drafted by the Panel based on the outcomes data and tempered by the Panel's expert opinion. As in the previous Guideline, statements were graded using three levels with respect to the degree of flexibility in their application. A "standard" has the least flexibility as a treatment policy; a "recommendation" has significantly more flexibility; and an "option" is even more flexible. These three levels of flexibility are defined as follows:

- 1. **Standard**: A guideline statement is a standard if: (1) the health outcomes of the alternative interventions are sufficiently well known to permit meaningful decisions and (2) there is virtual unanimity about which intervention is preferred.
- 2. **Recommendation**: A guideline statement is a recommendation if: (1) the health outcomes of the alternative intervention are sufficiently well known to permit meaningful decisions, and (2) an appreciable but not unanimous majority agrees on which intervention is preferred.
- 3. **Option**: A guideline statement is an option if: (1) the health outcomes of the interventions are not sufficiently well known to permit meaningful decisions, or (2) preferences are unknown or equivocal. Options can exist because of insufficient evidence or because patient preferences are divided and may/should influence choices made.

The guideline was examined by 69 peer reviewers, and approved by the Practice Guidelines Committee and the Board of Directors of the AUA. The Guideline is published on the AUA website (http://www.auanet.org). A summary version of the Guideline will be published in *The Journal of Urology*.

Diagnostic Evaluation

The Panel decided that the diagnostic section of the 2003 Guideline required updating. After review of the recommendations for diagnosis published by the 2005 International Consultation of Urologic Diseases¹² and reiterated in 2009 in an article by Abrams et al (2009), the Panel unanimously agreed that the contents were valid and reflected "best practices". ¹³ The diagnostic guidelines by Abrams et al (2009) are revisited in Appendix A7. ¹³ Two treatment algorithms, one on the basic management of LUTS in men and one on the detailed management for persistent bothersome LUTS—were adapted for this Guideline and are included in Appendix A1 as Figures 1.1 and 1.2, respectively. ¹³

Basic Management

The algorithm describing basic management of BPH/LUTS classifies diagnostic tests as either recommended or optional. A "recommended test" should be performed on every patient during the initial evaluation whereas an "optional test" is a test of proven value in the evaluation of select patients. In general, optional tests are performed during a detailed evaluation by a urologist.

If the initial evaluation demonstrates the presence of LUTS associated with results of a digital rectal exam (DRE) suggesting prostate cancer, hematuria, abnormal prostate-specific antigen (PSA)

levels, recurrent infection, palpable bladder, history/risk of urethral stricture, and/or a neurological disease raising the likelihood of a primary bladder disorder, the patient should be referred to a urologist for appropriate evaluation before advising treatment (Figure 1.1 in Appendix A7). Baseline renal insufficiency appears to be no more common in men with BPH than in men of the same age group in the general population.

Not Recommended: The routine measurement of serum creatinine levels is not indicated in the initial evaluation of men with LUTS secondary to BPH. [Based on review of the data and Panel consensus.]

When initial evaluation demonstrates the presence of LUTS only, with or without some degree of nonsuspicious prostate enlargement, if the symptoms are not significantly bothersome or if the patient does not want treatment, no further evaluation is recommended. The patient should be reassured and can be seen again if necessary. This recommendation is based on the opinion that patients with nonbothersome LUTS are unlikely to experience significant health problems in the future due to their condition.

In patients with bothersome symptoms, it is now recognized that LUTS has a number of causes that may occur singly or in combination. Among the most important are BPO, overactive bladder, and nocturnal polyuria. The physician can discuss with the patient treatment alternatives based on the results of the initial evaluation with no further tests being needed (See Figure 1.1 Recommended Tests in Appendix A7). There should be a discussion of the benefits and risks involved with each of the recommended treatment alternatives (e.g., watchful waiting, medical, surgical, or minimally invasive surgical treatments). Then the choice of treatment is reached in a shared decision-making process between the physician and patient.

If the patient has predominant significant nocturia and is awakened two or more times per night to void, it is recommended that the patient complete a frequency volume chart for two to three days. The frequency volume chart will show 24-hour polyuria or nocturnal polyuria when present, the first of which has been defined as greater than three liters total output over 24 hours. In practice, patients with bothersome symptoms are advised to aim for a urine output of one liter per 24 hours. Nocturnal polyuria is diagnosed when more than 33% of the 24-hour urine output occurs at night. Nocturia should be managed according to the algorithm in Figure 1.1 in Appendix A7 in that fluid intake should be reduced; other treatments, such as desmopressin, can also be considered. If symptoms do not improve sufficiently, these patients can be managed similarly to those without predominant nocturia.

If the patient has no polyuria and medical treatment is considered, the physician can proceed with therapy by focusing initially on modifiable factors such as concomitant drugs, regulation of fluid intake (especially in the evening), lifestyle (increasing activity) and diet (avoiding excess of alcohol and highly seasoned or irritative foods). ¹⁴ If pharmacological treatment is necessary, it is recommended that the patient be followed to assess treatment success and possible adverse events. The time from initiation of therapy to treatment assessment varies according to the pharmacological agent prescribed. An interval of two to four weeks is recommended for alpha-blockers and at least a three-month interval is recommended for 5-ARIs.

If treatment is successful and the patient is satisfied, once yearly follow-up should include a repeat of the initial evaluation. The follow-up strategy will allow the physician to detect any changes Copyright © 2010 American Urological Association Education and Research, Inc. ® that have occurred -- more specifically, if symptoms have progressed or become more bothersome, or if a complication has developed that requires surgery.

Detailed Management

If the patient's LUTS are being managed by a primary care giver and the patient has persistent bothersome LUTS after basic management, then a urologist should be consulted. The urologist may use additional testing beyond those recommended for basic evaluation (Figure 1.2 in Appendix A7).

If drug therapy is considered, decisions will be influenced by coexisting overactive bladder symptoms and prostate size or serum PSA levels. If there are coexisting BOO and overactive bladder symptoms then the patient can be treated with combination alpha-blocker and anticholinergic therapy. When BOO symptoms predominate, alpha-adrenergic blocking agents are the first treatment of choice for LUTS due to BPH. However, alpha-blockers alone, 5-ARIs alone, and/or combination alpha-blocker and 5-ARI therapy have shown the most efficacy when the prostate is enlarged as assessed by PSA levels, transrectal ultrasound (TRUS) or on DRE (Figure 1.2 in Appendix A7). As always, the decision for choice of therapy should be decided in concert with the patient's wishes and concerns.

If storage symptoms predominate, an overactive bladder due to idiopathic detrusor overactivity is the most likely cause if there is no indication of BOO from flow study. The treatment options of lifestyle intervention (fluid intake alteration), behavioral modification and pharmacotherapy (anticholinergic drugs) should be discussed with the patient. It is the expert opinion of the Panel that some patients may benefit using a combination of all three modalities. Should improvement be insufficient and symptoms severe, then newer modalities of treatment such as botulinum toxin and sacral neuromodulation can be considered. The patient should be followed to assess treatment success or failure and possible adverse events according to the section on basic management above.

Interventional Therapy

If the patient elects interventional therapy and there is sufficient evidence of obstruction, the patient and urologist should discuss the benefits and risks of the various interventions. Transurethral resection is still the gold standard of interventional treatment but, when available, new interventional therapies could be discussed. The techniques accepted for clinical use are summarized below.

If the patient's condition is not sufficiently suggestive of obstruction (e.g., peak urinary flow (Qmax) >10 mL/sec) pressure flow studies are optional as treatment failure rates are somewhat higher in the absence of obstruction. If interventional therapy is planned without clear evidence of the presence of obstruction, the patient needs to be informed of possible higher failure rates of the procedure.

Treatment Alternatives

Standard: Information on the benefits and harms of treatment alternatives for LUTS secondary to BPH should be explained to patients with moderate to severe symptoms (AUA-SI score ≥8) who are bothered enough to consider therapy.

[Based on Panel consensus.]

The patient must be informed of all available and acceptable treatment alternatives applicable to his clinical condition, as well as the related benefits, risks and costs of each modality so that he may actively participate in the choice of therapy (shared decision-making). Some patients with bothersome symptoms might opt for surgery, while others might opt for watchful waiting or medical therapy depending on individual views of benefits, risks and costs. The treatment choices (Table 1) are discussed in this chapter with the supporting evidence presented in Chapter 3.

Table 1.1. Treatment alternatives for patients with moderate to severe symptoms of BPH

Watchful Waiting

Medical Therapies

Alpha-Blockers

- Alfuzosin
- Doxazosin
- Tamsulosin
- Terazosin
- Silodosin*

5- Alpha-reductase inhibitors (5-ARIs)

- Dutasteride
- Finasteride

Combination Therapy

- Alpha blocker and 5-alpha-reductase inhibitor
- Alpha blocker and anticholinergics

Anticholinergic Agents

Complementary and Alternative Medicines (CAM)

Minimally Invasive Therapies

- Transurethral needle ablation (TUNA)
- Transurethral microwave thermotherapy (TUMT)

Surgical Therapies

- Open prostatectomy
- Transurethral holmium laser ablation of the prostate (HoLAP)
- Transurethral holmium laser enucleation of the prostate (HoLEP)
- Holmium laser resection of the prostate (HoLRP)
- Photoselective vaporization of the prostate (PVP)
- Transurethral incision of the prostate (TUIP)
- Transurethral vaporization of the prostate (TUVP)
- Transurethral resection of the prostate (TURP)

^{*}Silodosin was approved by the US Food and Drug Administration but there were no published articles in the peer reviewed literature prior to the cut-off date for the literature search.

Watchful Waiting

Standard: Patients with mild symptoms of LUTS secondary to BPH (AUA-SI score <8) and patients with moderate or severe symptoms (AUA-SI score ≥8) who are not bothered by their LUTS should be managed using a strategy of watchful waiting (active surveillance). [Based on review of the data and Panel consensus.]

Watchful waiting (active surveillance) is the preferred management strategy for patients with mild symptoms. It is also an appropriate option for men with moderate-to-severe symptoms who have not yet developed complications of LUTS and BOO (e.g., renal insufficiency, urinary retention or recurrent infection).

Watchful waiting is a management strategy in which the patient is monitored by his physician but currently receives no active intervention for BPH. The level of symptom distress that individual patients are able to tolerate is highly variable so watchful waiting may be a patient's treatment of choice even if he has a high AUA-SI score. Symptom distress may be reduced with simple measures such as avoiding decongestants or antihistamines, decreasing fluid intake at bedtime and decreasing caffeine and alcohol intake generally. Watchful waiting patients usually are reexamined yearly, repeating the initial evaluation as previously outlined in Figure 1.1 in Appendix A7.

As prostate volume assessed by DRE and/or serum PSA predicts the natural history of symptoms, flow rate and risk for AUR and surgery, patients may be advised, depending on the outcomes of these assessments, as to their individual risk. Measures to reduce the risk, such as medical intervention, may be offered depending on the circumstances.

Medical Management

Alpha-adrenergic Blockers (Alpha Blockers)

Option: Alfuzosin, doxazosin, tamsulosin, and terazosin are appropriate and effective treatment alternatives for patients with bothersome, moderate to severe LUTS secondary to BPH (AUA-SI score ≥8). Although there are slight differences in the adverse events profiles of these agents, all four appear to have equal clinical effectiveness. As stated in the 2003 Guideline, the effectiveness and efficacy of the four alpha blockers under consideration appear to be similar. Although studies directly comparing these agents are currently lacking, the available data support this contention.^{*}

[Based on review of the data and Panel consensus.]

Option: The older, less costly, generic alpha blockers remain reasonable choices. These require dose titration and blood pressure monitoring.
[Based on Panel consensus.]

^{*} Silodosin was approved by the U.S. Food and Drug Administration but there were no relevant published articles in the peer-reviewed literature prior to the cut-off date for the literature search.

Recommendation: As prazosin and the nonselective alpha-blocker phenoxybenzamine were not reviewed in the course of this Guideline revision, the 2003 Guideline statement indicating that the data were insufficient to support a recommendation for the use of these two agents as treatment alternatives for LUTS secondary to BPH has been maintained.

[Based on Panel consensus.]

Alpha-blockers are a widely used class of medications for the treatment of LUTS secondary to BPH. Noradrenergic sympathetic nerves have been demonstrated to effect the contraction of prostatic smooth muscle. Ninety-eight percent of alpha-blockers are associated with the stromal elements of the prostate and are thus thought to have the greatest influence on prostatic smooth muscle tone. Activation of these receptors and the subsequent increase in prostatic smooth muscle tone with urethral constriction and impaired flow of urine is thought to be a major contributor to the pathophysiology of LUTS secondary to BPH.

For the purposes of this Guideline, the specific agents reviewed included alfuzosin, doxazosin, tamsulosin and terazosin as they theoretically act in the location that will have the greatest benefit for symptoms with the fewest side effects. As these agents remain a mainstay of LUTS/BPH therapy, they were considered individually rather than by class. Alpha-blockers produce a significant symptom improvement compared to placebo, which the average patient will appreciate as a moderate improvement from baseline. The minor differences in efficacy noted between the different alpha-blockers are not statistically (when tested) or clinically significant.

The 2003 Guideline suggested that some patients treated with tamsulosin require the 0.8 mg dose to achieve the results obtained with doxazosin and terazosin titrated to response. This may present a cost-effectiveness problem for tamsulosin because the 0.8 mg daily dose requires two tablets and, thus, twice the expense of the lower dose, while the terazosin and doxazosin recommended dosages are available as one unit generic products and priced accordingly. However, during guideline development (March 2010), the Panel became aware that tamsulosin was available as a generic product which may have obviated this problem.

In clinical studies, rates for specific adverse events were low and similar between treatment and placebo groups. Dizziness was the most common adverse event, with rates reported between 2% and 14% in patients receiving alpha-blockers and somewhat lower rates with placebo. With regard to tamsulosin, the 10 % risk of ejaculatory disturbance cited in the 2003 Guideline appears to be lower in a more recent study noted in this review, understanding that this study used alternate metrics to gauge ejaculation alterations.

Although doxazosin and terazosin require dose titration and blood pressure monitoring, they are inexpensive, are dosed once daily, and appear to be equally effective to tamsulosin and alfuzosin. In addition, they have generally similar side effect profiles, except ejaculatory dysfunction which has been reported less frequently with alfuzosin. Moreover, these older agents do not appear to increase the risk of the intraoperative floppy iris syndrome (IFIS), and doxazosin has demonstrated efficacy relative to placebo over four years of follow-up. The Panel wishes to remind clinicians that these agents remain excellent choices for the management of bothersome LUTS attributed to BPH.

In the expert opinion of the Panel, the caveat remains that alpha-blocker monotherapy is not considered optimal therapy for hypertension. LUTS/BPH and hypertension should be managed separately.

Option: The combination of an alpha-blocker and a 5-ARIs (combination therapy) is an appropriate and effective treatment for patients with LUTS associated with demonstrable prostatic enlargement based on volume measurement, PSA level as a proxy for volume, and/or enlargement on DRE.

[Based on review of the data and Panel consensus.]

In previous studies of one-year duration or less, combination therapy proved equal to alpha blocker therapy in efficacy and safety, but superior to 5-ARI therapy.^{18, 19} However, the Medical Therapy of Prostate Symptoms (MTOPS) Study demonstrated that in the long term, among men with larger prostates, combination therapy is superior to either alpha-blocker or 5-ARI therapy in preventing progression and improving symptoms.⁷ It was the opinion of the Panel that there is insufficient information to gauge the utility of alpha-blocker withdrawal among men initially treated with combination therapy. Although not an unreasonable strategy, clinicians need to recognize that the optimal duration of combination therapy prior to discontinuation of the alpha-blocker remains in doubt.

Data from the long-term MTOPS Study suggests a time-limited impact of alpha-blockers on the outcomes of AUR and crossover to surgery. That is, while AUR and surgery rates were lower with doxazosin compared to placebo in the early years of follow-up, by five years rates of these outcomes were similar in both groups. The time-limited effect noted for doxazosin in MTOPS on these outcomes is likely a class effect.

The second major combination therapy study was the four-year, CombAT trial comparing tamsulosin, dutasteride and a combination of both; at present only the two-year data are available and published.¹⁷ In contrast to prior studies, eligible men had a prostate volume > 30 mL by TRUS and a serum PSA level of >1.5 ng/mL. Combination therapy resulted in significantly greater improvements in symptoms compared to dutasteride from month three and tamsulosin from month nine, and in BPH-related health status from months three and 12, respectively. A significantly greater improvement from baseline in peak urinary flow for combination therapy vs. dutasteride and tamsulosin monotherapies from month six was also noted. There was a significant increase in drug-related adverse events with combination therapy vs. monotherapies. The primary endpoints of the four-year analysis are similar to the MTOPS Study and include progression to urinary retention and need for prostate surgery as well as symptom progression.

When comparing results from the MTOPS and CombAT studies, the following important differences must always be considered as they affect many aspects of the trials, including the outcomes (Table 1.2).

Table 1.2. Differences in MTOPS and CombAT Study Characteristics

| | Medical Therapy of Prostate Symptoms Study (MTOPS) | Combination of Avodart and Tamsulosin (CombAT) |
|-------------------------------------|---|---|
| Treatments | Placebo vs finasteride vs doxazosin vs combination | Dutasteride vs. tamsulosin vs. combination |
| Setting | United States; select centers | International > 100 centers |
| Total number enrolled | N=3047 | N=4844 |
| Follow-up time | Up to 5.5 years | 4 years (2-year data available) |
| Endpoints | Composite progression | International Prostate Symptom Score at 2 years; progression at 4 years |
| Prostate size (mean) | 36.3 mL | 55.0 mL |
| Prostate-specific antigen (mean) | 2.4 ng/mL | 4.0 ng/mL |

Intraoperative Floppy Iris Syndrome

Recommendation: Men with LUTS secondary to BPH for whom alpha-blocker therapy is offered should be asked about planned cataract surgery. Men with planned cataract surgery should avoid the initiation of alpha-blockers until their cataract surgery is completed. [Based on review of the data and Panel consensus.]

Recommendation: In men with no planned cataract surgery, there are insufficient data to recommend withholding or discontinuing alpha blockers for bothersome LUTS secondary to BPH.

[Based on review of the data and Panel consensus.]

Intraoperative floppy iris syndrome (IFIS) was first described by Chang and Campbell in 2005 as a triad of progressive intraoperative miosis despite preoperative dilation, billowing of a flaccid iris, and iris prolapse toward the incision site during phacoemusification for cataracts. Operative complications in some cases included posterior capsule rupture with vitreous loss and postoperative intraocular pressure spikes, though visual acuity outcomes appeared preserved. The original report linked this condition with the preoperative use of tamsulosin; iris dilator smooth muscle inhibition has been suggested as a potential mechanism. On the preoperative use of tamsulosin; iris dilator smooth muscle inhibition has been suggested as a

To better understand the implications of IFIS for the use of alpha-blocker therapy for men with LUTS attributed to BPH, two focused literature searches were conducted covering the period 1/1/1999 – 2/5/2009. Reference lists of the retrieved papers were reviewed for additional original reports. A total of 32 unique articles were identified with 11 studies published in 10 reports providing the requisite information on the risk of IFIS. A review of these data supports the following conclusions:

- The risk of IFIS was substantial among men taking tamsulosin, ranging from about 43% to 90% in 10 retrospective and prospective studies (sometimes the denominator for these risks was patients, and sometimes eyes). 20, 22-31
- The risk of IFIS appears to be lower with older, generic alpha-blockers such as terazosin and doxazosin, with IFIS occurring in 0/11 patients (0%), 3/49 patients (6.1%), 1/51 eyes (2.0%) and 1/4 eyes (25%) in the four studies reporting on the risk of IFIS with these agents.^{20, 23, 28, 31}
- There is insufficient exposure data to estimate the risk of IFIS with alfuzosin.
- The dose or duration of alpha-blocker treatment that influences the risk of IFIS is unclear.
- Whether stopping alpha-blocker treatment at any time before surgery mitigates the risk of IFIS is unclear.
- If experienced ophthalmologists are aware of preoperative alpha-blocker use, pre- and intraoperative precautions can be taken to reduce the risk of IFIS complications and attain excellent visual outcomes, ^{21, 24} though it remains unclear if the residual risk and outcomes are any worse than among patients without IFIS.

It is important to note that after the IFIS literature search and review was completed, a study was published in the Journal of the American Medical Association examining the association of recent tamsulosin use with serious postoperative complications (e.g., retinal detachment, lost lens or lens fragment, or endophthalmitis) requiring reintervention within 14 days of cataract surgery. The study found that for every 255 men receiving tamsulosin in the immediate preoperative period, one of these complications would result. The study had insufficient power to determine whether discontinuation of tamsulosin reduced the risk of these complications, and no separate estimate of the risk was provided for other alpha blockers, including alfuzosin. Therefore, the Panel believed that these new findings were supportive of their original conclusions.

5-Alpha-reductase Inhibitors (5-ARIs)

Option: 5-ARIs may be used to prevent progression of LUTS secondary to BPH and to reduce the risk of urinary retention and future prostate-related surgery.

[Based on review of the data and Panel consensus.]

Recommendation: 5-ARIs should not be used in men with LUTS secondary to BPH without prostatic enlargement.

[Based on review of the data and Panel consensus.]

Option: The 5-ARIs are appropriate and effective treatment alternatives for men with LUTS secondary to BPH who have demonstrable prostate enlargement.

[Based on review of the data and Panel consensus.]

The compounds in this class approved for the treatment of BPH, finasteride at a dose of 5 mg daily, and dutasteride at a dose of 0.5 mg tablet daily, differ in two important pharmacological characteristics. 33-35

- Finasteride inhibits exclusively the 5-AR type II isoenzyme, while dutasteride inhibits both types I and II. This difference in activity leads to a reduction in serum levels of dihydroxytestosterone (DHT) by approximately 70% with finasteride compared to approximately 95% with dutasteride.³⁴ However, in the prostate, and specifically in BPH tissues, type II 5-AR is far more common than type I.³⁶ The reduction of DHT in prostate tissues relative to placebo is therefore less pronounced and has been measured at approximately 80% (finasteride)³⁷ and approximately 94% (dutasteride)³⁸.
- The serum half life of finasteride ranges from six to eight hours whereas that of dutasteride is five weeks. This pharmacokinetic difference may have implications in terms of treatment compliance as well as persistence of side effects.³⁹

There are no data from direct comparator trials or other sources to suggest that the clinical efficacy of the two 5-ARIs used for the appropriate indication is different. Comparisons are difficult if not impossible due to the fact that inclusion and exclusion criteria do not match for any trials of finasteride or dutasteride. In different studies, various thresholds have been proposed for the definition of prostate enlargement (25, 30 or 40 mL). In some studies, serum PSA has been recommended as a proxy for prostate size (using usually a threshold of 1.5 ng/dL).

The Panel was not charged with addressing the use of 5-ARIs for chemoprevention but understands the controversies for and against use in that indication.^{40, 41}

Finasteride

In the 2003 Guideline finasteride was found to be an appropriate BPH treatment option based on a thorough review of a large body of evidence consisting of randomized, placebo-controlled studies of one, two and four years duration. With finasteride, the average patient experiences a three-point improvement in the AUA-SI. Finasteride is less effective than an alpha-blocker in improving LUTS and is not an appropriate treatment for men with LUTS who do not have prostatic enlargement. Due to the more progressive nature of the disease in men with larger glands and/or higher PSA values, conservatively treated patients (watchful waiting or placebo groups) face an increasingly worse prognosis, enhancing the difference over time in outcomes between finasteride and no treatment or placebo groups. Finasteride reduces the risk of subsequent AUR and the need for BPH-related surgery with the absolute benefit increasing with rising prostate volume or serum PSA. Reported adverse events are primarily sexually related and include decreased libido, ejaculatory dysfunction, and ED. These events are reversible and uncommon after the first year of therapy.

The majority of studies with finasteride were published before the 2003 Guideline and since then the compound has lost patent protection. Only a small number of subset or post hoc analyses and open-label extension studies have been reported since the 2003 Guideline.

Dutasteride

Dutasteride is the second 5-ARI approved by the U.S. Food and Drug Administration for the use in men with LUTS and BPH. ⁴² Its pharmacological characteristics produce a more profound reduction in both serum and intraprostatic DHT levels compared with finasteride. Whether these differences are clinically important is unknown; there are no published trials directly comparing the two agents. Indirect comparisons of efficacy outcomes are limited in that only patients with baseline prostate volumes > 30

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mL by TRUS and serum PSA levels > 1.5 ng/mL were eligible for enrollment in dutasteride clinical trials, thus enriching the population for potential responders to 5-ARI treatment.

The clinical database for dutasteride consists mainly of three trials: the phase III randomized, placebo-controlled trial of two-year duration⁴³ with an open-label extension⁴⁴; a study evaluating the effect of a placebo-controlled withdrawal of an alpha-blocker from a combination therapy arm (SMART 1)⁴⁵; and a four-year study comparing dutasteride vs. tamsulosin vs. their combination of the two (CombAT) for which only the two-year interim data are published¹⁷. Dutasteride is untested among men with prostate volumes < 30 mL. Reported treatment-related adverse events include ED, decreased libido, gynecomastia and ejaculation disorders.

Combination Therapy with Alpha-adrenergic Antagonists

See Guideline Statement and text in section on alpha-adrenergic antagonists.

5-Alpha-reductase Inhibitors for Other Indications

Hematuria

Option: Finasteride is an appropriate and effective treatment alternative in men with refractory hematuria presumably due to prostatic bleeding (i.e., after exclusion of any other causes of hematuria). A similar level of evidence concerning dutasteride was not reviewed; it is the expert opinion of the Panel that dutasteride likely functions in a similar fashion. [Based on review of the data and Panel consensus.]

One of the early intraprostatic effects of finasteride has been the suppression of vascular endothelial growth factor (VEGF). 46-49 Initially anecdotally, 50 and then in long-term follow-up studies it was noted that men with prostate-related bleeding (e.g., all other causes of hematuria had been excluded) responded to finasteride therapy with a reduction or cessation of such bleeding and a reduced likelihood of recurrent bleeding. A prospective study verified these observations. 46

Prevention of Bleeding During Transurethral Resection of the Prostate (TURP)

Option: Overall, there is insufficient evidence to recommend using 5-ARIs preoperatively in the setting of a scheduled TURP to reduce intraoperative bleeding or reduce the need for blood transfusions.

[Based on review of the data and Panel consensus.]

Based on the effect of 5-ARIs on prostate-related bleeding, several investigators studied the effect of presurgical treatment with a 5-ARI on bleeding during TURP. Four studies were randomized, placebo-controlled and well executed. 54-57 Other studies were either uncontrolled 58, 59 or randomized but used poorly defined methods of measuring the blood loss. 60 One of the randomized and the two nonrandomized studies found a reduction in blood loss or transfusion requirements.

Anticholinergic Agents

Option: Anticholinergic agents are appropriate and effective treatment alternatives for the management of LUTS secondary to BPH in men without an elevated post-void residual and when LUTS are predominantly irritative.

[Based on Panel consensus.]

Recommendation: Prior to initiation of anticholinergic therapy, baseline PVR urine should be assessed. Anticholinergics should be used with caution in patients with a post-void residual greater than 250 to 300 mL.

[Based on Panel consensus.]

Anticholinergic (antimuscarinic) agents block the neurotransmitter acetylcholine in the central and the peripheral nervous system. This class of medication reduces the effects mediated by acetylcholine on its receptors in bladder neurons through competitive inhibition. Five muscarinic subclasses (M1 through M5) of cholinergic receptors have been described in the human bladder muscle, the majority comprises subtypes M2 and M3. While M2 receptors predominate, M3 receptors are primarily responsible for bladder contraction.⁶¹

Three randomized controlled trials (RCTs) evaluating the use of tolterodine either as monotherapy or in combination with an alpha-blocker in men with LUTS related to BPH were identified on the literature review. 62-64 Although, these trials do not sufficiently demonstrate the efficacy or effectiveness of tolterodine, the Panel concluded that the use of anticholinergic could benefit some patients. The use of PSA measurements does not appear applicable to predicting or monitoring the effectiveness of tolterodine for the treatment of BPH/LUTS. Randomized controlled trials investigating anticholinergic agents other than tolterodine for the treatment of LUTS secondary to BPH have not been published. The most common adverse event reported with tolterodine monotherapy in men with BPH related LUTS was dry mouth, ranging in frequency from seven to 24%. 62, 63, 65 The rate of urinary retention was similar to placebo in two of the largest RCTs. The occurrence of constipation, diarrhea, and somnolence were also similar in frequency to placebo. 62, 63 In available RCTs, the overall withdrawal rate from tolterodine therapy ranged from 11% -- 12%. 62, 63 Withdrawal due to adverse events ranged from 0.02% to 0.3%. 62, 64 ED and ejaculation disorders were not reported with the use of tolterodine alone or in combination with tamsulosin. Significant morbidity and mortality resulting from tolterodine use was not reported in any of these RCTs.

Complementary and Alternative Medicines (CAM)

Recommendation: No dietary supplement, combination phytotherapeutic agent or other nonconventional therapy is recommended for the management of LUTS secondary to BPH. [Based on review of the data and Panel consensus.]

Recommendation: At this time, the available data do not suggest that saw palmetto has a clinically meaningful effect on LUTS secondary to BPH. Further clinical trials are in progress and the results of these studies will elucidate the potential value of saw palmetto extracts in the management of patients with BPH.

[Based on review of the data and Panel consensus.]

Recommendation: The paucity of published high quality, single extract clinical trials of Urtica dioica do not provide a sufficient evidence base with which to recommend for or against its use for the treatment of LUTS secondary to BPH.

[Based on review of the data and Panel consensus.]

Nonconventional approaches to the management of LUTS due to BPH have been of great interest to patients for many years. Of particular appeal are dietary supplements, which include extracts of the saw palmetto plant (Serenoa repens) and stinging nettle (Urtica dioica), among several others. Since the publication of the last version of this Guideline, higher-quality evidence has begun to appear and assessments of the efficacy of the dietary supplements are beginning to evolve.

By far the most commonly studied extract is that of the saw palmetto plant. Systematic reviews of the earlier evidence suggested that saw palmetto extracts may have modest efficacy in the treatment of LUTS. ^{66, 67} However, more recent studies with more rigorous methods have generally failed to confirm a clinically important role for saw palmetto in the management of BPH. ^{68, 69} Further studies are ongoing, and more definitive evidence regarding the use of saw palmetto will be forthcoming.

Minimally Invasive Therapies

Standard: Safety recommendations for the use of transurethral needle ablation of the prostate (TUNA) and transurethral microwave thermotherapy (TUMT) published by the U.S. Food and Drug Administration should be followed:

http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/default.htm. [Based on review of the data.]

Transurethral Needle Ablation (TUNA) of the Prostate

Option: TUNA of the prostate is an appropriate and effective treatment alternative for bothersome moderate or severe LUTS secondary to BPH.

[Based on review of the data and Panel consensus.]

TUNA is described in detail in Chapter 3. Since the development of the 2003 Guideline, little new information on effectiveness and safety has been published. There are only three prospective, randomized trials (one trial reports outcomes at two time points). The provements in symptoms, QoL, and urinary flow rates are significant but do not generally match the result of TURP and, taken together, lack sufficient detail on comorbidity of subjects. The remainder are cohort studies from which the reporting of outcomes varies considerably. In addition, the bulk of the literature suggests a high long-term retreatment rate. TUNA is safe with low peri-operative complications (such as bleeding) and has a low to nonexistent rate of associated ED for which this therapy is attractive. The Panel concluded that a degree of uncertainty remains regarding TUNA because of a paucity of high-quality studies.

Transurethral Microwave Thermotherapy (TUMT)

Option: TUMT is effective in partially relieving LUTS secondary to BPH and may be considered in men with moderate or severe symptoms.

[Based on review of the data and Panel consensus.]

TUMT heats the prostate using a microwave antennae mounted on a urethral catheter. This interventional therapy is effective in partially relieving the symptoms and bother believed secondary to BPH. TUMT is the least operator-dependent of the BPH interventions and predicting responders is difficult and inconsistent.

A systematic review of TUMT data (see Table 3.6 in Appendix A8) reveals a heterogeneous mix of studies of various sample sizes and TUMT protocols often using different outcome measures with varying durations of follow-up. This leads to conflicting results, as may be seen in studies of shorter versus longer follow-up. There is no compelling evidence from comparator trials to conclude that one device is superior to another.

Earlier, low-energy TUMT devices similarly possessed comparatively less clinical efficacy than later, higher energy counterparts but also carried a lower risk of side effects. The durability of TUMT treatment appears to have improved with the advent of higher energy, later generation devices. One should also note, however, that the concept of durability with TUMT may be misleading, as the data suffer from selection bias. Most studies analyze only those patients who remained in the study at the time of analysis; these patients would tend to represent the best "responders". In many studies, less than half of the initial group of men treated was analyzed at the end of the study period. An intent-to-treat analysis which considers therapeutic failures provides a better measure of the true effectiveness and durability of TUMT. Outpatient capability, lack of sexual side effects and avoidance of actual surgery are attractive to patient and clinician alike. But perhaps there is one issue that has held back greater utilization: the perception that these approaches lack sufficient durability of effect to assume a greater role in the management of LUTS.

Surgical Procedures

Surgical intervention is an appropriate treatment alternative for patients with moderate-to-severe LUTS and for patients who have developed AUR or other BPH-related complications. By definition, surgery is the most invasive option for BPH management and generally, patients will have failed medical therapy before proceeding with surgery. However, medical therapy may not be viewed as a requirement because some patients may wish to pursue the most effective therapy as a primary treatment if their symptoms are particularly bothersome. As with other medical treatment alternatives, the decision to elect surgery as the treatment alternative is based upon the patient's own views of treatment risks vs. benefits. The 2003 Guideline recognized that TURP remained the benchmark for therapy. Alternative technologies such as laser-assisted TURP were reported to offer lower morbidities but were typically still performed in the operating room setting and require anesthesia. In addition to open prostatectomy (e.g., retropubic, suprapubic), surgical options for BPH management include:

- Transurethral holmium laser ablation of the prostate (HoLAP)
- Transurethral holmium laser enucleation of the prostate (HoLEP)
- Holmium laser resection of the prostate (HoLRP)
- Photoselective vaporization of the prostate (PVP)
- Transurethral incision of the prostate (TUIP)
- Transurethral vaporization of the prostate (TUVP)
- Transurethral resection of the prostate (TURP)
 - Monopolar
 - o Bipolar

Laparoscopic and robotic prostatectomy (considered investigational)
 Recommendation: Surgery is recommended for patients who have renal insufficiency
 secondary to BPH, who have recurrent UTIs, bladder stones or gross hematuria due to BPH,
 and those who have LUTS refractory to other therapies. The presence of a bladder
 diverticulum is not an absolute indication for surgery unless associated with recurrent UTI or
 progressive bladder dysfunction.

[Based on review of the data and Panel consensus.]

Open Prostatectomy

Option: Open prostatectomy is an appropriate and effective treatment alternative for men with moderate to severe LUTS and/or who are significantly bothered by these symptoms. The choice of approach should be based on the patient's individual presentation including anatomy, the surgeon's experience, and discussion of the potential benefit and risks for complications. The Panel noted that there is usually a longer hospital stay and a larger loss of blood associated with open procedures.

[Based on review of the data and Panel consensus.]

Open prostatectomy involves the surgical removal (enucleation) of the inner portion of the prostate via a suprapubic or retropubic incision in the lower abdominal area. Open prostatectomy typically is performed on patients with prostate volumes greater than 80 to 100 mL. ⁷³⁻⁸³ The Panel noted that there is significant risk of blood loss, transfusion and a longer hospital stay associated with open prostatectomy than TURP. Open prostatectomies may be needed only for men with very enlarged prostate glands (it may be more effective than TURP in relieving the blockage of urine flow), and for men with bladder diverticula (pockets), or stones.

Laser Therapies

Option: Transurethral laser enucleation (holmium laser resection of the prostate [HoLRP], holmium laser enucleation of the prostate [HoLEP]), transurethral side firing laser ablation (holmium laser ablation of the prostate [HoLAP], and photoselective vaporization [PVP]) are appropriate and effective treatment alternatives to transurethral resection of the prostate and open prostatectomy in men with moderate to severe LUTS and/or those who are significantly bothered by these symptoms. The choice of approach should be based on the patient's presentation, anatomy, the surgeon's level of training and experience, and a discussion of the potential benefit and risks for complications. Generally, transurethral laser approaches have been associated with shorter catheterization time and length of stay, with comparable improvements in LUTS. There is a decreased risk of the perioperative complication of transurethral resection syndrome. Information concerning certain outcomes, including retreatment and urethral strictures, is limited due to short follow-up. As with all new devices, comparison of outcomes between studies should be considered cautiously given the rapid evolution in technologies and power levels. Emerging evidence suggests a possible role of transurethral enucleation and laser vaporization as options for men with very large prostates (> 100 g). There are insufficient data on which to base comments on bleeding. [Based on review of the data and Panel consensus.]

In general, laser energy can be used to produce a variety of effects within prostate tissue including coagulation necrosis or vaporization and resection of tissue. Today, the holmium and variants of the PVP laser are the most common laser technologies used to treat prostate disease.

Transurethral Holmium Laser Ablation of the Prostate (HoLAP)

The holmium:YAG laser may be used to treat prostatic tissue transurethrally using a 550 micron side-firing laser fiber in a noncontact mode. This technology delivers laser energy at a wavelength of 2120 nm (infrared range) which is absorbed primarily by water and results in an optical penetration depth of 0.4 mm. The HoLAP procedure is intended to be comparable to TURP in that the prostatic lobes may be vaporized down to the surgical capsule resulting in a TURP-like effect.

Transurethral Holmium Laser Enucleation of the Prostate (HoLEP)

The holmium laser has been used to enucleate the prostate adenoma, separating the adenoma from the surgical capsule, from apex to base, after any median lobe has been freed from the bladder neck. Typically, the technology is utilized for larger glands that previously would have been treated surgically with an open prostatectomy. Generally, the results compare favorably to open prostatectomy in the hands of an experienced surgeon. Ad-86 In other trials, improvements in symptom scores, QoL indices, and flow rate, approach those obtained after TURP. Nonetheless, long-term data beyond two years are still lacking, and the procedure requires specialized training and equipment. The Panel believes that the learning curve for holmium laser enucleation of the prostate appears to be greater than that of other technologies.

Operative times for holmium enucleation have been improved significantly with the advent of the tissue morcellator. By morcellating tissue within the bladder, the resection technique could be modified to allow complete enucleation of the median and lateral lobes of the prostate.

Holmium Laser Resection of the Prostate (HoLRP)

The prostatic adenoma is resected using a holmium laser fiber and a specially adapted resectoscope. ⁸⁹ Data suggest that the intermediate-term, symptomatic improvement obtained after holmium laser resection may be comparable to that obtained after TURP, with a slightly reduced risk of bleeding, need for blood transfusions, and an absence of transurethral resection (TUR) syndrome. ⁹⁰

Photoselective Vaporization of the Prostate (PVP)

PVP of the prostate is a form of transurethral prostatectomy performed using a 600 micron side-firing fiber in a noncontact mode. The primary difference from HoLAP is its wavelength of 532 nm (in the green visible spectrum) which is absorbed by both the water irrigation and hemoglobin resulting in an optical penetration depth of 0.8 mm. The other acronyms for this procedure, KTP (potassium tintanyl phosphate) and LBO (lithium borate), identify the crystal used in the laser generator. Typically performed using normal saline irrigation and a continuous flow scope, the goal of PVP is to create a TURP-like cavity after ablating the various prostatic lobes down to the surgical capsule. Symptom scores improved consistently in all studies, ^{91, 92} as did QoL scores ^{93, 94} and maximum urinary flow rates. ^{94, 95}

Transurethral Incision of the Prostate (TUIP)

Option: TUIP is an appropriate and effective treatment alternative in men with moderate to severe LUTS and/or who are significantly bothered by these symptoms when prostate size is less than 30 mL. The choice of approach should be based on the patient's individual presentation including anatomy, the surgeon's experience and discussion of the potential benefits and risks for complications.

[Based on review of the data and Panel consensus.]

TUIP is an outpatient endoscopic surgical procedure limited to the treatment of smaller prostates (30 mL of resected weight or less). In the TUIP procedure, one or two cuts are made in the prostate and prostate capsule, reducing constriction of the urethra. In the appropriate patient, TUIP results in degrees of symptomatic improvement equivalent to those attained after TURP. ⁹⁶⁻⁹⁹ In addition, compared to TURP, TUIP results in a significantly reduced risk of ejaculatory disturbance. TUIP also was associated with a slightly higher rate of secondary procedures.

Transurethral Electrovaporization of the Prostate (TUVP)

Option: TUVP is an appropriate and effective treatment alternative in men with moderate to severe LUTS and/or who are significantly bothered by these symptoms. The choice of approach should be based on the patient's individual presentation including anatomy, the surgeon's experience and discussion of the potential benefit and risks for complications. [Based on review of the data and Panel consensus.]

Transurethral electrovaporization is an adaptation of an old device, the roller ball electrode. Compared to TURP, transurethral electrovaporization results in equivalent, short-term improvements in symptom scores, urinary flow rate, and QoL indices. There is a decreased risk of the perioperative complication of transurethral resection syndrome compared with traditional monopolar TURP. However, the rates of postoperative irritative voiding symptoms, dysuria and urinary retention, as well as the need for unplanned secondary catheterization, appear to be higher. Reoperation rates were higher with TUVP than with TURP. Long-term comparative trials are needed to determine if the transurethral electrovaporization approach is superior to standard TURP.

Transurethral Resection of the Prostate (TURP)

Option: TURP is an appropriate and effective primary alternative for surgical therapy in men with moderate to severe LUTS and/or who are significantly bothered by these symptoms. The choice of a monopolar or bipolar approach should be based on the patient's presentation, anatomy, the surgeon's experience and discussion of the potential risks and likely benefits. [Based on review of the data and Panel consensus.]

Option: Overall, there is insufficient evidence to recommend using 5-ARIs in the setting of a pre-TURP to reduce intraoperative bleeding or reduce the need for blood transfusions. [Based on review of the data and Panel consensus.]

TURP involves the surgical removal of the prostate's inner portion via an endoscopic approach through the urethra, with no external skin incision. Historically, this procedure was the most common active treatment for symptomatic BPH but potential morbidities, desire to shorten catheter dwell time and pressure to reduce hospital length of stay have stimulated the development of alternative procedures. In the interval since the 2003 Guideline was published, reports concerning TURP that met inclusion criteria for this Guideline were limited to studies focused on TURP as a comparison.

Consequently, the Veterans Affairs (VA) Cooperative Study remains the most definitive published study of the efficacy and safety of TURP.¹⁰⁰ The VA Cooperative Study found a 1% risk of urinary incontinence (which was similar to the incidence in the watchful waiting group) and an overall decline in sexual function that was identical to the watchful waiting treatment group. Usually performed under general or spinal anesthesia, TURP requires a hospital stay. One unique complication of TURP is TUR syndrome, a dilutional hyponatremia that occurs when irrigant solution is absorbed into the bloodstream. Other complications that have been reported in more than 5% of patients include (in order of frequency): erectile dysfunction (which may not in all cases be attributable to the surgery); irritative voiding symptoms; bladder neck contracture; the need for blood transfusion; UTI; and hematuria.

Bipolar resection of the prostate utilizes a specialized resectoscope loop that incorporates both the active and the return electrodes. This design limits the dispersal of the current flow in the body which theoretically reduces the deleterious effects of the stray current flow. The bipolar loop can be used to resect tissue as well as coagulate, vaporize and transect tissue. Because the bipolar resectoscope uses 0.9% sodium chloride solution as irrigation fluid, the risk of TUR syndrome is eliminated.

Laparoscopic and Robotic Prostatectomy

Option: Men with moderate to severe LUTS and/or who are significantly bothered by these symptoms can consider a laparoscopic or robotic prostatectomy. There are insufficient published data on which to base a treatment recommendation.

[Based on review of the data and Panel consensus.]

Laparoscopic and robotic prostatectomies are techniques currently associated with the treatment of prostate cancer but a single cohort study has reported on consecutive patients undergoing laparoscopic simple prostatectomy for the treatment of LUTS. ¹⁰¹ The operation can take three to five hours, which is longer than traditional surgery.

Future Research

Given the increasing aging male population, the health burden of benign prostate disorders such as BPH, will be a major arena for research in the future. Therefore, there is a substantial need to develop a long-range vision to focus and promote efforts to better understand and manage benign prostate disease. In 2010, the AUA launched an initiative to identify national research priorities in urology. Known as the AUA Foundation National Urology Research Agenda (NURA), this document defines the top issues facing urology, and BPH is identified as an area for scientific opportunity. The authors cite the relationship between BPH and co-morbidities as a high priority as well as a more objective method Copyright 2010 American Urological Association Education and Research, Inc.

for diagnosing BPH. Inflammation of the prostate is an important area of study, and the role of diet, lifestyle, and sociodemographics on BPH is important.

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) convened a panel of key opinion leaders that included basic researchers, translational scientists, epidemiologists, and clinicians and clinical researchers to develop a comprehensive strategic plan for advancing research in benign prostate disease. This focused group of research and thought leaders identified four major areas of key significance for future investigation: (1) basic science, (2) epidemiology/population-based studies, (3) translational opportunities, and (4) clinical sciences. The following represents a synopsis of their findings and recommendations of the NIDDK Prostate Research Strategic Plan. 102

There are a host of major clinical opportunities in the future with respect to clinical science development in BPH. This includes:

- 1. Defining the clinical phenotype: definitions and their importance
- 2. Measuring disease severity and outcomes
- 3. Issues in clinical trial design
 - a. Study concepts for drug therapy, phytotherapies, behavioral and lifestyle interventions
- 4. Additional intervention therapies.

These chosen topics illustrate the pressing need for improved methods to diagnose and measure disease symptoms, severity and progression; development of new drug therapies, derived from both synthetic and naturally occurring compounds; and identification and clinical testing of prevention strategies; and for further development of intervention therapies based on non- or minimally invasive approaches. It is anticipated that progress in these areas has the potential to advance clinical care for patients with benign prostate disease beyond current strategies of symptom management, which in many cases are incompletely effective for the individual patient and are not generally effective across patients classified as having the same disorder.

High Priority Recommendations for Future Research:

- Make obesity and lifestyle interventions a priority area for BPH disease. This should include studies of specific hypotheses of how LUTS/BPH is impacted by obesity and related diseases; new and enhanced collaborative efforts between urologists, clinical trialists, exercise physiologists and dietary experts; and assessments of the relationship between the various manifestations of metabolic syndrome and LUTS/BPH.
- Develop preventive strategies aimed at underlying common pathophysiology of benign prostate disease.
- Develop studies that assess disease "phenotypes" and lead to better disease definitions (e.g. size versus morphological characteristics and their relative importance in producing symptoms, obstructive versus irritative symptoms relative to prostate morphology and size, and patient phenotypes relative to urologic symptom profiles).
- Encourage the study of primary prevention for LUTS/BPH.
- Develop a plan for a multidisciplinary working group to develop a specific research agenda for symptom and health status measurement related to male LUTS. This effort should include

- investigators interested in the broad spectrum of underlying conditions, as well as the developers of the prominent instruments. Professional societies, national and international, and other government organizations are also suggested as participants.
- Development of collaborative network to standardize treatment assessment. This may take the
 form of a LUTS Treatment Collaborative Network (LTCN) that would allow the critical
 aggregation of thought leaders, trial design experts, industrial collaborators, and various federal
 agencies to identify clinically meaningful assessments of promising medical, minimally invasive,
 and surgical treatments.

Conflict of Interest Disclosures

All panel members completed Conflict of Interest disclosures. Those marked with (C) indicate that compensation was received; relationships designated by (U) indicate no compensation was received.

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Chapter 2: Methodology

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Introduction

The clinical recommendations presented in this report are based on a systematic review and synthesis of the clinical literature on current and emerging therapies for the treatment of benign prostatic hyperplasia (BPH). The methodology follows the same process used in the development of the 2003 Guideline and, as such, did not include an evaluation of the strength of the body of evidence as will be done in future Guidelines produced by the American Urological Association (AUA).

The expert Panel examined three overarching key questions for pharmacotherapeutic, surgical, and alternative medicine therapies:

- 1. What is the comparative efficacy and effectiveness of currently available and emerging treatments for BPH? What are the predictors of beneficial effects from treatments?
- 2. What are the adverse events associated with each of the included treatments and how do the adverse events compare across treatments?
- 3. Are there subpopulations in which the efficacy, effectiveness, and adverse event rates vary from those in general populations? Efficacy measures the extent to which an intervention produces a beneficial result under ideal conditions, such as clinical trials, whereas effectiveness measures the extent to which an intervention in ordinary conditions produces the intended result.

Study Selection and Data Abstraction

To identify relevant citations, the AUA research librarian searched Ovid Medline from January 1, 1999 through February 28, 2008. The search period overlapped with that of the prior AUA Guideline for BPH (2003) in order to capture any citations that were in the process of being indexed for Medline prior to June 30, 1999. The search strategy included the Medical Subject Headings (MeSH) for BPH and LUTS: "Prostatic Hyperplasia" [MesH] AND Benign NOT Case reports NOT Editorials NOT Comments NOT Abstracts NOT Letters to editor NOT Author replies (Limits: Entrez Date from 2006/06/01 to 2008/03/31, Humans, Male, English); "Urinary Tract" [MeSH] AND Symptoms AND Lower NOT Case reports NOT Editorials NOT Comments NOT Abstracts NOT Letters to editor NOT Author replies (Limits: Entrez Date from 2006/06/01 to 2008/04/22, Humans, Male, English).

Study inclusion and exclusion criteria (Table 2.1) were determined by the Panel chair, co-chair, and the methodologist in order to clearly define the scope and to achieve a reproducible and explicit process. All titles and abstracts from the bibliographic searches were reviewed by the Panel chair and the co-chair and the relevant articles were selected and then the full-text reviewed for inclusion. To update the search from January 2007 through February 2008, titles, abstracts and full-text were dual reviewed by either the Panel chair or co-chair and the methodologist, and consensus was achieved at the full-text level. Descriptive data were abstracted into Microsoft Word and numeric data into Microsoft Excel by a reviewer on the methodologist's staff and checked by a second reviewer. Abstracted data included study design, setting, population characteristics (including, age, AUA-Symptom Index (SI) score, Quality of Life (QoL) question, peak urine flow [Qmax; mL/sec], and for procedural studies, prostate volume and percentage of subjects in urinary retention) and details of the intervention

(device, procedure, drug dosage and formulation). The Panel chair and co-chair selected outcomes for abstraction and synthesis that were relevant to the clinician such as urinary flow and volume outcomes, as well as outcomes important to patients, such as symptoms and QoL. Also abstracted were data on adverse events for both pharmacotherapy and procedural interventions. For the latter, intraoperative, peri-operative, as well as short-term (<30 days) and longer-term adverse events were examined.

Table 2.1 Study inclusion and exclusion criteria

| Domain | Inclusion criteria | Exclusion criteria |
|---------------|--|--|
| Population | - Men ≥ 45 years of age without significant risk of non-benign prostatic hyperplasia (BPH) causes of lower urinary tract symptoms (LUTS) | Men with polyuria, underlying neurologic disease, or prior lower urinary tract disease Men <45 years of age with voiding dysfunction |
| Interventions | Procedures | Procedures |
| | Open prostatectomy: transvesical, perineal, retropubic, suprapubic | Water-induced thermal therapy |
| | Laparoscopic prostatectomy | Plasmakinetic Tissue Management System |
| | Transurethral procedures a. Laser coagulation | Interstitial laser coagulation (ILC) |
| | b. Holmium laser resection/enucleation(HoLRP; HoLEP) | High intensity focused ultrasound (HIFU) |
| | c. Vaporization of tissue | 5. Absolute ethanol injection |
| | i.KTP green light laser photoselective vaporization of the prostate (KTP-PVP) | 6. Botox |
| | ii.Thulium: YAG laser | 7. Stent placement (e.g., UroLume®) |
| | iii.PlasmaKinetic vaporization of the prostate (PKVP) | 8. Balloon dilation |
| | iv. Transurethral vaporization of the prostate (TUVP) | 9. Rotoresection of the prostate |

v.Holmium laser ablation of prostate (HoLAP)

d. Transurethral resection of the prostate (TURP):

monopolar, bipolar

- e. Transurethral incision of the prostate (TUIP)
- f. Transurethral radiofrequency needle ablation

(TUNA)

g. Thermal-based therapies

i.Transurethral microwave treatments

- 1. CoreTherm®
- 2. Prostatron®
- 3. Targis®
- 4. TherMatrx®
- 5. Prolieve™

Pharmacotherapy

- 1. Anticholinergic agents
 - a. Monotherapy: tolterodine
 - b. Combination therapy with alpha blockers
- 2. Alpha-adrenergic blockers: alfuzosin, doxazosin, tamsulosin, terazosin,
- 3. 5 alpha-reductase inhibitors (5-ARIs): dutasteride, finasteride

- 10. Nd:YAG laser
- Visual laser ablation of the prostate (VLAP), contact laser ablation of the prostate (CLAP)

Drugs

- 1. Naftopidil (investigational)
- 2. Silodosin*
- Immediate-release alfuzosin
 (2.5 mg TID)
- Sustained release alfuzosin (5 mg BID)
- 5. Alfuzosin 15 mg QD (10 mg QD)
- 6. Tamsulosin oral controlled absorption system
- Antidiuretic hormone (vasopressin)

| | 4. Combination therapy of alpha blockers and 5-ARIs Complementary and Alternative Medicines (CAM) a. Saw palmetto b. Urtica dioica c. Combination phytotherapies | |
|-------------------------------------|--|--|
| | Watchful waiting | |
| Comparators | Interventions will be compared among each other, including the strategy of watchful waiting. Different techniques for the same surgical procedure will be compared Dose-ranging studies for pharmacotherapeutic agents and CAM | Studies with an included intervention compared to another intervention not included in this review |
| Efficacy and effectiveness outcomes | 1. Morbidity 2. Mortality 3. Pressure, flow, volume a. Voided volume b. Maximum flow rate c. Post-void residual d. Prostate volume measured by transrectal ultrasonography or magnetic resonance imaging | Pressure, flow volume a. Percent of residual (%) b. Bladder capacity at first desire to void c. Bladder capacity at strong desire to void d. Detrusor pressure at cystometric capacity e. Bladder compliance f. Detrusor opening |

- e. Transition zone prostate volume
- f. Detrusor pressure at maximum flow
- 4. Symptoms
 - a. American Urological Association Symptom Index/International Prostate Symptom Score (AUA-SI/IPSS) (total)
 - b. Boyarsky symptom index
 - c. Madsen-Iversen symptom index
 - d. Other study-specific scores
- 5. Quality of life, function
 - a. Disease-specific measures
 - i. Quality of life measure from IPSS
 - ii. BPH impact index
 - iii. Other custom measures
 - b. Generic measures
- 6. Other:
 - a. Prostate-specific antigen
 - b. Prostate cancer on histology
 - c. Resected weight

pressure

- g. Amplitude of overactive detrusor contractions
- h. Invasive pressure-flow studies
- i. Prostate volume
 assessed by digital rectal
 exam
- 2. Symptoms
 - a. Partial symptom scores
 - b. Symptom diaries with unvalidated scoring systems
- 3. Other
 - a. Dihydrotestosterone
 - b. Estradiol
 - c. Blood pressure

| Harms and withdrawals | Total withdrawals or loss to follow-up Withdrawals due to adverse effects | Intraoperative and immediate postoperative |
|---|---|--|
| | 3. Mortality | a. Serum sodiumb. Expired ethanol |
| | 4. Surgical complications | levels |
| | i.Intraoperative | c. Irrigation fluid used |
| | ii.Immediate postoperative complications (<24 h) | |
| | iii.Short-term complications (<30 d) | |
| | iv.Long-term complications | |
| | 5. Secondary procedures | |
| | 6. Sexual function | |
| 7. Drug adverse eventsa. Symptomatic hypotension; postural change, | | |
| | a. Symptomatic hypotension; postural change, dizziness | |
| b. Sexual function | | |
| | c. Significant morbidity | |
| Setting | There were no restrictions based on geographic location of the study or on other study setting characteristics. | |
| Study design | Key Question 1: efficacy/ effectiveness: | Case reports for both benefit |
| , | a. Pharmacotherapy, CAM: randomized controlled trials (RCTs) and controlled comparative trials (CCTs) | and adverse events |
| | b. Procedures, watchful waiting: RCTs,CCTs, observational studies | |

| | 2. Key Question 2: Adverse events: RCTs, CCTs, | | |
|-----------------|---|----|-------------------------------|
| | observational studies | | |
| | | | |
| | 3. Key Question 3: Subpopulations: study designs | | |
| | as noted above | | |
| | | | |
| | | | |
| | Minimum duration of follow-up | | |
| | | | |
| | Procedures: no restrictions | | |
| | 2. Pharmacotherapy and alternative and CAM: 12 | | |
| | weeks | | |
| | Weeks | | |
| | 3. Watchful waiting: 12 weeks | | |
| | | | |
| Publication | 1. Studies in which the full text is available in | | Studies with an English |
| characteristics | English | | abstract but non-English full |
| | | | text |
| | | | 6. 1 |
| | | | Studies not published in |
| | | | English |
| | | 3 | Studies where publication is |
| | | | available in abstract form |
| | | | |
| | | | only |
| | | 4. | Letters, commentaries, |
| | | | opinion pieces |
| | | | - F |
| | | 5. | Theses and dissertations |
| | | | Name the area in |
| | | 6. | Narrative reviews |
| | | | |

^{*}Silodosin had been approved by the U.S. Food and Drug Administration but there were no relevant published articles in the peer-reviewed literature prior to the cut-off date for the literature search.

Data Synthesis

A qualitative analysis of the available evidence was performed on all interventions and outcomes. A narrative synthesis was presented, along with in-text tables summarizing important study and population characteristics, outcomes and adverse events. Forest plots of study effect sizes were prepared when there were at least three to four points for an intervention. Studies were stratified by Copyright ©2010 American Urological Association Education and Research, Inc. 8

study design, comparator, follow-up interval, and intensity of intervention. Meta-analyses (quantitative synthesis) of outcomes of randomized controlled trials were planned; however, data were either sparse (i.e., there were small numbers of studies in certain categories), or not sufficiently homogeneous for the pooled effect to be meaningful.

The studies varied with respect to patient selection; randomization; blinding mechanism; run-in periods; patient demographics, comorbidities, prostate characteristics, and symptoms; drug doses; other intervention characteristics; comparators; rigor of follow-up; follow-up intervals; trial duration; timing of the trial; suspected lack of applicability to current practice in the United Sates; and techniques of outcomes measurement. These data limitations affected the quality of the materials available for review, making formal meta-analysis impractical or futile. Thus, the Panel and extractors were required to review the material in a systematic fashion rather than one with statistical rigor.

Detailed efficacy, effectiveness and complications outcomes are found in Chapter 3 of the guideline.

Guideline Development and Approvals

The treatment guideline was drafted by the Panel based on the outcomes data and tempered by the Panel's expert opinion. As in the previous Guideline, the guideline statements were graded with respect to the degree of flexibility in their application. The three levels are essentially the same as in the previous guideline. A "standard" has the least flexibility as a treatment policy; a "recommendation" has significantly more flexibility; and an "option" is even more flexible. These three levels of flexibility are defined as follows:

- 1. **Standard**: A guideline statement is a standard if: (1) the health outcomes of the alternative interventions are sufficiently well known to permit meaningful decisions and (2) there is virtual unanimity about which intervention is preferred.
- 2. **Recommendation**: A guideline statement is a recommendation if: (1) the health outcomes of the alternative intervention are sufficiently well known to permit meaningful decisions, and (2) an appreciable but not unanimous majority agrees on which intervention is preferred.
- 3. **Option**: A guideline statement is an option if: (1) the health outcomes of the interventions are not sufficiently well known to permit meaningful decisions, or (2) preferences are unknown or equivocal. Options can exist because of insufficient evidence or because patient preferences are divided and may/should influence choices made.

The draft was reviewed by the Panel, examined by 69 peer reviewers, and approved by the Practice Guidelines Committee and the Board of Directors of the AUA. A full description of the methodology is presented in Chapter 2 of this guideline. The Guideline is published on the AUA website (http://www.auanet.org). A version of Chapter 1 will be published in *The Journal of Urology*.

Conflict of Interest

All authors, staff and consultants self-reported potential financial conflicts of interest in accordance with AUA policy. Disclosures were made available to all Panel members prior to meetings, and at the beginning of each meeting, AUA staff reviewed the AUA conflict of interest policy, which requires recusal of individuals with potential conflict of interest.

Chapter 3: Results of the Treatment Outcomes Analyses

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Introduction

It is the hope that this clinical Guideline will provide a useful reference on the effective evidence-based management of male lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH). The current Guideline reviews a number of important aspects in the management of LUTS presumed secondary to BPH (LUTS/BPH) in our male population as an update to the 2003 AUA Guideline on BPH. It speaks to diagnostic tests available to identify the underlying pathophysiology and help management of symptoms. Pharmacotherapy and watchful waiting as well as lifestyle issues are addressed, including complementary and alternative medicines (CAM). The current literature for standard surgical options, as well as that on minimally invasive procedures is similarly reviewed. Despite the rigorous methodology and detail used in these various areas, there are some areas where data could not be found (randomized controlled trials [RCTs]) for some topics. In some situations, the Panel, not surprisingly, was forced to recommend best practices based on expert opinion.

The expert Panel examined three overarching key questions for current and emerging pharmacotherapeutic, surgical, and alternative medicine therapies: (1) What are the comparative efficacy and effectiveness of currently available and emerging treatments for BPH? What are the predictors of beneficial effects from treatments? (2) What are the adverse events associated with each of the included treatments and how do the adverse events compare across treatments? (3) Are there subpopulations in which the efficacy, effectiveness and adverse event rates vary from those in general populations?

A qualitative analysis of the available evidence was performed on all interventions and outcomes. A narrative synthesis was presented along with in-text tables summarizing important study and population characteristics, efficacy and effectiveness outcomes and safety outcomes. Forest plots of study effect sizes were prepared when there were at least three to four points for an intervention. Studies were stratified by study design, comparator, follow-up interval and intensity of intervention. Meta-analyses (quantitative synthesis) of outcomes of RCTs were planned; however, data were either sparse (i.e., there were small numbers of studies in certain categories), or not sufficiently homogeneous for the pooled effect to be meaningful. The studies varied with respect to patient selection; randomization; blinding mechanism; run-in periods; patient demographics, comorbidities, prostate characteristics and symptoms; drug doses; other intervention characteristics; comparators; rigor of follow-up; follow-up intervals; trial duration; timing of the trial; suspected lack of applicability to current practice in the United Sates; and techniques of outcomes measurement. These data limitations affected the quality of the materials available for review, making formal meta-analysis impractical or futile. The resulting evidence tables for each treatment alternative evaluated are presented in Appendix A8.

Based on the evidence and Panel expertise guideline statements were developed by the Panel and are presented in Chapter 1. Statements that are new or have been updated from the 2003 Guideline are outlined in Table 3.1.

Table 3.1. New and updated guideline statements in the 2010 Guideline

| Agent/Therapy | Guideline Statement |
|---|--|
| Alpha-adrenergic Blockers | Option: Alfuzosin, doxazosin, tamsulosin, terazosin are appropriate and effective treatment alternatives for patients with bothersome, moderate to severe LUTS secondary to BPH (AUA Symptom Index score ≥8). Although there are slight differences in the adverse events profiles of these agents, all four appear to have equal clinical effectiveness.* [Based on review of the data and Panel consensus.] *Silodosin was approved by the FDA but there were no published articles in the |
| | peer- reviewed literature prior to the cut-off date for the literature search. |
| Intraoperative Floppy Iris Syndrome and Alpha blocker Use | Recommendation: Men with LUTS secondary to BPH for whom alpha blocker therapy is offered should be asked about planned cataract surgery. Men with planned cataract surgery should avoid the initiation of alpha blockers until their cataract surgery is completed. [Based on review of the data and Panel consensus.] Recommendation: In men with no planned cataract surgery, there are insufficient data to recommend withholding or discontinuing alpha blockers for bothersome LUTS secondary to BPH. [Based on review of the data and Panel consensus.] |
| 5-Alpha-reductase Inhibitors (5-ARIs) for Other Indications | Hematuria Option: Finasteride is an appropriate and effective treatment alternative in men with refractory hematuria presumably due to prostatic bleeding (i.e., after exclusion of any other causes of hematuria). A similar level of evidence concerning dutasteride was not reviewed; it is the expert |

opinion of the Panel that dutasteride likely functions in a similar fashion. [Based on review of the data and Panel consensus.] **Prevention of Bleeding During TURP** Option: Overall, there is insufficient evidence to recommend using 5-ARIs preoperatively in the setting of a scheduled TURP to reduce intraoperative bleeding or reduce the need for blood transfusions. [Based on review of the data and Panel consensus.] Option: Anticholinergic agents are appropriate and effective treatment alternatives for the management of LUTS secondary to BPH in men without an elevated post void residual and when LUTS are predominantly irritative. [Based on Panel consensus.] Anticholinergic Agents **Recommendation:** Prior to initiation of anticholinergic therapy, baseline post-void residual (PVR) urine should be assessed. Anticholinergics should be used with caution in patients with a PVR greater than 250 to 300 mL. [Based on Panel consensus.] **Recommendation:** Complementary and No dietary supplement, combination phytotherapeutic agent, or other Alternative Medicines nonconventional therapy is recommended for the management of LUTS (CAM) secondary to BPH. This includes saw palmetto and Urtica dioica.

[Based on review of the data and Panel consensus.]

| Minimally Invasive Therapies | Safety recommendations for the use of transurethral needle ablation (TUNA) of the prostate and transurethral microwave thermotherapy published by the U.S. Food and Drug Administration should be followed. http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/default.htm [Based on review of the data.] |
|---|---|
| | |
| Transurethral Needle Ablation of the Prostate and Transurethral Microwave Thermotherapy | TUNA and and Transurethral Microwave Thermotherapy (TUMT) of the prostate is an appropriate and effective treatment alternative for bothersome moderate or severe LUTS secondary to BPH. [Based on review of the data and Panel consensus.] |
| | Option: |
| Laser Therapies | Transurethral laser enucleation (holmium laser resection of the prostate [HoLRP], holmium laser enucleation of the prostate [HoLEP]), transurethral side firing laser ablation (holmium laser ablation of the prostate [HoLAP] and photoselective vaporization [PVP]) are appropriate and effective treatment alternatives to transurethral resection of the prostate and open prostatectomy in men with moderate to severe LUTS and/or who are significantly bothered by these symptoms. The choice of approach should be based on the patient's presentation, anatomy, the surgeon's level of training and experience and discussion of the potential benefit and risks for complications. Generally, transurethral laser approaches have been associated with shorter catheterization time and length of stay with comparable improvements in LUTS. There is a decreased risk of the perioperative complication of transurethral |

resection syndrome. Information concerning certain outcomes, including retreatment and urethral strictures, is limited due to short follow-up. As

with all new devices, comparison of outcomes between studies should be considered cautiously given the rapid evolution in technologies and power levels. Emerging evidence suggests a possible role of transurethral enucleation and laser vaporization as options for men with very large prostates (> 100 g). There are insufficient data on which to base comments on bleeding.

[Based on review of the data and Panel consensus.]

Option:

Option:

Transurethral Resection of the Prostate (TURP)

TURP is an appropriate and effective primary alternative for surgical therapy in men with moderate to severe LUTS and/or who are significantly bothered by these symptoms. The choice of a monopolar or bipolar approach should be based on the patient's presentation, anatomy, the surgeon's experience and discussion of the potential risks and likely benefits.

[Based on review of the data and Panel consensus.]

Laparoscopic and Robotic Prostatectomy Men with moderate to severe LUTS and/or who are significantly bothered by these symptoms can consider a laparoscopic or robotic prostatectomy. There are insufficient published data on which to base a treatment recommendation.

[Based on review of the data and Panel consensus.]

Types of treatment outcomes

Two types of treatment outcomes -- efficacy and adverse events -- were evaluated in the development of this Guideline. Because efficacy outcomes were measured on a scale that could change with treatment and time course, while adverse events were measured as occurrences, restrictions were imposed on the data requirements and the analytic methods used for each type of outcome.

Efficacy and Effectiveness Outcomes

Efficacy outcome measures evaluate the efficacy of the treatment in relieving the symptoms or sequelae of BPH. In the past, the direct outcomes (e.g., those that patients can directly perceive) of BPH therapies have been measured in a qualitative fashion (e.g., as improved, unchanged, or worsened) and/or by global subjective assessment either by physicians or patients. More recently, quantitative measurement tools have been developed and validated. Symptom scores and quality of life (QoL) questionnaires are examples of instruments that provide an objective assessment of subjective phenomena and allow a numerical estimate of the severity of LUTS, the bother induced, interference with daily activities and impact on disease-specific QoL.

Symptom Scores

A variety of symptom scores utilized to evaluate BPH therapies are discussed below and are presented in Appendices A5 and A6. The current international standard, the American Urological Association Symptom Index/International Prostate Symptom Score (AUA-SI/I-PSS), is in widespread use.

Validated Symptom Scores

The AUA commissioned the development of a quantitative symptom severity and frequency score. The resulting instrument is a seven-question questionnaire with a response scheme from 0 to 5 for each question for a total score ranging from zero to 35 in the order of increasing symptom severity and frequency. Symptoms of both irritative and obstructive LUTS are addressed. This AUA-SI has been culturally and linguistically validated, has been translated into many languages and is identical to the first seven symptom questions of the I-PSS which is used worldwide.

The Danish Prostatic Symptom Score is another validated symptom scoring instrument that incorporates the concept of bother due to symptoms in addition to simple enumeration of symptom severity and frequency.¹

Modified Symptom Scores

Modified symptom scores are slight modifications of recognized, but not necessarily validated, scoring systems. An example of a modified scoring system that has been utilized extensively in trials of the 5-ARI, finasteride, is the Quasi-AUA-SI. Only studies that employed complete symptom scores were included; those that used partial scales (e.g., bothersomeness or irritability scales) were excluded.

Studies using the AUA-SI or I-PSS with scoring based on ranges other than zero to 35 were rescaled for consistency.

Quality of Life Scoring Instruments

Quality of life scoring instruments can be classified under two broad categories: (1) generic instruments, such as the SF-36, that do not focus on the impact of a particular disease state or a set of symptoms and (2) disease-specific QoL instruments, which measure the impact of specific diseases or sets of symptoms on the health of a given individual. Of all generic and disease-specific QoL scoring instruments, the BPH Impact Index (BPH II) and the Disease Specific QoL Question have been validated and were used herein.

The BPH II was developed and validated by the AUA Measurement Committee (1995) with the objective of determining the degrees to which urinary problems affect various domains of health and impact the perception of health in a given individual. Three questions are scored on a scale from zero to three and one question on a scale from zero to four, for a total score ranging from zero to 13 in order of increasing severity. The BPH II has been used in studies of medical as well as many invasive therapies, thus providing comparative data.

A single global question complements the seven individual symptom severity and frequency questions of the AUA-SI by adding a disease specific QoL (called the Disease Specific QoL Question) dimension. Clearly, a single question cannot possibly capture the global impact of LUTS on the quality of an individual's life; however, it has been accepted as a valuable beginning for a patient/physician conversation regarding this issue. The question simply asks, "If you were to spend the rest of your life with your urinary symptoms the way they are right now, how would you feel about this?" The answer scheme ranges from "delighted" to "terrible," on a score from zero to six, in the order of increasing severity.

Peak Urinary Flow Rate

The urinary flow rate is the strength or intensity of the urinary stream over time determined by measurement of the voided volume and the voiding or micturition time. Units are expressed in mL/sec. Dividing the voided volume by the voiding or micturition time yields the average urinary flow rate (e.g., 200 mL [voided volume] divided by 20 seconds [voiding time] yields an average urinary flow rate of 10 mL/sec). The most commonly reported measure is the peak or maximal urinary flow rate (Qmax). This parameter, however, is nonspecific in that Qmax decreases with advancing age in both sexes. In addition, a lower-than-expected urinary flow rate can be caused by bladder muscle weakness, subvesical or bladder outlet obstruction (BOO), or urethral stricture.

In the interpretation of the Qmax, a minimum voided volume is usually required for the flow rate recording to be valid. A flow rate of less than 10 mL/sec is more suggestive of an obstructed state, while a flow rate above 15 mL/sec is more suggestive of a nonobstructed state. Flow rates between 10

and 15 mL/sec are considered equivocal. The interpretation of this measurement is based on the correlation between free flow rates and invasive pressure-flow studies which suggest that the probability of obstruction is very low if the maximum flow rate is over 15 mL/sec, while the probability is relatively high if the maximum flow rate is under 10 mL/sec.

Unfortunately, Qmax correlates poorly with subjective symptoms such as severity and frequency of bother, QoL, residual urine or prostate size. Peak urinary flow is a weak, patient-oriented outcome in that the patient only marginally experiences flow rate differences (primarily based on urination time). Although Qmax is not particularly useful from a diagnostic point of view, it is recommended as an optional test prior to treatment discussion because the result may predict the natural history as well as the response to certain therapeutic interventions. The Panel elected to include this outcome in the analysis because repeated urinary flow rate recordings are useful for patient follow-up and in comparing treatment outcomes among trials using the same or different treatments.

Efficacy Outcomes Not Analyzed

Although initially considered for review, several efficacy and effectiveness outcomes were excluded from the final analysis as part of the 2010 BPH Guideline. These comprised the following urodynamic parameters: invasive pressure flow studies, percent (%) of residual volume voided, bladder capacity at first desire/strong desire to void, detrusor pressure at cystometric capacity, bladder compliance, detrusor opening pressure and the amplitude of overactive detrusor contractions. There were several reasons for their elimination, including concerns about test-retest reproducibility, predictability of long-term outcomes, controversy about the proper interpretations of measurement, lack of Panel consensus, applicability to general LUTS/BPH patients and a small number of articles for review.

Several papers reported on prostate volume as measured by digital rectal exam (DRE). Such outcomes were rejected because estimating prostate size by DRE is notoriously unreliable. Correlation coefficients between DRE and transrectal ultrasound (TRUS) measurements vary widely from 0.4 to 0.9 and unfortunately greater experience in performing this measurement does not necessarily lead to greater accuracy, although training with a dedicated model may improve precision.^{3, 4} In general, the volume of smaller prostates is overestimated and of larger glands is underestimated with the degree of underestimation increasing with increasing actual size.

Symptom scores using only portions of validated questionnaires were excluded because of concerns about applicability, validation and interpretation of results. Similarly, symptom diaries with unvalidated scoring systems were also excluded. Biologic measures of dihydrotestosterone (DHT), estradiol and blood pressure were excluded because of concerns about clinical utility and applicability, laboratory assay variability, predictability of long-term outcomes and a small number of articles for review.

Safety Outcomes

The adverse events outcomes include side effects and complications of treatment and disease progression (e.g., development of urinary retention). Adverse events have been grouped together since there were no consistent reporting standards or naming standards for such events.

Watchful Waiting

The expectant management of LUTS/BPH is defined as "watchful waiting or active surveillance". Many men with BPH and LUTS do not require treatment because their symptoms are not significantly interfering with their QoL. Moreover, progression of symptoms or deterioration of QoL occurs only in a portion of men and treatment intervention is still effective, even when delayed. Watchful waiting studies, like the Veterans Affairs Cooperative Trial (VA CO-OP)⁵, demonstrate slight symptom improvement in up to one third of men. However, the magnitude of the symptom improvement is small. Even placebo, arguably more effective than watchful waiting, produces no more than a one to two point mean improvement in symptom score in men followed for four years.⁶

Acute urinary retention (AUR) and invasive treatment occur in a certain subset of men followed conservatively. These complications are more frequent in men with larger prostates and higher serum prostate-specific antigen (PSA) levels than in other men. For example, men with a PSA of 3.3 ng/mL or greater have approximately a 5% annual risk of AUR or surgery compared to less than 2% annual risk for men with a PSA less than 1.3 ng/mL. Even in the highest risk groups, not all men develop AUR or require surgery. Therefore, serum PSA and prostate size can be used as parameters to advise men on their overall risk but not as the sole basis for treatment recommendations.

Study Outcomes

In addition to the above citations that were published prior to the 2003 Guideline, a focused literature search was conducted to identify those studies with long term follow-up reporting outcomes in a group of men who received the approach of watchful waiting with no active therapy. Through this process, we identified four studies published in peer-reviewed journals that met the above criteria. Detailed evidence tables reviewing these studies are provided in Appendix A8. The Panel review of these data supports the following.

The placebo arm of the Medical Therapy of Prostate Symptoms (MTOPS) Trial was analyzed to determine the rate and clinical predictors of BPH progression. A total of 737 men were randomized to placebo and the average length of follow-up was 4.5 years. Clinical progression of BPH [defined as an increase in the AUA symptom score of four or more points, AUR, urinary incontinence, renal insufficiency, or recurrent UTI (urinary tract infection)] occurred at the rate of 4.5 events per 100 person-years, which equals a cumulative incidence of 17% over the course of the study. Progression of the symptom score, as defined *a priori* as a sustained increase of four points on the I-PSS was the most

common event (3.6 per 100 person-years). BPH-related invasive treatment was delivered to 40 men (5.4%), with a rate of 1.3 events per 100 person-years.

In the MTOPS placebo group, a total prostate volume of more than 31 mL correlated with increased rates of clinical progression (p<0.0001), worsening of symptoms (p=0.001), urinary retention (p=0.034) and need for invasive surgical treatment (p=0.0005), compared with smaller prostates. Similarly, men with baseline PSA of greater than 1.6 mg/dL had significantly increased rates of clinical progression and other adverse outcomes (p<0.05). Qmax increased by 1.4 mL per second on average during MTOPS in the placebo group, however, men with a baseline Qmax of less than 10.6 mL per second had a significantly greater risk of clinical progression (p=0.011), worsening symptoms (p=0.0005), and surgical treatment (p=0.033) than subjects with a higher Qmax. Postvoid residual volume of more than 39 mL also predicted adverse outcomes. Age >62 years predicted clinical progression (P=0.0002) and worsening symptoms (P=0.0003), compared with younger men.

In an observational study, Djavan and colleagues (2004) examined 397 men with mild symptoms of BOO (I-PSS<8) over four years of follow-up. ¹⁰ Clinical progression as defined by an increase in I-PSS to ≥8 occurred at the following rates: six-months (6%); 12 months (13%); 24 months (24%); 36 months (28%); and 48 months (31%). Urinary retention occurring in 4.9% and 0.6% required transurethral resection of the prostate (TURP). Predictors for progression included higher baseline PSA (p=0.001), higher transition zone volume (p=0.001), and a greater obstructive symptom score (p=0.04). It is important to note that the differences in the definition of "progression" in such studies so as not to overestimate the risk of clinical progression.

Sarma and colleagues (2004) surveyed 369 African-American men in a prostate cancer and BPH study, recontacting them four years later to examine the progression of LUTS. Only men with complete baseline AUA-SI data and no BPH-related treatment during the four-year follow-up were included in the final survey, which examined 149 men. In this select group, I-PSS did not change significantly during the four-year follow-up. Of men who initially had mild-to-no symptoms at baseline (AUA-SI \leq 7), 26.4% reported moderate to severe symptoms at follow-up and this progression of symptoms occurred across age decade and increased with age to the seventh decade. Of men who initially had moderate-to-severe symptoms, at least 50% continued to report moderate-to-severe symptoms. In a multivariate model, older age predicted progression (p=0.01) and younger age predicted regression (P<0.0001).

In another longitudinal cohort study of men with mild LUTS (mean I-PSS score 4.6 [SE 0.05]), 456 men completed a five-year follow-up survey (53% of those who completed the baseline survey). Treatment was not required by 72.8% of men, while 26% started pharmacotherapy and 1.5% had a TURP. No predictors of symptom progression were identified. Age (p=0.0008) and symptom bother (p=0.007) predicted the need for therapy.

Summary

Watchful waiting is an appropriate strategy for many men with LUTS/BPH. It is the recommended management for men who do not have bothersome symptoms and have not developed complications of BOO from BPH. Age, baseline symptom score, serum PSA and prostate size are helpful to predict the risk of AUR and need for surgery in men managed by watchful waiting. However, neither prostate size nor serum PSA should be used as the sole determinant of the need for active therapy. The overall benefit and risks of therapy must also be considered.

Medical Therapies

Alpha-adrenergic Antagonists (Alpha-blockers)

Alpha-adrenergic antagonists, also known as alpha-blockers, are a widely used class of medications for the treatment of LUTS secondary to BPH, a disease symptom complex attributed, with various levels of evidence, to arise from two major components: static and dynamic, with an increase in prostatic smooth muscle tone believed to be largely responsible for the latter. Noradrenergic sympathetic nerves have been demonstrated to effect the contraction of prostatic smooth muscle. The prostate gland contains high levels of both α_1 - and α_2 -adrenergic receptors α_1 -17; 98% of α_1 -adrenoreceptors are associated with the stromal elements of the prostate, and are thus thought to have the greatest influence on prostatic smooth muscle tone. Activation of these receptors and the subsequent increase in prostatic smooth muscle tone with urethral constriction and impaired flow of urine is thought to be a major contributor to the pathophysiology of LUTS secondary to BPH. In addition, there is variable evidence that adrenergic receptors further mediate LUTS secondary to BPH via their activation within the central nervous system (CNS) and bladder.

Alpha-blockers are not unique to the prostate. The two basic subtypes of alpha-receptors (α_1 and α_2) are distributed ubiquitously throughout the human body. In general, α_2 -receptors are typically located presynaptically and down-regulate norepinephrine release via a negative feedback mechanism. α_1 -receptors are the postsynaptic receptors that affect a response to neurotransmitter release. Several subtypes of the α_1 -receptors have been identified and classified into three groups: α_{1A} , α^{1B} and α_{1D} . ^{16, 18, 19} Both α_{1A} and α_{1B} -receptors have been identified within the prostate. The α_{1A} -receptors are the predominant adrenoreceptors expressed by stromal smooth muscle cells. ¹⁵ In contrast, the α_{1B} receptors are predominantly located in the smooth muscle of arteries and veins, including the microvasculature contained within the prostate gland. ¹⁹ Within the genitourinary system, α_{1D} -receptors are mainly located in the bladder body and dome. ²⁰ α_{1D} -receptors are also located in the spinal cord where they are presumed to play a role in the sympathetic modulation of parasympathetic activity. ²¹

Knowledge of α_1 -receptor subtype location and action has been instrumental to targeting of BPH therapy to useful locations. Given their location, α_{1A} -receptors are optimal targets for therapy. Blockade of the α_{1A} -receptors has been shown to reduce prostatic tone and improve the dynamic Copyright ©2010 American Urological Association Education and Research, Inc. $^{\circ}$ 13

aspects of voiding. Blockade of α_{1B} receptors leads to venous and arterial dilation as smooth muscle cells in the vessel walls relax. In some patients this can cause dizziness and hypotension due to decreased total peripheral resistance, potentially serious side effects. Stimulation of α_{1D} -receptors can lead to detrusor instability and blockade of these receptors has been shown in animal models to reduce irritative voiding symptoms.

In an effort to maximally reduce LUTS and to minimize side effects, alpha-blocker development focused on binding to the α_1 -receptors and with reduced activity at α_2 -receptors (unlike phenoxybenzamine, a nonselective α_1/α_2 -receptor blocker). These second generation agents included terazosin, doxazosin and alfuzosin. More recently available third generation agents (e.g. tamsulosin) are thought to be more selective antagonists for prostatic α_{1A} -receptors. These drugs target the smooth muscle cells contained within the prostate gland and exert lesser effects on the other alpha-blocker subtypes that regulate blood pressure. Despite the convenient classification system mentioned above, it is critical that clinicians treating LUTS/BPH realize that the *in vitro* specificity of receptor antagonism and adrenergic generation does not necessary imply an advantage for the improvement of LUTS or the minimization of side effects.

For the purposes of this Guideline the specific agents included are **alfuzosin**, **doxazosin**, **tamsulosin and terazosin** as they theoretically act in the location that will have the greatest benefit for symptoms with the fewest side effects, remain a mainstay of LUTS/BPH therapy, and thus will be reviewed individually below. For reference, detailed evidence tables are provided in Appendix A8.

Alfuzosin

Alfuzosin, a second-generation α_1 -adrenoreceptor antagonist, is indicated for the management of moderate to severe BPH symptoms. Alfuzosin is approved for the treatment of bothersome urinary symptoms attributed to BPH as well as acute urinary retention. This medication is available in several countries other than the United States as immediate-release (two to three daily doses) and long-acting formulations (once daily dose).

Randomized Controlled Trials (RCTs)

We identified five unique RCTs that fulfilled the prespecified inclusion criteria ²⁴⁻²⁸ plus a meta-analysis of three RCTs, ²⁹ two of which were included in the five RCTs, along with an additional unpublished data set. Patient inclusion and exclusion criteria were similar across studies. In particular, 'significant other urologic disease' was an exclusion criterion in all trials. Significant comorbidities, such as heart failure, ²⁸ unstable angina, ^{25, 28} poorly controlled diabetes mellitus, ²⁸ significant renal or hepatic disease, ^{25, 28} postural hypotension ^{25, 27, 29} and significant cardiac diseases contraindicating the use of alpha-blockers were generally explicitly excluded. Studies varied greatly in population size, from 81 to 955. ²⁹ Study follow-up periods were either three months, ^{24, 27-29} six months or two years Most RCTs had a placebo run-in period of two to four weeks. Study participants were usually randomized at the end of the run-in period, however, one trial randomized beforehand and 18 subjects did not receive *Copyright © 2010 American Urological Association Education and Research, Inc.* ¹⁴

the study drug.²⁸ In trials where the run-in period preceded randomization, it was unclear how many subjects were withdrawn during the run-in period.^{24, 26, 27} The study settings were largely Western Europe and North America.

The mean patient ages in years in these trials ranged in the mid 60's. Some data were provided on comorbid conditions. Hypertension was common across study groups, ranging from 27% (treatment arm) to 41% (placebo arm).²⁵ Other co-morbidities were occasionally reported, including coronary heart disease (6% to 10%)²⁵, cardiovascular disease (46%)²⁷, and mild-to-moderate renal insufficiency (63%)²⁷. I-PSS was reported at baseline in all studies, and ranged from 16.8 to 21.7 across treatment groups. Qmax ranged from 5.1 to 9.3 mL/s in the four studies reporting these data. Most of the trials examined the long-acting formulation of alfuzosin (10 mg once daily). One trial examined the short-acting formulation with up-titration from 2.5 mg to 5 mg twice daily,²⁸ and another trial compared 10 mg once daily to 2.5 mg three times daily.²⁷ Five of the randomized studies of alfuzosin were placebo-controlled; in the sixth the comparator was doxazosin.

Single-group Cohort Studies

Six observational studies of alfuzosin (in 12 publications) were identified.³⁰⁻⁴¹ These studies were included in the safety and adverse events analyses only. All were single-group cohort studies of men with LUTS suggestive of BPH. One study was an open-label extension of an (included) RCT.³⁸ Patient exclusion criteria were fairly uniform across studies and included severe medical comorbidities, history of postural hypotension, other urological disorders, and BPH surgery anticipated within three to 12 months of study initiation. Two studies excluded potential participants who had demonstrated lack of efficacy to prior alpha-blocker therapy: the ALF-ONE Study and a study reported by Saad and colleagues (2005).^{32, 35}

Recruitment techniques were not described; in all studies it was unclear how participants were selected. Sample size varied greatly, from 33 participants in an open-label extension study³⁰ to the large ALF-ONE study^{32, 40} and a study by Lukacs and colleagues $(2000)^{36, 41}$. All cohort studies but one were \geq 12 months in duration, generally longer than the RCTs.³⁵

The mean age in years was generally in the mid 60's. Hypertension was common among study participants for whom data were reported 23%, 31 35% and 31.5%. 36 Patients with severe comorbidities were generally excluded with two studies that presented comorbidity rates reporting low rates of diabetes mellitus (5% in ALF-ONE)³¹ and ischemic heart disease (5% in ALF-ONE³¹ and 12.2% in a second study³⁵). In a third study, comorbidities were reported in 60% of participants, however, details as to their nature were not reported. 36 There was some variation in baseline I-PSS, with four cohorts reporting scores between 15.5 and 19.6 and one reporting a score of 21.6 (SE 0.4). 37

Alfuzosin doses and formulations varied across studies: alfuzosin 10 mg daily was administered in three studies, ^{33, 35, 38} alfuzosin SR 5 mg twice daily in one study ³¹ and the short-acting formulation (2.5 mg three times daily) in two studies. ^{36, 37}These cohort studies were conducted in Western Europe or

Canada, with ALF-ONE also including centers in Africa and the Middle East. None of these studies were conducted in the United States.

Efficacy and Effectiveness Outcomes

Morbidity

The incidence of surgical treatment during the follow-up period was similar between groups with six-months²⁵ and two-year²⁶ follow-up. The incidence of AUR was similar between the alfuzosin and placebo groups at two-years follow-up (p=0.82).^{25, 26} McNeill and colleagues (2005) noted high rates of urinary retention during 3-month follow-up (64% with alfuzosin and 97% with doxazosin, p-value not reported).²⁵ This study included subjects with AUR at baseline who then had a successful trial without a catheter with alfuzosin (phase 1 of the study).

Symptoms and Quality of Life

Total I-PSS improved significantly (p<0.05) compared with placebo in all five RCTs. Data were insufficient to perform a meta-analysis; only two studies presented comparable doses and follow-up periods (three-month data for 10 mg daily). A third study with three-month data was a meta-analysis containing data from two included studies. Roerhborn and colleagues (2006) published two-year data as cumulative incidence of I-PSS worsening in graphical form. We attempted to obtain three- and six-month data from the study sponsor who has possession of the primary data for this trial, but received no response. The filling and voiding subscores of the I-PSS decreased significantly (p<0.05) in both studies reporting these outcomes.

In the active comparator trials, I-PSS improved more with doxazosin (mean dose, 6.1 mg daily; mean change, -9.2) than with alfuzosin 2.5 mg twice to three times daily (mean change, 7.5; betweengroup p<0.05). ²⁸

QoL score also improved in all five studies (p<0.05). Again, data were insufficient to perform a meta-analysis; only two studies presented comparable doses and follow-up periods.^{24, 27} QoL was not reported in the active comparator trial of doxazosin vs. alfuzosin.²⁸

Pressure, Flow, Volume Outcomes

Qmax also improved significantly with alfuzosin 10 mg daily compared with placebo in three trials with follow-up between three and 12 months^{24, 26, 27}, as well as in the meta-analysis at three months.²⁹ Improvements were approximately 1 to 2 mL per second. Significant improvement did not occur, however, with alfuzosin 15 mg daily at three months follow-up.²⁴ Postvoid residual volumes, prostate volume, and detrusor pressure at maximum flow were not reported as outcomes in these studies. In the active comparator trial of doxazosin vs. alfuzosin, Qmax improved in both treatment groups (approximately 3 mL per second), with no significant difference between groups (p>0.05).²⁸ In this same comparator trial post-void residual volume increased at 14-weeks follow-up with alfuzosin

(mean change, 9.6 mL; p>0.05) and decreased with doxazosin (mean change, -29.2 mL; between-group p<0.05). These differences do not appear clinically meaningful.

Prostate-specific Antigen Levels

Follow-up PSA decreased slightly with alfuzosin compared with placebo at two-year follow-up (p=0.07) in the only study reporting this outcome.²⁶

Predicators of Efficacy, Effectiveness, and Harms

Few studies provided data on the predicators of either intended benefits or harms. No study examined the relationship between race/ethnicity and benefits or harms. One trial noted that lower I-PSS at baseline predicted worsening of symptoms over two-year follow-up, and that a higher I-PSS at baseline predicted BPH-related surgery.²⁶

Several studies examined the relationship between patient age and outcomes. One trial found that age was not a predictor for the outcomes of I-PSS, AUR, or BPH-related surgery with alfuzosin treatment.²⁶ The incidence of adverse events related to vasodilation with alfuzosin 15 mg daily were increased in subjects 65 years of age and older, compared with younger subjects.²⁴ There were no significant differences in adverse events rates related to vasodilation between older and younger patients with 10 mg daily, however. Another trial examining the lower dosage found similar results.²⁷ Roehrborn and colleagues (2006) noted that alfuzosin was well tolerated in patients over 65 years of age and in persons taking antihypertensive medications.²⁶

Safety Outcomes

Withdrawals and Adverse Events

Randomized Controlled Trials. Overall withdrawal rates were variable in the five placebocontrolled trials, ranging from 3% (six-month study)²⁵ to 33.9% (two-year follow-up)²⁶, with rates generally similar between treatment groups. Withdrawal rates were 19% with doses of alfuzosin 2.5 mg two or three times daily, compared with 12% with doxasosin 1 to 8 mg daily at 14 weeks follow-up.²⁸

Mortality rates were reported in only two of the five placebo-controlled trials of alfuzosin^{25, 28} with one sudden cardiac death in the alfuzosin group in a three-month study²⁸ and no deaths in a second, six-month trial.²⁵ Rates of treatment-emergent adverse events were generally similar between treatment and placebo groups. Rates varied significantly among studies, however, from 8.4% and 13.1% (treatment and placebo, respectively)²⁵, to more than 50% in a study with two years of follow-up.²⁶

Rates of specific adverse events were low and similar between treatment and placebo groups. Dizziness was the most commonly reported adverse event, ranging from 2% to 9% with alfuzosin and somewhat lower rates with placebo. Sexual function was reported in four studies with no significant difference between treatment groups (alfuzosin, doxazosin and placebo). In the active controlled trials,

alfuzosin and doxasosin had similar rates of adverse events, including dizziness and erectile dysfunction (ED).

Single-group Cohort Studies. Withdrawals rates varied across studies and were generally higher with longer follow-up: up to 36% in the ALF-ONE cohort with three-year follow-up.³⁴ Withdrawals due to adverse events were generally low, ranging from 3.9%³⁸ to 8.6%.³⁴ Incidence rates for treatment-emergent adverse events varied greatly across studies, and were also generally higher with longer follow-up. The highest rate was reported in three-year follow-up of 689 subjects in ALF-ONE³⁴, where 71.4% reported at least one treatment-emergent adverse event. A high rate of one or more treatment emergent adverse event was also reported in a 12-month study (43%).³⁸ In contrast, 7% of participants reported a treatment-emergent event in another 12-month study where "the appearance of adverse medical events was carefully monitored and recorded throughout the trial."³⁷ Lukacs and colleagues (2000) noted that 61% of adverse events occurred in the first three months of treatment.³⁶

Doxazosin

Doxazosin is also a second-generation α_1 -adrenoreceptor antagonist, indicated for the management of moderate to severe BPH symptoms. As a long-acting agent, it is also dosed once-daily. Doxazosin not only elicits a dose-dependent response but its side-effect profile has also been shown to be dose dependent. In order to reduce the frequency of side effects (i.e., postural hypotension and syncope), doxazosin is typically initiated at a dose of 1 mg once daily. The dose may be increased to 8 mg/day, depending on response and tolerability.

Randomized Controlled Trials (RCTs)

The nine RCTs evaluating doxazosin that were identified involved various comparators, follow-up intervals, doses, and formulations, so that synthesis across all trials was not meaningful. For reader ease, the data is presented by comparator, dose, ⁴² formulation, ^{43, 44} whether placebo-controlled ⁴⁴⁻⁴⁷ or active—treatment controlled. ⁴⁷⁻⁴⁹ An additional study examined success of discontinuing doxazosin while taking finasteride, so-called "withdrawal therapy". ⁵⁰ There were no cohort studies with a comparison group identified, but there were five single-group cohort studies reporting doxazosin adverse events. ⁵¹⁻⁵⁵ The sample size of these five studies varied from 102 to 3,694.

The MTOPS study was included in the 2003 Guideline even though it was published after the cut-off date (June 1999) for study inclusion for that report. ⁴⁶ This important study is included in the 2010 AUA BPH Guideline in a more abbreviated fashion for that reason. In this blinded study, 3,047 men were randomized to one of four treatments: doxazosin, finasteride, combination doxazosin and finasteride, and placebo. This trial was unique in that the primary outcome was clinical progression as defined by a composite endpoint (sustained four point rise in AUA-SI, acute retention, renal insufficiency, and recurrent UTI or urinary incontinence) examined over 4.5 years.

Similar to the MTOPS study, the Prospective European Doxazosin and Combination Therapy (PREDICT) trial was a blinded study of four treatments: doxazosin, finasteride, combination doxazosin Copyright © 2010 American Urological Association Education and Research, Inc. * 18

and finasteride, and placebo.⁴⁷ Of note, PREDICT differed from MTOPS in that it was only 52 weeks in duration and evaluated only the standard outcomes, I-PSS and Qmax, rather than assessing the impact on clinical progression.

As mentioned above, one RCT examined the clinical outcome of 272 men with enlarged prostates (>40 g) who were withdrawn from doxazosin therapy after initially receiving combination therapy with finasteride.⁵⁶

Single-group Cohort Studies

The five single-group cohort studies that included 102 to 3,694 participants reported adverse events with doxazosin use. ⁵¹⁻⁵⁵ One large observational study of men receiving 4 mg to 8 mg of doxazosin in a gastrointestinal therapeutic system (GITS) formulation ⁵⁴ was a longitudinal extension of an earlier double-blind trial examining 178 hypertensive and 272 normotensive patients ⁵¹. One study examined the effect of doxazosin 4 mg and tolterodine 2 mg in 144 consecutive men with BOO. ⁵⁵

Efficacy and Effectiveness Outcomes

Morbidity

A dose-ranging study comparing doxazosin 4 and 8 mg daily over three months (n= 82) noted adverse events rates were similar between treatment groups, although dizziness and nasal stuffiness were more common with the 8 mg dose; no statistical analysis was reported. ⁴² In the MTOPS study, the most common side effects reported in the doxazosin arm were dizziness, postural hypotension, and asthenia. Men receiving combination therapy experienced the same level of side effects noted in each of the monotherapy arms.

Symptoms and Quality of Life

AUA Symptom Index/International Prostate Symptom Score (Total). The doxazosin dose-ranging study comparing 4 mg and 8 mg daily doses over three months (n=82) noted improved AUA-SI in both treatment groups with a significant difference between groups (p=0.03). Similar findings was noted when with the Boyarsky score (p=0.009, 4 vs. 8 mg doses). In a trial comparing doxazosin GITS with the standard formulation doxazosin and placebo, the total I-PSS improved in all three groups (p<0.001) at 13-weeks of follow-up. Both active treatments were more effective than placebo (p<0.001), but there was no difference between the active groups.

As mentioned above, MTOPS reported on the clinical progression of a composite endpoint.⁴⁶ The most common event triggering a progression event was a four point change in AUA-SI and the rate of this event was reduced in all three active-treatment groups. There was no significant difference between either finasteride or doxazosin monotherapies and the combination doxazosin and finasteride. In the shorter duration PREDICT study, I-PSS improved significantly with doxazosin monotherapy and the

combination, while the I-PSS decrease with finasteride therapy was not significantly different than with placebo.⁴⁷

International Index of Erectile Function (IIEF). In a trial comparing the effects of doxazosin GITS and standard formulations on sexual function in sexually active men, investigators noted that the GITS consistently improved sexual function regardless of baseline function using the International Index of Erectile Function (IIEF) to measure intercourse and sexual satisfaction domains (p<0.05). The difference between the GITS and standard formulation was significant for the erectile function domain (p<0.005). The clinician is cautioned about considering alpha-blockers as a useful therapy for the treatment of ED as this was not adequately addressed in this limited study.

BPH Impact Index. Several active-treatment controlled trials were identified that used the BPH II, including a comparison of the doxazosin GITS with tamsulosin in a blinded study. ⁴⁸ The BPH II improved significantly in both treatment groups at 12 weeks (p<0.05) with no differences noted between the groups.

Other Custom Measures. As mentioned above, the MTOPS assessed the clinical progression of a composite endpoint. ⁴⁶ Throughout the trial, the overall rate of clinical progression per 100 person years was 4.5 in the placebo group, 2.7 with doxazosin (p<0.0001 vs. placebo), 2.9 with finasteride (p=0.002 vs. placebo), and 1.5 in the combination group (p<0.001 vs. placebo). The risk of overall progression increased with increasing baseline PSA (a proxy for prostate volume) in the placebo and doxazosin groups (p<0.006), but not in the finasteride or combination groups. The numbers needed-to-treat analysis indicated that to prevent one case of progression 8.4 individuals would need to be treated with combination therapy, 13.7 with doxazosin and 15.0 with finasteride.

As mentioned previously, the "withdrawal therapy" trial was an RCT that examined success rates after discontinuing doxazosin.⁵⁶ Initially 272 men with prostate volume of at least 40 g were treated with finasteride 5 mg and doxazosin 2 mg, titrated up to 4 or 8 mg daily. Men with a favorable response (n=240) after one month were randomized to receive: 5 mg finasteride plus 2 mg doxazosin (n=100), 5 mg finasteride plus 4 mg doxazosin (n=80), and 5 mg finasteride plus 8 mg doxazosin (n=60) daily. Within each group, men were then randomized (but not in a blinded fashion) to discontinue doxazosin at threemonth intervals. Among men discontinuing doxazosin at three months, successful discontinuation (defined as the patient declining to restart doxazosin) occurred in 20% of men receiving 2 mg doxazosin, 15% of men receiving 4 mg, and 13% of men receiving 8 mg. Success rates improved over time, with little difference among doxazosin dose groups. In men discontinuing doxazosin at 12 months, success was achieved by 84% of the 2 mg group, 85% in the 4 mg group, and 87% in the 8 mg group. The authors concluded that in men with moderately large prostates receiving combination therapy, the alpha blocker can be successfully discontinued after nine to 12 months in most men, regardless of dose. The lack of blinding is obviously a limitation of the study, as is the small number of subjects in each treatment group (there was no power calculation, but power was very likely insufficient to detect clinically important treatment effects). The general applicability of withdrawal therapy noted here and

elsewhere has not been determined, thus the clinician is warned to consider this approach as experimental.

Pressure, Flow, Volume Outcomes

Maximum Flow Rate. In the doxazosin dose-ranging study, the investigators noted improved Qmax in both 4 mg and 8 mg treatment groups with no difference between doses. 42 In the trial comparing doxazosin GITS with the standard formulation doxazosin, and placebo, Qmax improved with both formulations compared with placebo (p<0.001) but there were no differences between active treatments (p=0.257). 44

In the PREDICT study, Qmax improved significantly with only doxazosin mono-therapies and the combination, while finasteride outcomes were no different than placebo.⁵⁷ The shorter duration of treatment may be a large factor in the modest effect noted with 5-alpha-reductase inhibition.

Prostate Volume (Measured by TRUS or Magnetic Resonance Imaging [MRI]). In a companion publication to MTOPS, investigators noted that in men with prostate volumes <25 mL, combination therapy was no better than doxazosin monotherapy in improving the risk of progression, AUA-SI and Qmax.⁵⁸ Among men with glands >25 mL, combination therapy led to greater clinical benefit than either monotherapy.

Acute Urinary Retention. As mentioned above, MTOPS assessed the clinical progression of a composite endpoint including AUR. ⁴⁶ The rate of AUR was reduced with finasteride and combination therapy. Doxazosin delayed, but did not prevent AUR (p=0.23). Findings were similar for the rates of crossover to invasive therapy for BPH which were reduced by finasteride and combination therapy but not doxazosin. In the PREDICT study, AUR and need for surgery were infrequent and highest in the placebo group with no events in the combination arm. ⁵⁷ It appears logical that the larger cohort and longer duration noted in MTOPS supports a time-limited impact of doxazosin on the hard outcomes of AUR and crossover to surgery. This effect noted with doxazosin is thought by the Panel to be a class effect.

Safety Outcomes

Withdrawals and Adverse Events

Single-Group Cohort Studies. In the doxazosin single-cohort studies, dizziness and symptomatic hypotension were the most commonly reported adverse events. Rates for these side effects varied across studies from 14.7% (dizziness)⁵¹ to <1% (postural hypotension).^{52, 54} Other adverse events were infrequently reported.

The large study by Hernandez and colleagues (2005) was an observational surveillance study of men on 4 mg to 8 mg of doxazosin GITS for six months. In total, 107 patients (2.9%) withdrew from the study due to adverse events.⁵⁴ The rate of postural hypotension was 1.1% and syncope 0.05% (an additional two men experienced syncope not attributed to the drug). Four men reported ED; three of

these cases were considered unrelated to the study drug. Importantly, this publication does not indicate how the researchers decided whether an adverse event was attributed to the study drug or not.

In a longitudinal extension of earlier double-blind trials, Fawzy and colleagues (1999) examined 178 hypertensive and 272 normotensive patients. ⁵¹ The dose of doxazosin could be titrated in hypertensive patients up to a dose of doxazosin 16 mg daily, whereas normotensive patients were titrated only up to 8 mg daily. The incidence of drug-related adverse events in normotensive men was approximately half the rate seen in hypertensive patients (6.6% vs. 12.4% per year). In hypertensive men achieving 48-month follow-up, the rate of drug-related adverse events was 14.3% per year. However, the incidence of severe adverse events was similar between the hypertensive and normotensive patients (7.1% vs. 6.6% per year, respectively). Drug-related adverse events were less common in older than younger hypertensive patients, although the discontinuation rate was slightly higher in the older subgroup (10.3% vs. 6.8% per year, p-value not reported).

In a study examining sexual effects of doxazosin after three months of treatment, overall IIEF scores improved at one month (p=0.0177), and improvements were maintained at the final follow-up of three months. 53 Among patients with lower IIEF scores at baseline (\leq 16), patients demonstrated a significant improvement in scores at three-month follow-up (p<0.01); statistically significant improvement was not seen among men with higher IIEF scores.

Lee and colleagues (2004) administered doxazosin 4 mg daily with added tolterodine 2 mg daily if needed, to 144 consecutive men with BOO, and compared outcomes between men with and without overactive bladder. The most common adverse events reported with doxazosin were dizziness (2%), postural hypotension (1.3%), and abnormal ejaculation (1.3%). Dry mouth (27%), the most commonly reported adverse event in patients receiving tolteridine, led to treatment discontinuation in two of 16 patients with this complaint. Acute urinary retention developed in 3.3% of men on combined tolteridine and doxazosin and resolved with overnight catheterization.

Tamsulosin

Tamsulosin is a third-generation alpha-blocker with greater specificity for the α_{1A} -adrenoreceptor in relation to the α_{1B} -adrenoreceptor with a putative advantage in reduced need for titration (i.e., 0.4 mg, 0.8 mg) and less hypotensive side effects. Clinical studies have also demonstrated that tamsulosin can be co-administered with antihypertensive medications such as nifedipine, enalapril and atenolol without any increased risk of hypotensive or syncopal episodes.

Randomized Controlled Trials (RCTs)

Eight RCTs examined tamsulosin, including two placebo-controlled trials,^{59, 60} two direct drug comparisons,^{61, 62} three direct drug trials with a placebo comparison group⁶³⁻⁶⁵ and a trial examining the effects of withdrawing tamsulosin when dutasteride therapy was continued ("withdrawal therapy").⁶⁶ In addition, a meta-analysis of three previously published RCTs comparing tamsulosin to placebo and to alfuzosin with respect to sexual side effects were identified.⁶⁷ The Combination of Adovart and *Copyright* © 2010 American Urological Association Education and Research, Inc. ²

Tamsulosin (CombAT) trial, an RCT comparing tamsulosin, dutasteride, and the combination, is discussed in the section on dutasteride.

Sample sizes ranged from 205 to 2,152 with study duration ranging from 12 weeks to one year. Placebo run-in periods ranging from seven to 28 days were included in the design of five of the studies. The mean total I-PSS score at baseline ranged from approximately 16 to 20 and mean age from 60 to 65 years. Qmax was more heterogeneous across studies: mean values ranged from 8.7 to 13.4 mL per second. Several studies specifically excluded men with significant comorbidities. 61,62

Intervention dosing and drug formulation varied across studies. The most common dose was tamsulosin 0.4 mg daily. ^{59, 62-64, 67} One study compared the oral controlled absorption system (OCAS) at 0.4 mg and 0.8 mg daily to the standard modified release formulation (0.4 mg daily). ⁵⁹ Several studies used lower doses of 0.2 mg twice daily ⁶⁰ or 0.2 mg once daily. ⁶¹ In the Symptom Management After Reducing Therapy (SMART-1) study, Barkin and colleagues (2003) randomized 327 men with symptomatic BPH to 0.5 mg dutasteride plus 0.4 mg tamsulosin for 36 weeks, or to 0.5 mg dutasteride plus 0.4 mg tamsulosin for 24 weeks followed by dutasteride plus a tamsulosin-matched placebo for 12 weeks. ⁶⁶

Because of the considerable heterogeneity across comparators, study populations, and drug doses and formulations, the data were synthesized in a qualitative manner since the Panel did not believe that a meta-analysis would be meaningful.

Single-group Cohort Studies

Six single-group cohort studies of adverse events with tamsulosin as the primary intervention were identified. In addition, two single-group cohort studies were included with cataract surgery as the primary intervention, assessing the outcome of intraoperative floppy iris syndrome (IFIS). ^{68, 69} Follow-up ranged between 12 weeks⁷⁰ and 5 years⁷¹.

Efficacy and Effectiveness Outcomes

Symptoms and Quality of Life

AUA Symptom Index/International Prostate Symptom Score (Total). Total I-PSS decreased compared with placebo in the three studies reporting this outcome (P<0.05), all with 12-week follow-up. ^{59, 63, 64} When compared with finasteride 5 mg daily, tamsulosin 0.2 mg daily ⁶¹ or 0.4 mg daily ⁶² did not differ in I-PSS or Qmax at 24- and 26-week follow-up. One trial randomized men to alfuzosin, tamsulosin, or placebo, but did not report changes or tests of significance for the comparison of the two active drugs. ⁶⁴ Similarly, Kaplan and colleagues (2006) did not compare tamsulosin to tolterodine. ⁶³

In the Symptom Management After Reducing Therapy (SMART-1) RCT, Barkin and colleagues (2003) examined combination therapy with dutasteride 0.5 mg daily and tamsulosin 0.4 mg daily for 24 weeks followed by either continuation of both drugs or continuation of dutasteride with tamsulosin-placebo for 12 weeks. ⁶⁶ Of men with baseline I-PSS less than 20, 84% switched to dutasteride

monotherapy at 24 weeks without deterioration in their symptoms by week 30. In men with severe BPH symptoms at baseline, 42.5% reported a worsening of symptoms after tamsulosin withdrawal at week 24, compared with 14% who reported symptom deterioration among those who continued dual therapy. The general applicability of withdrawal therapy noted here and elsewhere has not been determined thus the clinician is warned to consider this strategy as experimental.

QoL from I-PSS. As reported above, one study using the oral controlled absorption system (OCAS) reported that the QoL score improved more with tamsulosin OCAS 0.4 mg and modified-release 0.4 mg daily than with placebo. 59 Another study also reported a more favorable change in QoL for tamsulosin (P<0.05). 61

Other custom measures. In one study the primary outcome was the Symptom Problem Index (SPI), a validated symptom questionnaire related to the I-PSS, but scored differently.⁶² The SPI improved in both treatment groups (finasteride 5 mg or tamsulosin 0.4 mg once daily), but improved sooner with tamsulosin, with significant differences between groups (p<0.05) in favor of tamsulosin through week 18. Between weeks 26 and 52, however, there were no significant differences between the groups. Sexual function, as measured with a questionnaire that was not reported as validated, was not significantly different between the two drugs.⁶²

Pressure, Flow, Volume Outcomes

Maximum Flow Rate. As reported above, in one study using the oral controlled absorption system (OCAS), Qmax improved significantly in one trial reporting that outcome.⁵⁹

Predictors of Efficacy and Effectiveness

Included trials did not generally examine the predictors of efficacy or adverse events. A *post hoc* analysis of a trial comparing tamsulosin and finasteride demonstrated that the greater improvements in Qmax with tamsulosin compared with finasteride at weeks one, six and 18, was significant for patients with prostate volume less than 50 mL, but was not significant for larger glands.⁶² There was no significant differential effect after 18 weeks between the two drugs with large or small glands.

Safety Outcomes

Withdrawals and Adverse Events

Randomized Controlled Trials (RCTs). Rates of total withdrawals from studies were variable; for the 12-week trials rates ranged from 5%⁵⁹ to 29%.⁶¹ In the latter study, both tamsulosin and finasteride groups lost approximately the same percentage of subjects, the majority due to failure to return for follow-up. In addition, in this trial, there were more treatment-emergent adverse events with finasteride (2.5%) than with tamsulosin (3.9%). Rates of treatment emergent adverse events varied markedly across these trials. The highest rate was reported by Kawabe and colleagues (2006)where the rate was 82%

with tamsulosin and 72% with placebo. 60 This finding contrasts markedly with another trial where rates for tamsulosin were approximately 4%. 61

Dizziness was commonly reported, with higher rates in the tamsulosin group compared with placebo in one trial, ⁶³ similar rates in a second trial, ⁵⁹ while a third trial reported higher rates in the placebo group. ⁷² Syncope and postural hypotension were uncommon (< 1% to 2%). Hofner and colleagues (1999) examined sexual function with tamsulosin and alfuzosin in a meta-analysis of two placebo-controlled trials of tamsulosin and a head-to-head trial of tamsulosin compared with alfuzosin. ⁶⁷ Tamsulosin produced a higher rate of abnormal ejaculation than placebo (p=0.045) but rates of ED and decreased libido were not significantly different (p>0.05). Tamsulosin was comparable to alfuzosin with respect to adverse sexual effects.

Single-group Cohort Studies. In a study with five-year follow-up, Palacio and colleagues (2004) reported a total of 114 nonserious adverse reactions during the first year; only 3.6% of men had an adverse reaction, all within the first year. Adverse reactions were not defined and it was unclear if any withdrawals were due to adverse events. Batista and colleagues (2002) examined more than 2,700 patients in a single-group cohort study, and included all patients with LUTS between 45 and 75 years of age who visited a group of urologists' offices. Study participants therefore had a variety of comorbid conditions: hypertension 18.4%, diabetes mellitus 12.1%, and cardiovascular disease (unspecified) 10.5%.

In a much smaller cohort, 88% of subjects had a positive medical history, including 35% with cardiovascular disease. Using prescription monitoring data, Mann and colleagues (2000) reported adverse events for men issued a tamsulosin prescription. The response rate for the questionnaire was 57.4%, and 92% of returned forms had event data. After six months of treatment, 68.6% of men were still taking tamsulosin. Patients reported dizziness, malaise, and headache most commonly. General practitioners also reported adverse events; the most common events were dizziness, nausea, and palpitations.

Terazosin

Terazosin is an α_1 -selective antagonist with a relatively long half-life that allows for once-daily dosing. As noted in the 2003 Guideline, terazosin is an effective medical treatment for reducing LUTS and the impairment of QoL due to urinary symptoms created by BPH. It has been shown that the response to terazosin is dose dependent. Not surprising, the side effect profile has also been shown to be dose dependent. In order to minimize the frequency of side effects (i.e., postural hypotension and syncope) terazosin is typically initiated at a dose of 1 mg once daily. Depending on response to therapy and tolerability, the dosage may be increased to 10 mg/day.

Randomized Controlled Trials (RCTs)

Two RCTs examined terazosin.^{75, 76} A secondary analysis of the VA CO-OP trial⁷⁷ (included in the 2003 Guideline) by Johnson and colleagues (2003) assessed changes in nocturia with medical treatment.⁷⁵

Single-group Cohort Studies

A two-group cohort study compared 60 patients with symptomatic BPH receiving either terazosin titrated up to 5 mg daily, or finasteride 5 mg daily. Rates of adverse events were low, and dizziness occurred more frequently with terazosin (13%) than with finasteride (3%). Supine hypotension occurred in one patient on terazosin.

Efficacy and Effectiveness Outcomes

Morbidity

One RCT was a retrospective analysis of the Hytrin Community Assessment trial (HYCAT).⁷⁶ The incidence of blood pressure-related adverse events with terazosin was similar between men on no antihypertensive treatment (13.5%) and men on antihypertensive treatment (14.3%). The rates of blood pressure-related adverse events in the placebo groups were 9.0% in men not on antihypertensive therapy and 5.9% in men using such therapy.

Safety Outcomes

Symptoms and Quality of Life

Another RCT, the VA CO-OP trial, compared terazosin 10 mg daily, finasteride 5 mg daily, combination therapy of both drugs, and placebo. Of the original 1,229 men randomized, 1,078 completed one- year of treatment. Of those, all but 38 reported one or more episodes of nocturia, so that 1,040 men were included in this secondary analysis. After one-year of treatment, the mean number of episodes of nocturia was 1.8 with terazosin, 2.1 with finasteride, 2.1 with placebo, and 2.0 with combination therapy compared with baseline values of 2.5, 2.5, 2.4, and 2.4, respectively. Terazosin significantly reduced nocturia episodes compared with finasteride (p=0.0001), combination therapy (p=0.03) and placebo (p=0.0001). Combination therapy also reduced nocturia episodes compared with finasteride (p=0.04) and placebo (p=0.03).⁷⁵

Intraoperative Floppy Iris Syndrome

Intraoperative floppy iris syndrome (IFIS) is a condition first described by Chang and Campbell (2005) as a triad of progressive intraoperative mioses despite preoperative dilation, billowing of a flaccid iris, and iris prolapse toward the incision sites during phacoemusification for cataracts. ⁷⁹ Operative complications in some cases included posterior capsule rupture with vitreous loss and postoperative intraocular pressure spikes, though visual acuity outcomes appeared to be preserved. The original

report linked this condition with preoperative use of the alpha-blocker tamsulosin. A possible mechanism linking alpha blockers with IFIS is inhibition of the iris dilator smooth muscle. ^{79, 80}

To better understand the implications of IFIS for the use of alpha blocker therapy for men with LUTS attributed to BPH, two focused literature searches were conducted covering the period 1/1/1999 – 2/5/2009, using search terms as follows:

("Iris Diseases "[MeSH] OR "intraoperative floppy-iris syndrome" [TIAB] OR IFIS [TIAB] OR "Floppy Iris" [TIAB]) AND (BPH [TIAB] OR "Benign prostatic hyperplasia" [TIAB] OR "Prostatic Hyperplasia" [MeSH]) AND 1999/01/01 [PDAT]: 2009/02/05 [PDAT] AND English [Lang] NOT (Case Reports [PT] OR Editorial [PT] OR News [PT] OR Comment [PT] OR Letter [PT] OR "Historical Article" [PT] OR Biography [PT]) ("Iris Diseases" [Mesh] OR "intraoperative floppy-iris syndrome" [TIAB] OR IFIS [TIAB] OR "Floppy Iris" [TIAB]) AND ("tamsulosin" [TIAB] OR "Adrenergic alpha-Antagonists" [MeSH] OR "doxazosin" [TIAB] OR "prazosin" [TIAB] OR "tamsulosin" [TIAB] OR "alfuzosin" [TIAB] OR "trimazosin" [TIAB] OR "phenoxybenzamine" [TIAB]) AND ("1999/01/01" [PDAT]: "2009/02/05" [PDAT]) AND English [lang] NOT (Case Reports [PT] OR Editorial [PT] OR News [PT] OR Comment [PT] OR Letter [PT] OR "Historical Article" [PT] OR Biography [PT]) NOT (BPH [TIAB] OR "Benign prostatic hyperplasia" [TIAB] OR "Prostatic Hyperplasia" [MeSH])

The two searches yielded a total of 32 unique articles. In addition, reference lists of the retrieved papers were reviewed for original reports describing the risk of IFIS in association with alpha blockers.

Through this process, we identified 11 studies published in 10 reports providing information on the risk of IFIS with the use of various alpha blockers, and the implications of this condition for men prescribed alpha blockers for LUTS (Appendix A8). A review of these data supports the following conclusions:

The risk of IFIS is substantial among men taking tamsulosin, ranging from about 43% to 90% in 10 retrospective and prospective studies (sometimes the denominator for these risks is patients, and sometimes eyes). ^{68, 69, 79, 81-88}

The risk of IFIS appears lower with older, generic alpha blockers such as terazosin and doxazosin, with IFIS occurring in 0/11 patients (0%), 3/49 patients (6.1%), 1/51 eyes (2.0%), and 1/4 eyes (25%) in the four studies reporting on the risk of IFIS with these agents. ^{69, 79, 84, 88} There is insufficient exposure data to estimate the risk of IFIS with alfuzosin.

It is unclear whether dose or duration of alpha-blocker treatment influences the risk of IFIS. It is unclear whether stopping alpha-blocker treatment any period of time before surgery mitigates the risk of IFIS. If experienced ophthalmologists are aware of preoperative alpha-blocker use, pre- and intra-operative precautions can be taken to reduce the risk of IFIS complications and attain excellent visual

outcomes, ^{80, 85} though it remains unclear if the residual risk and outcomes are any worse than among patients without IFIS.

It is important to note that after the IFIS literature search and review was completed, a study was published in the Journal of the American Medical Association examining the association of recent tamsulosin use with serious postoperative complications (e.g., retinal detachment, lost lens or lens fragment, or endophthalmitis) requiring reintervention within 14 days of cataract surgery. ⁸⁹ The study found that for every 255 men receiving tamsulosin in the immediate preoperative period, one of these complications would result. The study had insufficient power to determine whether discontinuation of tamsulosin reduced the risk of these complications, and no separate estimate of the risk was provided for other alpha blockers, including alfuzosin. ⁸⁹ Therefore, the Panel believed that these new findings were supportive of their original conclusions.

Summary

Alpha-blockers produce significant symptom improvement compared to placebo that the average patient will appreciate as a moderate improvement from baseline. The minor differences in efficacy noted between the different alpha blockers are not statistically (when tested) or clinically significant.

The 2003 Guideline suggested that some patients treated with tamsulosin require the 0.8 mg dose to achieve the results obtained with doxazosin and terazosin titrated to response. This presents a cost-effectiveness problem for tamsulosin (which is not yet available generically) because the 0.8 mg daily dose requires two tablets and thus, twice the expense of the lower dose, while the terazosin and doxazosin recommended dosages are available as one unit generic products and priced accordingly. As this problem was not noted in the 2003 Guideline, it was the opinion of the Panel to include this comment in current guideline results.

Similarly, while in previous studies of one-year duration or less, combination therapy proved equal to alpha-blocker therapy, but superior to 5-ARI therapy, MTOPS demonstrated that in the long-term, among men with larger prostates, combination therapy is superior to either alpha blocker or 5-ARI therapy in preventing progression and improving symptoms. It was the opinion of the Panel that there is insufficient information to gauge the utility of alpha-blocker withdrawal therapy among men initially treated with combination therapy. Although not an unreasonable strategy, clinicians need to recognize that the optimal duration of combination therapy prior to discontinuation of the alpha-blocker remains in doubt.

Data from the long-term MTOPS trial suggests a time limited impact of alpha-blockers on the hard outcomes of AUR and crossover to surgery. That is, while AUR and surgery rates were lower with doxazosin compared to placebo in the early years of follow-up, by five years, rates of these outcomes were similar in both groups. The time-limited effect noted for doxazosin in MTOPS on these outcomes was judged by the Panel to be a class effect.

Qmax also improved significantly with alpha-blockers when compared with placebo. Improvements were approximately 1 mL to 2 mL per second from baseline.

Rates for specific adverse events were low and similar between treatment and placebo groups. Dizziness was the most common adverse event, with rates reported between 2% and 14% with alpha blockers and somewhat lower rates with placebo.

Sexual function was reported sporadically in the studies reviewed with no significant difference between treatment groups. Some studies report improved sexual function when using alpha blockers. The clinician is cautioned about considering alpha-blockers as a useful therapy for the treatment of ED as this outcome was not globally addressed in these limited studies. Tamsulosin produced a higher rate of abnormal ejaculation than placebo, but rates of ED and decreased libido were not significantly different.

In general, although doxazosin and terazosin require dose titration and blood pressure monitoring, they are inexpensive, can be taken once daily, appear equally effective to tamsulosin and alfuzosin, and have generally similar side effect profiles. Moreover, these older agents do not appear to increase the risk of the IFIS, and doxazosin has demonstrated efficacy relative to placebo over four years of follow-up. The Panel wished to remind clinicians that these agents remain excellent choices for the management of bothersome LUTS attributed to BPH.

In the expert opinion of the Panel, the caveat remains that alpha blocker monotherapy is not considered optimal therapy for hypertension. LUTS/BPH and hypertension should be managed separately.

5-Alpha-reductase Inhibitors (5-ARIs)

As the indication for treatment with 5-ARIs and combination therapy hinges on prostate volumes and PSA thresholds, the treating physician may discuss the relationship between PSA and prostate size with the patient. This conversion is enabled by the enzyme 5-AR, of which there are two isoenzymes known as types I and type II. Both testosterone and DHT bind to the androgen receptor, although dihydroxytestosterone (DHT) does so with greater affinity and is thus considered to be the more potent androgenic steroid hormone. The T/DHT-androgen receptor complex within the nucleus of the cells of the prostate initiates transcription and translation, thus promoting cellular growth and ultimately contributing to the condition of BPH with an imbalance between growth and apoptosis or cellular death in favor of growth, and subsequent cellular mass or volume increase. 90, 91

While there are several medical and surgical ways to reduce the influence of androgenic steroids on the growth of the prostate (e.g., medical or surgical castration), the only hormonal therapies with an acceptable benefit—to-risk ratio are the 5-ARIs. These molecules act via the reduction of DHT in the prostate which leads to a reduction in the overall androgenic growth stimulus in the prostate, an increase in apoptosis and atrophy and ultimately a shrinkage of the organ ranging from 15-25% measured at six months. The atrophy is most pronounced in the glandular epithelial component of the prostate, which is the source of the production and release of serum PSA. It is for this reason that the *Copyright* © 2010 American Urological Association Education and Research, Inc. *

organ shrinkage is associated with a reduction in serum PSA by approximately 50% (and a concomitant decrease in serum free PSA by 50%, which means that the ratio of free/total PSA remains constant). For reference, detailed evidence tables reviewing the studies evaluated by the Panel per the below are provided in Appendix A8.

Finasteride

Randomized Controlled Trials (RCTs)

In the 2003 Guideline finasteride was found to be an appropriate BPH treatment option based on a thorough review of a large body of evidence consisting of randomized, placebo-controlled studies of one year, two years, and four years duration. The majority of studies with finasteride were published before the 2003 Guideline and since then the molecule has lost patent protection. Only a small number of subsets or post hoc analyses and open-label extension studies have been reported since the 2003 Guideline was published. We identified one placebo-controlled trial, the Proscar Long-Term Efficacy and Safety Study (PLESS). 94-96 The primary publication by McConnell and colleagues was published in 1998, thus was included in the prior report. 95 The PLESS trial randomized 3,040 subjects to either finasteride 5 mg daily or to placebo, and finasteride improved symptoms and reduced the risk of development of AUR and the need for BPH-related surgery.

A second open label extension study was identified, which reported six-year follow-up data from a one-year placebo-controlled RCT comparing finasteride 1 mg or 5 mg daily to placebo. Data on 725 of the original 1,657 men randomized were available for five or six year follow-up of finasteride 5 mg daily (depending on whether they had received active treatment or placebo during the RCT in the first year).

Efficacy and Effectiveness Outcomes

Symptoms, Bother and Quality of Life

Previous analyses of randomized, placebo-controlled trials had shown an improvement in standardized symptom scores (I-PSS or Quasi I-PSS) superior to placebo. Numerically improvements of three to four points had been reported and were maintained for six to 10 years of follow up. ^{97, 98} The magnitude of improvement was similar when patients were stratified by prostate volume or serum PSA. However, the natural history is more accelerated in men with larger glands and higher serum PSA values, and thus, the difference between finasteride and placebo – the attributable effect – becomes more accentuated in those patients over time. ⁹⁹⁻¹⁰²

Findings regarding bother, interference and QoL scores were similar to those regarding the I-PSS or quasi I-PSS score. Bruskewitz and colleagues (1999) examined bother as measured with questionnaire items similar to those in the AUA symptom problem index in the PLESS Study, and found that mean reductions in overall bother were significantly greater with finasteride than placebo from four-month through four-year follow-up (p<0.001). Mean interference domain score and daily activity questions were also improved more with finasteride than placebo (p<0.05). In addition, no significant difference *Copyright* 2010 American Urological Association Education and Research, Inc. 30

was found between treatment groups with respect to ED, satisfaction with sexual activity, and sexual interest. On examination in the PLESS of age cohorts of men 65 years of age or more, and men less than 65 years, finasteride significantly improved a modified AUA-SI, and reduced prostate volume and the risk for AUR and/or BPH-related surgery at four-year follow-up in both age cohorts. ¹⁰⁴ Rates of adverse events did not appear to relate to age, and there was no significant difference in cardiovascular events between finasteride and placebo treatment in either age cohort.

Urodynamic parameter and Prostate Volume Measures

Previous analyses of randomized, placebo-controlled trials had shown a sustained improvement in peak flow rates superior to placebo. Previous analyses of randomized, placebo-controlled trials had shown a reduction in prostate volume by about 15-25% which is achieved at 6 months and sustained over time. This decrease in prostate volume is independent of baseline volume and baseline serum PSA values

Safety Outcomes

Previous analyses of randomized, placebo-controlled trials had shown that in the first six to 12 months of treatment, patients on finasteride experience ED, libido disturbances and ejaculatory problems at about twice the rate as the placebo control patients. Thereafter the rates are similar suggesting that age-related deterioration in sexual and ejaculatory function is responsible rather than direct drug effects. In PLESS sexual adverse events were reported more frequently with finasteride (15%) than placebo (7%) during the first year of the study (p<0.001), however, during years two through four no between-group difference was noted in the incidence of new sexual adverse events (7% in both groups). Study discontinuation due to sexual adverse events occurred in 4% of finasteride patients and 2% with placebo.

A two-year open-label extension study of PLESS reported no difference in serious adverse events between the finasteride and placebo groups. The most common drug-related sexual adverse events were erectile dysfunction (2% in the group on finasteride during the RCT and the open label extension, and 4% in the group switched to finasteride from placebo). The incidence of prostate cancer was 3% with both continuous finasteride and men switched from placebo to finasteride. The most common drug-related adverse effects were sexual, including ejaculation disorders (3.1% year ibe, 0.4% year six), decreased libido (3.8% year one, 0.7% year six), and erectile dysfunction (4.8% year one, 0.4% year six). One clinical center participating in this open-label extension study published data on their 43 study participants at up to 10 years of follow-up. These authors noted that 7.0% of men discontinued therapy due to sexual side effects; they did not report specific adverse events.

In another open-label extension study, Vaughan and colleagues (2002) reported outcomes at seven to eight years of follow-up from two phase two, double-blind, three- to six-month clinical trials of finasteride compared with placebo. ¹⁰⁸ The most common drug-related adverse events were erectile

dysfunction (year one of the open label extension study, 6.4%; year five, 1.2%) ejaculation disorder (5.8% year one; 3.7% year five), and decreased libido (11% year one; 1.5% year five).

Dutasteride

Randomized Controlled Trials (RCTs)

Dutasteride is the second 5-ARI approved by the U.S. Food and Drug Administration (FDA) for the use in men with LUTS and BPH. ¹⁰⁹ Pharmacologically it differs substantially from finasteride in that it inhibits both isoenzymes of the 5-alpha reductase (vs. only type II), has a longer half-life (five weeks vs.. six to eight hours), and thus leads to a more profound reduction in both serum and intraprostatic DHT levels. Direct comparison trials have not been published, and when indirectly comparing efficacy parameters one has to remember that in all clinical trials with dutasteride patients had to have a baseline prostate volume of > 30 mL by TRUS and a serum PSA of > 1.5 ng/mL, thus enriching the population for potential responders to 5-ARI treatment.

The clinical database for dutasteride consists mainly of the phase-three randomized, placebo-controlled trial of two year duration ¹¹⁰ with an open label extension trial, ¹¹¹ a study aiming to test the effect of a placebo-controlled withdrawal of an alpha-blocker from a combination therapy arm (SMART 1), ¹¹² and a four-year study comparing dutasteride vs. tamsulosin vs. combination (CombAT) for which only the two year interim data are published ¹¹³.

Efficacy and Effectiveness Outcomes

Symptoms, Bother and Quality of Life

Roehrborn and colleagues (2002) randomized 4,325 men with BPH and moderate to severe symptoms to dutasteride 0.5 mg daily or to placebo and followed them for 24 months. ¹¹⁴ These data are pooled from three identical phase-three clinical trials, encompassing 400 sites in the United States and 19 other countries. AUA-SI improved significantly in both treatment groups (p<0.001), with significantly greater improvement with dutasteride (-4.5) compared with placebo (-2.3) (p<0.001).

In the CombAT Trial, I-PSS improved in all three treatment groups (combination -6.2, dutasteride -4.9, tamsulosin -4.3) and combination therapy was superior to both monotherapies at nine months through 24 months(p<0.001). Quality of life, BPH II, patient perception of study medication were assessed in the CombAT Trial, and combination therapy was found to be superior to both monotherapies, with dutasteride being superior to tamsulosin in these measures at 24 months. In these measures are 24 months.

Urodynamic Parameter and Prostate Volume Measures

In the phase-three trials, Qmax increased by +0.6 ml/sec under placebo and +2.2 ml/sec under dutasteride (between-group p<0.001). In CombAT the increase in Qmax was greatest with combination (+2.4), and greater with dutasteride (+1.9) than with tamsulosin (+0.9) (p<0.0001) at 24 months. In the phase three trials total prostate and transition zone volumes were reduced by a mean of -25.7% and -20.4%, respectively, in the dutasteride arm (P <0.001). In CombAT at month 24 the adjusted *Copyright* ©2010 American Urological Association Education and Research, Inc. 32

mean% change in total prostate volume from baseline was -26.9% in the combination group, -28.0% in the dutasteride group and 0.0% in the tamsulosin group (combination vs. tamsulosin p <0.001 and combination vs. dutasteride p not significant). At month 24, the adjusted mean% change in transition zone volume from baseline was -23.4 in the combination group, -22.8% in the dutasteride group and 8.8 in the tamsulosin group (combination vs. tamsulosin, p <0.001; and combination vs. dutasteride, p-value was not significant).

Safety Outcomes

Progression Events

In the phase three trials, the relative risk of AUR with dutasteride vs. placebo was 0.43 (95% CI, 0.29 to 0.62) and the relative risk for BPH-related surgery was also significantly decreased [relative risk 0.52 (95% CI, 0.37 to 0.74)]. No progression data are available from the CombAT trial interim two-year analysis.

Adverse Events

In the phase three trial, withdrawal rates were similar between groups (30% with dutasteride and 33% with placebo). ¹¹⁴ Withdrawal rates due to adverse events (approximately 9%), and incidence of all treatment-emergent adverse events (approximately 75%) were similar between groups. ED, decreased libido, gynecomastia, and ejaculation disorders were more common with dutasteride than placebo (p<0.001).

In CombAT, any adverse event was reported at a rate of 63% to 65% in all three treatment groups. Any drug-related adverse event occurred at a higher rate in the combination group (24%) than with dutasteride (18%) or tamsulosin (16%) (combination therapy vs. dutasteride or tamsulosin, p<0.001).

Combination Therapy

Randomized Controlled Trials (RCTs)

In the 1990s, two studies of 12 months duration were conducted testing the hypothesis that combination medical therapy may be superior to monotherapy. ^{116, 117} The VA CO-OP used placebo vs. terazosin vs. finasteride vs. combination, and the European PREDICT trial used doxazosin instead of terazosin. Both studies concluded that combination therapy was **not** superior to alpha-blocker monotherapy. They were criticized on account of the relatively short duration of only one year and the fact that patients were enrolled regardless of prostate size and serum PSA leading to a study population of at or below average sized prostates and serum PSA values. A meta-analysis had shown that finasteride was superior to placebo only in men with enlarged prostates and/or higher serum PSA values ^{101, 118}

The National Institues of Health/National Institute of Diabetes and Digestive and Kidney Diseases (NIH/NIDDK) also conducted in the 1990s a combination therapy study the primary outcome parameter being a composite progression endpoint. ^{119, 120} The MTOPS study enrolled over 3,000 men with at or below average sized prostates (similar to the VA COOP) and randomized them to placebo vs. doxazosin 4 mg or 8 mg daily vs. finasteride 5 mg daily vs. combination of doxazosin and finasteride. Men were treated and followed for up to 5.5 years. The risk of overall clinical progression--defined as an increase above base line of at least four points in the AUA-SI, AUR, urinary incontinence, renal insufficiency, or recurrent UTI was significantly reduced by doxazosin (39% risk reduction, p<0.001) and finasteride (34% risk reduction, p=0.002), as compared with placebo. The reduction in risk associated with combination therapy (66% for the comparison with placebo, p<0.001) was significantly greater than that associated with doxazosin (p<0.001) or finasteride (p<0.001) alone. The risks of AUR and the need for invasive therapy were significantly reduced by combination therapy (p<0.001) and finasteride (p<0.001) but not by doxazosin. Doxazosin (p<0.001), finasteride (p=0.001), and combination therapy (p<0.001) each resulted in significant improvement in symptom scores, with combination therapy being superior to both doxazosin (p=0.006) and finasteride (p<0.001) alone. Although not a primary outcome, symptom and flow rate improvement were superior in the combination therapy arm compared to both monotherapies.

The second major combination therapy study conducted was the CombAT trial in which 4,844 men were randomized to receive tamsulosin 0.4 mg vs. dutasteride 0.5 mg vs. combination therapy with both over four years; at present only the two year data are available and published. In contrast to prior studies, but in keeping with the study protocol of only enrolling patients with prostatic enlargement in LUTS/BPH trials with dutasteride, men had to have a prostate volume > 30 mL by TRUS and a serum PSA of >1.5 ng/mL. Combination therapy resulted in significantly greater improvements in symptoms vs. dutasteride from month three and tamsulosin from month nine, and in BPH-related health status from months three and 12, respectively. A significantly greater improvement from baseline in Qmax for combination therapy vs. dutasteride and tamsulosin monotherapies from month six was also noted. There was a significant increase in drug related adverse events with combination therapy vs. monotherapies. The four-year data from CombAT are expected in 2009 and the primary endpoints will be progression to urinary retention and need for prostate surgery as well as symptom progression, similar to the MTOPS study.

When comparing results from MTOPS and CombAT differences must always be considered as they affect many aspects including the outcomes of the trials (Chapter 1, Table 1.3).

Efficacy and Effectiveness Outcomes

Symptoms, Bother and Quality of Life

MTOPS. The four-year mean reduction in symptom score was 4.9 in the placebo group, 6.6 in the doxazosin group, 5.6 in the finasteride group, and 7.4 in the combinationtherapy group (all active therapies superior to placebo).

CombAT. At month 24, mean decreases in I-PSS from baseline were 6.2 for combination therapy vs. 4.9 and 4.3 for dutasteride and tamsulosin, respectively. The decrease for combination therapy was significantly greater vs. that of either monotherapy (each comparison p<0.001). Superior improvements for combination therapy were also reported regarding storage and voiding subscores as well as BPH II, QoL scores and other humanistic questionnaires.

Urodynamic Parameter and Prostate Volume Measures

MTOPS. Maximal urinary flow rate improved over time in all active-treatment groups as compared with placebo (p<0.001 for each pairwise comparison). At four years, the mean improvement was 4.0 mL per second in the doxazosin group, 3.2 mL per second in the finasteride group, and 5.1 mL per second in the combination-therapy group.

CombAT. At month 24 increases in Qmax from baseline were 2.4 mL/sec for combination therapy vs. 1.9 and 0.9 mL per second for dutasteride and tamsulosin, respectively. At month 24 the adjusted mean percent change in total prostate volume from baseline was -26.9% in the combination group, -28.0% in the dutasteride group and 0.0% in the tamsulosin group (combination vs. tamsulosin, p<0.001 and combination vs. dutasteride, p-value not significant).

Safety Outcomes

Progression Events

MTOPS. Progression was defined as a twice verified worsening of the I-PSS by four points or greater *or* renal insufficiency *or* urinary retention *or* incontinence *or* recurrent UTI *or* renal insufficiency, the last occurring never, and the first being the most common accounting for 78% of all progression events. Over the duration of the study, the rate of overall clinical progression among men in the placebo group was 4.5 per 100 person-years. As compared with placebo, doxazosin reduced the risk of progression by 39%, to 2.7 per 100 person-years (p<0.001), and finasteride by 34%, to 2.9 per 100 person-years (p=0.002). The reduction in risk associated with doxazosin did not differ significantly from that associated with finasteride. As compared with placebo, combination therapy reduced the risk of overall clinical progression by 66%, to 1.5 per 100 person-years (p<0.001), a significantly greater reduction than was induced by either drug alone (p<0.001 for each pairwise comparison of combination therapy with monotherapy, with one degree of freedom).

CombAT. Not reported at the two-year interim analyses.

Adverse Events

MTOPS. The most common adverse events that occurred more frequently in the doxazosin group than in the placebo group were dizziness, postural hypotension, and asthenia. The most common adverse events that occurred more frequently in the finasteride group than in the placebo group were erectile dysfunction, decreased libido, or abnormal ejaculation. The individual adverse effects in the combination-therapy group were similar to those for each drug alone, with the exception of abnormal ejaculation, peripheral edema, and dyspnea, all of which occurred more frequently in patients taking both drugs.

CombAT. Drug related adverse events that were numerically more common in the combination group than in either monotherapy group were erectile dysfunction [7.4 vs. 6.0 (dutasteride) vs. 3.8 (tamsulosin)], retrograde ejaculation [4.2 vs. 0.6 (dutasteride) vs. 1.1 (tamsulosin)], altered (decreased) libido [3.4 vs. 2.8 (dutasteride) vs. 1.7 (tamsulosin)], ejaculation failure, semen volume decreased, loss of libido and nipple pain.

Anticholinergic Agents

Anticholinergic agents interrupt the interaction between acetylcholine and cholinergic (muscarinic) receptors (M1, M2, M3, M4, and M5). In the human bladder, the subtypes M2 and M3 are most predominant. While there are mostly M2 receptors in the bladder, the M3 receptors are primarily responsible for bladder contraction. Blockade of this interaction results in a reduction in smooth muscle tone and theoretically an amelioration of diseases associated with excess contraction of these muscles. These drugs have typically been used to treat overactive bladder symptoms (OAB) in men and women. Recognizing that symptoms of OAB and LUTS secondary to BPH overlap, it is certainly possible that LUTS in many men who suffer from this condition may in fact be due to bladder dysfunction. For this reason, the use of anticholinergic agents is reasonable to consider in men with LUTS notwithstanding the concern about the development of AUR in those with potential BOO. For reference, detailed evidence tables reviewing the studies evaluated by the Panel are provided in Appendix A8.

Tolterodine

Tolterodine is a competitive muscarinic receptor antagonist. It acts on the M1, M2, M3, M4, and M5 muscarinic receptors and is indicated for the treatment of overactive bladder with symptoms of urge urinary incontinence, urgency, and frequency. Generic tolterodine is available in 1 mg and 2 mg doses for twice daily use, and long-acting (LA) or extended-release (ER) tolterodine formulations are available in 2 mg and 4 mg doses for once-daily use.

Randomized Controlled Trials (RCTs)

There were only a small number of published studies on the use of anticholinergic agents either as monotherapy or in combination with other medical therapy for the treatment of BPH-related LUTS that met the inclusion criteria for this analysis. Three RCTs were identified; however they do not

sufficiently demonstrate the efficacy or effectiveness of tolterodine.^{63, 122, 123} Although RCTs, these studied have limited patient enrollment and predominately report secondary, qualitative outcomes for assessment of BPH treatment response as compared to quantitative outcomes such as the I-PSS, uroflow, and serum PSA which makes analysis and comparison of these data difficult.

RCTs investigating treatments utilizing anticholinergic agents other than tolterodine for the treatment of LUTS secondary to BPH do not exist. Future studies investigating the effects of the newer agents on men with LUTS may be beneficial.

Single-group Cohort Studies

Two single-group cohort studies were identified. The first was a large prospective study that involved 1,080 men and evaluated men with LUTS/BPH for whom tolterodine 4 mg daily was prescribed for the treatment of frequency, urgency, or urgency incontinence and Qmax of at least 15 mL per second. The cohort included men without BOO and men on alpha blocker therapy who had not improved after six weeks of treatment. Overall, 42% of men had tolterodine added to unsuccessful alpha antagonist treatment. Median I-PSS scores decreased from 17 to 10. Mean post-void residual did not increase although two patients did develop AUR requiring catheterization.

A second cohort study examined 43 consecutive men with BPH and LUTS in whom a mean of 5.7 months of alpha blocker treatment had failed due to lack of efficacy or adverse events. Hean 24-hour micturition frequency decreased from 9.8 to 6.3 voids and nocturia decreased from 4.1 to 2.9 episodes nightly. Significant changes in the AUA-SI (-6.1), Qmax (1.9 mL per second), and post-void residual (-22 mL) were also observed.

Efficacy and Effectiveness Outcomes

Morbidity

The available data shows that the use of tolterodine as monotherapy or in combination with an alpha antagonist does not appear to increase the risk of urinary retention as compared to placebo. Mortality associated with the use of tolterodine was not reported.

Symptoms and Quality of Life

The three RCTs all have limited patient enrollment and predominately report secondary, qualitative outcomes for assessment of BPH treatment response. Only one study reported the use of the total AUA/I-PSS and found that combination therapy with tamsulosin and tolterodine significantly improved total I-PSS as compared with placebo. There was no significant difference in total I-PSS changes from baseline between tamsulosin and tolterodine monotherapies.

In the largest of the three trials, combination therapy with tolterodine 4 mg daily and tamsulosin 0.4 mg demonstrated similar efficacy in QoL (*Urolife BPH Quality of Life 9 Questionnaire*) as monotherapy with tamsulosin primarily suggesting an alpha antagonist effect. Monotherapy with

tolterodine was not significantly different than treatment with placebo in total QoL outcomes.⁶³ Athanasopoulos et al found that QoL improved only in the combination group of tolterodine and tamsulosin as compared to tamsulosin alone.¹²³

Pressure, Flow, Volume Outcomes

Abrams et al (2006) compared tolterodine to placebo and demonstrated no significant differences in maximum flow rates between the two groups however a statistically significant reduction in detrusor pressure at maximum flow in the tolterodine group was found. ¹²² Interestingly, post-void residual increased in both groups. In the study by Athanasopoulos et al when comparing tamsulosin alone vs. the combination with tolterodine, maximum flow rate improved in both groups, and QoL improved in the combination group, however, neither group experienced a significant reduction in post-void residual. ¹²³

Prostate-Specific Antigen Levels

There are no studies on the relationship between PSA, prostate size, and the effect of tolterodine for treatment of BPH/LUTS.

Predictors of Efficacy, Effectiveness and Harms

The included trials did not evaluate predictors of efficacy, effectiveness, or harms with the use of tolterodine.

Safety Outcomes

Withdrawals and Adverse Events

Randomized Controlled Trials. Three RCTs reported similar adverse event and withdrawal rates. In the study by Abrams et al (2006) in which men were randomized to either tolterodine 2 mg twice daily or placebo, the total number of adverse events was similar between the tolterodine (58%) and placebo (51%) groups. The rates of withdrawal due to adverse events were also similar between tolterodine (6%) and placebo (7%). Dry mouth was much more common with tolterodine (24%) compared with placebo (1%). Other specific adverse events including urinary retention were reported at similar rates between the tolterodine and placebo groups.

In a smaller unblinded trial, 50 men were randomized between monotherapy with tamsulosin 0.4 mg and combination therapy with tamsulosin and tolterodine 2 mg twice daily. ¹²³ The overall withdrawal rate due to adverse events was 8% with 4% of men withdrawing due to an adverse event in the monotherapy group and 12% in the combination group. Dry mouth was the cause for withdrawal in 8% of men in the combination group. No events of urinary retention were reported.

In a large double blinded, placebo controlled study by Kaplan and colleagues (2006), 879 men were randomized to either daily tamsulosin 0.4 mg, daily tolterodine ER 4 mg, daily combination therapy

with both medications and placebo.⁶³ The overall withdrawal rate due to an adverse event was 14% in this study. Dry mouth was the most commonly reported adverse event, occurring in 21% of men using combination therapy and in 7% of men in each of the monotherapy groups. The rates of AUR were low (<0.5%) in all treatment groups.

ED and ejaculation disorders were not reported with the use of tolterodine alone. Ejaculatory disorders were reported with tolterodine in combination with tamsulosin in 3.0- 4.3% of men. ^{63, 122, 123} Significant morbidity and mortality as a result of tolterodine use was not reported in any of the available RCTs.

Single-group Cohort Studies. Two single-group cohort studies using tolterodine ER 4 mg daily were reviewed. In the largest study in which 1,080 men were enrolled, the total withdrawal rate was 14.3% where 1.6% withdrew due to specifically to an adverse event and 3.2% withdrew due to a lack of efficacy. ¹²⁴ In the second single group cohort study of 43 consecutive men four (9%) withdrew due to dry mouth. ¹²⁵

Summary

Anticholinergic agents are not approved by the FDA for the treatment for LUTS secondary to BPH. There are data however to suggest that the use of anticholinergics may be beneficial in the amelioration of LUTS in some men. Tolterodine has been the only anticholinergic agent significantly studied in men with LUTS to date. One study exists suggesting that the combination of tamsulosin and tolterodine (an anticholinergic agent) significantly improved total I-PSS compared to placebo and monotherapy with either agent.

Complementary and Alternative Medicines (CAM)

Most CAM therapies used for BPH are dietary supplements. These products are usually extracts of plants (phytotherapy) used alone or in combination. They are available over-the-counter in the United States 126 and as a result, most patients who use dietary supplements self-medicate with these products and often do not inform their physicians about their use. 127 The Dietary Supplement Health and Education Act, passed by the United Stages Congress in 1994, specifically exempted manufacturers of dietary supplements from prospective oversight by the FDA and requires manufacturers to demonstrate safety and efficacy prior to marketing. 128 Consumers and physicians, therefore, often have limited data of uncertain quality on which to make judgments about the wisdom of using or recommending a dietary supplement for the treatment of a medical condition. Furthermore, the quality and purity of these over-the-counter supplements are not rigorously monitored, adding further uncertainty about the value and safety of these products. 129-131

Among the dietary supplements, the most commonly used, and the product for which the greatest evidence exists, is an extract of the berry of the saw palmetto plant (*Serenoa repens, Sabal serrulata*). Other products commonly marketed for BPH therapy include extracts of the African plum *Copyright* © 2010 American Urological Association Education and Research, Inc. ® 39

tree (*Pygeum africanum*), stinging nettle (*Urtica dioica*), pumpkin seed (*Curcubita pepo*), South African star grass (*Hypoxis rooperi*) and rye pollen (*Secale cereale*). Despite many years of research and a large number of publications, the quality, size, and length of most studies are suboptimal, making it impossible to offer firm recommendations and clear clinical guidance. Most studies have been small and very short in duration (often three months or less), and have used products of uncertain quality and purity and inadequate analytic strategies and outcome assessments for both efficacy and safety. Better studies have begun to appear in the literature recently, and these are included in below but the overall quality of the literature in this area remains poor. Apart from these few dietary supplements, saw palmetto and *Urtica dioica*, no other CAM modality has a sufficient evidence base to merit discussion about recommendations. For reference, detailed evidence tables reviewing the studies evaluated by the Panel are provided in Appendix A8.

Single-extract Products

Saw Palmetto

The saw palmetto plant is a dwarf palm tree that grows predominantly in the southeastern United States. Extracts of the saw palmetto berry have been used for centuries for treatment of LUTS and have become extremely popular in recent years for BPH therapy in Europe and the United States.

In vitro evidence suggests that saw palmetto extracts might have pharmacologic properties that would be expected to relieve BPH-related symptoms. Several lines of evidence of variable quality have proposed that saw palmetto has 5-ARI activity, anti-inflammatory effects, and anti-proliferative properties. ¹³³

A prior Cochrane meta-analysis (dated January 2002) found 21 randomized trials of saw palmetto and concluded that the evidence supported a modest beneficial effect of saw palmetto on both symptoms and flow rates and found few adverse effects associated with its use. ¹³⁴ A recent update of this systematic review (dated April 2009), incorporating more recent trials, concluded that, "Serenoa repens was not more effective than placebo for treatment of urinary symptoms consistent with BPH." ¹³⁵

Since the prior publication of the 2003 Guideline, three new placebo-controlled trials compared saw palmetto with placebo. ¹³⁶⁻¹³⁸ These trials employed sample sizes of 85 to 225 participants with follow-up times lasting three to 12 months. All trials used a dose of 320 mg per day of the extract in single or divided doses.

In addition to the placebo-controlled trials, two trials compared saw palmetto 320 mg/day with tamsulosin 0.4 mg/day. Five other trials examined combinations of dietary supplements, in which one of the constituents was saw palmetto (see below).

Efficacy and Effectiveness Outcomes

Symptoms and Quality of Life

AUA-SI. Among the three most recently reported placebo-controlled trials, two found no significant between-group differences in AUA-SI scores at study closeout. The largest of these found a between-group difference of only 0.04 points with a 95% CI (-0.93 to 1.01 points) that excluded a clinically meaningful difference in AUA-SI scores between the saw palmetto and placebo groups. The smaller study reported a 1.7-point between-group difference with a confidence interval of -0.5 to 4.0, an interval that does not exclude a difference of at least three points, which is often considered a clinically meaningful change in AUA-SI scores.

One trial found a modest benefit of saw palmetto compared to placebo (a between-group improvement in AUA-SI scores of 2.2 points; p = 0.04), though no parallel changes in any objective measurement of urinary function was found and 22% of participants had baseline Qmax values greater than 15 mL per second. ¹³⁷

One of the two trials that compared saw palmetto with tamsulosin in 704 men reported a decline in AUA-SI scores of 4.4 points in both treatment groups;¹³⁹ the other also reported no significant difference in the change in symptom scores among 40 randomized men.¹⁴⁰ Despite an apparent improvement in symptoms among the participants in each treatment group, within-group comparisons are of little value for assessment of specific pharmacologic efficacy of any supplement, as this response may be due to regression to the mean and a strong placebo effect.

BPH Impact Index. The BPH II is a four-item self-administered questionnaire designed to assess the impact of a patient's BPH symptoms on his general activities and perceptions of health. Bent et al (2006), found a nonsignificant difference in between-group changes in BPHII scores [-0.24 points (favoring saw palmetto) with a 95% CI: -0.60 to 0.13]. The BPHII was not assessed in either of the other two placebo-controlled studies nor in the studies comparing saw palmetto with an alpha blocker. 139, 140

International Prostate Symptom Score Quality of Life Item. Most studies measured changes in the single QoL question from the I-PSS. In the two placebo-controlled studies reporting this outcome, there were no significant differences between groups in changes in the QoL question, ^{137, 138} despite the fact that one study found a significant difference in AUA-SI scores. ¹³⁷ The largest placebo-controlled study did not report this outcome separately. ¹³⁶

In the two comparisons of saw palmetto with the alpha blocker tamsulosin, there was no significant difference in changes in LUTS-related QoL between the treatment arms. $^{139,\,140}$

Sexual Functioning. The O'Leary Sexual Functioning Questionnaire was measured in two of the placebo-controlled studies. ^{136, 137} In both studies, only small changes in any treatment group were observed over the follow-up periods and there were no statistically significant or clinically meaningful differences in changes between groups. The results were similar in the one trial with tamsulosin-treated controls that reported sexual-functioning outcomes; this study also reported that saw palmetto-allocated participants had fewer ejaculatory disturbances compared to those assigned to the alphablocker. ¹³⁹

Other Outcomes. The largest placebo-controlled study found no significant differences between groups in either the mental or physical subscales of the SF-36 scores.¹³⁶

Pressure, Flow, Volume Outcomes

Peak Urinary Flow. Peak urinary flow was reported in all placebo-controlled trials. None of the trials reported a significant difference in Qmax between saw palmetto and placebo-treated participants, including the one trial that did find a difference in symptoms. The active-controlled studies comparing saw palmetto with tamsulosin also found no significant difference in urinary flow rates at closeout. 139, 140

Postvoid Residual. Bent et al (2006) reported only small overall changes in PVR for both treatment groups in their study with small, nonsignificant differences between groups (-4.5 mL (favoring placebo), 95% CI: -24.4 to 15.4). Neither of the other two placebo-controlled studies reported outcomes for PVR. 137, 138

One of the tamsulosin-controlled studies reported similar reductions in PVR among treatment groups (declines of 23.6 to 28.1 mL, p = 0.42). The other study did not report PVR results .¹³⁹

Prostate Volume. One placebo-controlled trial reported changes in prostate size as measured by TRUS; in this study, the overall difference in prostate volume changes was -1.2 mL (favoring placebo; 95% CI: -3.9 to 1.5 mL). The change in the transition-zone volume was 1.3 mL (95% CI: -1.6 to 4.1 mL) (Bent 2006). 136

In the two active-controlled trials, changes in prostate volume were \leq 1.0 mL in all treatment groups with no significant between-group differences (p= 0.27^{139} and p= 0.6^{140}).

Safety Outcomes

Adverse Events

No significant differences in rates of adverse events were found between the two arms of all placebo-controlled trials, though only one study conducted thorough laboratory testing for potential toxicity. The active-comparator trials (saw palmetto vs. tamsulosin) also found no significant difference in adverse events with the exception of a greater frequency of ejaculatory disturbances among participants randomized to the alpha blocker in one study. Substantial evidence suggests that saw palmetto does not affect serum PSA levels. 136, 139, 143-145

Urtica Dioica

In addition to saw palmetto, the only other single phytotherapeutic with recently published data is an extract of the stinging nettle plant (Urtica dioica). Prior studies of Urtica have been inconsistent; few trials of a pure Urtica extract exist.

Prior studies of Urtica dioica suggested that it may have moderate efficacy for treatment of BPH with few adverse effects. The recent single-extract study was a placebo-controlled RCT of Urtica (100 mg

daily) for six months in men with moderately severe symptoms of BPH. ¹⁴⁶ Two studies of combination products containing Urtica dioica are discussed below.

Efficacy and Effectiveness Outcomes

Symptoms and Quality of Life

The single-extract study showed a substantially greater decline in the AUA-SI among the active-treatment group (-7.0 points) compared to the placebo-treated participants (-1.5 points, p = 0.002)¹⁴⁶, a difference that would generally be considered to be clinically meaningful. The BPH II, I-PSS QoL item, and sexual functioning were not assessed in this study.

Pressure, Flow, Volume Outcomes

Peak Urinary Flow. In this trial, the Qmax was substantially improved in the Urtica-treated group compared to the placebo group (+8.2 vs. +3.4 mL per second, p< 0.05). 146

Postvoid Residual. Postvoid residual volume declined to a greater extent in the active treatment group compared to the placebo group (37 vs. 3 mL, p<0.001). 146

Prostate Volume. Prostate volume, as measured by TRUS, decreased by 3.8 mL among the participants randomized to Urtica while the decrease was only 0.2 mL among those randomized to placebo; this difference in change scores was not statistically significant. ¹⁴⁶

Safety Outcomes

Adverse Events

No adverse events in either treatment group were reported in this trial and withdrawal rates were similar between the two arms. ¹⁴⁶ PSA levels were essentially unchanged in the two groups over the course of the six-month study.

Combination Products

Phytotherapies for BPH are often sold as combination products, containing a blend of extracts proposed to be helpful for LUTS. Most of these products contain saw palmetto in addition to a variety of other dietary supplements. Among the more recently published randomized trials, six studies have reported comparative effects of five different herbal blends: two trials of a combination of saw palmetto and Urtica dioica (one placebo-controlled¹⁴⁷, the other using a tamsulosin comparator¹⁴⁸), three placebo-controlled trials of a product containing saw palmetto¹⁴⁹⁻¹⁵¹ and one trial of an Ayurvedic herbal blend of phytotherapies that did not contain saw palmetto.¹⁵²

Sample sizes for these trials ranged from 40 to 257 and follow-up times varied from three months to 15 months. All trials used the AUA-SI as the primary outcome measure; secondary outcomes and completeness of adverse-event assessments varied among the trials.

Efficacy and Effectiveness Outcomes

Symptoms and Quality of Life

AUA-SI. The two largest trials of saw palmetto-containing herbal combinations showed significant improvements in the active-treatment arms compared to the placebo arms; ^{147, 150} the two smaller trials found no significant differences but may have been hindered by insufficient statistical power^{149, 151} (the first of these was a mechanistic study and was not intended to be fully powered for symptom outcomes). The tamsulosin-comparator trial with the saw palmetto-containing product found no differences between the treatment arms, ¹⁴⁸ while the trial of the combination product without saw palmetto reported a significantly greater improvement in AUA-SI among the participants allocated to the herbal-treatment group. ¹⁵²

BPH Impact Index. The effect of study treatments on BPHII were not reported in any of these studies.

I-PSS QoL Question. The only trial of this set to report on changes in the QoL item from the I-PSS reported that the effect of the saw palmetto-Urtica blend was noninferior to the effect of tamsulosin. ¹⁴⁸

Sexual Functioning. The same study reported no effect of either the saw palmetto-Urtica blend or the alpha-blocker on indices of sexual or erectile functioning over the course of the trial.¹⁴⁸

Other Outcomes. No other clinically relevant outcomes were reported in these trials. Marks et al (2000) reported that participants treated with a saw palmetto blend had a greater reduction in% epithelium and an increase in the percent of atrophic glands in biopsy specimens.¹⁴⁹

Pressure, Flow and Volume Outcomes

Peak Urinary Flow. Peak urine flow outcomes were not reported for either of the active-comparator trials. Among the four placebo-controlled trials of saw palmetto-containing compounds, three found no significant difference between treatment groups while one reported a small but significant difference between groups.¹⁵¹

Post-void Residual. Three studies found no significant differences in changes in PVR between the active-treatment and placebo groups over the study period. $^{149,\,150,\,152}$

Prostate Volume. Prostate volume was measured in two placebo-controlled studies of saw palmetto-containing combination products. In both of these trials, there was little change in overall prostate size and no significant differences between groups in observed changes in the prostate volume. 149, 151

Safety Outcomes

Reported adverse events and withdrawal rates were generally low among all arms of all reported studies.

Minimally Invasive Therapies

Transurethral Radiofrequency Needle Ablation

Transurethral radiofrequency needle ablation (TUNA) of the prostate for treatment of the manifestations of BPH employs a cystoscope-like device. The lumen of the prostatic urethra is directly visualized with an endoscope and two needles are inserted from the prostatic lumen laterally into the prostatic adenoma. A double needled is inserted on both the right and left sides (some have likened the appearance to the antennae of a butterfly). Each needle simultaneously emits radiofrequency energy sufficient to heat the prostate to a temperature exceeding that necessary to cause prostatic tissue necrosis in an oval-shaped lesion around the needle tips. Four areas of necrosis result from each round of treatment, which lasts several minutes. Depending on prostatic size and length, multiple dual insertions at different levels along the length of the prostate may be utilized. The concept is to heat the transition zone of the prostate while sparing the urethral mucosa; preserving the mucosa reduce pain and improve patient tolerance. Over time the necrotic tissue will be absorbed, reducing prostatic volume. Considerable literature has been generated evaluating the prostate morphology before and after TUNA using TRUS, MRI, PSA and endoscopy to evaluate this volume reduction issue. The conclusion now is that the reduction in prostatic volume is less than initially anticipated. BPH histologic architecture is likely replaced, in part, with scar, leaving a modest at best volume reduction.

Efforts have turned to identifying possible alternative mechanisms of action for TUNA. Concepts such as prostatic muscle dysfunction, alpha adrenergic nerve dysfunction and other concepts were proposed; however, no clear conclusion has been reached. Attempts to identify favorable candidates for TUNA, both in terms of short-term response and in durability of improvement, have also been found to be difficult and inconsistent. Currently the only device available in the United States is the TUNA device marketed by Medtronic.

Randomized Prospective Trials

Four randomized, prospective trials comparing TUNA to TURP have been published. Roehrborn et al (1999) summarized outcomes of I-PSS, QoL, detrusor pressure and maximum urinary flow at six months and Hill et al (2004) provided five-year follow-up including I-PSS, QoL, max flow and post-void residual (PVR) in the same group of 121 patients. Hindley et al (2001) compared TUNA to TURP in 50 patients at 24 months, reporting on AUA-SI, QoL, maximum urinary flow and detrusor pressure. No significant short-term complications, including need for transfusion, were reported in either arm of these three reports, nor was bleeding reported a fourth randomized trial. Operative time for TUNA was 44 minutes compared to 55 minutes for TURP in this last report.

Roehrborn et al (1999) found that AUA-SI decreased from 20 to 10.8 points in the TUNA group and the TURP patients had a score of 8.1 at six months. By five years Hill et al (2004) reported that I-PSS (not AUA SI as originally reported by Roehrborn et al (1999) in the same patients) was now 11.7 and 7.8

for TUNA and TURP, respectively. ¹⁵³ Hindley et al (2001) reported decreases in I-PSS at 24 months from 25 points to nine for TUNA and three for TURP. ¹⁵⁴ **The Panel concludes that, based on these reports,** the symptom improvement is significant and sustained for both treatments, with somewhat greater improvement in the symptom score for TURP.

A similar trend can be seen for QoL in the Roehrborn et al (1999), with significant improvements at six months in both arms, but with TURP QoL the improvement was better than with TUNA.⁷ The improvement for both arms was sustained at five years but there was a slight deterioration in both arms.¹⁵³ The Hindley et al (2001) recorded similar QoL changes.¹⁵⁴

Maximum flow improvement in the Roehrborn report went from 8.8 mL per second at baseline to 13.5 and 20.8 mL per second for TUNA and TURP, respectively. Hill et al (2004) found little change in flow for either TUNA or TURP over six month result when examining five year data from the same trial. On the other hand, Hindley et al (2001) found much less improvement in flow for TUNA; the maximum flow improved from 8.5 to 9.8 mL per second for TUNA and from 9 to 18.4 mL per second for TURP. Hill et al (2004) reported retreatment with TURP in 9/65 (14%) of TUNA treated-patients whereas one (2%) of TURP patients received TUIP retreatment. One patient in the Hindley et al (2001) TUNA-treated group went on to subsequent TURP. Hill et al (2004) reported no retrograde ejaculation for the TUNA group but a 41% incidence for the TURP arm. ED developed in 3.1% of TUNA-treated patients and 21.4% of TURP-treated patients. This ED rate for TURP is significantly higher than generally reported for TURP.

In summary, these four randomized trials established that statistically significant improvements occur for symptoms, QoL, and urinary flow, with the exception of the Hindley et al (2001) study which reported a small improvement in maximum flow rates for TUNA. Short-term complications, including the need for transfusion, are uncommon or nonexistent. Erectile dysfunction and retrograde ejaculation are more common with TURP than TUNA, and generally very few sexual side effects are seen with TUNA. Retreatment rates are considerably higher for TUNA than TURP.

Single-Group Cohort Studies

Nine single-group cohort studies involving TUNA were identified in the literature. Four are larger group studies; ¹⁵⁶⁻¹⁵⁹ the others included fewer than 50 patients. These cohort studies are often retrospective and occasionally stated to include consecutive patients. These studies confirm that symptom scores, QoL and Qmax improve in a fashion very similar to that reported in the randomized trials and will not be detailed again here. Likewise these cohorts confirm that retrograde ejaculation is very rare to nonexistent. But these studies, which range in follow-up from two years to as long as 10 years, provide additional information on perioperative bleeding, patient selection, and need for retreatment. These issues are summarized. ^{157, 160, 161}

Generally these studies focused on patients who had failed medical therapy for BPH, with one exception in which previously untreated patients were recruited.¹⁵⁹ The prostates in these studies were

moderately enlarged, ranging from 38 to 57 mL. ^{161, 162} Rosario et al (2007) performed TUNA on six anticoagulated patients and encountered no significant bleeding, establishing that TUNA has a role in the actively anticoagulated patient. ¹⁵⁸ These studies do not provide enough data on comorbidities to draw a conclusion about performing TUNA on patients with significant comorbidities. Significant procedure-related bleeding, which was not encountered in the randomized trails, did occur in two of 30 patients and required catheter balloon traction to control bleeding. ¹⁶² Another report encountered one case of bleeding (in one of 70 patients) requiring bladder irrigation. ¹⁵⁸ Thus, bleeding is unusual but a risk nonetheless.

In the cohort studies, rates of urinary retention and the need for catheterization varied greatly but were common. Rosario et al (2007) noted that only one of their first nine patients voided after the procedure so they adopted routine postprocedure catheterization for all patients for seven days. Specific practice variations and attitudes such as this make it difficult to discern the rate of retention and duration of retention. In another series, the failure to void rate by day one after TUNA was 32% with subsequent catheterization duration averaging 6.3 days. High rates of retention were reported in other series as well. 162, 164

Retreatment was common in studies with longer follow-up. Fujimoto and colleagues (2003) reported that 13 of 41 patients had either TURP or pharmacotherapy with 24 months of TUNA. ¹⁶⁰ In a study with a median follow up of 112 months, 83% of 70 patients had deterioration of symptoms over time and of these, 50% had invasive therapy and 20% had drug treatment for BPH. ¹⁵⁸ Zlotta et al (2003) reported retreatment rates of 23% by five years with more than half of retreated patients opting for invasive treatment. ¹⁵⁹

Attempts have been made to identify preoperative parameters that might predict success or failure. In a group of 41 patients, prostate volume and prostate transition zone volume decreased significantly at three months and the difference was not significant at 12 months; when patients were evaluated for differences in baseline prostate volume and transition zone, no differences were found between responders and those patients who fared less well. In another study of 24 patients, 10 had obstructed voiding patterns. They were more likely at baseline to be over the age of 70, have a higher detrusor pressure, a greater residual volume and a worse QoL score.

Summary

The Panel concludes based on the available literature that there remains a degree of uncertainty regarding TUNA because of a paucity of higher quality studies. There are only three prospective randomized trials (one trial is reported at two time points) and all reports taken together lack sufficient detail on the comorbidity of subjects. Most are cohort trials and the reporting of results varies considerably. Since the 2003 Guideline, little new information has been published. For reference, detailed evidence tables reviewing the studies evaluated by the Panel are provided in Appendix A8.

TUNA is safe with low perioperative complications including bleeding. TUNA has a low to nonexistent rate of sexual dysfunction and is attractive for that alone. Improvements in symptoms, QoL and urinary flow rates are significant but do not generally match the result of TURP and the bulk of the literature suggests a high retreatment rate when patients are observed over many years.

Transurethral Microwave Thermotherapy

Transurethral microwave thermotherapy (TUMT) has evolved through several iterations over the past 15 years. These have included variations in the route of administration (transrectal vs. transurethral), energy levels (low vs. high), and concomitant urethral cooling. The early 1980's and 1990's saw the advent of the first TUMT machines, beginning with the Primus (Tecnomatix Medical, Brussels, Belgium) prostate machine and the Prostathermer (Biodan Medical Systems Ltd., Rehovot, Israel), originally developed to treat prostate cancer. These systems were responsible for the term "hyperthermia" that evolved to describe their mechanism of action. Hyperthermia techniques failed, however, since early devices were unable to generate temperatures sufficient to ablate prostatic tissue and to adequately target the transition zone transrectally. Newer TUMT devices would seek greater temperatures (i.e., "thermotherapy,") as well as a transurethral approach to target the transition zone. EDAP-Technomed (Lyon, France) developed a TUMT device in the early 1990's that could achieve interstitial temperatures of 50°C to 80°C. These use of these higher temperatures led to the development of cooling systems to offset the higher energy effects on the urethra, bladder neck and adjacent tissues. The early cooling systems initially used in second generation TUMT devices were not highly efficient and often deeper lesions than intended were created in the prostatic peripheral and central zones. The development of thermotherapy devices also led to the new goal of TUMT paralleling the tissue ablation seen with TURP. Manufacturers have therefore continued developing higher energy systems with more complex and efficient cooling systems, leading to more effective third generation systems. These modifications have allowed higher microwave energy delivery while decreasing urethral morbidity. Ultimately, heat to the transition zone with preservation of the urethra mucosa would lead to delayed coagulation necrosis with comcomitant decreases in pain during the procedure and the ability to perform the procedure in an office setting.

FDA-Approved Transurethral Microwave Thermotherapy Devices

TMx-2000™ (TherMatrx®, American Medical Systems)

The TMx-2000™ system represents the lowest power (23W) TUMT device available, which operates at 915MHz and lacks a cooling mechanism. The catheter offers variable radiating helical coil lengths: 2.5 cm for prostatic urethral lengths of three to four cm, 3.5 cm for four to five cm length prostates and 4.5 cm for five to 5.7 cm length prostates. The TMx-2000 is contraindicated in patients who have received previous pelvic radiation and is FDA-approved only for symptomatic relief, not for improvement in urodynamic parameters or obstruction.

Prostatron[®] (Urologix, Inc.)

The original Prostatron device utilized a monopole antenna that exhibited significant backheating. The updated version of this antenna now employs an active urethral cooling system to compensate for backheating. It operates at a frequency of 1296 MHz, significantly higher than other TUMT systems and is capable of generating up to 80W of power.

Targis[®] (Urologix, Inc.)

A second generation microwave device, the Targis® system uses a dipole antenna with frequencies in the range of 902 to 928 MHz. The catheter balloon in the Targis system is inflated with water and positioned 0.4 cm away from the end of the antenna. Targis is unique in that it uses coolant water at 8°C during therapy to protect the urethra and bladder neck. Contraindications to Targis include a prostatic urethral length less than three cm and middle lobe enlargement. A third generation update to the Targis design employs an expandable urethral balloon along with changes in the device catheter to more effectively cool the urethral surface during treatment, allowing greater safe energy delivery to the prostate (Cooled ThermoCath®, CTC, Urologix, Inc.). The treatment time has been decreased to 28.5 minutes.

CoreTherm™® (Prostalund, Inc.)

CoreTherm represents the only TUMT device to use an interstitial probe with three sensors to monitor intraprostatic temperature, thereby providing a mechanism to control and adjust the volume of tissue ablation. It operates at a frequency of 915 MHz with three different length catheters: white (for prostates greater than 55 mm in length), blue (for prostates 30 to 55 mm), and yellow (for prostates less than 30 mm) and can deliver up to 100W of power. The heat distribution of the system reflects the backheating component, where an exposed inner conductor is positioned at the tip of a coaxial cable.

Prolieve™ (Boston Scientific Corporation)

The Prolieve™ system uses a frequency of 915 MHz with a monopolar antenna. It contains an expandable urethral balloon that inflates with circulated water maintained at 34°C. Despite the expected loss of energy that would be anticipated from heat dissipation with this large volume of cooling water, the system is capable of running at 50W to achieve interstitial temperatures of 41°C to 46°C.

Study Outcomes

Initial studies evaluating the efficacy of TUMT utilized low-energy protocols, mostly with the Prostatron device. Dahlstrand et al (1995) compared 32 patients treated with TURP vs. 37 patients treated with low energy TUMT. ¹⁶⁷ Improvements were seen in Madsen-Iversen symptom score, PVR, and free flow rate, up to 24 months posttreatment, although improvements in the last category were

more pronounced with TURP. High energy (HE) TUMT was then developed to increase tissue destruction and theoretically yield greater improvements in voiding ability. These newer devices included Prostatron® 2.5 and Targis®, as well as the Urowave (Dornier Medical Systems, Inc., Wessling, Germany). Others now include Prolieve™ (Boston Scientific Corporation), TMx-2000™ (American Medical Systems) and CoreTherm® (Prostalund, Inc.). Generally, data from one manufacturer's device cannot be applied to other manufacturers' devices since each has unique power delivery characteristics, resulting in differing levels of tissue destruction.

TMx-2000™

The TMx-2000™ system was studied in a multi-institutional, randomized trial including 119 patients in 2002. ¹⁶⁸ At three months after study initiation, patients were allowed to cross over from sham to active treatment. Statistically significant declines in AUA-SI (22.4 to 10.6) were seen at 12 months, although recatheterization was required in 16.8% of patients. Maximum Qmax increased from 8.9 to 13.5 mL per second. No major adverse events were noted. A 2003 update to this experience confirmed improvements in AUA-SI, although urodynamics data was not provided. ¹⁶⁸

Prostatron

D'Ancona et al (1998) compared the 2.5 year outcome of HE-TUMT using the Prostatron[®] 2.5 (31 patients) to TURP (21 patients). ¹⁶⁹ After two years, Madsen-Iverson scores improved in 56% and 74% of patients after TUMT and TURP treatments, respectively. By urodynamic measurements, however, one-third of patients remained obstructed two years after treatment with TUMT. At 2.5 years follow-up, 19% of patients treated with TUMT required retreatment.

Francisca et al (1999) randomized 122 patients to treatment with Prostatron® 2.5 TUMT (66 patients) or TURP (56 patients). ¹⁷⁰ While TURP demonstrated greater efficacy in improving Qmax, PVR, I-PSS, and prostate volume, TUMT demonstrated a significantly lower rate of sexual side effects, e.g. retrograde ejaculation (32% vs. 63% in TURP) at one year. Floratos et al (2001) updated the Francisca et al (1999) experience with 144 patients randomized to either HE-TUMT (78 patients) or TURP (66 patients) with a median follow-up of 33 months. ^{170, 171} In the TUMT-treated group, I-PSS decreased from 20 to 12 at three years, while Qmax increased from 9.2 to 11.9 mL per second. In the TURP group, at three years, I-PSS decreased from 20 to three, while Qmax increased from 7.8 to 24.7 mL per second. The cumulative risk of retreatment between the two groups was not statistically significant.

Ohigashi et al (2007) described the durability of TUMT effects after treatment with the Prostatron® 2.0; 102 patients were treated and the risk of necessity for retreatment calculated. Kaplan-Meier analyses demonstrated that 67% of patients required additional treatment within five years after TUMT, with a median period of 37 months. Qmax greater than 6.5 mL per second, a urethral length less than 40 mm, and age >64 years were all significant predictors of durable results. Laguna et al studied 388 patients treated with Prostatron 2.5 or 3.5. An improvement of 50% or more was

observed in I-PSS, QoL score, and Qmax in 57%, 62%, and 44% of patients, respectively. Absolute mean changes at one year were -9.7, -2.0, and 5.2 mL per second, respectively.

The broadest Prostatron experience has been published by Vesely et al (2005) with an 11 year follow-up of 452 patients treated with either Prostasoft 2.0 (323 patients) or Prostasoft 3.5 (129 patients). With version 2.0, 67% of patients were satisfied with the results of treatment; 18% of patients experienced complications, 25% had transient UTI, 16% had urinary retention and 32% of patients required retreatment. I-PSS decreased from 15.9 and 2.9 and QoL scores decreased from 12.0 and 2.1. With Prostasoft 3.5, 82% of patients were satisfied; 17% experienced complications, 25% had UTIs, 26% had urinary retention, and 7% required retreatment. I-PSS decreased from 19.8 and 3.8 to 11.2 and 1.5, respectively.

Targis

Djavan et al (2001) compared 51 patients treated with Targis TUMT vs. 52 treated with alpha blockers. While mean I-PSS, Qmax, and QoL scores improved for both groups, the TUMT group demonstrated a greater magnitude of improvement. Between-group differences were 35%, 22%, and 43% greater, respectively, for the TUMT group with a sevenfold lower actuarial treatment failure rate. These effects were maintained for at least 18 months. In a prospective trial where 200 patients were treated with Targis TUMT, Thalmann et al demonstrated that median Qmax increased from six to 13 mL per second at 24 months. Median PVR decreased from 170 mL to 27 mL, while I-PSS decreased from 23 to three. Two years after treatment, 59 patients agreed to undergo repeat urodynamic evaluation; median detrusor pressure at Qmax decreased from 86 to 58 cm H₂O. Osman et al (2003) compared the one-year subjective vs. urodynamic changes in 40 TUMT patients. While AUA-SI decreased from 20.5 to nine, Qmax increased from 9.2 to 15 and the Schafer nomogram number decreased from four to two. Qmax paralleled improvement with the obstructive component of the AUA-SI for the first three months; afterwards, improvements in irritative symptoms accounted for the bulk of AUA-SI improvement.

Miller et al (2003) studied the durability of Targis® TUMT over three centers in 150 patients for five years. AUA-SI improved 11.5 (53%) and 10.6 (47%) points at one and five years, while Qmax improved by 3.4 (48%) and 2.4 (37%); 31 patients required retreatment. Of note, five-year follow-up existed for only 59 of the original 150 patients. Berger et al (2003) studied Targis® TUMT in 78 high risk patients with AUR with a mean follow-up of 34 months; 87.1% of patients were able to void afterwards, although 7.3% experienced repeat retention within two years. Mean Qmax improved to 11.1 mL per second while mean PVR decreased to 46 mL. The largest prospective Targis® trial involved 345 patients treated over nine institutions. In this study, Kaplan et al (2004) demonstrated that 65% of patients showed at least a 50% reduction in symptom scores the first year, with a mean I-PSS improvement of 11.1 points. In the 85 patients available for five-year follow-up, absolute I-PSS improvement was maintained at 8.4 points. Flow rates improved from 7.5 to 10.5 mL per second at three years.

Cooled ThermoCath

This microwave catheter technique is based on minor modifications of the initial Targis balloon device. It features different antenna structure and larger beds for cooling urethral membrane. Huidobro et al conducted the first multicenter trial with the cooled thermoCath (CTC) system vs. Targis[®]. Forty patients were followed for 12 months after TUMT. Thirty-six demonstrated decreased prostate volume (8% with CTC vs. 21% with Targis 60), QoL (44% vs. 58%), AUA symptom score (41% vs. 60%), and increased Qmax (28% vs. 55%).

CoreTherm

Gravas et al (2007) reviewed the single-institution, 41 patient experience with ProstaLund Feedback Treatment (PLFT). 181 With PLFT, treatment is usually stopped when 55°C is measured in any part of the treatment zone. PLFT is thought to compensate for the interindividual and intraindividual differences in prostatic blood flow, in contrast to standard TUMT devices. I-PSS decreased from 21.9 to 7.1, while Qmax increased from 8.4 to 17.8 mL per second at 12 months. The mean change in prostate volume was 19 mL over the same time period. No serious adverse effects were seen, although ejaculatory ability was mildly diminished (78% to 51.4%). de la Rosette et al (2003) studied 180 patients pooled from three prospective clinical trials and followed for 12 months. 182 Improvements in prostate volume reduction (52 to 34 mL), Qmax (7.7 to 16.1 mL per second), and I-PSS (20.9 to 6.4) were seen. Prostate volume reduction correlated with changes in Qmax and voiding pressure. Schelin (2006) evaluated 24 patients with BPH and chronic urinary retention also treated with PLFT; 19 (80%) of the patients were treated successfully with removal of the indwelling catheter. 183 Five failures occurred in patients with enlarged median lobes or large protruding lobes into the bladder. No serious complications occurred. David et al (2004) reviewed the outpatient experience of PLFT in 102 patients with a mean follow-up of 5.6 months in a retrospective, multicenter trial. 184 Mean postoperative catheter duration was 13 days. Mean AUA symptom score decreased from 18 to 11 at three months. Qmax increased from 7.8 to 14 mL per second.

Schelin et al (2006) studied the efficacy of PLFT in 54 patients with chronic urinary retention against 52 TURP patients in a prospective, multicenter trial. Both groups were catheter-free at six month follow-up. Mean catheterization time was 34 days for TUMT vs.verus five days for TURP. I-PSS at six months was significantly less for TURP (4.4) vs. TUMT (7.3). Qmax at six months was not statistically different between the two groups.

Wagrell et al (2004) reported a prospective, randomized, multicenter trial that studied 154 patients treated with either HE-TUMT via PLFT (103 patients) vs.verus TURP (51 patients) with a median follow-up of 36 months. No statistically significant differences were found in Qmax or QoL between the two groups, although I-PSS was different at 36 months (8.2 for TUMT vs. 5.0 for TURP). TUMT had a lower rate of serious adverse events (2%) compared to TURP (17%). The most frequent side effects of TUMT were impotence (8%), PSA increase (5%), and hematuria (4%).

Mattiasson et al (2007) updated the Wagrell et al (2004) experience with an expanded five-year follow-up of TUMT (103 patients) vs. TURP (51 patients); 96 patients (62 TUMT, 34 TURP) were available for follow-up at 60 months. Ten percent of TUMT patients required additional BPH treatment, while 4.3% of TURP patients required retreatment. I-PSS decreased from 21.0 to 7.4 for TUMT and from 20.5 to 6.0 for TURP; QoL decreased from 4.3 to 1.1 and from 4.2 to 1.1 in the same groups. Qmax increased from 6.7 to 11.4 mL per second for TUMT and from 7.9 to 13.3 mL per second for TURP. PVR decreased from 106 to 70 mL for TUMT and from 94 to 51 mL for TURP. No statistically significant differences were found between the two groups' end results. Eighty complications were seen in the TUMT group, while 39 were seen in the TURP group.

Prolieve™

Bock et al (2004) reviewed the one-year clinical experience with the Prolieve™ system in a multicenter, randomized trial; 94 patients treated with Prolieve™ TUMT were compared to therapy with finasteride alone in 31 patients. Fewer than 20% of patients required catheterization after TUMT. AUA-SI improvement was significantly greater in the TUMT group (49.3%) than in the finasteride group (19.1%) at six months. The magnitude of improvement was similar among patients with prostates greater and less than 50 g.

Summary

TUNA, as well as TUMT, has been utilized consistently over recent years with about 20,000 radiofrequency cases and around 80,000 microwave thermotherapy cases annually in the United States. A systematic review of TUMT data reveals a heterogeneous mix of studies of various sizes and TUMT protocols, often using different outcome measures with varying durations of follow-up. This leads to conflicting results, as may be seen in studies of shorter vs. longer follow-up. For reference, detailed evidence tables reviewing the studies evaluated by the Panel are provided in Appendix A8.

Older, low-energy TUMT devices similarly possess comparatively less clinical efficacy than newer, higher energy counterparts but also carry a lower risk of side effects. The durability of TUMT treatment appears to have improved with the advent of higher energy, later generation devices. One should also note however that the concept of durability with TUMT may be misleading, as the data suffer from a selection bias. Most studies analyze only those patients who remain in the study at the time of analysis; these patients would tend to represent the best "responders." In many studies, less than half of the initial group of men treated is analyzed at the end of the study period. Intent-to-treat analyses where therapeutic failures are considered are required to give a better idea of the true effectiveness and durability of TUMT. It is also important to note that the quality of the TURP comparator group in many of the series is influenced by surgeon skill and patient selection, and will therefore materially impact influence head-to-head comparisons between the therapies. The rate of utilization did not reach initial expectations, and has held more or less steady in recent years. Outpatient

capability, lack of sexual side effects and avoidance of actual surgery are attractive to patient and clinician alike. But perhaps the one issue that has held back greater utilization is not short term efficacy but the perception that these approaches lack sufficient durability of effect to assume a greater role in the management of LUTS.

Surgical Therapies

Surgery, by definition, is the most invasive option for the management of LUTS and BOO. The mechanism of action for surgical interventions is based on the classic BOO model wherein the enlarging or obstructing prostate tissue increases the urethral resistance to flow, thus requiring ever higher intravesical pressures to void. The physiologic obstruction then results in subjective symptoms that lead men to seek medical care. Surgical treatment of BOO is defined as the mechanical debulking of tissue within the prostatic fossa. Urodynamically, the underlying BOO and the surgical results can be demonstrated using multichannel measures of intravesical pressure and simultaneous flow. A classic picture of obstruction would appear urodynamically as an elevated intravesical pressure relative to a low urinary flow rate. Direct intraurethral pressure measures have also been applied as a measure of BOO though it has not gained widespread acceptance due in part to concerns over reliability.

As a management option, surgery is typically performed in the operating room setting, requires anesthesia and is associated with the greatest risks for morbidity and higher costs. Traditionally, the gold standards have been an open prostatectomy (retropubic, suprapubic) for very large prostates or those with large bladder calculi and a monopolar TURP. For small prostates (<30 g), the option for a transurethral incision of the prostate (TUIP) has been found to be associated with fewer complications but comparable efficacy.

In the 21st century, surgical management of BPH continues to evolve towards less invasive, endoscopic procedures that are viable alternatives to open prostatectomy. In addition to open prostatectomy and TURP, newer surgical options include bipolar or saline TURP, transurethral holmium laser enucleation of the prostate (HoLEP), potassium-titanyl-phosphate photovaporization of the prostate (PVP) laser ablation of the prostate, holmium laser ablation of the prostate (HoLAP), and transurethral electrovaporization of the prostate (TUEVP). The clinical data supporting the use of these surgical procedures including several comparative trials are herein reviewed. Systematically, current evidence describing the background literature and outcomes for each procedure have been considered. For reference, detailed evidence tables reviewing the studies evaluated by the Panel are provided in Appendix A8.

Open Prostatectomy

Randomized Controlled trials (RCTs)

Two surgical approaches to open prostatectomy for BPH are in common use: the Millin modified retropubic prostatectomy and the classical transvesical prostatectomy. No new RCTs examining effectiveness were identified in the current review of the literature.

Cohort Studies with a Comparison Group

One retrospective study was identified that compared rates of repeat prostatectomy between open prostatectomy and standard TURP using a population-based cohort in Western Australia. Hospital data and death records were gathered on all 19,598 men undergoing prostate surgery for BPH between 1980 and 1995. In a second study, open prostatectomy (n=69) was compared with TURP (n=16) in 85 Kenyan men. Hospital data and death records were gathered on all 19,598 men undergoing prostate surgery for BPH between 1980 and 1995.

Single-group Cohort Studies

The 12 single-group cohort studies examining open prostatectomy that were identified in this review generally included subjects with larger glands or patients needing surgery for bladder or other pelvic or inguinal conditions. Otherwise, inclusion and exclusion criteria were similar to those of other surgical interventions, including significant LUTS and no prior history of prostate surgery or suspicion of prostate cancer. Approximately half of the studies were retrospective series and a number of the studies examined only intra- and peri-operative outcomes and complications without examination of efficacy and effectiveness outcomes. Follow-up intervals ranged from the immediate postoperative period up to 11 years. ¹⁹¹ The various techniques of open prostatectomy included transvesical ¹⁹²⁻¹⁹⁷ and retropubic. ¹⁹⁸ In some studies various techniques were used with the data and not stratified by approach. ^{191, 199} Bernie et al compared the three techniques, namely transversica, retropubic, and perineal. ²⁰⁰ Other reports did not indicate the specific surgical approach. ²⁰¹

Efficacy and Effectiveness Outcomes

Symptoms and Quality of Life

I-PSS or AUA-SI and QoL scores improved in all studies reporting this outcome, with follow-up between three months and more than three years. IIEF¹⁹⁴ and the Madsen-Iversen score¹⁹⁶ improved significantly at six and 12 months, respectively. Postvoid residual and Qmax also improved significantly in all studies examining this outcome at mean follow-up up to three years. In the only study of sexual function after surgery, a significant increase in sexual desire and overall satisfaction was observed.¹⁹⁴

Safety Outcomes

Withdrawals and Treatment Failures

Few prospective studies reported attrition and few retrospective studies reported the completeness of data collection at the end of the follow-up interval. Reoperation for treatment failure was rarely reported. Follow-up of 56 men at up to 11 years (mean 36 months) after open prostatectomy identified only one patient who needed additional therapy for BPH (continued drug treatment). ¹⁹¹ In another study, the reoperation rate was 3.9% at mean follow-up of 42 months, but no details were provided as to the treatment rendered. ¹⁹⁷

Perioperative and Short-Term Outcomes

Intraoperative blood loss more than 1000 mL was reported in several studies using the retropubic approach. ^{191, 200, 202} Serretta and colleagues (2002) reported "severe bleeding" in 11.6% of subjects, with 8.2% of subjects requiring blood transfusions, while others reported even higher rates of intra- or peri-operative transfusions: 16% and 19%. ^{192, 199, 202} However, several studies did report lower transfusion rates (<10%). ^{193, 195, 197} Hospital stay for open prostatectomy ranged between five to seven days in many studies; ^{191, 193, 195-197, 199, 200} however, the mean length of stay was approximately 11 days in other studies of transvesical prostatectomy. ^{192, 202} Bernie and Schmidt compared hospital stays among surgical approaches and reported five and six days for retropubic and suprapubic approaches, respectively. ²⁰⁰ Mean catheter duration was between five and seven days.

Longer-term Complications

Mortality was infrequently reported in these studies and perioperative death rates were low (\leq 1%) and generally related to cardiovascular disease. ^{193, 195, 202} In the large (n=1,800) series by Serretta and colleagues, one perioperative death was reported. ¹⁹⁹ The discovery of incidental prostate cancer in resected specimens was reported at rates of 2%, ¹⁹³ 3.1%, ²⁰¹ 6.5%, ¹⁹² 11% ¹⁹⁵ and 17%. ²⁰² Incontinence was reported at rates between 0.5% and 8%, with several studies reporting much lower rates of permanent incontinence. ^{196, 199} Bladder neck contracture was reported at 3% to 6% ^{191, 196, 197, 202} and in one of six subjects undergoing perineal open prostatectomy in a single series. ²⁰⁰

Laparoscopic Prostatectomy

Cohort Studies with a Comparison Group

A single cohort study (n=60) compared consecutive patients undergoing laparoscopic prostatectomy with a consecutive retrospective cohort of open prostatectomy. 203

Single-group Cohort Studies

Sotelo and colleagues (2005) in the U.S. and Venezuela reported a series (n=17) of laparoscopic retropubic simple prostatectomies. Subjects had glands at least 60 g (mean 93 g). Copyright ©2010 American Urological Association Education and Research, Inc. 56

When laparoscopic and open approaches were compared, the mean operative time was greater in the laparoscopic group (115 vs. 54 minutes, p<0.01) 203 while blood loss, catheter duration, and hospital stay were greater with the open procedure. There was no difference in the rate or severity of complications. Sotelo reported a mean operative time of 156 minutes (range 85 to 380) and a mean blood loss of 516 mL (range 100 to 2500 mL). Five patients required transfusion and complications occurred in three patients. AUA-SI and Qmax improved significantly at follow-up between three months and two years.

Laser Therapies

Holmium Laser Ablation of the Prostate (HoLAP)

Single-group Cohort Studies

One publication updated previously published data reviewed in the 2003 Guideline, thereby fulfilling inclusion criteria for this revision. Gilling and colleagues (1996) published seven year follow-up on a serious of 79 men undergoing HoLAP. At seven-years follow-up, only 34 men in the original cohort were available.

Holmium Laser Enucleation of the Prostate (HoLEP)

Randomized Controlled Trials (RCTs)

Procedures involving the holmium laser were examined in eight RCTs, with various comparators: one small (*n*=40) trial that compared HoLEP to plasmakinetic enucleation of the prostate and followed patients for 12 months, ²⁰⁷ standard monopolar TURP, ²⁰⁸⁻²¹¹ holmium laser bladder neck incision, ²¹² and open prostatectomy. ^{213, 214} Inclusion criteria were similar across studies: men presenting with LUTS of severity suggesting that surgical treatment was indicated. Follow-up intervals ranged from six months ²¹³ to five years. ²¹⁵ Sample size ranged between 40^{207, 212} and 200 subjects. ²⁰⁹ Few studies provided any details on how subjects were selected. Mean age in the studies ranged between approximately 65 and 71 years, mean I-PSS ranged between 19 and 26, and QoL score between four and five. Large prostate glands were examined in several studies: >100 g, ^{213, 215} 40 to 200 g²¹¹ and 70 to 220 g. ²¹⁴ The percentage of subjects in urinary retention at baseline was generally not reported; in two studies such subjects were excluded from study participation. ^{210, 211}

Cohort Studies with a Comparison Group

One small study (n=20) compared a cohort of patients who received HoLEP with a cohort of patients who had open prostatectomy. ²¹⁶ Four studies examined HoLEP compared with TURP. ²⁰⁸⁻²¹¹

Single-group Cohort Studies

There were 15 publications of single-group cohort studies examining HoLEP. Several of these publications reported overlapping populations. ^{209, 217-223} Few details were provided on participant

recruitment and many of the studies were retrospective examinations of surgical series including only patients where complete data were available. ^{224-226 218} Follow-up was generally less than one year, although several included longer follow-up. ^{217, 218, 220, 227} Mean age was between 65 and 74 years. I-PSS ranged 19 to 23, although one study had a somewhat lower baseline mean value of approximately 14. ²²⁴ Mean baseline Qmax ranged between 4.5 and 9.0 mL per second. A significant percentage of subjects were in urinary retention at baseline in several studies, although this information was infrequently reported at baseline. ^{217, 221, 222, 224} The majority of studies examined the holmium:YAG (Versapulse) end-firing laser produced by Lumenis, Inc. used with the Lumenis tissue morcellator. ^{217-224, 226-228} Wattage used was between 65W and 100W.

Holmium Laser Resection of the Prostate (HoLRP)

Randomized Controlled Trials

The effectiveness and safety of holmium-YAG laser (HoL-YAG) was compared to TURP in one RCT with two-year follow-up. 229, 230

Single-group Cohort Studies

Two single-group cohort studies were identified which examined HoLRP. Chilton and colleagues reported a retrospective series of 259 men undergoing HoLRP. Yamanishi and colleagues described a small, prospective series (n=32) of HoLRP.

Potassium-Titanyl-Phosphate Photovaporization of the Prostate (PVP)

Randomized Controlled Trials (RCTs)

The effectiveness of the PVP laser was reported one RCT (PVP laser vs. TURP: early results of a randomized trial).²³³

Cohort Studies with a Comparison Group

A cohort study compared PVP using the GreenLightTM laser with standard TURP. ²³⁴

Single-group Cohort Studies

We identified 18 publications of single-group cohort studies examining the potassium-titanyl-phosphate (PVP) laser. ²³⁵⁻²⁵² Inclusion criteria for treatment with the PVP laser in cohort studies was typical of BPH surgical series (i.e., men with LUTS suggestive of BPH). Sample size varied greatly, ranging from 10²³⁸ to 208²⁴⁹. Follow-up interval ranged from six weeks²³⁶ to three years, ²⁴⁶ with only two studies providing data for longer than 12 months. ^{246, 249} Mean age of study participants ranged between 64 and 79 years, and the mean age was 75 years or greater in several studies. ^{237, 243, 251} Baseline mean I-PSS ranged broadly, from 16²⁴¹ to approximately 30 in a study of high-risk men with larger prostates. ²³⁷ Qmax also varied across studies, with mean values between 5.5 mL per second ²³⁷ and 13 mL per

second. ²³⁹ Men in urinary retention were excluded in some studies, ^{234, 238, 242, 252} while in others a significant pecentage had chronic urinary retention. ^{237, 243, 244, 251}

Thulium: YAG Laser

Single-group Cohort Studies

Bach and colleagues (2007) reported a cohort of 54 consecutive patients treated with the RevoLix[™] laser for LUTS due to BPH. ²⁵³ Mean prostate size was 30.3 mL and mean resection time was 52 minutes.

Efficacy and Effectiveness Outcomes

Similar to the analysis of the surgical therapies in the 2003 analysis, the symptom score and peak-flow data were available for most laser treatments and QoL scores were available for most treatments. The BPH II scores were not recorded for any surgical trials. When laser therapies were evaluated in RCTs, TURP was the most common comparison group and often referred to as the historical gold standard. Other comparison groups included open prostatectomy, bipolar TURP and laser therapy with and without 5-ARIs.

Symptoms and Quality of Life

AUA Symptom Index. All studies evaluating AUA-SI symptom improvement following laser therapy of the prostate reported improved AUA-SI scores three weeks²⁵⁴ to six years²⁵⁵ after therapy. The AUA-SI improvements were not significantly different from the comparison groups in those studies with a randomized controlled design or those with a cohort group. Data from RCTs are limited to holmium laser therapies. The difference in AUA symptom scores when compared open prostatectomy (at three months and five years),^{256, 257} and TURP (at 12 and 24 months) did not reach statistical significance in three trials²⁵⁸⁻²⁶⁰ but there was a greater improvement with HoLEP than TURP in one trial with 12 month follow up.²⁶¹ Further, the improvement in AUA-SI following HoLEP do not appear to be significantly different in men with larger prostates. When HoLEP was compared with holmium laser bladder neck incision (HoBNI), there was no significant difference between treatment groups for AUA symptom score at three-, six- and 12-month follow-up.²⁶²

A single-group cohort study of holmium ablation of the prostate reported improvements in AUA-SI score three months postoperatively that were sustained at seven years, although no statistics were provided.²⁵⁸ Holmium laser resection of the prostate also resulted in improved AUA-SI scores and these improvements were sustained at 24 months but were not significantly different from a cohort TURP group.²⁶³ Single-cohort studies utilizing PVP laser therapy reported that I-PSS or AUA-SI improved consistently in all studies, with follow-up intervals ranging from six weeks²⁶⁴ to five years.²⁶⁵ Monoski and colleagues (2006) examined the relationship between preoperative urodynamic parameters and outcomes in 40 patients in urinary retention.²⁶⁶ Postoperatively, subjects with detrusor overactivity had more voiding symptoms than those without detrusor overactivity. Men without impaired detrusor *Copyright* ©2010 American Urological Association Education and Research, Inc.*

contractility at baseline had a better I-PSS, flow rates, and post-void residual volumes at up to six months of follow-up compared with men with impaired detrusor contractility. Single-cohort studies involving PVP laser reported that men with no evidence of bladder instability and lower PSA values (representing smaller prostates with an average volume of 48.3 mL) prior to therapy were noted to have greater improvement in their AUA-SI scores compared to men with greater pretreatment PSA values (representing a mean prostate volume of 83 mL).²⁶⁷ The concurrent use of 5-ARIs did not appear to impact the AUA symptom score at one year in men who have been treated with the PVP laser.

The I-PSS associated with HoLEP decreased 13 to 18 points at one month, and the reduction in symptom score (11.7 point decrease from baseline) was maintained at the five-year follow-up. The reductions in scores for the PVP laser were slightly less at one month (range 4 to 16 point decrease), although by three months the decrease in AUA-SI score was comparable to HoLEP (range 9 to 20.9 point decrease) and at five years was lower than HoLEP (19.4 point decrease in symptom score form baseline). The outcomes associated with the thulium laser were reported for 54 patients in a single cohort study and improvement in the AUA-SI score at 12 months; ²⁵³ however, there was insufficient information to assess statistical validity of this improvement.

Summary

All laser therapies produce major improvements in the AUA-SI scores. While there are no direct comparisons between the various laser technologies, the improvements in symptom scores appear to be comparable to other surgical therapies and durable to five years.

International Prostate Symptom Score Quality of Life Question

A greater percentage of studies included QoL scores compared to the analysis conducted for the 2003 AUA Guideline; however, the only RCTs that pursued QoL data involved holmium laser enucleation/ablation of the prostate compared to TURP or bipolar TURP, and these studies support that the QoL improved in all treatment groups with no significant differences at one- and two-²⁵⁸⁻²⁶⁰ and six-years²⁵⁵ follow-up and greater improvement in HoLEP compared to TURP at one-year in one study.²⁶¹

In general, HoLEP QoL scores appeared to improve 3.5 points at one month following therapy. Data from a single investigator suggest that the QoL assessment in the interval between one year and six years follow-up is still improved but variable, as reported scores ranged between -2.6 compared to baseline at one-year, -3.4 at three years, and -2.2 points below baseline at six years. Single group cohort studies using holmium ablation of the prostate report that the improvements in QoL scores noted at three months postoperatively were sustained at seven years although no statistics were provided.²⁵⁸ When HoLEP was compared with HoBNI, there was no significant difference between treatment groups for QoL at the three-, six- and 12-month follow-up.²⁶²

Quality of life data associated with outcomes from PVP laser therapy also improved in all studies and the variability over time appeared to be less than with HoLEP. ^{265, 268} The improvement in the initial QoL scores at one month was less than HoLEP (range -2.2 points to -2.7 points) but improvements at *Copyright* [©] 2010 American Urological Association Education and Research, Inc. ^{*} 60

three months appeared equivalent (range -2.8 to -4 points); by one year QoL scores were consistently better (range -3.9 to -4.1 points) and were maintained in the longest reported study at two years (single study -3.9 points).

The QoL score improved in all single-cohort group studies of the PVP laser. In the single cohort study that included 54 patients improvement was found in the QoL score at one-year however, due to limited data, conclusions about this modality cannot be drawn.²⁵³

Summary

Although data are limited, the QoL score improved post-laser therapy when evaluated at oneand two-year follow-up regardless of the procedure type (except for thulium, for which conclusion could not be drawn).

Pressure, Flow, Volume Outcomes

Peak Urinary Flow Rate. The only RCTs of laser therapy that reported Qmax involved HoLEP; Qmax improved in both treatment groups in the three of four studies reporting this outcome. In general, there were no significant differences between groups at one-year. Further, Qmax was improved but not significantly different from open prostatectomy and bipolar TURP between three months and five years of follow-up. Long-term randomized studies that compared HoLEP to bipolar TURP reported improved Qmax at up to five-years of follow-up. All other studies involving laser therapy reported improved maximum flow rate.

Maximum urinary flow rates improved in all studies reporting this parameter after HoLEP. The improvements in maximum flow rate at three months (range from 9.8 to 23.2 mL per second) appeared to be maintained at two years in a single study reporting average maximum flow rate of 12 mL per second)²⁷¹ and was reported to decrease slightly at six years in another single study that reported an average maximum flow rate 9.9 mL per second.²⁵⁵ When a holmium laser was used to ablate the prostate, a single-group cohort study reported that the improvements in QoL scores noted at three months postoperatively were sustained at seven years although no statistics were provided.²⁷²

When HoLEP was compared with HoBNI, there were no significant differences between treatment groups for Qmax at the three-, six- and 12-month follow-up. ²⁶² Single-group cohort studies involving HoLAP and TURP indicate that the Qmax improved in both groups with improvements sustained at up to 24 months follow-up and was similar in both groups. ²⁶³ Maximum flow rates following PVP laser therapy also increased in all studies reporting this parameter with a range at one month of 7.5 to 11.8 mL per second; and a range of 7.7 to 19.5 mL per second 3 months posttherapy. ^{265, 273, 274} The maximum urine flow rates at two years (range 18.8 to 21.1 mL per second) and five years (a single study reporting 14.4 mL per second) after therapy appeared to improve significantly, but the five-year data are limited to a single study center. ²⁶⁵ The outcomes associated with the thulium laser were reported for 54 patients in a single-cohort study and suggested a significant improvement in the Qmax at 12 months. ²⁵³

Outcomes of RCTs, where available, yielded no statistically significant differences among laser therapies beyond the initial six months. All surgical therapies provided similar outcomes over time with regard to peak flow.

Urinary Postvoid Residuals. In one RCT, HoLEP and TURP achieved similar improvements in the post-void residuals at six months after therapy;²⁵⁸ however, at 12 months, further improvements in the post-void residuals favored the HoLEP-treated patients.²⁷⁵ When HoLEP was compared in RCTs to open prostatectomy at three months and five years, both therapies showed improvement in the post-void urinary residuals and there was no significant difference between these therapies.^{256, 257} Similar findings were reported in an RCT comparing bipolar TURP and HoLEP, and the improvements in the post-void residuals were not significantly different between arms at 12 months²⁶⁹ or 72 months.²⁷⁰ A single-cohort study reported that the improvement in post-void residual was not related to the size of the prostate gland.

PVP laser therapy also produced a significant improvement in post-void residuals; there was no significant difference at one year if the patient was treated with concurrent 5-ARIs.²⁷⁶ The single-cohort studies of PVP reported that the improvements in the post-void residual were durable at two years^{267, 273} and five years²⁶⁵ following treatment. The studies involving thulium laser therapy did not report the outcomes for the post-void urinary residuals.

Summary

Laser therapies, with the exception of thulium lasers, appear to offer similar improvements in the post-void residuals compared to other surgical therapies such as TURP and open prostatectomy. Further, the improvements in the post-void residuals following holmium laser therapy and PVP are durable; however, there is insufficient evidence to evaluate the durability for the thulium laser.

Prostate Volume. Changes following laser therapy may impact the outer diameter of the prostate as well as the inner lumen of the urethra. Thus total prostate volume measured after ablative therapies may not accurately reflect the amount of prostate tissue removed or the changes in the prostate. Studies concerning holmium lasers do not address changes in prostate volume following therapy but do refer to weight of resected tissue. Four studies examined HoLEP compared with TURP. ²⁵⁸⁻²⁶¹ Weight of resected tissue was significantly greater with HoLEP compared with TURP in two studies, ^{258,259} with no significant difference in a third study. ²⁶¹ PVP lasers are reported in single-cohort studies to be associated with a decrease in prostate volume when assessed at three months and 12 months following therapy. ^{265, 274, 277-280} There is no information concerning the impact of the thulium laser on prostate volume or the impact of any laser therapy on the transition zone volume.

Detrusor Pressure at Maximum Flow. The literature does not contain information concerning the impact of the various laser therapies on the detrusor pressures at maximum flow.

Prostate-specific Antigen. PSA values have been indentified as a useful marker for risk of progression of LUTS leading to surgical therapy. The implications of changes in the PSA value following

laser therapy are unknown. PSA was unchanged in six studies reporting PSA values after laser therapy. ^{265, 274, 277-280} One study reported that PSA values decreased following PVP laser therapy, and cautioned that if the PSA increased the patient should be treated with an appropriate antibiotic and the PSA repeated upon completion of the antibiotics; if the PSA did not decrease, a prostate needle biopsy should be completed to rule out prostate malignancy. The authors reported that patients whose PSA failed to decrease had a 50% risk of a diagnosis of prostate cancer.

Safety Outcomes

Total Withdrawals or Loss to Follow-up

Reported withdrawal rates from RCTs of holmium lasers compared to TURP were similar for both groups. Randomized controlled studies of the holmium laser compared to open prostatectomy found a total withdrawal rate of 38.3% at five years. In single cohort studies utilizing the PVP laser, the withdrawal rate was very high in the long-term, but the reasons for withdrawal were not reported.

Perioperative Mortality

There are limited data concerning the mortality rates associated with laser therapy in articles published since the 2003 AUA guideline. Mortality was reported in two studies comparing HoLEP with bipolar TURP, with rates ≤1%. Mortality rates were infrequently reported in the PVP series and typically mortality was unrelated to prostate surgery. Phere is great difficulty estimating the mortality rate for all surgical therapies that treat the obstruction causing LUTS. The concerns for mortality rates associated with laser therapies are referred to the section addressing mortality for all surgical therapies.

Short-term Adverse Events

Intraoperative Complications. Intraoperative, immediate, postoperative, and short-term complications involve a broad spectrum of events and reporting rates may be based on subjective thresholds. Some technologies have complications unique to that treatment modality, such as morcellation injuries associated with HoLEP. Randomized studies that compared HoLEP to bipolar TURP reported complications due to morcellation, including incomplete tissue morcellation due to blade malfunction (1.9%)²⁹⁰ and bladder mucosal injury (1.9%²⁹¹ and 2.8%²⁹²). Capsular perforation was reported in HoLEP studies at rates of 0.3%,²⁷⁰ 0.6%,²⁹³ 1.5%²⁹¹ and 1.9%²⁹⁰ while the incidence in HoLRP was one out of 281 study participants.^{263, 294}

Operative time. The ability to directly compare laser therapies with respect to the operative time is constrained by the fact that each laser modality seems to select from patient populations with different baseline characteristics and seldom selects the same comparison therapy as a control. When HoLEP was compared with HoBNI, the operating time was significantly shorter with HoBNI (mean seven minutes) than HoLEP (P<0.001). 262 RCTs comparing HoLEP to open prostatectomy indicate similar

weight of prostate tissue resected but a longer operative time for holmium enucleation. ^{256, 295} This is in contrast to a cohort comparison study that reported operative times were similar despite greater tissue resection with holmium enucleation. A single-group cohort study of HoLEP indicated that operative time was related to prostate gland size, which would seem logical. When compared to bipolar TURP, RCTs report a wide range of operative times for HoLEP compared to bipolar TURP. One study reported that operative times and, importantly, the weight of resected tissue was similar for both HoLEP and bipolar TURP. ²⁶⁹ However, other studies reported enucleation times of 86 minutes in a large series, which was improved from 112 minutes in their initial series of 118 cases. ²⁵⁵ The longest mean operative time was reported in a series by Kuo et al (2003) (133.6 minutes), where mean resected weight was 68 g and morcellation time ranged between 12 and 19 minutes. ^{291, 293}

An RCT of laser ablation of the prostate indicated that this modality required a significantly shorter operative time compared to TURP (P< 0.001), but HoLEP also resected significantly less prostate tissue weight. ^{296, 297} A single-cohort study reported that the average weight of prostate tissue resected was 11 g and the procedure required an average operative time of 47 minutes. ²⁹⁴ All of the reported studies involving PVP laser ablation of the prostate are single-cohort studies, and the reported operative ranged from 38 to 137 minutes; ^{264-268, 273, 274, 277-280, 282-289} however, because of the ablative nature of the PVP laser it is not possible to accurately report a weight of resected tissue, which limits comparison. The sole study for the thulium laser is a single-cohort study reporting an operative time of 52 minutes in men with a mean pretreatment prostate volume of 32 mL.

Hematuria. Data from RCTs indicated that HoLEP was associated with less hematuria compared to open prostatectomy^{256, 295}, while comparison studies with a single cohort would support that there is no statistically significant difference with HoLEP. When HoLEP was compared to a cohort group, the report indicated that the extent of blood loss is related to the size of the prostate gland.²⁶¹ Studies concerning HoLEP did not report the blood loss associated with the procedure. Only one study involving PVP laser attempted to quantify the blood loss associated with PVP laser ablation, which was estimated to be 56 mL.²⁶⁸ A second single cohort study reported "uncontrolled bleeding in 11.3% of patients.²⁸⁰

Transfusion. Data concerning transfusion risk associated with laser therapies for LUTS due to BPH are limited. There is a single RCT involving HoLRP indicating a lower risk of transfusion when compared to TURP. Data from the single cohort studies utilizing HoLEP report a transfusion rate of less than 1% while studies of PVP laser ablation and thulium laser ablation indicated that no patient required a transfusion. The single-group cohort studies utilizing HoLEP reported two of 281 patients who required perioperative transfusion, both of whom had an underlying bleeding disorder or were on anticoagulants. PVP laser studies consistently reported a decrease in hemoglobin, but statistical significance was rarely reported. No study reported administration of blood transfusions or any case of TUR syndrome or significant electrolyte imbalance in the perioperative period. Patients required

transfusion; however the Panel felt that the small study population of 54 patients was not sufficient to reliably estimate the risk for blood transfusion.²⁵³

Transurethral Resection Syndrome. The ramifications of TUR syndrome dictated the historical concerns for the incidence of this complication. While there are no RCTs involving laser therapies that discuss TUR syndrome, single-cohort studies utilizing PVP and thulium laser reported that no patients developed TUR syndrome. The use of lower procedure irrigation pressures, better optics used in today's cystoscopes and normal saline irrigation appear to have significantly decreased the risk of TUR syndrome.

Infections/Urinary Tract Infections (UTIs). The category of infections or UTIs includes a wide variety of infectious diseases, such as wound infections, epididymitis, orchitis, and bacterial UTI reported at any time after an intervention. The published data in the interval from the 2003 analysis of the literature does not provide sufficient information to assess a change in risk. There was a single-cohort study concerning thulium laser ablation that reported an 11% UTI rate following treatment. This rate is higher than expected from other transurethral technologies available today and the reason for the difference is not clear. Meta-analyses of RCTs showed rates of infection/UTI in patients treated with transurethral laser coagulation, TUIP, or transurethral vaporization of the prostate (TUVP) were not statistically significantly different from those for TURP-treated patients; single RCTs also found similar results for either TUVP or open prostatectomy compared to TURP. Results from systematic reviews revealed rates ranging from 5% for TUIP to 9% for transurethral laser coagulation and TUVP one small single-arm study reported a 1% rate in patients treated with holmium laser resection/enucleation. No RCTs reported UTI rates for holmium laser resection/enucleation.

Irritative Voiding Symptoms. Minimally invasive and surgical procedures induce irritative voiding symptoms immediately after and for some time subsequent to the procedure. Periprocedure and postprocedure adverse events associated with voiding symptoms include frequency, urgency, and urge incontinence and are categorized as postprocedure irritative adverse events. Such events are reported more often following heat-based therapies than following tissue-ablative surgical procedures. Because they impact QoL, irritative events are important and warrant documentation. Unfortunately, all patients will have some symptoms during the healing process immediately following the procedure. Because there is no standard for reporting this outcome, some studies reported these early symptoms while others did not. Further, because it is not possible to stratify these complaints according to severity, it is not possible to compare the degree of bother of these symptoms across therapies.

RCTs involving HoLEP found a significantly greater rate of irritative voiding in the HoLEP patients (59%) compared to TURP patients (30%),²⁵⁹ while single-cohort HoLEP studies indicated that only 7% to 11% of patients experience irritative voiding symptoms in the postoperative period.^{259, 298} Single-cohort studies utilizing the PVP laser indicated that 6%²⁸⁵ to 52%²⁶⁸ of patients reported a mild transient dysuria, while 9.4% of patients experienced a prolonged period of irritative voiding and 2.9% patients required medical therapy to help control the irritative symptoms.

Acute Urinary Retention. The category of AUR reflects the number of patients requiring repeat catheterization after a protocol-defined postprocedure period of catheterization. Unfortunately, some studies report "protocol-required" or "investigator option" episodes of postprocedure catheterization while others report only catheterization performed for inability to urinate. Further, new technologies are resulting in earlier removal of catheters with much shorter hospital stays. The earlier attempts to remove the catheter are likely to increase the reported rates of repeat catheterization compared to historical rates associated with other technologies and longer hospital stays. Such differences in reporting are reflected in the wide confidence intervals (CI) for frequency estimates. The only literature concerning rates of repeat catheterization available for this analysis involves the PVP laser where single-cohort studies indicate repeat catheterization rates of <5% in several studies, ^{265, 268, 278, 283, 288} while other studies indicate repeat catheterization rates between 10% and 15%. ^{267, 274, 279, 284, 285} Single-cohort studies utilizing the PVP laser report that the urinary catheters were generally removed between 18 and 36 hours postoperatively. ^{264-268, 273, 274, 277-280, 282-289} In fact, several series noted patients were not catheterized postoperatively, at the surgeon's discretion. ^{264, 267, 278, 283, 283, 286} The mean catheter time associated with the thulium laser was 1.7 days. ²⁵³

Hospital Stay. Randomized controlled studies comparing HoLEP to open prostatectomy^{256, 295} and to TURP^{258, 261} all found that hospital stays were significantly shorter for patients treated with HoLEP (p<0.01), yet HoLEP and bipolar TURP were associated with an equivalent number of days in the hospital.²⁵⁹ Studies comparing HoLEP to open prostatectomy showed that the number of days in the hospital were significantly shorter for HoLEP;²⁵⁷ one single-cohort study reported that length of hospital stay was independent of prostate size.²⁶¹ Randomized controlled studies also showed a shorter length of stay for patients treated with holmium resection of the prostate.^{263, 294} When HoLEP was compared with HoBNI the hospital stay and catheter duration were short (<24 hours) in both groups.²⁶²

Studies concerning PVP ablation are limited to single-cohort studies and the range of hospital stay was short in some series, ^{265, 280, 282} while more than three days in other series. ^{274, 279, 283, 288, 299} This wide range is believed to be a reflection of the change in technology over the review period as the laser energy increased in increments from 40W to 100W over time. In addition, various protocols in select institutions facilitated early discharge from the hospital. The average hospital stay reported in the study utilizing the thulium laser was 3.5 days. ²⁵³

Long-term Adverse Events

Urinary Incontinence. The category urinary incontinence represents a heterogeneous group of adverse events, including total and partial urinary incontinence, temporary or persistent incontinence, and stress or urge incontinence. The update of the literature in the interval since the 2003 AUA Guideline provides limited additional information concerning incontinence. Randomized controlled studies involving HoLEP compared to TURP present mixed information with the incontinence rate reported as similar on in one study, ²⁶¹ while a second study reported an increased incontinence rate in

the HoLEP population.²⁵⁸ The Panel recognized that this rate was higher than expected but felt the general urologist's experience with HoLEP was less than other technologies and the report warranted observation. When HoLEP was compared with HoBNI, incontinence was reported in 44% of HoLEP patients and none after HoBNI.²⁶² In a small trial that compared HoLEP to the bipolar TURP that followed patients for 12 months, the incontinence rates were almost identical.¹⁸⁸ Unfortunately, there was no information concerning PVP ablation or thulium laser therapy.

Secondary Procedures. The issues surrounding secondary procedures were well presented in the 2003 AUA guideline and reiterated here. 8 Secondary procedures, defined as interventions rendered by the treating physician for the same underlying condition as the first intervention, are challenging to classify. Examples of such procedures include initiation of medical therapy following a minimally invasive or surgical treatment, minimally invasive treatment following surgical intervention, or surgical intervention following a minimally invasive treatment. Enumerating secondary procedures from published reports is difficult. First, the threshold for initiating a secondary procedure varies by patient, physician, and the patient-physician interaction. In the absence of clearly defined thresholds for the success or failure of an initial intervention, secondary procedures are initiated on the basis of subjective perceptions on the part of either patients or treating physicians, which may not be reproducible or comparable between investigators, trials, or interventions. In many cases, patients involved in treatment trials feel a sense of responsibility toward the physician; given this commitment, patients may abstain from having a secondary procedure even through they may feel inadequately treated. Conversely, patients involved in treatment trials are more closely scrutinized in terms of their subjective and objective improvements; therefore, failures may be recognized more readily and patients may be referred more quickly for additional treatment. Moreover, the duration of trials and follow-up periods both affect rates at which secondary procedures are performed. Thus, although patients receiving longterm follow-up are at greater risk for treatment failure than those followed for short periods, it is virtually impossible to construct Kaplan-Meier curves or perform survival analyses for secondary procedure rates. In short, while it is quite clear that secondary procedures and treatment failures cause major health expenditures for the treatment of patients with BPH, it is also clear that the current literature does not allow a meaningful comparison of secondary procedures across therapies. As a result, the estimates for secondary procedure rates should be viewed with caution.

Reoperation rates following various laser therapies are inconsistently reported, often due to the limited length of follow-up or the small numbers of patients in these studies. Randomized controlled studies comparing HoLEP with open prostatectomy reported similar reoperation rates of 10% compared to 8.3% for open prostatectomy. Other RCTs compared HoLEP to bipolar TURP and found that the reoperation rates (0.3% at three years; and 4.2% at five years with HoLEP compared to bipolar TURP. Single-cohort studies involving HoLEP reported a reoperation rate of 0.3% after Three years and 4.2% after five years which would appear to be similar to the results from the RCTs. Other RCTs.

When HoLEP was compared with HoBNI the need for a second surgical procedure over the one year follow-up occurred in four of 20 HoBNI patients and in none after HoLEP. 262

Single-cohort studies concerning PVP lasers found a reoperation rate of 0% in a number of studies^{265, 273, 277, 279} and less than 5% in other studies.^{267, 274, 278, 284} In one cohort with three-year follow-up, the retreatment rate was 4.3%, but the entire series had not yet completed the three-year evaluation at the time of publication, so additional cases may present.²⁶⁷ A five-year cohort study reported no retreatments.²⁶⁵

Bladder Neck Contracture/Urethral Stricture. RCTs utilizing HoLEP indicated that the rate of bladder neck contracture was similar to the rate following open prostatectomy and bipolar TURP, while single-cohort studies indicated that the rate of bladder neck contracture was between 1.3 and four%. The rate of bladder neck contracture following PVP laser ablation of the prostate was reported at 0% and $1\%^{277,279}$ to $2\%^{265,267,274,278,280}$ in single-cohort studies. Urethral stricture was reported in between $0\%^{277}$ and $7.6\%^{274}$ of study participants. Urethral strictures following HoLEP were reported at rates of 0%, 291 1.3%, 270 to 5.6%. 254

Sexual Dysfunction. Surgical interventions have the capacity to induce sexual dysfunction in the form of ED or in the form of retrograde or absent ejaculation. These adverse events were classified as either ED or ejaculatory dysfunction. Randomized controlled studies indicate that both HoLEP and TURP increase the risk of ED and that the risk following therapy is not significantly different with either treatment. When HoLEP was compared with HoBNI, decreased erectile function occurred at similar rates in both groups and retrograde ejaculation was very common postoperatively (80% for HoBNI and 100% for HoLEP).

Postoperative sexual function was infrequently reported after PVP therapy and studies reporting ED reported no new cases postoperatively. ^{265, 268, 273, 277, 286} Paick and colleagues (2007) examined sexual function at 6 months postoperatively and found that all IIEF domains improved. ²⁸⁹

Ejaculatory disorders were common after HoLEP and their rate of occurrence was not significantly different from TURP. ^{258, 261} Single-cohort studies of HoLRP also reported similar high rates of ejaculatory disorders following treatment. ^{276, 294}

Transurethral Incision of the Prostate

Randomized Controlled Trials (RCTs)

A single RCT compared TUIP to TURP in 100 subjects with prostate weights not exceeding 30 g with a two-year follow-up. 301

In this RCT, both groups improved significantly in nocturnal voiding frequency, I-PSS, QoL, and Qmax but there were no statistically significant differences in these outcomes between groups, except for QoL, for which the percentage change was greater with TURP.³⁰¹

Transurethral Vaporization of the Prostate

Randomized Controlled Trials (RCTs)

We identified 10 RCTs comparing TUVP with standard TURP using a variety of electro-vaporization devices. 302-312 Inclusion and exclusion criteria were generally similar across studies, excluding subjects with prior pelvic surgery, prostate cancer, and neurologic disorders. Recruitment occurred from accessible populations awaiting surgery for BPH but details were rarely provided on how subjects were selected. The mean age of study participants was similar across studies, ranging between approximately 65 and 70 years. The mean baseline I-PSS was generally between 20 and 25; however, in two studies some of the study groups had lower mean scores. 305, 312 The QoL score was between four and five in studies reporting those baseline data. There was significant variation in Qmax at baseline, ranging from two to 20 mL per second in individual treatment groups. There was also much variation in preoperative prostate gland size: one study examined small glands (mean prostate volume of treatment groups ranged from 24 to 34 mL), 305 while another examined larger glands (mean of treatment groups, 54 mL and 63 mL). TUVP was performed with a variety of vaporization devices and the comparator in these studies was standard TURP. Several studies reported on "vaporization" techniques using the bipolar vaporization device (Gyrus Medical) 313-315 and these studies are examined in the section on TURP in this report.

Efficacy and Effectiveness Outcomes

AUA-SI was measured in all 10 trials comparing TURP to TUVP. 302-312 These trials consistently demonstrated improvements in I-PSS after both TURP and TUVP, generally with no statistically significant difference between treatment groups. The only study that demonstrated a significant difference reported that I-PSS improved more with a thick loop TUVP than with the standard thin loop TURP at one-year of follow-up. 302 Several studies examined I-PSS and QoL at longer follow-up periods and found no difference between treatments. Qmax improved in both treatment groups; however the between-group error was inconsistent across studies. In studies where post-void residual was compared between treatments, no significant differences were found, with improvements noted with both treatments. 302, 304, 306, 308-311

Safety Outcomes

Withdrawals and Treatment Failure

Withdrawal rates were only reported in three of the 10 trials, with high rates of attrition when follow-up was two years or more. Mortality rates were low, largely due to cardiovascular disease, and never attributed to the surgical intervention. Reoperation rates were higher with TUVP than with TURP. At 12-months follow-up, reoperation for AUR rates were 8% with TUVP and 4% with TURP. ³⁰³ At the five-year follow-up, 13% of both the TURP and TUVP treatment arms required reoperation. ³⁰⁹

Perioperative and Short-term Adverse Events

The weight of resected tissue was similar between groups in studies reporting this outcome. 302, 305, 308, 310, 312 Operative time was similar in TURP and TUVP in six studies, 302-305, 311 significantly longer with TURP in two studies 308, 310, and significantly longer with TUVP than TURP in another study. 309 Operative blood loss was significantly greater with TURP than TUVP in the three studies examining this outcome. 303, 304, 308 Blood transfusions were given in the perioperative period more frequently with TURP than TUVP. 304, 306

Duration of catheterization was significantly greater with TURP than TUVP in several studies, ^{304,} ^{309, 312} although two studies noted no difference ^{306, 308}. Duration of hospital stay was consistently longer with TURP than with TUVP, ^{306, 308-310, 312} with a statistically significant difference in two studies. ^{309, 310} Recatheterization rates were generally low and similar between TUVP and TURP groups. One study, however, reported higher rates of postoperative urinary retention: 23% with TUVP and 8% with TURP. ³⁰⁹

Longer-term Adverse Events

Urethral stricture and bladder neck stenosis were uncommon and occurred with both treatments. ED at follow-up was reported at rates identical to baseline in both groups in three studies. 302, 304, 306, 311

Transurethral Resection of the Prostate

Randomized Controlled Trials (RCTs)

A total of 11 RCTs compared standard monopolar TURP to various bipolar TURP techniques. ³¹³⁻³²³ One additional RCT compared preoperative treatment with dutasteride to placebo, both followed by standard TURP. ³²⁴ Subjects all had LUTS suggestive of BPH; in most studies few other inclusion criteria were reported. Total sample size ranged between 40³²³ and 240 subjects ³¹⁷ and follow-up intervals varied between three weeks ³¹⁹ and 21 months. ³²³ The mean age of subjects in these RCTs was in the 60's, with baseline I-PSS between 20 and 24, QoL score between two and four, and Qmax between 5.1 and 10.9 mL per second. The two main bipolar techniques used were the Gyrus Plasmakinetic System (Gyrus, Birmingham, UK), ^{313-317, 319, 320} and the AMCI Elite system (ACMI Corp). ³²² One study referred to transurethral resection in saline (TURIS) system using bipolar electrodes at 270W for cutting and 75W for coagulation, with no other specification. ³²¹

Cohort Studies with a Comparison Group

We identified two cohort studies with comparison groups. ^{325, 326} Lee and colleagues (2005) compared TURP to TURP plus TUIP over a mean follow-up of 38 months with 1135 patients available for the retrospective analysis. ³²⁵ A second study compared the Gyrus Plasmakinetic system with monopolar TURP. ³²⁶

Single-group Cohort Studies

Nineteen single-group cohort studies were identified which examined TURP efficacy, effectiveness, or adverse events. ³²⁷⁻³⁴⁵ Inclusion criteria were similar across cohort studies and were similar to those reported above for RCTs of TURP. Methods for recruiting subjects or identifying the study cohort were not generally reported. Sample size varied greatly (ranging from 21 to 1,014 participants), and seven studies had a sample size greater than 200 participants. ^{327, 335, 336, 339, 342-344} Duration of follow-up ranged between one day ³³⁰ and 13 years, ³⁴⁴ with most studies ranging between three and 12 months. One study reported a combined cohort of TURP (65%) and open prostatectomy (35%). ³³⁸

The mean age of included subjects was generally in the late 60's and early 70's, thus somewhat older than the mean age in RCTs of TURP. Standard monopolar TURP procedures were examined in most of these studies, with no additional details provided. Three studies examined the Gyrus Plasmakinetic (bipolar) system^{328, 334, 335} and another a coagulating intermittent cutting device.³²⁷

Efficacy and Effectiveness Outcomes

Total I-PSS and QoL improved significantly in all studies reporting these outcomes. Erectile function did not change significantly as assessed with the IIEF six months post-TURP.³⁴²

Postvoid residual decreased significantly in all studies and Qmax increased in all studies in the range of 6 to 10 mL per second. Prostate volume decreased by approximately 20 g in two studies. ^{334, 342}

Predictors of Efficacy and Effectiveness Outcomes

Several studies examined the relationship between various demographic and clinical characteristics and efficacy or effectiveness outcomes. 337, 340, 343-345 Machino and colleagues (2002) categorized 62 patients into those with equivocal obstruction and those with obstructive symptoms, as defined by the Abrams-Griffins nomograph. 337 The authors concluded that neither urodynamic obstruction nor detrusor instability alone predicted outcomes of TURP; however, outcomes were significantly worse in patients who were not obstructed but had detrusor instability. Age was predictive of postoperative Qmax and overall complication rates. 340 Seki and colleagues (2006) found that a higher degree of BOO (Schafer obstruction grade) predicted improvements in I-PSS and QoL and that baseline detrusor overactivity negatively predicted these outcomes. 343 In a retrospective cohort study of 217 patients who underwent TURP with a long-term mean follow-up (13 years, SD 4.1) symptomatic failure and decreased flow rate were associated with detrusor underactivity rather than obstruction. 344 Preoperative obstruction grade (Schafer) correlated with improvements in obstruction grade, symptom index, and QoL. 345 Patients with a stable bladder postoperatively (either stable or unstable preoperatively) showed significantly better improvement in I-PSS and QoL than patients in whom an unstable bladder persisted or developed postoperatively.

Safety Outcomes

Withdrawals and Adverse Events

Treatment Failure. Treatment failure rates were infrequently reported; in one study, 13.3% were operated on for urinary retention post-TURP.³²⁷

Perioperative and Short-term Adverse Events. Intracapsular perforation was reported in 5% of 522 subjects in the only study reporting this outcome. TUR syndrome was reported at rates of 1.1% and two% of subjects. Transfusions occurred in 2% to 9% of patients, with the highest rate occurring in a study with prostates estimated between 70 g and 150 g preoperatively. Clot retention was infrequent in the only study reporting this outcome (2.3%). Mean catheter time was 1.3 days in one study and longer in another study of larger prostates.

Longer-term Complications. Urethral stricture was reported in 1.8% of men with glands less than 70 g and 3.5% of those with larger glands (70-150 g) in one study³⁴⁰ and 10%³³⁵ in a second study. Bladder neck stenosis was reported in approximately 1.5%. Mortality rates were infrequently reported in prospective cohort studies.

Monopolar TURP vs. Various Bipolar TURP. Operating or resection time varied across studies and was similar between the Gyrus Plasmakinetic system and standard TURP in four studies, ³⁴⁶⁻³⁴⁹ but significantly less with the Plasmakinetic system compared with standard TURP in other studies. ³⁵⁰⁻³⁵² TUR syndrome was reported at rates of 0%, ^{346, 349, 351-353} 0.8%, ³⁵⁴ 1.7% ³⁵⁰ and 3.9% ³⁴⁷ with standard TURP and 0% with the comparison bipolar technique in all studies.

Hemorrhage requiring transfusion was reported more frequently with standard TURP (5.3%,³⁵⁰ 2.0%³⁴⁷ and 5.4%³⁵¹) compared with the Plasmakinetic system (0.8%, 0% and 0%, repectively). Perioperative transfusion was reported more frequently with the TURIS system than with standard TURP (3.4% vs. 0.8%). Intraoperative complications were rarely reported; capsule perforation occurred in 5.7% of subjects with TURP and 1.7% with PK-TURP.³⁵⁰ Hospital stay was significantly shorter (P<0.05) with the PK-TURP than with standard TURP.^{348, 350, 351} Duration of catheterization was also shorter with the Plasmakinetic system than with standard TURP.^{346-348, 350-352} Duration of catheterization was not significantly different between the AMCI Elite system and TURP.³⁵³

Use of preoperative 5-alpha-reductase inhibitors. Four randomized, placebo-controlled, well executed studies, 355, 356 357, 358 two non-controlled 359, 360 and one randomized study with poorly defined methods of measuring the blood loss 4 explored the ability of 5-ARIs prior to TURP to reduce blood loss associated with TURP. Only one of the randomized and the two nonrandomized studies showed a reduction in blood loss or transfusion requirements. Other studies found no significant differences between the treatment group and placebo for blood loss during surgery, excessive or severe bleeding, or clot retention. 362

Summary

Surgical therapies remain a principal option in management of men with moderate to severe LUTS and/or those who are significantly bothered by these symptoms. The updated literature review revealed remarkable evolution in the technology and broadening evidence for various forms of transurethral lasers and bipolar TURP. Open prostatectomy, TUIP and monopolar TURP remain as gold standards by which newer transurethral approaches are compared.

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Appendices

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Appendix 1. BPH Guideline Panel Members and Consultants (2003)

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September 2010

American Urological Association, Inc. BPH Guidelines Panel

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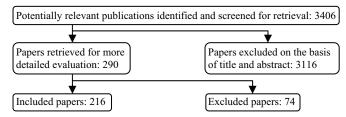
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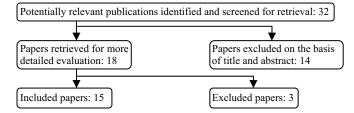
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Appendix 4 QUOROM Tree

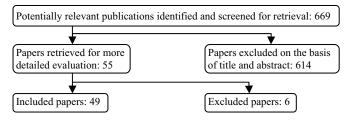
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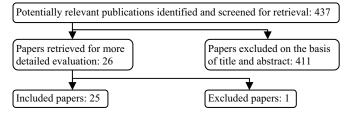
Update (articles from reference checking): Performed November 2007



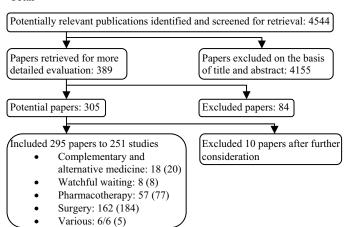
Update: 10.01.2006 - 03.31.2008



Update (gap search): 01.01.1999 - 06.30.2000



Total



Appendix A5

BPH Impact Index

| Patient Name:D | OB: ID: Date of ass | essment: | | | | | | |
|--|--|---------------------------------------|--|--|--|--|--|--|
| Initial Assessment () Monitor during: Therapy () after: Therapy/surgery () | | | | | | | | |
| much physical discomfort did any urinary problems cause you? 2. Over the past month, how much did you worry about your health because of any urinary problems? None □ Only a little □ Some □ A lot □ Source of any urinary problems? | | | | | | | | |
| 1. Over the past month how much physical discomfort did any urinary problems cause you? | None □ Only a little □ | Some □ A lot □ | | | | | | |
| 2. Over the past month, how much did you worry about your health because of any urinary problems? | None □ Only a little □ | Some □ A lot □ | | | | | | |
| 3. Overall, how bothersome has any trouble with urination been during the past month? | Not at all bothersome □ Bothers me a little □ | Bothers me some □ Bothers me a lot □ | | | | | | |
| 4. Over the past month, how much of the time has any urinary problem kept you from doing the kind of things you would usually do? | None of the time | Most of the time ☐ All of the time ☐ | | | | | | |
| | Total Score: (Scoring based on 0-4 point scale) | | | | | | | |

Appendix 6: The AUA Symptom Index

Appendix 1-A: The American Urological Association (AUA) Symptom Index for Benign Prostatic Hyperplasia (BPH) and the Disease Specific Quality of Life Question

| Patient Name: DOB: | ID: | | / | Date of assessment: | | | -: |
|--|--------------------|--------------------------|-------------------------------|------------------------|----------------------------|--------------------|----|
| Initial Assessment() Monitor during: | Therapy () after: | | | Therapy/surgery () | | | |
| AU | A BPH S | Symptom | Score | | | | |
| | Not at all | Less than 1 time in 5 | Less than half the time | About half the time | More than half the time | Almost always | |
| Over the past month, how often have you had a sensation of not emptying your bladder completely after you finished urinating? | 0 | 1 | 2 | 3 | 4 | 5 | |
| Over the past month, how often have you had to urinate again less than two hours after you finished urinating? | 0 | 1 | 2 | 3 | 4 | 5 | |
| 3. Over the past month, how often have you found you stopped and started again several times when you urinated? | 0 | 1 | 2 | 3 | 4 | 5 | |
| 4. Over the past month, how often have you found it difficult to postpone urination? | 0 | 1 | 2 | 3 | 4 | 5 | |
| 5.Over the past month, how often have you had a weak urinary stream? | 0 | 1 | 2 | 3 | 4 | 5 | |
| Over the past month, how often have you had to push or strain to begin urination? | 0 | 1 | 2 | 3 | 4 | 5 | |
| | None | 1 time | 2 times | 3 times | 4 times | 5 or more times | |
| 7. Over the past month, how many times did you most typically get up to urinate from the time you went to bed at night until the time you got up in the morning? | 0 | 1 | 2 | 3 | 4 | 5 | |

The Disease Specific Quality of Life Question

The International Prostate Symptom Score uses the same 7 questions as the AUA Symptom Index (presented above) with the addition of the following Disease Specific Quality of Life Question (bother score) scored on a scale from 0 to 6 points (delighted to terrible):

"If you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about that?"

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Appendix 1-1

Appendix A7

Diagnostic Evaluation

The Panel decided that the diagnostic section of the 2003 Guideline required updating. After review of the recommendations for diagnosis published based on the 2005 International Consultation of Urologic Diseases and reiterated in 2009 in an article by Abrams et al, the panel unanimously agreed that the contents were valid and reflected "best practices" The diagnostic guidelines by Abrams et al are revisited below. In the classification of diagnostic tests and studies a recommended test should be performed on every patient during the initial evaluation whereas an optional test is a test of proven value in the evaluation of select patients. In general, optional tests are done during a detailed evaluation and performed by a urologist.

A basic evaluation should be performed on every patient presenting to a health care provider with lower urinary tract symptoms (LUTS; Figure 1.1) (Abrams 2009).

Basic Management of LUTS in Men

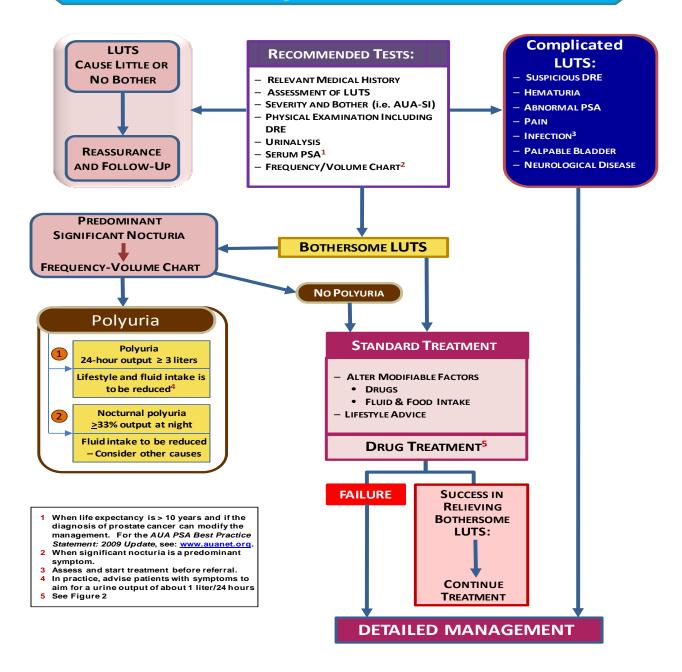


Figure 1.1. Basic management of lower urinary tract symptoms (LUTS) in men (adapted with permission from Abrams 2009). AUA-SI, American Urological Association Symptom Index; DRE, digital rectal exam; PSA, prostate-specific antigen.

History

The medical history should focus on the nature and duration of LUTS, sexual function, general health issues including fitness for invasive procedures, current medications, and prior surgical procedures that could affect LUTS.

Assessment of Symptoms and Bother

The American Urological Association Symptom Index (AUA-SI), Quality of Life (QoL) question, and the benign prostatic hyperplasia (BPH) Impact Index (BII) (see Appendices A5 and A6) are excellent, validated, quantitative assessment tools to evaluate symptoms and bother. A quantitative assessment of bother (as defined in the QoL question) is recommended to grade the severity of LUTS and to understand the degree of bother caused by those symptoms.

Physical Examination and Digital Rectal Exam

A focused physical examination should be performed to assess the suprapubic area for bladder distention, and motor and sensory function of the perineum and lower limbs. A digital rectal exam (DRE) should be performed to evaluate anal sphincter tone and the prostate gland with regard to approximate size, consistency, shape and abnormalities suggestive of prostate cancer.

The DRE estimation of prostate volume has been shown to be inaccurate when compared to transrectal ultrasound (TRUS). The volumes of small prostates tend to be overestimated and those of large glands tend to be underestimated. Training with a dedicated model has shown to improve the accuracy of DRE (Yanoshak, Roehrborn et al. 2000; Roehrborn, Sech et al. 2001).

Urinalysis

Urine should be analyzed using any of the widely available dipstick tests to determine if the patient has hematuria, proteinuria, pyuria or other pathological findings (eg, glucosuria, ketonuria, positive nitrite test, etc). Examination of the urinary sediment and culture is indicated if the results of the dipstick are abnormal. The results of urinalysis may guide additional testing independent of the evaluation for LUTS.

Serum Prostate-Specific Antigen Levels

As an alternative way of estimating prostate size, serum prostate-specific antigen (PSA) may be utilized, particularly when the key question is whether the prostate is greater or less than a threshold volume. For example, to achieve a specificity of 70% while maintaining a sensitivity between 65% and 70%, approximate age-specific criteria for detecting men with prostate glands exceeding 40 mL have been found to be PSA levels >1.6 ng/mL, >2.0 ng/mL, and >2.3 ng/mL for men with BPH in their 50s, 60s, and 70s, respectively (Roehrborn, Boyle et al. 1999). Similar findings were reported by other investigators (Bohnen, Groeneveld et al. 2007).

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The benefits and risks of using serum PSA testing to diagnose prostate cancer should be discussed with the patient including the possibilities of false-positive and false-negative results, complications of subsequent TRUS-guided biopsy, and false-negative biopsies. For an update on the AUA's 2009 best practice statement on PSA, please see http://www.auanet.org/content/guidelines-and-quality-care/clinical-guidelines/main-reports/psa09.pdf.

Frequency Volume Charts

Frequency volume charts (voiding diary or time and amount voiding charts) should be used when nocturia is the dominant symptom but may also be used in other settings. The time and voided volume are recorded for each micturition during several 24-hour periods and help to identify patients with isolated nocturnal polyuria or excessive fluid intake, which are common in the aging male.

Detailed Evaluation and Recommended Tests

Detailed Quantification of Symptoms by Standardized Questionnaires

When patients present with LUTS, the use of the AUA-SI for the objective documentation of symptom frequency from the patient's perspective is highly recommended (Figure 1.2) (Abrams 2009). The BII can also be used.

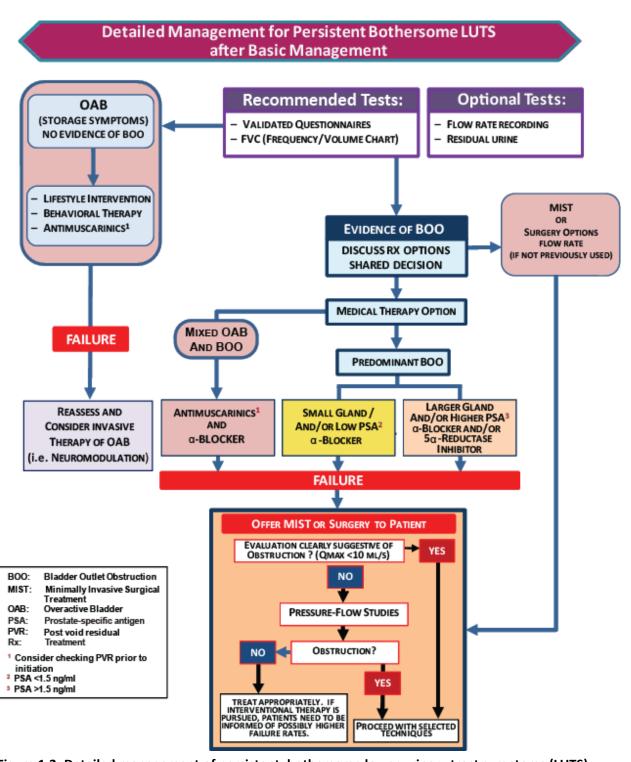


Figure 1.2. Detailed management of persistent, bothersome lower urinary tract symptoms (LUTS) after basic management (adapted with permission from Abrams 2009).

Flow Rate Recording

Urinary flow rate measurement is optional. It is useful in the initial diagnostic assessment and during or after treatment to confirm response. Despite the noninvasive nature of the test and its clinical value, it is an optional test in the detailed evaluation to be performed before embarking on any invasive therapy. Peak urinary flow (Qmax) is the best single measure to estimate the probability of a patient to be urodynamically obstructed, but a low Qmax does not distinguish between obstruction and decreased detrusor contractility. Because of the intra-individual variability and the volume dependency of the Qmax, at least 2 flow rates should be obtained, ideally both with a volume greater than 150 mL voided urine.

Residual Urine

The determination of post void residual urine is optional in the initial diagnostic assessment of the patient and during subsequent monitoring as a safety parameter. The determination is best performed by noninvasive transabdominal ultrasonography. Because of the marked intra-individual variability of residual urine volume, the test should be repeated to improve precision, particularly if the first residual urine volume is significant and suggests a change in the treatment plan.

Pressure Flow Studies

Pressure flow studies, although invasive, are the only tests that directly measure the relative contribution of the bladder, bladder outlet, and prostate to lower urinary tract function, dysfunction, or LUTS. They are not indicated in the routine evaluation of men with LUTS or to predict the response to medical therapy but may be beneficial in cases in which Qmax is greater than 10 mL per second to determine the need for invasive therapy to relieve BOO. A pressure flow study is the only method with the potential to distinguish men with a low urinary flow rate due to detrusor underactivity from those with BOO. This distinction is made by relating detrusor pressure at maximum urinary flow rate to the maximum flow rate.

Prostate Imaging with Transabdominal or Transrectal Ultrasound

When residual urine is determined by transabdominal ultrasonography with a machine generating real-time B-mode images, prostate shape, size, configuration and protrusion into the bladder may be simultaneously evaluated. Outside of this context, imaging of the prostate by transabdominal or transrectal ultrasound is optional in selected patients. The success of certain treatments may depend on anatomical characteristics of the prostate gland (eg, hormonal therapy, thermotherapy, or transurethral incision of the prostate). When such treatments are planned, transabdominal or TRUS may be used to assess prostatic size and shape. In men with serum PSA increased above the locally accepted reference

Copyright [©]2010 American Urological Association Education and Research, Inc. [®] Not to be distributed or copied. range, TRUS is the method of choice to evaluate the prostate and to guide a needle biopsy of suspicious areas, or to perform systematic biopsies to rule out prostate cancer.

Upper Urinary Tract Imaging with Ultrasonography

Although imaging of the upper urinary tract by computerized tomography (or intravenous urography or ultrasonography) is not recommended as a routine procedure, it may be indicated in patients presenting with 1 or more of the signs or symptoms, history of upper urinary tract infection (UTI) or urolithiasis, renal insufficiency (in this case ultrasonography is the preferred imaging study), and recent onset nocturnal enuresis. Upper tract imaging is also indicated for hematuria (microscopic or macroscopic) if conditions suggestive of primary renal disease are not present or if any of the following are present in the patient with microscopic findings: smoking history; occupational exposure to chemicals or dyes; history of gross hematuria; age greater than 40 years; previous urologic disorder or disease; history of irritative voiding symptoms; or history of recurrent UTIs (AUA Best Practice Statement on Asymptomatic Microscopic Hematuria).

Endoscopy of Lower Urinary Tract

Endoscopic evaluation of the lower urinary tract is not recommended in an otherwise healthy patient with an initial evaluation consistent with BOO, although it has certain indications as previously described for imaging. There are treatment alternatives in which success or failure depends on the anatomical configuration of the prostate (eg, transurethral incision of the prostate, thermotherapy, etc). Endoscopy is recommended if considered helpful when such treatment alternatives are contemplated.

Basic Management

If initial evaluation demonstrates the presence of LUTS associated with one or more of the findings of DRE suspicious of prostate cancer, hematuria, abnormal PSA levels, recurrent infection, palpable bladder, history/risk of urethral stricture, or a neurological disease raising the likelihood of a primary bladder disorder, the patient should be referred to a urologist for appropriate evaluation before advising treatment (Figure 1.1).

When initial evaluation demonstrates the presence of LUTS only, with or without some degree of nonsuspicious prostate enlargement, if the symptoms are not significantly bothersome or if the patient does not want treatment, no further evaluation is recommended. The patient is reassured and can be seen again if necessary. This recommendation is based on the opinion that this category of patients with nonbothersome LUTS is unlikely to experience significant health problems in the future due to their condition.

In patients with bothersome symptoms, it is now recognized that LUTS has a number of causes that may occur singly or in combination. Among the most important are benign prostatic obstruction, an overactive bladder and nocturnal polyuria. The physician can discuss treatment alternatives with the Copyright $^{\circ}2010$ $American\ Urological\ Association\ Education\ and\ Research\ Inc.$

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patient based on the results of initial evaluation with no further tests being needed. (See Figure 1.1 Recommended Tests.) There should be a discussion of the benefits and risks involved with each of the recommended treatment alternatives (watchful waiting, medical, interventional surgical, or minimally invasive surgical treatments [MIST]). The choice of treatment is reached in a shared decision-making process between the physician and patient.

If the patient has predominant significant nocturia and gets out of bed to void 2 or more times per night, it is recommended that the patient complete a frequency volume chart for 2-3 days. The frequency volume chart will show 24-hour polyuria or nocturnal polyuria when present, the first of which has been defined as greater than 3 liters total output over 24 hours. In practice, patients with bothersome symptoms are advised to aim for a urine output of 1 liter/24 hours. Nocturnal polyuria is diagnosed when more than 33% of the 24-hour urine output occurs at night. The patient should be treated according to the nocturia algorithm (Figure 1.1), ie, fluid intake should be reduced and treatments such as desmopressin can be considered. If symptoms do not improve sufficiently he can be treated along the same lines as men without predominant nocturia.

If the patient has no polyuria and medical treatment is considered, the physician can proceed with therapy based mainly on first altering modifiable factors such as concomitant drugs, regulation of fluid intake especially in the evening, lifestyle changes (avoiding a sedentary lifestyle) and dietary advice (avoiding dietary indiscretions such as excessive intake of alcohol and highly seasoned or irritative foods) (Brown 1997).

If treated pharmacologically, it is recommended that the patient be followed to assess treatment success or failure and possible adverse events. The time after initiation of therapy for the assessment of treatment success varies according to the pharmacological treatment prescribed and is usually 2 to 4 weeks for alpha blocker therapy and at least 3 months for a 5α -reductase inhibitor.

If treatment is successful and the patient is satisfied, follow-up should be repeated approximately once a year by repeating the initial evaluation as previously outlined. The follow-up strategy will allow the physician to detect any changes that have occurred in the last year, more specifically, if symptoms have progressed or become more bothersome, or if a complication has developed creating an indication imperative for surgery. If medical treatment fails and the patient is not satisfied, he should be referred to a urologist (if not already doing so) for further evaluation and possibly interventional treatment.

Detailed Management

If the patient's LUTS are being managed by a primary care giver and the patient has persistent bothersome LUTS after basic management then a urologist should be consulted (if not done already). The urologist may use additional testing beyond those tests recommended for basic evaluation.

If drug therapy is considered, decisions will be influenced by coexisting overactive bladder symptoms and prostate size or serum PSA levels. If there are coexisting BOO and overactive bladder

Copyright [©]2010 American Urological Association Education and Research, Inc. [®] Not to be distributed or copied. symptoms, then the patient can be treated with alpha blocker and anticholinergic combination therapy. When BOO symptoms predominate, alpha adrenergic blocking agents are the first treatment of choice for LUTS due to BPH. However, alpha blockers alone, 5-alpha-reductase inhibitors (5-ARIs) alone, and/or combination therapy with an alpha blocker and 5-ARI have shown the greatest efficacy when the prostate is enlarged as assessed by PSA levels, TRUS or on DRE (Figure 1.2). As always, the decision for choice of therapy should be decided in concert with the patient's wishes and concerns.

If storage symptoms predominate, an overactive bladder due to idiopathic detrusor overactivity is the most likely cause if there is no indication of BOO from flow study. The treatment options of lifestyle intervention (fluid intake alteration), behavioral modification and pharmacotherapy (anticholinergic drugs) should be discussed with the patient. It is the expert opinion of the Panel that some may benefit using a combination of all 3 modalities. Should improvement be insufficient and symptoms severe, then newer modalities of treatment such as botulinum toxin and sacral neuromodulation can be considered.

It is recommended that the patient be followed to assess treatment success or failure and possible adverse events according to the section on basic management above.

Interventional Therapy

If the patient elects to have interventional therapy and there is sufficient evidence of obstruction, patient and urologist should discuss the benefits and risks of the various interventions. Transurethral resection is still the gold standard for interventional treatment but, when available, new interventional therapies could be discussed. The techniques accepted for clinical use are summarized in the guideline.

If the patient's condition is not sufficiently suggestive of obstruction, eg, Qmax >10 mL/sec, pressure flow studies are optional as treatment failure rates are somewhat higher in the absence of obstruction. If interventional therapy is planned without clear evidence of the presence of obstruction, the patient needs to be informed of possible higher failure rates of the procedure.

Appendix A8

Table 3.1. Alfuzosin

Table 3.1a. Characteristics of alfuzosin randomized, controlled trials

| Author, Year, | Total sample size | Demographic characteristics of the comparison group | Run-in period | Outcomes reported |
|--|---|---|-----------------------|--------------------------------------|
| Country | Treatment groups (sample | | | |
| Study duration | size*) | | | |
| | Formulation | | | |
| Alfuzosin compared with p | | | | |
| McNeill SA, 2005 Europe and south Africa | 360 | Age: 69.3(8.3) | Run-in: none, placebo | Phase 1 TWOC failure |
| ALFAUR Study | Phase 1: Alfuzosin 10mg QD (238) | Total I-PSS: NR | | Phase 2 |
| | Placebo QD (122) | Qmax: NR | | Failure-free survival rates (surgery |
| Phase 1: 3d Phase 2: 6m | Phase 2 Alfuzosin 10mg QD (82) | First episode of AUR at baseline | | not needed) I-PSS score |
| | Placebo QD (83) | | | |
| | Formulation: not specified | | | |
| Roehrborn CG, 2001 USA and Canada | 536 | Age: 63.6(NR) | Run-in: 4w, placebo | I-PSS scores |
| 3m | Alfuzosin 10mg QD (170) | Total I-PSS: 21.5 | | Qmax |
| 3m | Alfuzosin 15mg QD (165) Placebo QD (167) | Qmax: 8.4 | | Withdrawal incidence |
| | Formulation: not specified | | | Adverse events |
| Roehrborn, 2003 North American, Europe | 955 | Age: 63.7(NR) | Run-in: 1m, placebo | I-PSS scores |
| Meta-analysis of 3 trials: | Alfuzosin 10mg QD (473) Placebo QD (482) | Total I-PSS: 18.7(4.4) | | PFR |
| Van Kerrebroek 2000, | _ , , | Qmax: NR | | Withdrawal incidence |
| Roehrborn 2001, and unpublished study | Formulation: not specified | | | Adverse events |
| 3m (84 d) | | | | |
| Roehrborn CG, 2006 Multicenter, international | 1522 | Age: 66.5(6.9) | Run-in: unclear | I-PSS scores |
| | Alfuzosin 10mg QD (749) | Total I-PSS: 19.2(4.7) | | Qmax |
| ALTESS | Placebo QD (757) | Qmax: 8.8(2.0) | | AUR rates |
| 2y | Formulation: not specified | | | Withdrawal incidence |
| | | | | Adverse events |
| | 1 | 1 | ı | |

| Van Kerrebroeck P, 2000 | 447 | Age: 64.6(7.5) | Run-in: 1m, placebo | I-PSS scores |
|---------------------------|--|------------------------|-----------------------|----------------------|
| Netherlands | | | | |
| | Alfuzosin 10mg QD (137) | Total I-PSS: 17.8(4.3) | | Qmax |
| RCT | A16 : 0.5 FFF (1.47) | 0 01/20 | | WY d 1 1 1 1 1 1 |
| 3m | Alfuzosin 2.5mg TID (147) Placebo TID (152) | Qmax: 9.1(2.0) | | Withdrawal incidence |
| 3111 | Placebo TID (132) | | | Adverse events |
| | Formulation: not specified | | | Adverse events |
| | | | | |
| Alfuzosin compared with d | oxazosin | | | |
| De Reijke TM, 2004 | 210 | Age: 62.8(7.4) | Run in: 2w, doxazosin | I-PSS scores |
| Netherlands, Denmark | | | | |
| | Dose titrated over time and with | Total I-PSS: 19.1(5.2) | | PVR |
| 14w | effect 2.5mg BID to TID, and | 5.1(2.0) | | |
| | 5mg BID; mean: 8.8mg/day | Qmax: 5.1(2.0) | | Qmax |
| | (93) 1-8mg QD; mean: 6.1mg/day | | | Withdrawal incidence |
| | (87) | | | withdrawar includite |
| | (67) | | | |
| | Formulation: not specified | | | |

* Number of patients randomized
Data are reported as mean (standard deviation) unless otherwise indicated.

Table 3.1b. Efficacy and effectiveness outcomes in alfuzosin randomized, controlled trials

| Author, Year Study duration | Intervention (no. of patients assessed) | Baseline [mean (SD)] | Endpoint [mean (SD)] | Within group difference (within group P-value) | Between group difference (P-value) | |
|-----------------------------|---|----------------------|----------------------|--|---------------------------------------|--|
| .10 | | ternational Prostate | e Symptom Score (I- | PSS) | • | |
| McNeill SA, 2005 | Alfuzosin 10mg QD (82) | NR | 8.75(NR) | NR | Vs placebo: NR (P=0.012) | |
| 6m | Placebo QD (83) | NR | 11.45(NR) | NR | NR | |
| Roehrborn CG, 2001 | Alfuzosin 10mg QD (170) | 18.2(6.3) | NR | -3.6 (NR) | Vs placebo: -2.0 (P=0.001) | |
| 3m | Alfuzosin 15mg QD (165) | 17.7(5.7) | NR | -3.4 (NR) | Vs placebo: -1.8 (P=0.004) | |
| | Placebo QD (167) | 18.2(6.4) | NR | -1.6 (NR) | NR | |
| Roehrborn CG, 2003 | Alfuzosin 10mg QD (473) | 18.7(4.6) | 12.7(6.1) | -6.0 (NR) | Vs placebo: -1.8 (P<0.001) | |
| 3m | Placebo QD (482) | 18.8(4.4) | 14.6(6.8) | -4.2 (NR) | NR | |
| Roehrborn CG, 2006 | Alfuzosin 10mg QD (749) | 19.2(4.7) | NR | -5.9 (NR) | Vs placebo: -1.2 (P=0.0017) | |
| 2y | Placebo QD (757) | 19.2(4.7) | NR | -4.7 (NR) | NR | |
| 2y Van Kerrebroeck P, | Alfuzosin 10mg QD (137) | 17.3(3.5) | 10.4(4.7) | -6.9 (NR) | Vs placebo: -2.0 (P=0.002) | |
| 2000 | Alfuzosin 2.5mg TID (147) | 16.8(3.7) | 10.5(6.1) | -6.4 (NR) | Vs placebo: -1.5 (P=0.02) | |
| 3m | Placebo QD (152) | 17.7(4.1) | 12.8(6.7) | -4.9 (NR) | NR | |
| Alfuzosin compa | red with doxazosin | | | | | |
| De Reijke TM, 2004 | Alfuzosin 2.5mg BID/TID (87) | 18.0(4.8) | NR | -7.5 (P<0.00) | Vs doxazosin: 1.7 (P<0.05) | |
| 14w | Doxazosin 1-8mg/day (93) | 19.1(5.2) | NR | -9.2 (P<0.001) | NR | |
| | | Quality of Life (C | QoL) Sub-score | | | |
| | red with placebo | | | | | |
| McNeil SA, 2005 | Alfuzosin 10mg QD (82) | NR | 1.66(NR) | NR | Vs placebo: NR (0.004) | |
| 6m | Placebo QD (83) | NR | 2.27(NR) | NR | NR | |
| Roehrborn CG, 2001 | Alfuzosin 10mg QD (170) | 3.8(1.1) | NR | -0.7 (NR) | Vs placebo: -0.4 (P=0.002) | |
| 3m | Alfuzosin 15mg QD (165) | 3.7(1.1) | NR | -0.7 (NR) | Vs placebo: -0.4 (P=0.002) | |
| | Placebo QD (167) | 3.7(1.1) | NR | -0.3 (NR) | NR | |
| Roehrborn CG, 2003 | Alfuzosin 10mg QD (473) | 3.6(1.0) | 2.6(1.2) | -1.0 (NR) | Vs placebo: -0.3 (P<0.001) | |

| Roehrborn CG, 2006 | Alfuzosin 10mg QD (749) | | | | |
|-----------------------|---------------------------|----------|-------------|-----------|--------------------------------|
| | | 3.8(1.1) | NR | -1.3 (NR) | Vs placebo: -0.4 (P<0.001) |
| 2y | Placebo QD (757) | 3.8(1.1) | NR | -0.9 (NR) | NR |
| Van Kerrebroeck P, | Alfuzosin 10mg QD (137) | 3.3(0.9) | 2.2(1.1) | -1.1 (NR) | Vs placebo: -0.5 (P=0.0008) |
| 2000 | Alfuzosin 2.5mg TID (147) | 3.3(1.0) | 2.2(1.1) | -1.0 (NR) | Vs placebo: -0.4 (P=0.005) |
| 3m | Placebo QD (152) | 3.3(1.0) | 2.6(1.3) | -0.6 (NR) | NR |
| | red with doxazosin | | | | |
| De Reijke TM, | Alfuzosin 2.5mg BID/TID | NR | NR | NR | NR |
| 2004 | Doxazosin 1-8mg/day | NR | NR | NR | NR |
| 14w | | Eili | - Ck | | |
| Alfuzosin compe | red with placebo | rilling | g Sub-score | | |
| McNeill SA, 2005 | Alfuzosin 10mg QD (82) | NR | NR | NR | NR |
| 6m | Placebo QD (83) | NR | NR | NR | NR |
| Roehrborn CG, 2001 | Alfuzosin 10mg QD (170) | 8.1(3.0) | NR | -1.4 (NR) | Vs placebo: -1.0 (P=0.0006) |
| 3m | Alfuzosin 15mg QD (165) | 7.9(2.5) | NR | -1.3 (NR) | Vs placebo: -0.9 (P=0.003) |
| | Placebo QD (167) | 7.9(3.0) | NR | -0.4 (NR) | NR |
| Roehrborn CG, | Alfuzosin 10mg QD (473) | NR | NR | NR | NR |
| 2003 | Placebo QD (482) | NR | NR | NR | NR |
| Roehrborn CG, 2006 | Alfuzosin 10mg QD (749) | NR | NR | NR | NR |
| 2y | Placebo QD (757) | NR | NR | NR | NR |
| Van Kerrebroeck P, | Alfuzosin 10mg QD (137) | 6.8(2.5) | 4.6(2.5) | -2.3 (NR) | Vs placebo: -0.7 (P=0.02) |
| 2000 | Alfuzosin 2.5mg TID (147) | 6.7(2.5) | 4.5(2.8) | -2.2 (NR) | Vs placebo: -0.6 (P=0.04) |
| 3m | Placebo QD (152) | 7.0(2.6) | 5.4(2.9) | -1.6 (NR) | NR |
| Alfuzosin compa | red with doxazosin | | | - | |
| De Reijke TM, | Alfuzosin 2.5mg BID/TID | NR | NR | NR | NR |
| 2004 | Doxazosin 1-8mg/day | NR | NR | NR | NR |
| 14w | | X7-: 1: | - C-1- C | | |
| Alfuzosin com | and with placeba | Voidin | g Sub-Score | | |
| McNeill SA, | Alfuzosin 10mg QD (82) | NR | NR | NR | NR |

| 2005 | Placebo QD (83) | NR | NR | NR | NR |
|---|---|---|-------------------------------|----------------------------|--|
| 6m | | | | | |
| Roehrborn CG, 2001 | Alfuzosin 10mg QD (170) | 10.1(4.4) | NR | -2.2 (NR) | Vs placebo: -1.1 (P=0.02) |
| 3m | Alfuzosin 15mg QD (165) | 9.9(4.1) | NR | -2.1 (NR) | Vs placebo: -1.0 (P=0.03) |
| | Placebo QD (167) | 10.3(4.3) | NR | -1.1 (NR) | NR |
| Roehrborn CG, | Alfuzosin 10mg QD (473) | NR | NR | NR | NR |
| 2003 | Placebo QD (482) | NR | NR | NR | NR |
| 3m | | | | | |
| Roehrborn CG, 2006 | Alfuzosin 10mg QD (749) | NR | NR | NR | NR |
| 2y | Placebo QD (757) | NR | NR | NR | NR |
| Van Kerrebroeck P, | Alfuzosin 10mg QD (137) | 10.4(3.2) | 5.8(3.4) | -4.6 (NR) | Vs placebo: -1.3 (P=0.005) |
| 2000 | Alfuzosin 2.5mg TID (147) | 10.1(2.9) | 6.0(4.1) | -4.2 (NR) | (P=0.005) Vs placebo: -0.9 (P=0.055) |
| 3m | Placebo QD (152) | 10.7(3.2) | 7.4(4.5) | -3.3 (NR) | NR |
| Alfuzosin compa | ared with doxazosin | () | | | |
| De Reijke TM, | Alfuzosin 2.5mg BID/TID | NR | NR | NR | NR |
| 2004 | Doxazosin 1-8mg/day | NR | NR | NR | NR |
| | | | | | |
| 14w | | | | | |
| | | Post Void Resi | dual (PVR) (mL) | | |
| Alfuzosin compa | red with placebo | | | | |
| | Alfuzosin 10mg QD (82) | NR | NR | NR | NR |
| Alfuzosin compa McNeill SA, 2005 | Alfuzosin 10mg QD (82) Placebo QD (83) | | | NR NR | NR NR |
| Alfuzosin compa McNeill SA, 2005 | Alfuzosin 10mg QD (82) | NR | NR | | |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, 2001 | Alfuzosin 10mg QD (82) Placebo QD (83) | NR NR | NR NR | NR | NR |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, 2001 | Alfuzosin 10mg QD (82) Placebo QD (83) Alfuzosin 10mg QD (170) | NR NR NR | NR NR NR | NR NR | NR NR |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, 2001 | Alfuzosin 10mg QD (82) Placebo QD (83) Alfuzosin 10mg QD (170) Alfuzosin 15mg QD (165) Placebo QD (167) | NR NR NR NR NR | NR NR NR NR NR NR | NR NR NR NR | NR NR NR NR |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, 2001 3m | Alfuzosin 10mg QD (82) Placebo QD (83) Alfuzosin 10mg QD (170) Alfuzosin 15mg QD (165) | NR NR NR | NR NR NR NR | NR NR NR | NR NR NR |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, 2001 3m Roehrborn CG, 2003 | Alfuzosin 10mg QD (82) Placebo QD (83) Alfuzosin 10mg QD (170) Alfuzosin 15mg QD (165) Placebo QD (167) Alfuzosin 10mg QD (473) Placebo QD (482) | NR NR NR NR NR NR NR NR | NR NR NR NR NR NR | NR NR NR NR NR | NR NR NR NR NR |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, | Alfuzosin 10mg QD (82) Placebo QD (83) Alfuzosin 10mg QD (170) Alfuzosin 15mg QD (165) Placebo QD (167) Alfuzosin 10mg QD (473) Placebo QD (482) Alfuzosin 10mg QD (749) | NR NR NR NR NR NR PS.3(75.0) | NR | NR NR NR NR NR | NR NR NR NR NR |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, 2001 3m Roehrborn CG, 2003 3m Roehrborn CG, 2006 | Alfuzosin 10mg QD (82) Placebo QD (83) Alfuzosin 10mg QD (170) Alfuzosin 15mg QD (165) Placebo QD (167) Alfuzosin 10mg QD (473) Placebo QD (482) Alfuzosin 10mg QD (749) Placebo QD (757) | NR NR NR NR NR NR NR NR | NR NR NR NR NR NR NR NR | NR NR NR NR NR NR NR | NR NR NR NR NR NR NR |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, 2001 3m Roehrborn CG, 2003 3m Roehrborn CG, 2006 | Alfuzosin 10mg QD (82) Placebo QD (83) Alfuzosin 10mg QD (170) Alfuzosin 15mg QD (165) Placebo QD (167) Alfuzosin 10mg QD (473) Placebo QD (482) Alfuzosin 10mg QD (749) Placebo QD (757) | NR NR NR NR NR NR STATE OF THE | NR | NR NR NR NR NR NR NR NR NR | NR |
| Alfuzosin compa McNeill SA, 2005 6m Roehrborn CG, 2001 3m Roehrborn CG, 2003 3m Roehrborn CG, 2006 | Alfuzosin 10mg QD (82) Placebo QD (83) Alfuzosin 10mg QD (170) Alfuzosin 15mg QD (165) Placebo QD (167) Alfuzosin 10mg QD (473) Placebo QD (482) Alfuzosin 10mg QD (749) | NR NR NR NR NR NR PS.3(75.0) | NR | NR NR NR NR NR NR NR NR | NR NR NR NR NR NR NR NR |

| 3m | | | | | |
|-----------------------|---------------------------|------------|----------------|-----------------|-------------------------------|
| | red with doxazosin | 1 | L | | _I |
| De Reijke TM, 2004 | Alfuzosin 2.5mg BID/TID | 75.4(73.8) | NR | +9.6 (P>0.05) | Vs placebo: +38.8 (P<0.05) |
| 14w | Doxazosin 1-8mg/day | 69.3(63.6) | NR | -29.2 (P<0.001) | NR |
| 1111 | | Oma | x (mL/s) | | |
| Alfuzosin compa | red with placebo | · · · · · | ii (iiizi o) | | |
| McNeill SA, 2005 | Alfuzosin 10mg QD (82) | NR | NR | NR | NR |
| 6m | Placebo QD (83) | NR | NR | NR | NR |
| Roehrborn CG, 2001 | Alfuzosin 10mg QD (170) | NR | NR | 1.7 (NR) | Vs placebo: 1.5 (P=0.0004) |
| 3m | Alfuzosin 15mg QD (165) | NR | NR | 0.9 (NR) | Vs placebo: 0.7 (P=0.12) |
| | Placebo QD (167) | NR | NR | 0.2 (NR) | NR |
| Roehrborn CG, 2003 | Alfuzosin 10mg QD (473) | 8.8(1.9) | 11.2(4.0) | 2.3 (NR) | Vs placebo: 1.2 (P=0.001) |
| 3m | Placebo QD (482) | 8.8(1.9) | 9.9(3.1) | 1.1 (NR) | NR |
| Roehrborn CG, | Alfuzosin 10mg QD (749) | 8.9(2.0) | NR | 12m: 2.0 (NR) | Vs placebo: 0.7 (NR) |
| 2006 | Placebo QD (757) | 8.8(2.0) | NR | 12m: 1.3 (NR) | NR |
| Van Kerrebroeck P, | Alfuzosin 10mg QD (137) | 9.4(1.9) | 11.7(3.9) | 2.3 (NR) | Vs placebo: 0.9 (P=0.03) |
| 2000 | Alfuzosin 2.5mg TID (147) | 8.7(1.9) | 11.9(4.3) | 3.2 (NR) | Vs placebo: 1.8 (P<0.0001 |
| 3m | Placebo QD (152) | 9.2(2.0) | 10.6(3.3) | 1.4 (NR) | NR |
| Alfuzosin compa | red with doxazosin | | | | |
| De Reijke TM, 2004 | Alfuzosin 2.5mg BID/TID | 10.6(3.1) | NR | 2.9 (P<0.001) | Vs placebo: -0.1 (P>0.05) |
| 14w | Doxazosin 1-8mg/day | 10.0(3.3) | NR | 3.0 (P<0.001) | NR |
| | | Acute Urin | nary Retention | | |
| | red with placebo | 1 | | | _ |
| McNeill SA, 2005 | Alfuzosin 10mg QD (82) | 3m: 64% | NR | NR | NR |
| 6m | Placebo QD (83) | 3m: 97% | NR | NR | NR |
| Roehrborn CG, | Alfuzosin 10mg QD (170) | NR | NR | NR | NR |
| 2001 | Alfuzosin 15mg QD (165) | NR | NR | NR | NR |
| 3m | Placebo QD (167) | NR | NR | NR | NR |
| Roehrborn CG, | Alfuzosin 10mg QD (473) | NR | NR | NR | NR |
| 2003 | Placebo QD (482) | NR | NR | NR | NR |
| 3m | | | | | |

| Roehrborn CG, 2006 | Alfuzosin 10mg QD (749) | 2.1% (16/754) | NR | NR | Vs placebo: NR (P=0.82) |
|-----------------------|---------------------------|-------------------------------|----------|------|-------------------------|
| 2y | Placebo QD (757) | 8.2% (14/761) | NR | NR | NR NR |
| Van Kerrebroeck P, | Alfuzosin 10mg QD (137) | NR | NR | NR | NR |
| 2000 | Alfuzosin 2.5mg TID (147) | NR | NR | NR | NR |
| | Placebo QD (152) | NR | NR | NR | NR |
| 3m | | | | | |
| Alfuzosin compa | red with doxazosin | | | | |
| De Reijke TM, | Alfuzosin 2.5 mg BID/TID | NR | NR | NR | NR |
| 2004 | Doxazosin 1-8 mg/day | NR | NR | NR | NR |
| 14w | | | | | |
| | | Prostate | Volume | | |
| | red with placebo | ND | NID | ND | ND |
| McNeill SA, | Alfuzosin 10mg QD (82) | NR | NR | NR | NR NR |
| 2005 6m | Placebo QD (83) | NR | NR | NR | NR |
| Roehrborn CG, 2001 | Alfuzosin 10mg QD (170) | 40.2 | NR | NR | NR |
| 3m | Alfuzosin 15mg QD (165) | 38.3 | NR | NR | NR |
| | Placebo QD (167) | 36.8 | NR | NR | NR |
| Roehrborn CG, | Alfuzosin 10mg QD (473) | NR | NR | NR | NR |
| 2003 | Placebo QD (482) | NR | NR | NR | NR |
| 3m | | | | | |
| Roehrborn CG, | Alfuzosin 10mg QD (749) | NR | NR | NR | NR |
| 2006 | Placebo QD (757) | NR | NR | NR | NR |
| 2y | | | <u></u> | | |
| Van | Alfuzosin 10mg QD (137) | NR | NR | NR | NR |
| Kerrebroeck P, | Alfuzosin 2.5mg TID (147) | NR | NR | NR | NR |
| 2000 | Placebo QD (152) | NR | NR | NR | NR |
| 3m | | | <u> </u> | | |
| | red with doxazosin | | | | |
| De Reijke TM, | Alfuzosin 2.5mg BID/TID | NR | NR | NR | NR |
| 2004 | Doxazosin 1-8mg/day | NR | NR | NR | NR |
| 14w | | | | | |
| |] | Detrusor Pressure (PSA (n | | 20)" | |
| Alfuzosin compa | red with placebo | 15/1 (11 | · S' | | |
| McNeill SA, | Alfuzosin 10mg QD (82) | 7.7(22.9) | NR | NR | NR |
| 2005 | Placebo QD (83) | 7.4(11.1) | NR | NR | NR |
| | 1 1accoo (D) (03) | 7.4(11.1) | INIX | INIV | INIX |

| 6m | | | | | |
|-----------------------|---------------------------|-------------------|---------|------------|----------------------------|
| Roehrborn CG, | Alfuzosin 10mg QD (170) | NR | NR | NR | NR |
| 2001 | Alfuzosin 15mg QD (165) | NR | NR | NR | NR |
| 3m | Placebo QD (167) | NR | NR | NR | NR |
| Roehrborn CG, | Alfuzosin 10mg QD (473) | NR | NR | NR | NR |
| 2003 | Placebo QD (482) | NR | NR | NR | NR |
| 3m | | | | | |
| Roehrborn CG, 2006 | Alfuzosin 10mg QD (749) | NR | NR | -0.6% (NR) | Vs placebo: -4.2% (P=0.07) |
| 2y | Placebo QD (757) | NR | NR | 3.6% (NR) | NR |
| Van | Alfuzosin 10mg QD (137) | NR | NR | NR | NR |
| Kerrebroeck P, | Alfuzosin 2.5mg TID (147) | NR | NR | NR | NR |
| 2000 | Placebo QD (152) | NR | NR | NR | NR |
| 3m | | | | | |
| | ared with doxazosin | | • | - | - |
| De Reijke TM, | Alfuzosin 2.5mg BID/TID | NR | NR | NR | NR |
| 2004 | Doxazosin 1-8mg/day | NR | NR | NR | NR |
| 14w | | | | | |
| | | Surgical Tr | eatment | | |
| | ared with placebo | _ | 1 | | 1 |
| McNeill SA, | Alfuzosin 10mg QD (82) | Failure-free | NR | NR | Vs placebo: |
| 2005 | | survival (no need | | | 3m: NR (P=0.04) |
| | | for BPH-related | | | 6m: NR (P=0.20) |
| 6m | | surgery) | | | |
| | | % needing | | | |
| | | surgery | | | |
| | | 3m: 10.4% (8/77) | | | |
| | | 6m: 19.7% | | | |
| | | (14/71) | | | |
| | | Improvement in | | | |
| | | survival, | | | |
| | | alfuzosin vs | | | |
| | | placebo: | | | |
| | | 3m: 11.4% (95% | | | |
| | | CI, 0.2 to 19.0%) | | | |
| | | 6m: 8.3% (95% | | | |
| | | CI, -4.6 to | | | |
| | | 21.3%) | 1 | | |
| | Placebo QD (83) | Failure-free | NR | NR | NR |
| | | survival (no need | 1 | | |
| | | for BPH-related | 1 | | |
| | | | 1 | 1 | i |
| | | surgery) | | | |

| Roehrborn CG, 2001 | Alfuzosin 10mg QD (170) Alfuzosin 15mg QD (165) Placebo QD (167) | surgery 3m: 26.1% (17/65) 6m: 35.7% (20/56) NR NR | NR NR NR | NR NR NR | NR NR NR |
|-----------------------------|--|--|----------------|----------------|----------------------------|
| 3m Roehrborn CG, | Alforagin 10mg OD (472) | NR | NR | NR | NR |
| 2003 | Alfuzosin 10mg QD (473) Placebo QD (482) | NR NR | NR NR | NR NR | NR NR |
| 2003 | Flacebo QD (482) | INK | INK | INK | INK |
| 3m | | | | | |
| Roehrborn CG, 2006 2y | Alfuzosin 10mg QD (749) | 5.1% (38/754) Absolute risk reduction: Vs placebo 22 (95% CI, -18 to 48) | NR | NR | Vs placebo: NR (P=0.18) |
| | Placebo QD (757) | 6.5% (49/761) | NR | NR | NR |
| Van | Alfuzosin 10mg QD (137) | NR | NR | NR | NR |
| Kerrebroeck P, | Alfuzosin 2.5mg TID (147) | NR | NR | NR | NR |
| 2000 | Placebo QD (152) | NR | NR | NR | NR |
| 3m | | | | | |
| | red with doxazosin | L N ID | N.D. | Lam | Lyp |
| De Reijke TM, | Alfuzosin 2.5mg BID/TID | NR | NR | NR | NR NR |
| 2004 | Doxazosin 1-8mg/day | NR | NR | NR | NR |
| 14w | | | | | |

^aNo studies reported this outcome.

Table 3.1c: Withdrawal and adverse event rates for alfuzosin randomized, controlled trials

| Author, Year Study duration | Overall withdrawal rate | Treatment (no. of patients randomized) | Withdrawal by treatment group | Withdrawal due to adverse effects | Percent of patients with 1 or more treatment-emergent adverse effects | |
|-----------------------------|----------------------------|--|-------------------------------|-----------------------------------|--|--|
| Alfuzosin compare | | | | | | |
| McNeill SA, 2005 | Phase 1: 1.4% (5/360) | Alfuzosin 10mg QD (238) | 1.7% (4/238) | 2.8% (10/360) | 8.4% (20/238) | |
| | | Placebo QD (122) | 0.8% (1/122) | NR | 13.1% (16/122) | |
| Phase 1: 2d Phase 2: 6m | Phase 2: 3.0% (5/165) | Alfuzosin 10mg QD (82) | 1.2% (1/82) | NR | 20.7% (17/82) | |
| | , , | Placebo QD (83) | 4.8% (4/83) | NR | 18.1% (15/83) | |
| Roehrborn CG, 2001 | 13.4% (72/536) | Alfuzosin 10mg QD (177) | 11.3% (20/177) | 4.5% (8/177) | 52% | |
| 3m | | Alfuzosin 15mg QD (181) | 17.7% (32/181) | 4.4% (8/181) | 43% | |
| | | Placebo QD (178) | 11.2% (20/178) | 2.2% (4/178) | 43% | |
| Roehrborn CG, 2003 | 9.1% (87/955) | Alfuzosin 10mg QD (473) | 9.5% (45/473) | NR | NR | |
| 3m | | Placebo QD (482) | 8.7% (42/482) | NR | NR | |
| Roehrborn CG, 2006 | 33.9% (513/1513) | Alfuzosin 10mg QD (754) | 30.5% (230/754) | 9.3% (69/754) | 53.1% (400/754) | |
| 2y | | Placebo QD (761) | 37.2% (283/761) | 7.6% (58/761) | 51.2% (390/761) | |
| Van Kerrebroeck P, | 9.0% (40/446) | Alfuzosin 10mg QD (143) | 11.2% (16/143) | 4.5% overall | NR | |
| 2000 | | Alfuzosin 2.5mg TID (149) | 9.4% (14/149) | NR | NR | |
| 3m | | Placebo QD (154) | 6.5% (10/154) | NR | NR | |
| Alfuzosin compare | ed with doxazosin | • | • | • | • | |
| De Reijke TM, 2004 | 16% (30/192) | Alfuzosin 2.5mg BID/TID (93) | 19.4% (18/93) | 7.5% (7/93) | 50.5% | |
| 14w | | Doxazosin 1- 8mg/day (99) | 12.1% (12/99) | 12.1% (12/99) | 48.5% | |

Table 3.1d. Adverse events in alfuzosin randomized, controlled trials

| Author, year | Intervention (no. of patients assessed) | Mortality | | | Cardiovascular | | | | Central | Nervous Sys | tem | GI | Intraoperative Floppy Iris | Sexua | al function |
|--------------------------|---|-----------------|--|---------------|----------------------------|--------------|----------------------|----------------------|------------------|-----------------|--------------|--------------------|-------------------------------|--|-----------------------------|
| Study duration | | | Dizziness | Hypotension | Orthostatic Hypotension | Syncope | Other cardiovascular | Asthenia/ fatigue | Headache | Malaise | Somnolence | Diarrhea, other | Syndrome | Ejaculation disorder | Erectile dysfunction |
| McNeill SA, 2005 | Phase 1: Alfuzosin 10mg QD (238) | 0% | Vasodilatory adverse effects: 2.5% (6/238) | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| hase 1: 2d hase 2: 6m | Placebo QD (122) | 0% | Vasodilatory adverse effects: 0.8% (1/122) | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| | Phase 2 Alfuzosin 10mg OD (82) | 0% | 0% | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| | Placebo QD (83) | 0% | 0% | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| toehrborn CG, 003 | Alfuzosin 10mg QD (472) | NR | 5.3% (25/472) | 2.1% (10/472) | NR | 0.2% (1/472) | NR | NR | 3.0% (14/472) | NR | NR | NR | NR | 0.6% | "impotence" 1.5% (7/472) |
| m | Placebo QD (483) | NR | 2.9% (14/483) | 1.7% (8/483) | NR | 0% | NR | NR | 2.1% (10/483) | NR | NR | NR | NR | NR | "impotence" 0.6% (3/483) |
| oehrborn CG, 006 | Alfuzosin 10mg QD (754) | NR | 6.0% (45/754) | 1.2% (9/754) | NR | 0.7% (5/754) | NR | NR | 3.3% (25/754) | 0.1% (1/754) | 0% (0/754) | NR | NR | Ejaculation disorder: 0.4% (3/754) | 2.0% (15/754) |
| y | Placebo QD (761) | NR | 4.6% (35/761) | 5% (4/761) | NR | 0.3% (2/761) | NR | NR | 2.2% (17/761) | 0% (0/761) | 0.4% (3/761) | NR | NR | Ejaculation disorder 0% (0/761) | 1.8% (14/761) |
| oehrborn CG, 001 | Alfuzosin 10mg QD (176) | NR | 7.4% (13/176) | 3.4% | NR | NR | NR | NR | 5.1% (9/176) | NR | 2.2% (4/176) | NR | NR | Temporary ejaculation disorder 0.6% | 2.8% (5/176) |
| | Alfuzosin 15mg QD (177) | NR | 9.0% (16/177) | 2.3% | NR | NR | NR | NR | 2.3% (4/177) | NR | 1.7% (3/177) | NR | NR | Temporary ejaculation disorder 0.6% | 1.1% (2/177) |
| | Placebo QD (175) | NR | 2.9% (5/175) | 3.4% | NR | NR | NR | NR | 2.3% (4/175) | NR | 0% (0/175) | NR | NR | Temporary ejaculation disorder 0% | 1.1% (2/175) |
| Van Kerrebroeck | Alfuzosin 10mg QD (143) | NR | 2.1% (3/143) | 0.7% (1/143) | NR | NR | NR | NR | 1.4% (2/143) | 1.4% (2/143) | 3.5% (5/143) | NR | NR | NR | NR |
| m | Alfuzosin 2.5mg TID (149) | NR | 4.7% (7/149) | 1.3% (2/149) | NR | NR | NR | NR | 2.0% (3/149) | 0.7% (1/149) | 0.7% (1/149) | NR | NR | NR | NR |
| | Placebo TID (154) | NR | 1.3% (2/154) | 0 | NR | NR | NR | NR | 0.6% (1/154) | 0% (0/154) | 2.6% (4/154) | NR | NR | NR | NR |
| Reijke TM, | Alfuzosin 2.5mg BID/TID (93) | 1.0% (1/105) | 11.8% (11/93) | 0% (0/93) | NR | 0% (0/93) | NR | NR | 6.5% (6/93) | 1.1% (1/93) | 0% (0/93) | NR | NR | NR | NR |

| ſ | 14w | Doxazosin 1- | 0(0%) | 14.1% (14/99) | 1.1% (1/99) | NR | 0% (0/99) | NR | NR | 5.1% (5/99) | 0% | 1% (1/99) | NR | NR | NR | NR |
|---|-----|--------------|-------|---------------|-------------|----|-----------|----|----|-------------|--------|-----------|----|----|----|----|
| | | 8mg/day (99) | | | | | | | | | (0/99) | | | | | ļ |
| | | | | | | | | | | | | | | | | |

Table 3.1e. Characteristics of alfuzosin single-group cohort studies

| Author, Year | Intervention | Demographic characteristics at baseline | Total withdrawal rate |
|-----------------------------|--------------------------------------|---|--|
| Country | Inclusion criteria | | Withdrawal rate due to |
| Study duration | Sample size | | adverse events |
| | | | Subject with one or more treatment |
| | | | emergent adverse events |
| Hartung R, 2006 | Alfuzosin 10mg QD | Age: NR | 19.3% (1259/6523) |
| Multi-center, international | LUTS suggestive of BPH | Total I-PSS: 17.3(6.7) | 6.44% (420/6523) |
| ALF-ONE study | 6523 at baseline | Qmax: NR | 23.9% (1558/6523) |
| 6m | | | |
| Nickel JC, 2006 | Alfuzosin 10mg QD | Subgroup with painful ejaculation | NR |
| ALF-One study | LUTS suggestive of bladder outlet | Age: 61.6(8.2) | 5.0% in subgroup with |
| ALI -One study | obstruction with painful ejaculation | Total I-PSS: 18.7(6.4) | painful ejaculation; 6.1% |
| 6m | 997 with painful ejaculation | Qmax: 13.2(11.8) | in those without painful ejaculation. |
| OIII | 3860 without painful ejaculation | Qmax. 13.2(11.8) | ejaculation. |
| | 1 | | 23.7% (236/997) in |
| | | | subgroup with painful ejaculation; 24.6 % in |
| | | | group without pain |
| Van Moorselaar, 2005 | Alfuzosin 10mg QD | Age: 65.9(8.5) | 23.2% (713/3076) |
| ALF-ONE study | LUTS suggestive of bladder outlet | Total I-PSS: 16.4(6.6) | 7.7% (238/3076) |
| | obstruction | Omax: NR | 38.9% (1197/3076) |
| 12m | 3076 | Qiliax. NK | 38.976 (1197/3070) |
| Eihilai M, 2006 | Alfuzosin 10mg QD | Age: 67.3(8.2) | 21.8% (183/839) |
| Europe | LUTS suggestive of BPH | Total I-PSS: 15.5(6.2) | 5.7% (48/839) |
| ALF-ONE study | 839 (interim analysis) | Omax: NR | 51.6% (433/839) |
| ALT-ONE Study | 637 (IIIICIIIII analysis) | Qiliax. INK | 31.070 (433/839) |
| 2y | | | |
| Vallancien, G, 2008 | Alfuzosin 10mg QD | Age: 67.6(8.4) | 35.7% (246/689) |
| ALF-ONE study | LUTS suggestive of BPH | Total I-PSS: 15.5(6.2) | 8.6% (59/689) |

| | | T | T |
|---|---|--|--|
| 3y | 689 | Qmax: NR | 71.4% (492/689) |
| IACOG, 2000 | Alfuzosin 2.5mg TID | Age: 64.6(0.4) | 14.5% (51/355) |
| Italy | Symptomatic patients with BPH, 50-80y | Total I-PSS: 21.6(SE 0.4) | 4.3% (15/355) |
| 12m | 355 | Qmax: 9.6(SE 0.1) | 7.1% (25/355) |
| Lukacs B, 2000 France 12, 36m | Alfuzosin 2.5mg (max. 7.5mg/day) or slow release 5mg twice daily <85y with LUTS 12m: 2829 36m: 7093 (includes persons in 12-m assessment) | 12m: Age: 65.9(0.1) Total I-PSS: 19.6(0.1) Qmax: NR 36m: Age: 66.7(0.2) Total I-PSS: NR Omax: NR | 12m: 13.7% (387/2829) 5.0% (141/2829) 14.8% (418/2829) 36m: 17.6% (1246/7093) NR |
| Saad F, 2005 | Alfuzosin: 10mg QD | Age: 63.1(19.0) | 1.7% (6/353) |
| Canada | Men ≥ 40y experiencing bothersome LUTS suggestive of BPH | Total I-PSS: 17.8(NR) | NR |
| 3m | 353 | Qmax: NR | 20.2% (70/353) |
| Shah T, 2002 Palit 2005 United Kingdom Unclear RCT with TWOC, then OLE 2y (Shah 2002) | Alfuzosin SR 5mg BID Placebo BID given at baseline; those with successful TWOC went on to OLE of alfuzosin SR 5 mg BID (reported here) 81 randomized 33 OLE | Age: 68.6(NR) Total I-PSS: NR Qmax: NR 100% in AUR at baseline for RCT | 54% (18/33) (2y) 69.7% (23/33) (4y) 1.2% (1/81) NR |
| 4y (Palit 2005) Van Kerrebroeck P, 2002, (OLE van Kerrebroeck 2000) | Alfuzosin 10mg QD >50y with micturition disorders related to | Age: 64.6 Total I-PSS: 17.1(3.6) | 9.3% (29/311) (during OLE) |
| Western Europe | BPH 360 (for safety) | Qmax: 9.1(2.0) | 3.9% (12/311) (during OLE) |
| 12m (including 3-m RCT) | | | 42.8% (154/360) |

Table 3.1f. Adverse events in alfuzosin single-group cohort studies

| Author, year | No. of patients | Mortality | | | Cardiovascul | ar | | Cen | tral Nervous Sy | vstem | Gastrointestinal | | | Intra- operative | Sexual function | |
|---|--|-------------|--------------------|---------|--|-------------------|-------------------|--------------------|------------------|--------------------|------------------|-------------------------|----------------------|----------------------|--|------------------|
| Dosage | Study duration | Drows iness | Hypotension | Syncope | Asthenia/ fatigue | Headache | Malaise | Somnolence | Complaints | Diarrhea, other | Nausea | Floppy Iris Syndrome | Abnormal ejaculation | Erectile dysfunction | | |
| Intervention: Alfuzos | | | | | • | | 1 | | | _ | , | | | | | |
| Hartung R, 2006 ALF-ONE study | 6523 6m | NR | 4.8% (315/6523) | NR | 0.7% (44/6523) | 0.2% (11/6523) | 1.7% (11/6523) | 2.4% (157/6523) | 0.1% (9/6523) | 0.8% (22/6523) | NR | NR | NR | NR | Retrograde Ejaculation 0.1% (9/6523 | 0.7% (45/6523) |
| Alfuzosin 10mg QD | | | | | | | | | | | | | | | | |
| Nickel JC, 2006 | 4857 | NR | 4.9% (237/4857) | NR | 0.7% (32/4857) | 0.3% (13/4857) | 1.7% (83/4857) | 2.6% (126/4857) | 0.1% (6/4857) | 0.4% (18/4857) | NR | NR | NR | NR | 0.2% (10/4857) | 0.9% (42/4857) |
| ALF-ONE study Alfuzosin 10mg QD | Onta reported for patients both with and without painful ejaculation | | | | | | | | | | | | | | | |
| Van Moorselaar, 2005 ALF-ONE study Alfuzosin 10mg OD | 3076 12m | NR | 6.2% (190/3076) | | 1.0% (32/3076) | 0.2% (6/3076) | NR | NR | 0.3% (9/3076) | NR | NR | NR | NR | NR | Retrograde Ejaculation 0.2% (6/3076) | 1.4% (43/3076) |
| Eihilai M, 2006 ALF-ONE study Alfuzosin 10mg QD | 839 2y | NR | 3.1% (26/839) | NR | 1.0% (8/839) | 0.5% (4/839) | 1.3% (11/839) | 1.2% (10/839) | 0.2% (2/839) | 0.4% (3/839) | NR | NR | NR | NR | Ejaculation failure 0.1% (2/839) Retrograde Ejaculation 0.1% (1/839) | 1.4% (12/839) |
| Vallancie, G, 2008 ALF-ONE study Alfuzosin 10mg QD | 689 3y | NR | 4.5% (31/689) | NR | Postural hypotension1.3 % (9/689) | 0.6% (4/689) | 2.3% (16/689 | 1.9% (13/689) | 0.4% (3/689) | 0.4% (3/689) | NR | NR | NR | NR | Ejaculation failure 0.3% (2/689) Retrograde Ejaculation 0.1% (1/689) | 2.0% (14/689) |

| IACOG, 2000 | 351 | 0.3% (1/355) Accidental | "Vertigo" 0.8% | NR | 2.6% (9/351) | NR | 1.7% (6/351) | 0.3% (1/355) | NR | NR | NR | NR | NR | NR | NR | NR |
|---|-------------|------------------------------------|-------------------|----|-------------------|----|---------------|--------------|-----------------|----|----|----|----|----|-------------------------------|--------------|
| Alfuzosin 2.5mg TID | 12m | | (3/355) | | | | | | | | | | | | | |
| Lukacs B, 2000a, 2000b | 2829 12m | 1.7% (48/2829) | 0.6% (16/2829) | NR | 1.6% (47/2829) | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| Alfuzosin 2.5mg TID | 7093 3y | 7.7% (549/7093) | 2.1% (NR) | NR | 0.4% (NR) | NR | NR | NR | NR | NR | NR | NR | NR | NR | Retrograde ejaculation: 0% | NR |
| Saad F, 2005 Alfuzosin 10 mg QD | 347 3m | 0 | 0 | NR | 0 | 0 | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| Shah T, 2002 Palit 2005 Alfuzosin SR 5mg BID | 33 2, 4y | 9.1% (3/33) (medical causes) | NR | | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| Van Kerrebroeck P, 2002 (OLE van Kerrebroeck 2000) Alfuzosin 10mg OD | 360 12m | NR | 2.5% (9/360) | | 2.8% (10/360) | NR | 3.6% (13/360) | 1.4% (5/360) | 1.1% (4/360) | NR | NR | NR | NR | NR | NR | 0.6% (2/360) |

Table 3.2. Doxazosin

Table 3.2a. Characteristics of doxazosin randomized, controlled trials

| Author, year | Total sample size | Demographic characteristics of the comparison group | Run-in period | Outcomes reported |
|---------------------------------|---|---|---|-------------------|
| Country | Treatment groups (sample size ^a) | | | |
| Study duration | Formulation | | | |
| Doxazosin 4mg QD compa | red with doxazosin 8mg QD | | | |
| MacDiarmid SA, 1999 | 82 | Age: 67.0(10.6) | Run in: NR | AUA SS |
| USA | Doxazosin 4mg QD (42) Doxazosin 8mg QD (40) | AUA SS: 17.4(8.7) | Patients recruited were taking Doxazosin 4mg QD | Boyarsky score |
| 12w | Formulation: not specified | Qmax: 15.1(9.7) | ≥ 3m prior to study | Qmax |
| Doxazosin compared with | doxazosin XL | | | |
| Andersen M, 2000 | 795 | Age: 64.9(range 50-80) | Run-in: 2w, placebo | IPSS |
| Denmark, Norway, Sweden | Doxazosin GITS 4 or 8mg QD (mean final dose in ITT | Total I-PSS: 17.7(4.3) | | Qmax |
| 13w | population 6.4mg QD (311) Doxazosin 1-8mg QD (mean final dose 6.0mg QD) (318) Placebo QD (155) Formulation: Doxazosin standard and GITS | Qmax: 10.3(2.6) | | |
| Kirby RS, 2005 | 680 | Age: NR | Run in: 2w, placebo | IIEF score |
| Europe, Canada, South Africa | Doxazosin XL 4 or 8mg QD (350) | Total I-PSS: NR | | |
| 13w | Doxazosin standard 1-8mg QD (330) Formulation: Doxazosin standard and XL | Qmax: NR | | |
| Doxazosin compared with | | | | |
| Ozbey I, 1999 | 57 | 48-82 | Run-in: none | PVR |
| Turkey | Doxazosin 2mg QD initially, then 4mg QD (29) | Total I-PSS: NR | | Qmax |
| 6m | Placebo QD (28) Formulation: doxazosin | Qmax: 10.71(2.71) | | |
| | standard | | | |

| Doxazosin GITS compared | l with tamsulosin | | | |
|-------------------------|--|--|-----------------------|----------------------|
| Pompeo AC, 2006 | Total: 165 | Age: 61.7(7.6) | Run-in: none | IPSS |
| 1 | | | 2w "washout phase" | |
| Brazil | A: Doxazosin 4mg GITS + | Total I-PSS: NR | 1 | QoL |
| | placebo QID 82 | | | |
| 12w | B: Tam 0.4mg + placebo QID | Qmax: NR | | |
| | 83 | | | |
| | | | | |
| | Formulation: Doxazosin GITS | | | |
| Doxazosin compared with | | [| T = | Lynna |
| Samli MM, 2004 | 50 | Age: 60(6.3) | Run-in: NR | IPSS |
| T. 1 | D : 0 OD (25) | T + 11 PCC 12 0/4 4) | | |
| Turkey | Doxazosin 8mg QD (25) | Total I-PSS: 13.8(4.4) | | Qmax |
| 12w | Terazosin 10mg QD (25) | Omay: 11 1(1 0) | | |
| 12W | Formulation: not specified | Qmax: 11.1(1.9) | | |
| Dovozosin compared with | finasteride, doxazosin + finasteride | and placeho | | |
| McConnell JD, 2003 | 3047 | Age: 62.6(7.3) | Run-in: 2w, placebo | Clinical progression |
| Kaplan SA, 2006 | JUT / | Ago. 02.0(7.3) | Kuii-iii. 2w, piaceoo | Cilineal progression |
| Johnson TM, 2007 | Doxazosin 1mg, titrated up to 4- | AUA SS: NR | | AUA SS |
| Bautista OM, 2003 | 8mg QD (756) | Non bb. INC | | NON 55 |
| Buttista OM, 2003 | Finasteride 5mg QD (768) | Qmax: 10.5(2.6) | | PVR |
| USA (MTOPS trial) | Doxazosin 1-8mg QD; | (2.00) | | |
| | finasteride 5mg QD (786) | | | Qmax |
| 4.5y (mean) | Placebo QD (737) | | | |
| | | | | PSA |
| | Formulation: not specified | | | |
| Kirby RS, 2003 | 1095 | Age: 64(7.0) | Run-in: 2w, placebo | IPSS |
| | | | | |
| Europe (PREDICT trial) | Doxazosin 1mg, titrated up to 4- | Total I-PSS: 17.3(4.7) | | Qmax |
| | 8mg QD (275) | | | |
| 52w | Finasteride 5mg QD (264) | Qmax: 10.4(2.7) | | PSA |
| | Doxazosin 1-8mg QD; | | | |
| | finasteride 5mg QD (286) | | | Adverse Events |
| | Placebo QD (270) | | | |
| | Formulation, notif1 | | | |
| Dovozosin + finastonid | Formulation: not specified th discontinuation of doxazosin | | L | |
| Baldwin KC, 2001 | 240 | Age: NR | No run-in | Successful |
| Daigwin KC, 2001 | 240 | Age. NK | ino fun-in | discontinuation |
| USA | Initial treatment of 272 men was | IPSS: NR | | discontinuation |
| OBA | with finasteride 5 mg and | 11 00. 141 | | |
| 12m | doxazosin 2 mg, titrated to 4 or | Qmax: NR | | |
| | 8 mg; men with a favorable | Zimii. Titi | | |
| | response (n=240) after 1m were | Prostate volume (g): >40; mean 54 (40 – 104) | | |
| | randomized to: | (6), | | |
| | | | | |
| | 5 mg finasteride + 2 mg | | | |
| | doxazosin (n=100) | | | |
| | 5 mg finasteride + 4 mg | | | |

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| doxazosin (n=80) 5 mg finasteride + 8 mg doxazosin (n=60) | | |
|--|--|--|
| Within each group, men were randomized to discontinue doxazosin at 3-month intervals | | |

^aNumber of patients randomized
Data are reported as mean (standard deviation) unless otherwise indicated.

Table 3.2b. Efficacy and effectiveness outcomes in doxazosin randomized, controlled trials

| Author, year Study duration | Intervention (no. of patients assessed) | Baseline [mean(SD)] | Endpoint [mean(SD)] | Within group difference (P-value) | Between group difference (P-value) |
|-----------------------------|---|---|------------------------|---|---|
| , | | AUA S | ymptom Score | | • |
| MacDiarmid SA, 1999 | Doxazosin 4mg QD (35) | 15.1(7.4) | 14.3(8.1) | -1.6 (P<0.05) | Vs. doxazosin 8mg QD: 3.7 (P=0.03) |
| 12w | Doxazosin 8mg QD (32) | 17.4(8.7) | 13.4(7.1) | -5.3 (NR) | NR |
| McConnell JD, 2003 4y | Doxazosin 1-8mg QD (756) | 17.0(5.8) | NR | Median change -6.0 (NR) | Vs. placebo: -2.0 (P<0.001) Vs. doxazosin 1-8mg QD; finasteride 5mg QD: 1.0 (P=0.035) Vs. finasteride 5mg QD: - 1.0 (P=0.002) |
| | Finasteride 5mg QD (768) | 17.6(5.9) | NR | Median change -5.0 (NR) | Vs. placebo: -1.0 (P=0.047) Vs. doxazosin 1-8mg QD; finasteride 5mg QD: 2.0 (P<0.001) |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (786) | 16.8(5.8) | NR | Median change -7.0 (NR) | Vs. placebo: -3.0 (P<0.001) |
| | Placebo QD (737) | 16.8(5.9) | NR | Median change -4.0 (NR) | NR |
| | | nternational Prosta | ate Symptom Sco | | |
| Pompeo AC, 2006 | Doxazosin 4mg QID (76) | NR | NR | NR (P=0.001) | Vs. tamsulosin: NR (P=0.759) |
| 12w | Tamsulosin 0.4mg QID (82) | NR | NR | NR (P=0.001) | NR |
| Andersen M, 2000 13w | Doxazosin GITS 4 or 8mg QD (311) | Per protocol analysis (n=772 out of 795 randomized) "ITT results similar" Note: text and table differ on whether measure of dispersion is SD or SE | NR | Least squared adjusted mean change -8.0(SE 0.3) (P<0.001) | Vs. placebo: 2.0 (P<0.05) Vs. doxazosin 1-8mg QD: 0.4 (P=0.321) |
| | Doxazosin 1-8mg QD (318) | NR | NR | Least squared adjusted mean change -8.4(SE 0.3) (P<0.001) | Vs. placebo: -2.4 (P<0.05) |

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| | Placebo QD (155) | NR | NR | Least squared adjusted mean change -6.0(SE 0.4) (P<0.001) | NR |
|------------------------|---|--|---------------|---|--|
| SamLi MM, 2004 | Doxazosin 8mg QD (25) | 14.4(6.2) | 8.2(3.7) | -6.2 (NR) | Post outcome, responders only Vs. terazosin: -0.7 (P=0.16) |
| 12W | Terazosin 10mg QD (25) | 13.8(4.4) | 8.3(4.2) | -5.5 (NR) | NR |
| Kirby RS, 2003 52w | Doxazosin 1-8mg QD (250) | 17.1(4.2) | 8.7(5.8) | -8.3 (NR) | Vs. placebo: -2.6 (P≤ 0.0001) Vs. finasteride 5mg QD: -1.7 (P≤0.01) Vs. doxazosin 1-8mg QD; finasteride 5mg QD: 0.2 (P>0.05) |
| | Finasteride 5mg QD (239) | 17.1(4.4) | 10.9(6.2) | -6.6 (NR) | Vs. placebo: -0.9 (P>0.05) |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (265) | 17.3(4.7) | 8.7(6.2) | -8.5 (NR) | Vs. placebo: -2.8 (P≤0.0001) Vs. finasteride 5mg QD: - 1.9 (P≤0.01) |
| | Placebo QD (253) | 17.2(4.5) | 11.8(6.9) | -5.7 (NR) | NR |
| | | | ymptom Scores | | |
| MacDiarmid SA, 1999 | Doxazosin 4mg QD (42) | Boyarsky score 17.4(8.3) | 17.9(8.3) | -0.6 (P<0.05) | Vs. doxazosin 8mg QD: 4.3 (P=0.009) |
| 12w | Doxazosin 8mg QD (40) | Boyarsky score 19.2(8.2) | 15.7(7.8) | -4.9 (P<0.05) | NR |
| Pompeo AC, 2006 | Doxazosin 4mg QID (82) | Prostatic Hyperplasia Impact Index 5.85(2.55) | 2.47(2.67) | NR (P=0.0001) | Vs. tamsulosin: NR (P=0.674) |
| 12w | Tamsulosin 0.4mg QID (82) | Prostatic Hyperplasia Impact Index 6.11(2.65) | 2.43(2.83) | NR (P=0.0001) | NR |
| | · | Qn | nax (mL/s) | | |
| MacDiarmid SA, 1999 | Doxazosin 4mg QD (42) | 16.0(7.8) | 14.9(7.1) | -0.6 (P<0.05) | Vs. doxazosin 8mg QD: - 2.0 (NR) |
| 12w | Doxazosin 8mg QD (40) | 15.1(9.7) | 17.9(10.3) | 1.4 (NR) | NR |
| Andersen M, 2000 | Doxazosin GITS 4 or 8mg QD (311) | Per protocol analysis (n=772 out of 795 randomized) "ITT results similar" | NR | Least squared adjusted mean change (reported) 2.6(SE 0.2) (P<0.001) | Vs. placebo: 1.8 (P <0.001) Vs. doxazosin 1-8mg QD: 0.4 (P=0.257) |

| | | 10.3(SE 2.6) | | | |
|-----------------------------|---|---|-------------|--|--|
| | Doxazosin 1-8mg QD (318) Placebo QD (155) | Note: text and table differ on whether measure of dispersion is SD or SE 10.0(SE 2.8) | NR NR | 2.2(SE 0.2) (P<0.001) 0.8(SE 0.3) (P<0.01) | Vs. placebo: 1.4 (P<0.001) |
| Ozbey I, 1999 | Doxazosin 2-4mg QD | 10.22(2.15) | 13.10(1.93) | 2.88 (P=0.01) | Vs. placebo: 3.89 (NR) |
| 6m | (21) Placebo QD (18) | 10.71(2.71) | 9.70(2.26) | -1.01 (NR) | NR |
| Pompeo AC, 2006 | Doxazosin 4mg QID (76) | 11.50(5.63) | 12.98(6.33) | NR | Vs. tamsulosin: NR (P=0.526) |
| 12w | Tamsulosin 0.4mg QID (78) | 11.55(6.5) | 13.68(7.56) | NR | NR |
| SamLi MM, 2004 | Doxazosin 8mg QD (25) | 10.8(2.7) | 13.1(3.1) | 2.3 (NR) | Post outcome, responders only Vs. terazosin: NR (P=0.63) |
| | Terazosin 10mg QD (25) | 11.5(1.9) | 12.9(2.3) | 1.4 (NR) | NR |
| McConnell JD, 2003 4y | Doxazosin 1-8mg QD (756) | 10.3(2.5) | NR | Median change 2.5 (NR) | Vs. placebo: NR (P<0.001) Vs. doxazosin 1-8mg QD; finasteride 5mg QD: NR (P=0.002) |
| | Finasteride 5mg QD (768) | 10.5(2.5) | NR | 2.2 (NR) | Vs. placebo: 0.8 (P=0.047) Vs. doxazosin 1-8mg QD; finasteride 5mg QD: -1.5 (P<0.001) Vs. doxazosin 1-8mg QD: -0.3 (P=0.089) |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (786) | 10.6(2.5) | NR | 3.7 (NR) | Vs. placebo: 2.3 (P<0.001) |
| | Placebo QD (737) | NR | NR | 1.4 (NR) | NR |
| Kirby RS, 2003 52w | Doxazosin 1-8mg QD (250) | 10.4(2.5) | 14.0(4.9) | 3.6 (0.3) | Vs. placebo: 2.2 (P≤0.0001) Vs. finasteride 5mg QD: NR (P≤0.0001) |
| | | 10.2(2.5) | 12.1(4.7) | 1.8 (NR) | Vs. placebo: 0.4 |
| | Finasteride 5mg QD (239) | 10.2(2.3) | | | (P<0.001) |
| | | 10.4(2.7) | 14.5(5.1) | 3.8 (NR) | (P<0.001) Vs. placebo: 2.4 (P≤0.0001) |

| Andersen M, | Doxazosin GITS 4 or | Unclear if per | NR | Least squared | Vs. doxazosin 1-8mg |
|---------------------|---|------------------------------|--------------------|---------------------------|---|
| 2000 | 8mg QD (311) | protocol | | adjusted mean | QD: 0.04(SE 0.10) (95% |
| 12 | | analysis (n=772 | | change | CI -0.15 – 0.22) (P>0.05) |
| 13w | | out of 795 randomized) or | | -1.3(SD 0.1) (P<0.001) | |
| | | ITT (780/795) | | (P<0.001) | |
| | Doxazosin 1-8mg QD | NR | NR | -1.4(SD 0.1) | NR |
| | (318) | | | (P<0.001) | |
| | Placebo QD (155) | NR | NR | -0.9(SD 0.1) (P<0.001) | NR |
| | | | ure at Qmax (cmH | | |
| Ozbey I, 1999 | Doxazosin 2-4mg QD (21) | 80.19(9.03) | 56.14(11.88) | -24.05 (P<0.05) | Vs. placebo: -32.28 (NR) |
| 6m | Placebo QD (18) | 82.38(9.07) | 90.61(9.42) | 8.23 (NR) | NR |
| | | Post Void Ro | esidual (PVR) (mL) | | |
| Ozbey I, 1999 6m | Doxazosin 2mg QD initial; doxazosin 4mg QD (21) | 32.19(20.29) | 20.14(14.65) | -12.05 (P>0.05) | Vs. placebo: -27.5 (NR) |
| OIII | Placebo QD (18) | 33.88(21.97) | 49.33(21.92) | 15.45 (NR) | NR |
| Pompeo AC, 2006 | Doxazosin 4mg QID (76) | 230.34(111.89) | 200.06(107.33) | NR NR | Vs. tamsulosin 0.4mg QD: NR (P=0.057) |
| 12w | Tamsulosin 0.4mg QID (78) | 193.19(124.42) | 245.79(142.74) | NR | NR |
| | | Prostate Specific | Antigen (PSA) (ng | /mL) | 1 |
| McConnell JD, | Doxazosin 1-8mg QD | 2.4(2.1) | NR | % change from | Vs. placebo: NR |
| 2003 | (756) | | | baseline | (P=0.291) |
| | | | | +13 (NR) | Vs. doxazosin 1-8mg |
| 4y | | | | | QD; finasteride 5mg QD: NR (P<0.001) |
| | Finasteride 5mg QD (768) | 2.4(2.1) | NR | -50% (NR) | Vs. placebo: NR (P<0.001) Vs. doxazosin 1-8mg QD; finasteride 5mg QD: NR (P=0.683) Vs. doxazosin 1-8mg QD: NR (P<0.001) |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (786) | 2.3(1.9) | NR | -50% (NR) | Vs. placebo: NR (P<0.001) |
| | Placebo QD (737) | 2.3(2.0) | NR | +15% (NR) | NR |
| Kirby RS, 2003 | Doxazosin 1-8mg QD (250) | 2.5(2.0) | 2.8(2.3); NR | 0.3 (NR) | NR |
| 52w | Finasteride 5mg QD (239) | 2.6(2.1) | 1.5(1.0); | -1.2 (NR) | NR |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (265) | 2.7(2.3) | 1.4(1.2); | -1.3 (NR) | Vs. placebo: -1.6 (NR) |
| | Placebo QD (253) | 2.6(2.1) | 2.9(2.6) | 0.3 (NR) | NR |
| | | | tate Volume | | |
| McConnell JD, | Doxazosin 1-8mg QD | 36.9(21.6) | NR | % change from | NR |

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| 2003 | (756) | | | baseline | |
|-----------------------------|--|---|----------------|---|------------------------------|
| | | | | +24% (NR) | |
| 4y | Fin 5mg QD (768) | 36.9(20.6) | NR | -19% (had "large" prostate at baseline) (NR) | NR |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (786) | 36.4(19.2) | NR | -19% (had "large" prostate at baseline) (NR) | NR |
| | Placebo QD (737) | 35.2(18.8) | NR | +24% (NR) | NR |
| | | | elated Surgery | | |
| Kirby RS, 2003 | Doxazosin 1-8mg QD (275) | NR | NR | Incidence of TURP 0.4% | NR |
| 52w | Finasteride 5mg QD (264) | NR | NR | 1.1% | NR |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (286) | NR | NR | 0% | NR |
| | Placebo QD (269) | NR | NR | 2.6% | NR |
| McConnell JD, 2003 4y | Doxazosin 1-8mg QD (756) | NR | NR | Invasive therapy due to BPH Rate per 100 P-Y; cumulative incidence (95% CI) 27; 3(range 2-5) | NR |
| | Finasteride 5mg QD (768) | NR | NR | 14; 2(range 0-3) | NR |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (786) | NR | NR | 12; 1(range 0-2) | NR |
| | Placebo QD (737) | NR | NR | 37; 5(range 3-7) | NR |
| | | | al Progression | | |
| McConnell JD, 2003 4y | Doxazosin 1-8mg QD (756) | Clinical progression defined as one or more of the following: an increase from baseline of AUA SS of 4+ points; AUR, UTI, incontinence; increased serum creatinine attributed to BPH NR | NR | Cumulative incidence (95% CI) 10(range 8-12) | Vs. placebo: NR (P<0.001) |
| | Finasteride 5mg QD (768) | NR | NR | 10(range 8-13) | Vs. placebo: NR (P=0.002) |

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| | Doxazosin 1-8mg QD; finasteride 5mg QD (786) | NR NR | NR NR | 5(range 4-7) 17(range 14-20) | Vs. placebo: NR (P<0.001) Vs. doxazosin 1-8mg QD: NR (P<0.001) Vs. finasteride 5mg QD: NR (P<0.001) NR |
|-----------------------|--|----------|--------------|--|--|
| | Tiaccoo QD (757) | | ry Retention | 17(talige 14-20) | TVIC |
| McConnell JD, 2003 | Doxazosin 1-8mg QD (756) | NR | NR | Cumulative incidence (95% CI) 1(range 0-2) | Vs. placebo: NR (P=0.23) |
| | Finasteride 5mg QD (768) | NR | NR | <1(range 0-1) | Vs. placebo: NR (P=0.009) |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (786) | NR | NR | <1(range 0-1) | Vs. placebo: NR (P<0.001) |
| | Placebo QD (737) | NR | NR | 2(range 1-4) | NR |
| Kirby RS, 2003 | Doxazosin 1-8mg QD (275) | NR | NR | Occurrance of AUR 0% | NR |
| 52w | Finasteride 5mg QD (264) | NR | NR | 1.1% | NR |
| | Doxazosin 1-8mg QD; finasteride 5mg QD (286) | NR | NR | 0% | NR |
| ax 1 1 1 1 | Placebo QD (269) | NR | NR | 1.5% | NR |

^aNo studies reported this outcome

Table 3.2c. Withdrawal and adverse event rates for doxazosin randomized, controlled trials

| Author, year Study duration | Overall withdrawal rate | Treatment (no. of patients randomized) | Withdrawal by treatment group | Withdrawal due to adverse events | No. of patients with 1 or more treatment- emergent adverse events (%) |
|-----------------------------|----------------------------|---|-------------------------------|--|--|
| Doxazosin 4mg QD | compared with doxaz | osin 8mg QD | • | | , , |
| MacDiarmid SA, 1999 | 15/82 (18.3%) | Doxazosin 4mg QD (42) | 7/42 (16.7%) | 4/42 (9.5%) | NR |
| 12w | | Doxazosin 8mg QD (40) | 8/40 (20%) | 5/40 (12.5%) | NR |
| Doxazosin XL comp | pared with doxazosin s | standard | | • | 1 |
| Andersen M, 2000 13w | 68/784 (8.7%) | Doxazosin GITS 4 or 8mg QD (311) | 22/311 (7.1%) | 4.7% Vs. doxazosin 1-8mg QD: P=0.022 Vs. placebo: P=0.241 | Withdrawals due to treatment-related AEs 3.5% |
| | | Doxazosin 1-8mg QD (318) | 38/322 (11.8%) | 9.3 % Vs. placebo: P=0.003 | 6.2% |
| | | Placebo QD (155) | 8/156 (5.1%) | 2.6% | 0.6% |
| Kirby RS, 2005 | 70/680 (10.3%) | Doxazosin XL 4 or 8mg QD (350) | 39/350 (11.1%) | 21/350 (6.0%) | NR |
| 13w | | Doxazosin S 1 to 8mg QD (330) | 31/330 (9.4%) | 16/330 (4.8%) | NR |
| Doxazosin compare | ed with placebo | | | | • |
| Ozbey I, 1999 6m | 18/55 (31.6%) | Doxazosin 2mg QD initial; doxazosin 4mg QD (29) | 8/29 (27.6%) | 2/29 (6.9%) (hypotension and vertigo) | NR, other than 2/29 with hypotension |
| | | Placebo QD (28) | 10/28 (35.7%) | 0% | NR |
| Doxazosin GITS co | mpared with tamsulos | | | • | 1 |
| Pompeo AC, 2006 | 29/165 (17.6%) | Doxazosin GITS 4mg QD82 | 17/82 (20.7%) | 2/82 (2.4%) | 17/82 (20.7%) P=0.383 |
| 12w | | Tam 0.4mg QD 83 | 12/83 (14.5%) | 4/83 (4.8%) | 22/83 (26.5%) |
| Doxazosin compare | ed with terazosin | | | | |
| SamLi MM, 2004 | NR | Doxazosin 8mg QD (25) | NR | NR | 1/25 (4%) |
| 12w | | Terazosin 10mg OD (25) | NR | NR | 1/25 (4%) |
| Doxazosin compare | ed with finasteride, do | xazosin + finasteride, a | nd placebo | • | 1 |
| McConnell JD, | NR (data presented | Doxazosin 1-8mg | 27% | "most often treatment | NR |
| 2003 | as person-years) | QD (756) | | was discontinued because of adverse | |
| 4.5y (mean) | | Finasteride 5mg | 24% | events" | NR |
| | | QD (768) | | | |
| | | Doxazosin 1-8mg QD; finasteride 5mg QD (786) | 18% | | NR |
| | | Placebo QD (737) | NR | | NR |

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| Kirby RS, 2003 | 29.6% (324/1095) (ITT population | Doxazosin 1-8mg QD (275) | 78/275 (28.4%) | 11.6% (32/275) | 155/275 (56.4%) |
|------------------|-------------------------------------|--|----------------|---|-----------------|
| 52w | was 1007/1095) | Finasteride 5mg QD (264) | 81/264 (30.7%) | 12.9% (34/264) | 93/264 (35.2%) |
| | | Doxazosin 1-8mg QD; Fin 5mg QD (286) | 89/286 (31.1%) | 12.2% (35/286) | 151/286 (52.8%) |
| | | Placebo QD (270) | 76/270 (28.1%) | 11.1% (30/270) | 82/270 (30.4%) |
| Baldwin KC, 2001 | NR | 5 mg finasteride + 2 mg doxazosin | NR | Of 272 men entering study, 32 did not | NR |
| USA | | (n=100) 5 mg finasteride + 4 | | continue with the study: 11 had no improvement | |
| 12m | | mg doxazosin (n=80) 5 mg finasteride + 8 mg doxazosin (n=60) | | and21 did not tolerate meds (dizziness and orthostatic hypotension) | |

Table 3.2d. Adverse events in doxazosin randomized, controlled trials

| Author, year | Intervent ion (no. of patients assessed) | Mortal ity | | Cardiova | scular | | C | entral Ner | vous Syst | tem | Gastrointe stinal | Intraoperative Floppy Iris | | Sexual Fu | nction | Urinary Tract |
|----------------------------|---|----------------------|-------------------|--|-------------|------------------------|--------------------|------------------|-------------|-----------------------------|----------------------|-------------------------------|-------------------------|------------------------|---|--------------------------|
| Study duration | | | Dizziness | Hypote nsion | Syncop e | Other cardi ovasc ular | Asthen ia/fatig ue | Heada che | Malai se | Somnole nce | Diarrhea, other | Syndrome | Ejaculation disorder | Retrograde ejaculation | Erectile dysfunction | Urinary incontinence UTI |
| Doxazosin - | 4mg compare | | | | | | | | | | | | | | | |
| MacDiar mid SA, 1999 | Doxazosi n 4mg QD (42) | NR | 3/42 (7.1%) | Postural hypotensi on: 3/42 (7.1%) | NR | NR | NR | 5/42 (12%) | NR | Fatigue 12/42 (28.6%) | NR | NR | NR | NR | 4/42 (9.5%) | NR NR |
| 12w | Doxazosi n 8mg QD (40) | NR | 6/40 (15%) | 3/42 (7.1%) | NR | NR | NR | 7/70 (10%) | NR | Fatigue 7/40 (17.5%) | NR | NR | NR | NR | 5/42 (12%) | NR NR |
| Doxazosin o | compared with | Doxazosir | | | | | | • | | | | | • | | | |
| Kirby RS, 2005 13w | Doxazosi n standard 1-8mg QD (350) | 1/350 (0.29%) | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | IIEF Improved in patients with sexual dysfunction at baseline; NSD between treatment groups | NR NR |
| | Doxazosi n XL 4 or 8mg QD (330) | 0% | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR NR |
| | GITS compare | | | | | | | | | | | | | | 1 | _ |
| Andersen M, 2000 | Doxazosi n GITS 4 or 8mg QD (311) | NR | 18/311 (5.7 %) | Postural hypotensi on: 4/311 (1.3%) | NR | NR | NR | 18/311 (5.7%) | NR | Asthenia 3.2% | NR | NR | NR | NR | NR | NR NR |
| | Doxazosi n 1-8mg QD (318) | NR | 27/318 (8.4%) | 7/318 (2.2 %) | NR | NR | NR | 13/318 (4.1%) | NR | Asthenia 5.0% | NR | NR | NR | NR | NR | NR NR |
| | Placebo QD (155) | NR | 3/155 (1.9%) | Postural hypotensi on: 1/155 (0.6%) | NR | NR | NR | 7/155 (4.5%) | NR | Asthenia 1.3% | NR | NR | NR | NR | NR | NR NR |
| Doxazosin o | compared with | placebo | | | | | | | | | | | | | | |
| Ozbey I, 1999 6m | Doxazosi n 2mg QD initial; doxazosin 4mg QD 29 | NR | NR | 2/29 (6.9%) | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR I | NR | NR NR |
| | 28 | NR | NR | 0% | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR I | NR | NR |
| | | | | | | | | | | | | | | | | NR |

| Doxazosin (| GITS compare | ed with tams | sulosin | | | | | | | | | | | | | |
|--|--|---|------------------------------------|---|------------------------------|-------|------|----------------|-------|--|-------|-----|-----------------------------------|----------|---|----------|
| Pompeo AC, 2006 | 82 | NR | 3/82 (3.7%) | NR | NR | NR | NR | 3/82 (3.7%) | NR | Asthenia 1.2% | NR | NR | 2/82 (2.4%) | NR | NR | NR NR |
| 12w | 83 | NR | 2/83 (2.4%) | NR | NR | NR | NR | 2/83 (2.4%) | NR | Asthenia 2.4% | NR | NR | 4/83 (4.8%) | NR | NR | NR NR |
| Doxazosin o | compared with | terazosin | | | | | | | | | | | | | | INK |
| SamLi MM, 2004 | 25 | NR | 1/25 (4%) | Postural hypotensi on: 0% | NR | NR | NR | 0% | NR | 0% | NR | NR | NR | NR | 0% | NR NR |
| 2004 12w | 25 | NR | 0% | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | 1/25 (4%) | NR NR |
| | | | | | | | | | | | | | | | | NR |
| | | | | + finasteride | | | LAID | I NIP | LND | 1 4 43 . | ND. | LND | 1.10 | L NID | 2.56 | ND |
| McConnel 1 JD, 2003 Kaplan SA, 2006 Bautista OM, 2003 USA (MTOPS trial) 4.5y(mean | *All adverse events: rate/100 person-year of follow-up | NR Breast cancer: 4 cases among men taking finaster ide alone or combni nation therapy NR | 2.33 Vs. | Postural hypotensi on: 4.03 | NR | NR NR | NR | NR | NR NR | Asthenia 0.82 Vs. placebo: P<0.05 | NR NR | NR | 1.10 1.78 Vs. placebo: | NR NR | 3.56 Decreased libido (100 P-Y) 1.56 4.53* | NR NR |
| | | | placebo : P<0.05 | on: 2.56 | | | | | | | | | P<0.05 | | Decreased libido (100 P-Y) 2.36 Vs. placebo: P<0.05 | NR |
| | 786 | NR | 5.35 Vs. placebo : P<0.05 | Postural hypotensi on: 4.33 | NR | NR | NR | NR | NR | Asthenia 0.78* Vs. placebo: P<0.05 | NR | NR | 3.05 Vs. placebo: P<0.05 | NR | 5.11* Decreased libido (100 P-Y) 2.51 | NR NR |
| | 737 | NR | 2.29 | Postural hypotensi on: 2.29 | NR | NR | NR | NR | NR | Asthenia 0.37 | NR | NR | 0.83 | NR | 3.32 Decreased libido (100 P-Y) 1.40 | NR NR |
| Kirby RS, 2003 Europe (PREDIC | 275 | NR | 43/275 (15.6%) | Hypotensi on: 14/275 (5.1%), P=0.01 | 2/275 (0.7%) Betwe | NR | NR | NR | NR | 11/275 (4%) Between -group | NR | NR | 1/275 (0.4%) Betweengroup P=0.16 | NR | 16/275 (5.8%) Between-group P<0.01 | NR NR |

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| | 1 | 1 | | 1 | 1 | 1 | 1 | | | D 0.51 | | T | | | 1 | |
|----------|-----|----|---------|-----------|----------------|----|----|----|----|---------|----|----|--------------|----|----------------|------|
| T trial) | | | n- | | en- | | | | | P=0.71 | | | | | | |
| | | | group | Postural | group P=0.0 | | | | | | | | | | | |
| 52w | | | P<0.01 | hypotensi | P=0.0 | | | | | | | | | | | |
| | | | | on: | 4 | | | | | | | | | | | |
| | | | | 16/275 | · | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | (5.8%), | | | | | | | | | | | | |
| | | | | P<0.01 | | | | | | | | | | | | |
| | 264 | NR | 21/264 | Hypotensi | 0% | NR | NR | NR | NR | 8/264 | NR | NR | 6/264 (2.3%) | NR | 13/264 | NR |
| | | | (8.0%) | on: 2/264 | | | | | | (3%) | | | | | (4.9%) | |
| | | | | (0.8%) | | | | | | | | | | | | NR |
| | | | | (******) | | | | | | | | | | | | |
| | | | | Postural | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | hypotensi | | | | | | | | | | | | |
| | | | | on: 2/264 | | | | | | | | | | | | |
| | | | | (0.8%) | | | | | | | | | | | | |
| | 286 | NR | 39/286 | Hypotensi | 6/286 | NR | NR | NR | NR | 9/286 | NR | NR | 7/286 (2.4%) | NR | 30/286 (10.5%) | NR |
| | | | (13.6% | on: 8/286 | (2.1% | | | | | (3.1%) | | | | | | |
| | | |) | (2.8%) |) | | | | | () | | | | | | NR |
| | | | , | (=, | , | | | | | | | | | | | |
| | | | | Postural | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | hypotensi | | | | | | | | | | | | |
| | | | | on: 8/286 | | | | | | | | | | | | |
| | | | | (2.8%) | | | | | | | | | | | | |
| | 270 | NR | 20/269 | Hypotensi | 1/269 | NR | NR | NR | NR | 6/269 | NR | NR | 4/269 (1.5%) | NR | 9/269 (3.3%) | NR |
| | | | (7.4%) | on: 4/269 | (0.4% | | | 1 | | (2.2%) | ĺ | | | | ` ′ | |
| | | | (7.170) | (1.5%) |) | | | | | (2.270) | | | | | | NR |
| | | | | (1.570) | , | | | | | | | | | | | 1414 |
| | | | | D . 1 | | | | | | | | | | | | |
| | | | | Postural | | | | 1 | | | ĺ | | | | | |
| | | | | hypotensi | | | | 1 | | | ĺ | | | | | |
| | | | | on: 4/269 | | | | | | | | | | | | |
| | | | | (1.5%) | | | | 1 | | | ĺ | | | | | |
| | | | | (1.0 / 0) | | l | | L | l | | | | | | 1 | |

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Table 3.2e. Characteristics of doxazosin single-group cohort studies

| Author, year | Intervention | Demographic characteristics at baseline | Total withdrawal rate |
|---|---|--|---|
| Country | Inclusion criteria | baseline | Withdrawal rate due to adverse events |
| Study duration | Sample size | | Subject with one or more treatment-emergent adverse events |
| Chung BH, 2006 | Doxazosin GITS 4-8mg | Age: 63.1(9.3) | 289/475 (60.8%) |
| South Korea | Inclusion: Symptomatic BPH | Total I-PSS: 20.4 (6.8) | 3/475 (0.6%) |
| 12m | 475 | Qmax: 11.3(5.1) | 47/475 (9.9%) had AEs |
| De Rose AF, 2002 | Doxazosin 4mg QD | Age: NR | 16/102 (15.7%) |
| Italy | Inclusion: BPH diagnosed based on patient history, DRE, PSA, I-PSS; stable sexual | IPSS: 22 for group with IIEF 6-10 | 3/102 (2.9%) (due to hypotension) |
| 3m | relationship of ≥ 6m; normal BP | Qmax: NR | Jr ··· · · · · |
| | 102 | | |
| Fawzy A, 1999 USA 48m (n=28, reached 48m and end of study) 807d (n=178, mean follow-up for those who started study; all are hypertensive) | Doxazosin 4-16mg QD; mean dose 7.9mg QD (n=28) Inclusion: outpatients ≥ 45y of age with symptoms of BPH and outflow obstruction; Qmax of 5-15mL/sec in a voided volume of 150-500mL, a postvoid residual volume less than <200mL, a daytime micturition frequency ≥ 4 and nocturia≥2; and sitting diastolic BP 90-114mmHg 178 (28 reached 48-m follow-up) | Age: 64.5(range 43.6-73.4) (n=28) Total I-PSS: NR Qmax: 10.45(NR) (n=153) | 28/178 completed 48-m follow-up; remainder had shorter follow-up; 25/178 withdrew; reasons NR Withdrawals due to AEs: Hypertensives: 19.1% (n=178); 8.6% per year) Normotensives: 15.1%; 8.3% per year Drug-related AEs: Hypertensives with 48-m follow-up: 57%; 14.3% per year (n=28) Normotensives: 6.6% per year (n=272) All hypertensives: 27.5%; 12.4% per year (n=178) Severe AEs: Hypertensives (n=178): 7.1% per year Normotensives: 6.6% per year |

| Hernandez C, 2005 | Doxazosin 4-8mg QD | Age: 65.1(8.3) | 401/3684 (10.9%) |
|-------------------|--|---|------------------|
| Spain | Inclusion: male patients > 40y old with | Total I-PSS: 16.8(NR) | 104/3684 (2.8%) |
| 6m | moderate to severe BPH symptoms > 7 points on the IPSS and a diagnosis of BPH by rectal examination and/or ultrasound | Qmax: NR | 136/3684 (3.7%) |
| | 3684 | | |
| Lee JY, 2004 | Doxazosin 2mg QD at bedtime for 1 month; | Age: 65.6y | NR |
| South Korea | if no improvement, increased to 4mg QD at bedtime for another 2m; if IPSS decreased by ≤ 3 points, tolterodine 2mg BID added | Total I-PSS: 23.22 (21.5 for BOO subgroup/25.15 for BOO+OAB | |
| 5m | for final 2m | subgroup) | |
| | Symptomatic BOO, normal urine analysis, benign DRE | Qmax: BOO 11.1(1.7); BOO+OAB: 10.7(2.1) | |
| | 144 76 with BOO | Prostate volume (mL): BOO: 29.4(7.1); BOO+OAB: 34.8(5.8) | |
| | 68 with BOO+OAB | | |

Table 3.2f. Adverse events in doxazosin single-group cohort studies

| Author, year | No. of patients assessed | Mortality | Cardiovasc | ular | | | Central Nei | rvous System | | | Gastrointestina | al | | Intraoperative Floppy Iris Syndrome | Sexual Function | on |
|----------------------|--------------------------|-------------------|--------------------------------|-------------------|--|-------------------|----------------------|-----------------|---------------------------------------|-----------------------------------|-----------------|--------------------|--------|---|----------------------|---|
| Dose | Study duration | | Dizziness | Drowsiness | Hypotension | Syncope | Asthenia, fatigue | Headache | Malaise Somnole nce | Dry mouth | Complaints | Diarrhea, other | Nausea | | Abnormal ejaculation | Erectile dysfunction |
| Chung BH, 2006 | 475 12m | NR | 13/475 (2.7%) | NR | Hypotension 2/475 (0.4%) Postural hypotension 2/475 (0.4%) | NR | NR | 1/475 (0.2%) | NR | NR | NR | NR | NR | NR | NR | 5 (1.1%) |
| De Rose AF, 2002 | 102 3m | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | IIEF improved significantly in men with baseline score 6-16 (P<0.01 |
| Fawzy A, 1999 | 178 48m | NR | 26/178 (14.6%) | NR | 2.8% | NR | NR | 6/178 (3.4%) | Somnole nce 4/178 (2.2%) Fatigue4. 5% | 1.1% | NR | NR | NR | NR | NR | NR |
| Hernandez C, 2005 | 3684 6m | 3/3684 (0.08%) | Postural dizziness 0.07% | 2/3684 (0.05%) | Hypotension 40/3684 (1.1%) Postural hypotension 10/3684 (0.3%) | 2/3684 (0.05%) | NR | NR | NR | Dry mouth 3/3684 (0.08%) | NR | NR | NR | NR | NR | 1/3684 (0.03%) |
| Lee JY, 2004 | 144 5m | NR | 3/144 (2%) | NR | Postural hypotension 2/144 (1.3%) | NR | NR | NR | NR | NR | NR | NR | NR | NR | 2/144 (1.3%) | NR |

Table 3.3 Tamsulosin

$Table \ 3.3a. \ Characteristics \ of \ tam sulos in \ randomized, \ controlled \ trials$

| Author, Year Country | Sample size | Demographic Characteristics | Dosage | Primary Outcomes Reported |
|--------------------------------|--|--|--|------------------------------|
| Study Type | Number of patients assessed at baseline (% of randomized) | | Formulation | Керопец |
| Study Type | Study Duration | | Run-in period | |
| Intervention: A: Tamsulo | | | | |
| Chapple, 2005 Multinational | Total: 2152 A(1): 99.7% (360/361) A(2): 99.7% (722/724) A(3): 99.9% (709/710) B:94.7% (338/357) 12 weeks | Age: A(1):64.7 (8.3) , A(2):64.6 (8.1) , A(3): 64.7 (8.3) , B:64.9 (7.9) Total I-PSS: A(1):18.5 (4.4) , A(2): 18.6 (4.5) , A(3): 18.5(4.5), B:18.3 (4.5) Qmax: A(1): 9.6 (1.8) , A(2): 9.6 (1.8), A(3):9.7 (1.8), B: 9.8 (1.8) | A(1): OCAS 0.4 mg qd A(2): OCAS 0.8 mg qd A(3): MR 0.4 mg qd B: Placebo Formulation(s): Oral controlled absorption system (OCAS), Modified release (MR) Run in: two week single-blind, placebo | I-PSS Qmax Adverse events |
| Kawabe, 2006 Japan | Total: 457 A: 192 (100%) | Age: A: 65.6 (7.0), B: 65.0 (6.9) Total I-PSS: A: 17.0 (5.7), B: 17.1 (6.1) | A: 0.2 mg BID B: placebo BID | I-PSS Scores Q max |
| RCT | B: 89 (100%) (silodosin 176, NR herein) | Qmax: A: 9.43 (2.8), B: 9.96 (2.7) | Formulation(s): not specified Run in: 7-day "washout" and 7-day observation period | Adverse events |
| Intervention: A: Tamsulo | | I | , and a contract process | |
| Lee E, 2002 Korea | Total: 205 A: 72/103(69.9%) | Age: A: 64.9 (6.8), B: 64.4 (7.2) Total I-PSS: A: 19.9 (7.2), B: 19.0 (72) | A: 0.2 mg QD B: 5 mg QD | I-PSS scores Omax |
| RCT | B: 74/102(72.5%) 24 weeks | Qmax: A: 9.2 (2.5) , B: 9.6 (2.9) | Formulation: not specified Run-in: NR | Adverse events |
| Rigatti P, 2003 Italy | Total: 403 A: 196/199 (98%) | Age: 63 (7.1) Total I-PSS: A: 16.3 (5.1), B: 16.9 (5.0) | A: 0.4 mg qd B: 5 mg qd | SPI symptom score I-PSS |
| RCT MICTUS Trial | B: 204/204 (100%) | Qmax: A:10.8 (3.7), B:10.8 (3.4) | Formulation: not specified | Adverse events |
| | 1 year | | Run-in: 2w single-blind, placebo-controlled | |
| | in B: Tamsulosin C: Placebo | | 1.41 | Lynaa |
| Nordling J, 2005 Denmark | Total: 625(ITT, n=611) | Age: A(1): 65 (51- 85), A(2): 65 (50 – 84), B: 64 (50-87), C: 64 (50 - 82) | A(1): 10 mg qd ER | I-PSS |

| | A(1): 100% (154/154) | | A(2): 15 mg qd ER | Qmax |
|------------------------|---------------------------------------|--|---|-------------------------|
| RCT | A(2): 100% (158/159) | Total I-PSS: A(1): 20 (NR), A(2): 20 (NR), B:20 (NR) C: 20 (NR) | B: 0.4 mg qd | Adverse events |
| | B: 100% (158/158) | Qmax: A(1): 8.9 (5.0-12.6) , A(2): 8.7 (5.0-11.9), B: 8.8 (4.7-12.0), C: 9.0 (4.0-12.5) | C: Placebo | |
| | C: 100% (153/154) | B. 6.6 (4.7-12.0), C. 9.0 (4.0-12.3) | Formulation: Extended Release (ER) | |
| | 12 weeks | | Run-in: 28 day single-blind, | |
| | | | placebo | |
| | ulosin B: Alfuzosin C: Placebo | 1 | T | |
| Hofner K, 1999 | Tamsulosin versus placebo | Age: NR | A: Tamsulosin 0.4 mg qd | Sexual function |
| United Kingdom | A: 381 (| | | |
| RCT | C1: 193 (tamsulosin placebo) | IPSS: NR | B: Alfuzosin 2.5 mg bid, titrated up to tid | |
| | Tamsulosin versus alfuzosin | Qmax: NR | | |
| | A: 131 | | C: Placebo | |
| | B: 124 | | Formulation: NR | |
| | 12 weeks | | D i1 21 | |
| I4 | | | Run-in: placebo, 2 weeks | |
| | Total: 879 | | A: Tam 0.4 mg qd | I-PSS Score |
| Kaplan S, 2006 | | Age: A: 61.7 (10.5), B: 61.8 (9.6), C: 62.8 (9.7), D: 61.0 (9.6) | | |
| United States | A: 215 | | B: Tolt 4 mg ER qd | Urinary incontinence |
| | B: 217 | Total I-PSS: A: 20.0 (5.0), B: 19.5 (5.2)C: 20.0 | | |
| RCT | C: 222 D: 225 | (5.4), D: 20.1(5.5) | C: Placebo | Symptom diaries |
| | D: 225 | Qmax: A: 13.4 (7.6) , B: 13.3 (7.8), C: 12.2 (6.6) | D: Tam 0.4 mg qd + Tolt 4 | Perception of treatment |
| | 3 months | ,D: 12.7 (6.8) | mg qd | benefit |
| | | | Formulation: Tolterodine: | |
| | | Men had diary-documented symptoms of overactive bladder and significant BOO (IPSS ≥ | Extended Release (ER) | |
| | | 12, PVR >200 mL and Qmax <5 mL/s) | Run-in: "baseline period" | |
| Intervention: A: Dutas | steride + Tamsulosin B: Dutasteride - | + Tamsulosin; Dutasteride + Placebo | 1 | |
| Barkin J, 2003 | Total: 327 | Age: A: 67.6 (7.1); B: 66.9 (7.5) | A: Dut 0.5mg qd + Tam | I-PSS scores |
| Multi-country | | 5 () | 0.4mg qd | |
| | A: 164 | Total I-PSS: A: 16.4(5.8); 16.5 (5.2) | 5 1 | OoL |
| RCT | B: 163 | | B: Dut 0.5mg qd + placebo | |
| | | Omax: NR | (12w) | Adverse events |
| SMART-1 trial | | | | |
| , | 36 weeks | | Formulation not specified | |
| | | | Run in: 1 month placebo run- | |
| | | | in; 1 week single-blind | |
| | | | washout period to monitor | |
| | | | Tamsulosin withdrawals | |
| | | | i ailisulosiii withurawais | |

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| F Number of patients randomized Data are reported as mean (standard deviation) unless otherwise indicated. | |
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Table 3.3b. Efficacy and effectiveness outcomes in tamsulosin randomized, controlled trials

| Author, | Intervention | Baseline | Within group P-value | Between group | Between group |
|-------------------------|--|---|-------------------------|---------------|---|
| Year | No. of patients | Endpoint | P-value | difference | P-value |
| Study duration | assessed | | | | |
| TD 4 1 7 4 4 | ID + + C + | Mean Change | | | |
| | al Prostate Symptom | | L NID | l ND | A (1) D |
| Chapple C, 2005 | A: Tamsulosin A(1): OCAS 0.4 mg QD A(2): OCAS 0.8 | Baseline: A(1): 18.5 (4.4), A(2):18.6 (4.5), A(3):18.5 (4.5) , B:18.3 (4.5)) | NR | NR | A(1):B <0.0001 A(2):B NR |
| | mg QD A(3): MR 0.4 mg QD B: Placebo A(1): 354, A(2): | Endpoint: A(1):NR, A(2):NR, A(3): NR, B:NR Mean Change: A(1):-7.7(NR) A(2):-8.0 (NR), A(3):-8.0 (NR) B:-5.8 (NR) (calculated) | | | A(3):B < 0.0001 A(2) vs. A(3) 0.9909 |
| | 707 A(3): 700, B:356 | , , , , , | | | |
| Kaplan S, 2006 | A:Tamsulosin 0.4 mg qd B: Tolterodine 4 | Baseline: A: 20.0 (5.0), B: 19.5 (5.2)C: 20.0 (5.4), D: 20.10 (5.5) | NR | NR | A: C, .007 B:C, NS |
| 12 WOOKS | mg qd C:Placebo | Endpoint: in table | | | D:C, <.01 |
| | D:Tolterodine 0.4 mg qd + Tamsulosin 0.4 mg qd | Mean Change: NR | | | |
| | A: 197, B: 206, C: 213, D: 203 | | | | |
| Kawabe, 2006 | A: Tamsulosin 0.2 mg bid B: Placebo bid | Baseline: A: 17.0 (5.7) B: 17.1(6.1) | NR | NR | NR |
| 12 WCCKS | A: 192 | Endpoint: A: NR B: NR | | | |
| | B: 89 | Mean Change: A: -6.8 (5.7)B: -5.3(6.7) (reported) | | | |
| Lee E, 2002 24 weeks | A: Tamsulosin0.2 mg QD | Baseline: A: 19.9 (7.2) B: 19.0 (7.2) | A: <0.05 B:<0.05 | NR | A: B >0.05 |
| 4 w data also | B: Finasteride5 mg QD | Endpoint: A:13.0(7.1); B: 13.1(7.6) | D.>0.03 | | |
| reported | A:78 B:83 | Mean Change: A:-6.9(NR) B:-5.8(NR) (reported) | | | |

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| Nordling J, 2005 12 weeks | A: Alfuzosin A(1): 10 mg qd A(2): 15 mg qd B: Tamsulosin 0.4 mg qd C: Placebo | Baseline: A(1): 18.0 (5.4) A(2):17.4 (4.8) B: 17.4 (5.6) C:17.7 (5.0) Endpoint: A(1):NR A(2):NR B:NR C:NR | NR | NR | A (1): C 0.007 A (2): C 0.05 |
|---------------------------------|--|---|----|---|--|
| | A(1): 154 A(2):158 B: 158 C:153 | Mean Change: A(1): -6.5(5.2) A(2):-6.0(5.6) B:-6.5(6.2) C:-4.6 (5.8) | | | B : C 0.014 |
| Rigatti P, 2003 26 weeks | A: Tamsulosin0.4 mg qd B:Finasteride 5 mg qd A:193 B:202 | Baseline: A: 16.3 (5.1) , B:16.9 (5.0) Endpoint: A:NR, B:NR Mean Change: A:-6.3 (5.5) B: - 5.7 (5.7) (reported) | NR | NR | A: B 0.080 |
| Barkin J, 2003 12 weeks | A: Dut 0.5mg qd + Tam 0.4mg qd B: Dut 0.5mg qd + placebo A: 164 B: 163 | Baseline: A: 16.5 (5.2) , B: 16.4 (5.8) Endpoint: A: 10.3(NR); B: 11.1(NR) Mean Change: A: -6.2 (NR); B: -5.3 (NR) | NR | NR | NR |
| | Q of L) Sub-score | | | | |
| Barkin J, 2003 36 weeks | A: Dut 0.5mg qd + Tam 0.4mg qd B: Dut 0.5mg qd + placebo A: 164 B: 163 | Baseline: A: NR; B: NR Endpoint: NR Mean Change: A: -1.1 (NR); B: -1.1(NR) | NR | NR | NR |
| Chapelle C, 2005 12 Weeks | A: Tamsulosin A(1): OCAS 0.4 mg QD A(2): OCAS 0.8 mg QD A(3): MR 0.4 mg QD B: Placebo | Baseline: A(1): 3.8 (1.1), A(2):3.8(1.1), A(3): 3.8 (1.1), B: 3.8(1.0) Endpoint: A(1):NR, A(2): NR, A(3): NR B: NR Mean Change: A(1): -1.4 (1.3), A(2): -1.4 (1.4), A(3): -1.4 (1.3), | NR | A(1): B 1.53(NR) A(2):B NR A(3):B 1.60 | A(1): B <0.01 A(2):B NR A(3):B <0.001 |

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| | A(1): 354 A(2): 707 A(3): 700 B: 356 | B: -1.1 (1.3) (reported) | | A(2):A(3 0.90(NR) | A(2): A(3) >0.05 (NS) |
|------------------|--|---|----------|----------------------|--------------------------|
| Kaplan S, 2006 | A: Tam 0.4 mg | Baseline: A: 4.6 (0.9), B: 4.6 (0.9), C: 4.6 (1.0), D: 4.6 (0.9) | NR | NR | A:C: P>0.05 |
| 3 months | B: Tolt 4 mg ER | | | | B:C: P>0.05 |
| | qd C: Placebo | Endpoint: NR (graphical data) | | | D:C: P<.01 |
| | D: Tam 0.4 mg | Mean Change: NR | | | D.C. P<.01 |
| | qd + Tolt 4 mg | | | | |
| | qd | | | | |
| | A: 198, B: 206, C: 213, D: 205 | | | | |
| Kawabe, 2006 | A: Tamsulosin0.2 mg BID | Baseline: A: 4.7 (0.8) B: 4.7 (0.9) | NR | NR | NR |
| 12 weeks | B: Placebo bid | Endpoint: A: NR B: NR | | | |
| | A: 192 B: 89 | Mean Change: A: -1.4 (1.3)B: -1.1 (1.2) | | | |
| Lee E, 2002 | A: Tamsulosin0.2 | Baseline: A: 4.1 (1.0) B: 3.9 (1.2) | A: <0.05 | NR | A: B <0.05 |
| 24 weeks | mg QD | Endpoint: A:2.6(1.2); B: 2.9(1.4) | B:<0.05 | | <0.05 |
| | B: Finasteride5 | | | | |
| 4 w data also | mg QD | Mean Change: A:-1.4(NR) B:- | | | |
| reported | A:78 | 0.9(NR) (reported) | | | |
| | B:83 | | | | |
| Rigatti P, 2003 | A: Tamsulosin0.4 | Baseline: A: 3.2(1.0), B:3.1(1.1) | NR | NR | A: B |
| 26 weeks | mg qd B: Finasteride5 | Endpoint: A:NR, B:NR | | | 0.163 |
| | mg qd | | | | |
| | A 102 | Mean Change: A:-1.1(1.2) B: -1.0 | | | |
| | A:193 B:202 | (1.2) | | | |
| Storage Sub-scor | | | l | L | |
| Chapple C, | A:Tamsulosin | Baseline: A(1): 7.8(2.6); A(2): | NR | A(1):B | A(1): B |
| 2005 | A(1): OCAS 0.4 | 7.77(2.6); A(3): 7.8(2.6), B: | | -0.7(NR) | < 0.001 |
| 12 Weeks | mg QD A(2): OCAS 0.8 | 7.6(2.6) | | A(2):B | A(2):B |
| 12 WOORS | mg QD | Endpoint: A(1):NR, A(2): NR, | | NR | NR |
| | A(3): MR 0.4 mg | A(3): NR B: NR | | 1 | |
| | QD B: Placebo | Moon Change: A(1): 2.0(2.8) | | A(3): B -0.7 (NR) | A(3):B <0.001 |
| | D. Placedo | Mean Change: A(1): -3.0(2.8), A(2): .3.0(2.8), A(3): -3/0(2/7), B: | | -0.7 (INK) | ~0.001 |
| | A(1): 354 | -2.2(2.7) (reported) | | A(2): A(3) | A(2): A(3) |
| | A(2):707 A(3)700 A(4)356 | | | 0.0 | >0.05 (NS) |
| Kawabe, 2006 | A: Tamsulosin0.2 | Baseline: A: 6.2(2.9) B: 6.3(2.8) | NR | NR | NR |

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| | DVD | T | 1 | ı | |
|--------------------------------------|---|---|--------------|----------------------|-----------------------------|
| 12 weeks | mg BID B: Placebo bid | Endpoint: A: NR B: NR | | | |
| | A: 192 | Mean Change: A: -2.1 (2.6), B: - | | | |
| | B: 89 | 1.5(2.6) (reported) | | | |
| Voiding Sub-scor | re | | | | |
| Chapple C, 2005 | A: Tamsulosin A(1): OCAS 0.4 mg OD | Baseline: A(1): 10.7 (3.4), A(2):10.9(3.3), A(3): 10.8 (3.4), B: 10.6(3.4) | NR | A(1):B -1 (NR) | A(1): B <0.001 |
| 12 Weeks | A(2): OCAS 0.8 | , | | A(2):B | A(2):B |
| | mg QD A(3): MR 0.4 mg | Endpoint: A(1):NR , A(2): NR, A(3): NR B: NR | | NR | NR |
| | QD B: Placebo | Mean Change: A(1): -4.7(4.0), | | A(3): B -1.2 (NR) | A(3):B <0.001 |
| | A(1): 354 A(2): | A(2): -5.0(4.1), A(3): -5.0(4.0), B: -3.7(3.8) | | A(2): A(3) | A(2): A(3) |
| | 707 A(3): 700 B:350 | | | 0.0 (NR) | >0.05 (NS) |
| Kawabe, 2006 | A: Tamsulosin0.2 mg BID | Baseline: A: 10.8(4.2), B: 10.9(4.4) | NR | NR | NR |
| 12 weeks | B: Placebo bid | Endpoint: A: NR B: NR | | | |
| | A: 192 | | | | |
| | B: 89 | Mean Change: A: -4.8 (4.1)B: - | | | |
| | | 3.8(4.8) | | | |
| IPSS obstructive | subscore | | | | |
| Nordling J, | A: Alfuzosin | Baseline: A1: 10.3(3.9); A2: | NR | NR | A1:C: 0.03 |
| 2005 | A(1): 10 mg qd A(2): 15 mg qd | 9.8(3.6); B: 9.8(4.0); C: 10.1(3.6) | | | A2:C: 0.09 B:C: 0.01 |
| 12 weeks | B: Tamsulosin0.4 | Endpoint: NR | | | B.C. 0.01 |
| | mg qd C: Placebo | Mean change: A1 -3.9(3.6); A2 - | | | |
| | | 3.7(3.8); B -3.9(4.1); C; -2.8(4.0) | | | |
| | | | | | |
| ŕ | mg BID | Baseline: A: 9.41(2.8); B: 10.2(2.7) | NR | NR | NR |
| 12 WCCKS | B. I laccoo old | Endpoint: NR | | | |
| | | Mean change: A: 2.6(4.0); B: 0.26(2.2) | | | |
| | qd | Baseline: A: 13.4 (7.6) , B: 13.3 (7.8), C: 12.2 (6.6) ,D: 12.7 (6.8) | All >0.05 | NR | NSD between any 2 treatment |
| 12 weeks | B: Tolt 4 mg ER qd | Endpoint: NR | | | groups (P>0.05) |
| | | Moon Change: A: 0.22(NID): D: | | | |
| | | | | | |
| | qd | 0.07(NR) | | | |
| Kawabe, 2006 12 weeks Kaplan S, 2006 | A: Tamsulosin0.2 mg BID B: Placebo bid A: Tam 0.4 mg qd B: Tolt 4 mg ER qd C: Placebo D: Tam 0.4 mg qd + Tolt 4 mg | Baseline: A: 9.41(2.8); B: 10.2(2.7) Endpoint: NR Mean change: A: 2.6(4.0); B: 0.26(2.2) Baseline: A: 13.4 (7.6) , B: 13.3 (7.8), C: 12.2 (6.6) ,D: 12.7 (6.8) Endpoint: NR Mean Change: A:-0.22(NR); B: -0.60(NR); C: -0.53(NR): D: | NR All >0.05 | NR NR | any 2 treatmen |

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| | A: 198, B: 206, C: | | | | |
|------------------------------------|--|---|-----------|-------|-------------------|
| | 213, D: 205 | | | | |
| Lee E, 2002 | A:Tamsulosin 0.2 mg QD | Baseline: A: 9.2 (2.5) B: 9.6 (2.9) | A: <0.05 | NR | A: B >0.05(NS) |
| 24 weeks | IIIg QD | Endpoint: A:11.5(3.2); B: | B:<0.05 | | 7 0.03(115) |
| | B: Finasteride5 | 11.7(4.3) | | | |
| 4 w data also | mg QD | | | | |
| reported | | Mean Change: A:2.2(NR) | | | |
| | A:78 B:83 | B:2.2(NR) (reported) | | | |
| Nordling J, | A: Alfuzosin | Baseline: A(1): 9.2(NR) A(2):8.9 | NR | NR | A(1): C |
| 2005 | A(1): 10 mg qd | (NR) B: 9.4 (NR) C:9.0(NR) | 1,120 | 1,110 | 0.02 |
| | A(2): 15 mg qd | | | | |
| 12 weeks | | Endpoint: A(1):NR A(2):NR | | | A(2):C |
| | B: Tamsulosin, | B:NR C:NR | | | 0.02 |
| | 0.4 mg qd | M Cl 4(1) 15 4(2) 14 | | | D.C. |
| | C: Placebo | Mean Change: A(1): 1.5 A(2): 1.4 B:1.4 C: 0.5 | | | B:C 0.02 |
| | C. Flacebo | B.1.4 C. 0.3 | | | 0.02 |
| | A(1): 154 | | | | |
| | A(2):158 | | | | |
| | B: 158 | | | | |
| | C:153 | | | | |
| Rigatti P, 2003 | A: Tamsulosin0.4 | Baseline: A: 10.8 (3.7), B:10.8 | NR | NR | A: B |
| 26 weeks | mg qd B: Finasteride5 | (3.4) | | | 0.163 |
| 20 weeks | mg qd | Endpoint: A:NR, B:NR | | | |
| | ing qu | Endpoint. 71.144, B.144 | | | |
| | A:193 | Mean Change: A:2.4 (5.9)) B: 1.9 | | | |
| | B:202 | (5.1) | | | |
| D | h :: (DGA) (/ | *) | 1 | | |
| | Antigen (PSA) (ng/m A: Tamsulosin 0.4 | Baseline: A: NR , B:NR | NR | NR | A:B |
| Rigatti P, 2003 | mg qd | baseline. A. INK, B.INK | INK | INK | <0.0001 |
| 26 weeks | B: Finasteride 5 | Endpoint: A:NR, B:NR | | | ·0.0001 |
| | mg qd | | | | |
| | | Mean Change: A:-0.13 (NR) B: - | | | |
| | A:193 | 0.78(NR) | | | |
| B (87 13 8 12 | B:202 | | 1 | | |
| Post Void Residu Kaplan S, 2006 | A:Tamsulosin 0.4 | Deceline: A: 56 5 (55 0) D: 50 5 | All >0.05 | NR | NSD between |
| Kapian 5, 2006 | mg qd | Baseline: A: 56.5 (55.0) , B: 50.5 (55.8) , C: 47.1 (47.7) , D:58.8 | A11 ~0.05 | INK | any 2 treatment |
| 3 months | B: Tolterodine 4 | (53.8) (53.8) | | | groups (P>0.05) |
| | mg qd | () | | | B-1-1 |
| | C:Placebo | Endpoint: NR | | | |
| | D:Tolterodine 0.4 | | | | |
| | mg qd + | Mean Change: A: 0.11(NR); B: | | | |
| | Tamsulosin 0.4 | 5.27(NR): C: -3.61(NR); D: 6.42 | | | |
| | mg qd | (NR) | | | |

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| | A:209 , B:210 , C:215 , D:217 | | | |
|------------------|----------------------------------|------------------------------------|--|--|
| Prostate Volume | : no study reported o | utcome data | | |
| Detrusor pressur | e @ max flow (cmH2 | 0): no study reported outcome data | | |

Table 3.3c: Withdrawal and adverse event rates for tamsulosin randomized, controlled trials

| Intervention | Number of patients | Overall Withdrawal | Withdrawal by Treatment | Withdrawal due to AEs | ≥1 treatment- emergent AE |
|---------------------|---------------------------|---------------------------|--|----------------------------------|-------------------------------------|
| Author, | randomized by | Withurawai | Treatment | ALS | Chicigent AL |
| vear | intervention | | | | |
| | amsulosin B: Placebo | | | | • |
| Chapple C, 2005 | A(1): 361 | 5.0% (107/2133) | A(1) 5.0% (18/361) | A(1): 3.9% (14/361) | A(1): 11.1% (40/360)* |
| | A(2): 724 | | A(2): 6.2% (45/724) | A(2): 3.9% (28/724) | A(2): 14.3% (103/722)* |
| | A(3): 710 | | A(3): 3.5% (25/710) | A(3): 1.5%(11/710) | A(3): 11.6% (82/709)* |
| | B: 338 | | B: 5.6%(19/338) | B: 1.7% (6/357) | B: 7.0% (25/356)* |
| Kawabe K, 2006 | A:192 | NR | NR | A: 5.7% (11/192) | Incidence rates of AEs: A: 82.3% |
| 2000 | B:89 | | | B: 4.5% (4/89) | B: 71.6% |
| | | | | | Incidence of drug- related AEs: |
| | | | | | A: 47.4% B: 36.4% |
| | amsulosin B: Finasteride | | • | | |
| Lee E, 2002 | A:103 | 28.8% (59/205) | A:30.1% (31/103) | A: 1.0% (1/103) (due to dyspnea) | A: 4/103 (3.9%) |
| | B:102 | | B:27.5% (28/102) | B: 5.9% (6/102) (all | B: 23/102 (22.5%) |
| | | | | due to decreased potency) | Between-group P<0.001 |
| Rigatti P, 2003 | A: 204 | 26 weeks 14.4%(58/403) | 26 weeks A: 19.1% (39/204) | A: 9.3% (19/204) | A: 63/196 (32.1%) |
| | B: 199 | 52 weeks | B: 9.5% (19/199) | B: 6.5% (13/199) | B: 60/204 (29.4%) |
| | | 26.8%(108/403) | 52 weeks A: 33.3%(68/204) B: 20.1%(40/199) | | |
| Intervention: A: A | Alfuzosin B: Tamsulosin (| C: Placebo | B. 20.170(10/199) | | |
| Nordling J, 2005 | A(1): 154 | 7.5% (47/625) | A(1): 5.8% (9/154) | A(1): 2.6% (4/154) | A(1): 37.7% (58/154) |
| | A(2): 159 | | A(2): 10.7% (17/159) | A(2): 8.8% (14/159) | A(2): 38.6% (61/158)* |
| | B: 158 | | B: 5.7% (9/158) | B: 3.8% (6/158) | B: 36.7% (58/158) |
| | C: 154 | | C: 7.8% (12/154) | C: 3.3% (5/154) | C: 34.0% (52/153)* |
| Intervention: A: T | amsulosin, B: Tolterodin | e ER, C: Placebo, D: T | olterodine ER combined v | vith Tamsulosin | ı |
| Kaplan S, 2006 | A: 198, B: 206, C: | 14.0% (123/879) | A: 13.5 % (29/215) | A: 3.3% (7/215) | NR |
| 1, | , | (| () | | |

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| A . T 0 4 1 | 212 D: 205 | | I | I | |
|-------------------------------------|------------------------------|-----------------------|-------------------------|------------------|-------------------|
| A: Tam 0.4 mg qd B: Tolt 4 mg ER | 213, D: 205 | | B: 12.4% (27/217) | B: 2.3% (5/217) | |
| qd | | | D. 12.470 (27/217) | D. 2.370 (3/217) | |
| C: Placebo | | | C: 14.4% (32/222) | C: 3.2% (7/222) | |
| D: Tam 0.4 mg | | | , , | , , | |
| qd + Tolt 4 mg | | | D: 15.1% (34/225) | D: 8.9% (20/225) | |
| qd | | | | | |
| Intervention: A: Tam | l Isulosin B: Alfuzosin (| C: Placebo | | | |
| Hofner K, | Tamsulosin versus | NR | NR | NR | NR |
| 1999 | placebo | | | | |
| | A: 381 (| | | | |
| Meta-analysis of 3 | C1: 193 | | | | |
| previously | (tamsulosin | | | | |
| published RCTs | placebo) | | | | |
| | Tamsulosin versus | | | | |
| | alfuzosin | | | | |
| | A: 131 | | | | |
| | B: 124 | | | | |
| | 12 weeks | | | | |
| Intervention: A: Du | tasteride + Tamsulosi | n B: Dutasteride + Ta | msulosin; Dutasteride + | - Placebo | |
| Barkin J, 2003** | A: 164 | 7.6% (25/327) | A: 6.7% (11/164) | A: 11/164 (15%) | A: 17.7% (29/164) |
| | B: 163 | | B: 8.6% (14/163) | B: 5/163 (3%) | B: 16.6% (27/163) |
| A: Dut 0.5mg qd + | | | | | |
| Tam 0.4mg qd | | | | | |
| B: Dut 0.5mg qd | | | | | |
| + placebo | | | | | |
| <u>-</u> I | | | | | |

^{*} number assessed for this outcome subset of total randomized

^{**} Barkin J, 2003: initial population size (327) is used to determine withdrawals since it is unclear if the authors are taking the 91% completion rate from the 24w population size (305) or the initial population size

Table 3.3d. Adverse events in tamsulosin randomized, controlled trials

| Intervention Author, | No. of patients assessed | Mortality | | Cardi | ovascular | | | CNS | | | Gastrointe | estinal | IFIS | Sexual F | ınction | Urinary | Tract |
|--|---|--|---|--|--|-----|------------------|------------------|---------|------------|--|---|------|--|--|-------------------------------------|--|
| Year | ussesseu | | Dizziness | Hypotens on | si Orthostati c Hypotensi on | ope | Asthenia/fatigue | Headache | Malaise | Somnolence | Diarrhea | Other GI | | Abnormal Ejaculation | Erectile Dysfunction | Urinary Incontinence Other | Other |
| Intervention: A | : Tamsulosin I | | | | | | | | | | | | | | | | |
| Chapple C, 2005 A(1): 0.4 mg QD A(2): 0.8 mg QD A(3): 0.4 mg QD B: placebo | A(1): 360 A(2): 709 A(3): 722 B: 356 | A (1): 0% A (2): 0.1% (1/709) A (3): 0.1% (1/722) B: 0.1% (1/356) | A(1): 1.4% (5/360) A(2): 1.3% (9/709) A(3): 2.4% (17/722) B: 1.4% (5/356) Between group comparis ons were not statistical ly significa nt | hypotensi hypotensi level of c A(1): 2.5° A(2): 3.9° | scular AEs (dizzion, orthostaticion, syncope, dejonsciousness % (9/360)* % (28/722) % (23/709) (8/356) | | NR | NR | NR | NR | NR | NR | NR | Abnormal ejaculation A(1): 1.9% (7/360) A(2): 3.1% (22/709) A(3): 5.3% (38/722) B:.3% (1/356) A3): B, 0.014 A(2): B, 0.0002 A(2): A(1), 0.04 Retrograde ejaculation A(1): 1.7% (6/360) A(2): 1.4% (10/709) A(3): 2.5% (18/722) B: 3% (1/356) | NR | NR | NR |
| Kawabe K, 2006 | A: 192 B: 89 | NR | A: 7.3% (14/192) B: 4.5% (4/89) | NR | NR NR | | NR | NR | NR | NR | Diarrhea A: 6.8% (13/192) B: 5.6% (5/89) | Loose stool A: 3.6% (7/192) B: 4.5% (4/89) | NR | A: 1.6% (3/192) B: 0% (0/89) | NR | A: 5.7% (11/192) B: 0% (0/89) | URTI A:27.6% (53/192) B: 19.1% (17/89) |
| Intervention: A | | | | LATE I | .m 1, | | Lym | 1 1/100 | Lym | Lym | L N ID | T + | Lam | In : | I 5 . | l vin | L N/D |
| Lee E, 2002 | A: 103 B: 102 | NR | NR | | NR NR | | NR | A: 1/103 B: 0 | NR | NR | NR | Loose stoole A: 0 B: 1/102 | NR | Decreased ejaculatory volume A: 0 B: 3/102 | Decreased potency A: 0 B: 15/102 Impotence A: 0 B: 5/102 | NR | NR |
| Rigatti P, | A: 204 | NR | NR | NR | NR NR | | NR | NR | NR | NR | NR | NR | NR | A: 2.9% (6/204) | Impotence | A: 0.5% | UR |

| 2003 | B: 199 | | | | | | | | | | | | | B: 1.0% (2/199) | A: 7/196(3.1%) B: 7/204(3.4% | (1/204) B: 0.5% (1/199) | A: 1/196 B: 1/204 |
|---|--|--------------------|--|---|-------|--|---|---|--|--|---|---|----|---|---|---|---|
| Nordling J, 2005 | A: Alfuzosin B: A(1): 154 A(2): 158 B: 158 C: 153 | NR | A(1): 5.8% (9/154) A(2): 7.0% (11/158) B: 1.9%(3/158) C: 4.0% (6/153) | A(1): 0% (0/15 4)^ A(2): 0.6% (1/15 8) B: 0.6% (1/15 8) C:0% (0/15 3) | NR | A(1): 0% (0/154) A(2): 1.3% (2/158) B: .6%(1/158) C: 0% (0/153) | A(1): 2.6% (4/154) A(2): 6.3% (10/158) B: 3.8% (6/158) C: 2.0% (3/153) | A(1):1.9% (3/154) A(2): 2.5%(4/15 8) B: 4.4%(7/15 8) C: 3.2%(5/15 3) | A(1): 0% (0/154) A(2): 0.6% (1/158) B: 0% (0/158) C: 0% (0/153) | A(1): 0% (0/154) A(2): 0.6% (1/158) B: 0% (0/158) C: 1.3% (2/153) | NR | NR | | Ejaculation disorder A(1): 1.3% (2/154) A(2): 0% (0/158) B: 3.2%(5/158) C: 0% (0/153) A(1): C, P=0.12 A(2):C, P=0.50 | A(1): 1.3% (2/154) A(2): 1.3% (2/158) B: 4.4% (7/158) C: 0% (0/153) NR | NR | NR |
| Kaplan S, 2006 | A: 215 B: 216 C: 220 D: 225 | NR | A: 6% (12/215) B: 1% (3/216) C: 1% (2/220) D: 3% (6/225) | NR | NR NR | NR | A: 1% (3/215) B: 1% (2/216) C: 3% (6/220) D: 1% (2/225) | A: 4% (9/215) B: 1% (2/216) C: 3% (7/220) D: 6% (14/225) | NR | A: 2% (5/215) B: 1% (2/216) C: 1% (2/220) D: 2% (4/225) | Diarrhea A: 1% B: 4% C: 2% D: 4% Constipati on A: 3% (6/215) B: 3% (7/216) C: 1% (3/220) D: 2% (5/225) | Dry mouth A: 7% B: 7% C: 2% D: 21% | | Ejaculation failure A: 2% (4/215) B: 0% C: 0% D: 3% (7/225) | NR | See urinary incontinence diary outcome variables | Urinary retention A: 0% B: 2/216 (0.9%) C: 3/220 (1.3%) D: 2/225 (0.9%) |
| Intervention: A Hofner K, 1999 Meta- analysis of 3 previously published RCTs | A: Tamsulosin I Tamsulosin versus placebo A: 381 (C1: 193 (tamsulosin placebo) Tamsulosin | 3: Alfuzosin NR | C: Placebo NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | Tam: 4.5%, placebo 1.0% P=0.045 Second comparison: Tam: 0.8% Alfuzosin: 0% P=1.00 | ED Tam: 0.8% Placebo: 1.6% P=0.409 Decreased libido Tam 1.0% Placebo: 0% | NR | NR |

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| | versus alfuzosin A: 131 B: 124 12 weeks | | | | | | | | | | | | | | P=0.554 Second comparison, impotence: Tam: 3.1% Alfuzosin: 2.4% P=1.00 | | | |
|-------------------|---|------------|----------------|--------------|-------------|-----------------|-----|----|--------------------|----|----|----|----|--------------------|---|---|----|--|
| Intervention: | A: Dutasteride | + Tamsulos | sin B: Dutaste | eride + Tams | ulosin; Dut | asteride + Plac | ebo | | | | | | | | | | | |
| Barkin J, 2003 | A: 164 B: 163 | NR | NR | NR | NR | NR | NR | NR | A: 3.7% B: 1.2% | NR | NR | NR | NR | A: 4.9% B: 5.5% | A: 3% B: 1.2% | UTI A: 0 B: 1.2% Dysuria A: 1.2% B: 1.2% | NR | |

[^]any occurrence of orthostatic hypotension, defined as > than or = to 2 mmHg decrease in systolic BP (SBP) when standing, compared with SBP recorded while supine was recorded; *cardiovascular events (i.e. palpitations, tachycardia, hypotension, orthostatic hypotension, dizziness

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Table 3.3e. Characteristics of tamsulosin single-group cohort studies

| Author, Year, Country | Intervention | Demographic Characteristics | Total Withdrawals |
|--|---|--------------------------------|--|
| Follow-up Interval | Inclusion Criteria | | Withdrawals Due to |
| | Sample Size | | AES |
| | | | ≥1 Treatment Emergent AE |
| Single Group Cohort(n=8) Intervention: Tamsulosin | | | |
| Batista J, 2002, Spain | Tamsulosin 0.4 mg qd | Age: 62.6 (6.77) | 15.9% (435/2740) |
| 3, 6 months | Aged 45-75 y with complains of LUTS compatible with BPO | Total I-PSS: 20.3 (7.0) | 2.4% (66/2740) |
| | 2740 | Qmax: NR | NR |
| Mann R, 2000, United | Tamsulosin (mean dose NR) | Age: 66(12) | 31.4% (3543/11282) |
| Kingdom 6 months | Prescription for tamsulosin issued between June 1996 and January 1998 (99.2% men) | Total I-PSS:NR | (stopped tamsulosin for any reason) |
| o mondis | | Qmax: NR | NR |
| | 12.484 (had event data; additional 1077 had no event data) | | NR |
| Muzzonigro G, 2005, Italy | Tamsulosin 0.4 mg MR qd | Age: 64.3 (8.1) | 8.4% (23/273) |
| 12 weeks | Aged ≥ 45 y; LUTS/BPH, total I-PSS ≥ 8 | Total I-PSS: 16.6 (6.20) | 1.9% (5/261) |
| | 273 | Qmax: 12.73 (6.9) | 2.6% (total of 11 AEs) |
| Narayan P, 2001 and 2003, USA | Tamsulosin 0.4 or 0.8 mg qd | 2001 | 30% (283/949) |
| 64 weeks (2001), 4y | Men ≥ 45y who completed a previous 1y OLE of tamsulosin | Age: 59.1 (NR) | 19% (176/949) |
| (2003) | | AUA symptom score: 17.7(NR) | 97% (925/949) |
| | 949 (2001) and 604 (2003) | Qmax: 10.1(NR) | |
| | Both 2001 and 2003 are open label | 2003 | 34.6% (209/604) |
| | extensions of 3 trials published in 1998; unclear why baseline sample size differs in the two publications. | Age: 58.9 | 15.7% (95/604) |
| | the two paoneutions. | AUA Symptom Score: 17.4 | NR |
| | | Qmax: 10.1(NR) | |
| Palacio A, 2004, Spain | Tamsulosin 0.4mg qd | Age: 65.4 (95% C.I., 65-65.7) | 6m: 0.9% (27/292) 5 y: 4.9 % (143/2921) |
| 5y | Male patients >45y have complaints of LUTS suggestive of BPO > 6m; total I-PSS | Total I-PSS: 17.8(17.6 – 18.0) | NR |

| | 7 2921 | Qmax: 11.26 mL/s (CI 95% 10.81- 11.71) | 12m: 105/292(3.6%); no events after 12m |
|--|--|--|--|
| Schulman CC, 2001 (includes Schulman 1999 | Tamsulosin 0.4mg qd or .8 mg qd | Age: 63.5 (8.1) | 66% (342/515) |
| and unpublished data) | Is an open label extension (OLE) study of a 12-week RCT; of 831 who entered the RCT, | Total I-PSS:nr Boyarsky symptom score: 9.6(3.0) | 17% (90/515) |
| 4y | 516 elected to participate in the OLE | Qmax:10.1 (3.2) | 76% (392/515) (26% considered drug-related |
| | 516 | , , | |

| Single-group Cohort (n=2) Intervention: Cataract Surgery | | | |
|---|---|-----------------------|---------------------------|
| Oshika T, 2007, Japan | Cataract surgery | Age: NR | NA |
| Intraoperative assessment | Persons undergoing cataract surgery and receiving alpha-1 antagonists at the time of surgery | Total I-PSS: NR | |
| | | Qmax: NR | |
| | 2643 eyes (1968 patients) 58 eyes of 50 persons taking tamsulosin | | |
| Srinivasan S, 2007, Canada | Cataract surgery | Age: 75.9 (57.0-91.0) | NA (retrospective cohort) |
| Intraoperative assessment | Men using alpha-blockers for benign prostatic hypertrophy | Total I-PSS: NR | |
| | Men who had cataract surgery by 2 experienced cataract surgeons, between January 2000 and July 2005 | Qmax: NR | |
| | 1612 cataract surgeries performed on 1298 men; 65 men | | |
| | (5%) were on systemic alpha-blockers; these 65 men had | | |
| | 95 cataract surgeries | | l |

[^]percentage of persons taking antihypertensive agents

Table 3.3f. Characteristics of tamsulosin single-group cohort studies

| Author, Year, Country | Intervention | Demographic Characteristics | Total Withdrawals |
|---|---|---------------------------------|---|
| Follow-up Interval | Inclusion Criteria | | Withdrawals Due to AEs |
| | Sample Size | | ≥1 Treatment Emergent AE |
| Single Group Cohort(n=8) Intervention: Tamsulosin | | | |
| Batista J, 2002, Spain | Tamsulosin 0.4 mg qd | Age: 62.6 (6.77) | 15.9% (435/2740) |
| 3, 6 months | Aged 45-75 y with complains of LUTS compatible with BPO | Total I-PSS: 20.3 (7.0) | 2.4% (66/2740) |
| | 2740 | Qmax: NR | NR |
| Mann R, 2000, United Kingdom | Tamsulosin (mean dose NR) | Age: 66(12) | 31.4% (3543/11282) (stopped tamsulosin for |
| 6 months | Prescription for tamsulosin issued between June 1996 and January 1998 (99.2% men) | Total I-PSS:NR | any reason) |
| | 12.484 (had event data; additional 1077 had | Qmax: NR | NR |
| M : C 2005 It 1 | no event data) | A (4.2 (0.1) | NR |
| Muzzonigro G, 2005, Italy | Tamsulosin 0.4 mg MR qd | Age: 64.3 (8.1) | 8.4% (23/273) |
| 12 weeks | Aged \geq 45 y; LUTS/BPH, total I-PSS \geq 8 | Total I-PSS: 16.6 (6.20) | 1.9% (5/261) |
| | 273 | Qmax: 12.73 (6.9) | 2.6% (total of 11 AEs) |
| Narayan P, 2001 and 2003, USA | Tamsulosin 0.4 or 0.8 mg qd | 2001 | 30% (283/949) |
| 64 weeks (2001), 4y | Men ≥ 45y who completed a previous 1y OLE of tamsulosin | Age: 59.1 (NR) | 19% (176/949) |
| (2003) | 949 (2001) and 604 (2003) | AUA symptom score: 17.7(NR) | 97% (925/949) |
| | | Qmax: 10.1(NR) | |
| | Both 2001 and 2003 are open label extensions of 3 trials published in 1998; | 2003 | 34.6% (209/604) |
| | unclear why baseline sample size differs in the two publications. | Age: 58.9 | 15.7% (95/604) |
| | | AUA Symptom Score: 17.4 | NR |
| | | Qmax: 10.1(NR) | |
| Palacio A, 2004, Spain | Tamsulosin 0.4mg qd | Age: 65.4 (95% C.I., 65-65.7) | 6m: 0.9% (27/292) 5 y: 4.9 % (143/2921) |
| 5y | Male patients >45y have complaints of LUTS suggestive of BPO > 6m; total I-PSS | Total I-PSS: 17.8(17.6 – 18.0) | NR |
| | 7 | Qmax: 11.26 mL/s (CI 95% 10.81- | |

| | 2921 | 11.71) | 12m: 105/292(3.6%); no events after 12m |
|--|---|--|--|
| Schulman CC, 2001 (includes Schulman 1999 | Tamsulosin 0.4mg qd or .8 mg qd | Age: 63.5 (8.1) | 66% (342/515) |
| and unpublished data) | Is an open label extension (OLE) study of a 12-week RCT; of 831 who entered the RCT, | Total I-PSS:nr Boyarsky symptom score: 9.6(3.0) | 17% (90/515) |
| 4y | 516 elected to participate in the OLE | Omax:10.1 (3.2) | 76% (392/515) (26% considered drug-related |
| | 516 | Qmax.10.1 (3.2) | considered drug-related |
| Single-group Cohort (n=2) Intervention: Cataract S | | | |
| Oshika T, 2007, Japan | Cataract surgery | Age: NR | NA |
| Intraoperative assessment | Persons undergoing cataract surgery and receiving alpha-1 antagonists at the time of | Total I-PSS: NR | |
| | surgery | Qmax: NR | |
| | 2643 eyes (1968 patients) 58 eyes of 50 persons taking tamsulosin | | |
| Srinivasan S, 2007, Canada | Cataract surgery | Age: 75.9 (57.0-91.0) | NA (retrospective cohort) |
| Intraoperative assessment | Men using alpha-blockers for benign prostatic hypertrophy | Total I-PSS: NR | , |
| and operation of the second of | Men who had cataract surgery by 2 experienced cataract surgeons, between January 2000 and July 2005 | Qmax: NR | |
| | 1612 cataract surgeries performed on 1298 men; 65 men (5%) were on systemic alphablockers; these 65 men had 95 cataract surgeries | | |

[^]percentage of persons taking antihypertensive agents

Table 3.3g. Adverse events in tamsulosin single-group cohort studies

| Author, Year | No. Patients | Mortality | | Cardiov | ascular | | | CNS | | (| Gastrointestina | 1 | Intra- operative | Sexual | Function |
|----------------------------------|-----------------|---------------------|-------------------|-------------------|----------------------------|----------------------|----------------------|-----------|--------------|------------------------|-----------------|----------|-------------------------|--------------------------------------|--------------------------------|
| Dose | Assessed | Other | Dizziness | Hypotension | Orthostatic hypotension | Syncope | Asthenia/ fatigue | Headache | Somnolence | Unspecified complaints | Diarrhea | Nausea | Floppy Iris Syndrome | Abnormal ejaculation | Erectile Dysfunction |
| | Follow- up | | | | | | | | | | | | | | |
| Intervention: Tamsi | ulosin | | • | | • | • | | ' | • | • | | ' | • | | |
| Batista J, 2002^ | 2740 | NR | 0.8% (22/2740) | 0.7% (18/2740) | 0.1% (3/274) | NR | NR | NR | NR | 0.4% (12/2740) | NR | NR | NR | Ejaculation disorder: 0.5% (13/2740) | NR |
| 0.4 mg qd | 6m | | | | | | | | | | | | | | |
| Mann R, 2000 | 12484 | 282/12484 ; none | 2.9 | 0.7 | NR | NR | Malaise: 1.9 | 1.6 | NR | NR | NR | 1.1 | NR | Retrograde ejaculation: 0.3 | ED or ejaculation failure: 2.6 |
| Various | 6m | attributed to | | | | | | | | | | | | | |
| All data reported | | tamsulosin | | | | | | | | | | | | | |
| as Incidence | | | | | | | | | | | | | | | |
| density per 1000 patient-months, | | | | | | | | | | | | | | | |
| month 2-6 of | | | | | | | | | | | | | | | |
| treatment | | | | | | | | | | | | | | | |
| Muzzonigro G, 2005 | 261 | NR | NR | 0% | NR | NR | NR | NR | NR | NR | NR | NR | NR | 0% | NR |
| Tamsulosin 0.4 | | | | | | | | | | | | | | | |
| mg MR qd | 949 | NID | 26.3% | NR | NR | NR | 15% (145/949) | 35% | 5% (46/ 949) | NID | 14% | 8% | NR | 200/ (200/040) | (0/ ((0/040) |
| Narayan P, 2001, 2003 | 949 | NR | (250/949) | NK | NK | NK | 15% (145/949) | (332/949) | 3% (46/ 949) | NR | (134/949) | (74/949) | NK | 30% (289/949) | 6% (60/949) |
| 0.4 mg qd and 0.8 | 64w | Rhinitis: 49% | (230/949) | | | | | (332/747) | | | (134/949) | (14/242) | | | |
| mg qd | 604 | Deaths: | 10.1% | NR | 1.3% (8/604) | 0.2% | NR | 18.4% | NR | NR | NR | NR | NR | Discontinued due to | NR |
| | 4y | 1.5% (9/609) | (61/604) | | | discontin ued due | | (111/604) | | | | | | abnormal ejaculation: 0.8% (5/604) | |
| | | | | | | to | | | | | | | | | |
| | | Rhinitis: | | | | syncope | | | | | | | | | |
| | | 26% Increased | | | | | | | | | | | | | |
| | | cough | | | | | | | | | | | | | |
| | | 11% | | | | | | | | | | | | | |

| Palacio A, 2004 | 2921 | NR | 0.8% (23/2921) | 0.5% (15/2921) | NR | NR | NR | 0.3% (9/2921) | NR | NR | NR | NR | NR | 1.5% (44/2921) | NR |
|-----------------------------|---|-------------------------|-------------------|---|----|-----------------|---------------|------------------|--------------|----|----|----|---|----------------------------------|---------------|
| 0.4mg qd | 5y | | | | | | | | | | | | | | |
| Schulman C, 2001 | 516 4y | 0.4% (2/516) | 8.5% (44/515) | Postural hypotension: 2.9% (15/515) | | 1.0% (5/515) | 3.9% (20/515) | 4.7% (24/515) | 0.8% (4/515) | NR | NR | NR | NR | 4.9% (25/515) Decreased libido: | 5.4% (28/515) |
| 0.4mg qd and 0.8mg qd | | Urinary retention: 4.5% | | 213/10 (10/10/10) | | | | | | | | | | 1.2% | |
| | | Prostate cancer: 1.4% | | | | | | | | | | | | | |
| Intervention: Catar | ract Surgery for | or Patients usin | g Tamsulosin | | | | | | | | | | | | |
| Oshika T, 2007 NA | 58 eyes (50 persons) Intraoper ative | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | Patients taking tamsulosin: 43.1% (25/58) No cases with prazosin | NR | NR |
| Srinivasan S, 2007 NA | 18 men Intraoper ative | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | or terazosin Of 65 men/95 eyes on systemic alpha- blockers, 14/95 (14.7%) had iris prolapsed and intraoperativ e miosis; 10/14 on tamsulosin | NR | NR |

[^]Adverse events listed here are adverse reactions that induced the discontinuation of treatment

Table 3.4. Terazosin
Table 3.4a. Characteristics of terazosin randomized, controlled trials

| USA Terazosin: 262 Finasteride: 252 Combination: 272 Placebo: 254 Secondary analysis of data from the VA Cooperative Study Program Trial included in prior report Included in prior report Lowe FC, 1999 Terazosin: 262 Finasteride: 252 Combination: 272 Placebo: 254 AUA-7 SI Terazosin: 16.3(NR) Finasteride: 15.9(NR) Combination: 16.1(NR) Placebo: 16.1(NR) Placebo: 16.1(NR) Omax: Terazosin: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: NR Terazosin: NR Terazosin: NR Terazosin: NR Total I-PSS: Terazosin: NR | Author, year | Total sample size | Demographic characteristics of the comparison group | Run-in period | Primary outcomes reported |
|--|--------------------------|---------------------|---|------------------|---------------------------|
| Johnson TM, 2003 USA Terazosin: 262 Finasteride: 252 Combination: 272 Placebo: 254 Secondary analysis of data from the VA Cooperative Study Program Trial included in prior report Included in prior report Lowe FC, 1999 1896 (included in this analysis of BP) USA Terazosin: 262 Finasteride: 252 Combination: 272 Placebo: 254 AUA-7 SI Terazosin: 16.3(NR) Finasteride: 15.9(NR) Combination: 16.1(NR) Placebo: 16.1(NR) Qmax: Terazosin: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Placebo: 10.4(NR) Placebo: 10.4(NR) Terazosin: dosage NR Total I-PSS: Terazosin: NR | Country | . | | | |
| USA Terazosin: 262 Finasteride: 252 Combination: 272 Placebo: 254 Secondary analysis of data from the VA Cooperative Study Program Trial included in prior report Included in prior report Lowe FC, 1999 Terazosin: 262 Finasteride: 252 Combination: 272 Placebo: 254 AUA-7 SI Terazosin: 16.3(NR) Finasteride: 15.9(NR) Combination: 16.1(NR) Placebo: 16.1(NR) Placebo: 16.1(NR) Qmax: Terazosin: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: NR Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: NR Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Finasteride: NR Finasteride: NR Finasteride: 10.5(NR) Finasteride: NR Finasteride: 15.9(NR) Finasteride: 10.5(NR) Finasteride: 10.5(NR | Study duration | i i | | | |
| USA Terazosin: 262 Finasteride: 252 Combination: 272 Placebo: 254 Secondary analysis of data from the VA Cooperative Study Program Trial included in prior report Included | Johnson TM, 2003 | 1229 | Age: | NR | Nocturia episodes |
| Finasteride: 252 Combination: 272 Placebo: 254 Secondary analysis of data from the VA Cooperative Study Program Trial included in prior report Inc | | | | | (see text) |
| Combination: 272 | USA | | | | |
| Secondary analysis of data from the VA Cooperative Study Program Trial included in prior report | | | | | |
| Secondary analysis of data from the VA Cooperative Study Program Trial included in prior report | 12 months | | | | |
| from the VA Cooperative Study Program Trial included in prior report I,078 completed 1y follow-up; 38 reported no episodes of nocturia; leaving 1,040 men for this analysis Terazosin: 10.4(NR) Placebo: 16.1(NR) Qmax: Terazosin: 10.4(NR) Finasteride: 15.9(NR) Combination: 16.1(NR) Placebo: 16.1(NR) Qmax: Terazosin: 10.4(NR) Placebo: 10.4(NR) Placebo: 10.4(NR) Terazosin: NR Placebo: NR Terazosin: NR Placebo: NR Total I-PSS: Terazosin: NR | | Placebo: 254 | | | |
| Study Program Trial included in prior report Study Program Trial included in prior report | | | | | |
| included in prior report episodes of nocturia; leaving 1,040 men for this analysis Lowe FC, 1999 Lowe FC, 1999 Terazosin: dosage NR Terazosin: NR Terazosin: NR Total I-PSS: Terazosin: NR | | | () | | |
| leaving 1,040 men for this analysis Combination: 10.4(NR) Finasteride: 10.5(NR) | | | | | |
| this analysis Terazosin: 10.4(NR) Finasteride: 10.5(NR) Combination: 10.4(NR) Placebo: 10.4(NR) Lowe FC, 1999 1896 (included in this analysis of BP) USA Terazosin: dosage NR Placebo Total I-PSS: 12 months Terazosin: NR Placebo Terazosin: NR | included in prior report | | ` / | | |
| Finasteride: 10.5(NR) Combination: 10.4(NR) Placebo: 10.4(NR) Lowe FC, 1999 1896 (included in this analysis of BP) USA Terazosin: dosage NR Terazosin: NR Placebo Total I-PSS: Terazosin: NR | | | | | |
| Combination: 10.4(NR) Placebo: 10.4(NR) Lowe FC, 1999 1896 (included in this analysis of BP) USA Terazosin: dosage NR Placebo Total I-PSS: Terazosin: NR Placebo Terazosin: NR Total I-PSS: Terazosin: NR | | this analysis | Terazosin: 10.4(NR) | | |
| Placebo: 10.4(NR) | | | | | |
| Lowe FC, 1999 1896 (included in this analysis of BP) USA Terazosin: dosage NR 12 months 1896 (included in this analysis of BP) Terazosin: NR Placebo: NR Total I-PSS: Terazosin: NR | | | \ \ / | | |
| analysis of BP) USA Terazosin: One of BP) Terazosin: NR Placebo: NR Total I-PSS: Terazosin: NR Placebo Terazosin: NR | I FC 1000 | 1006 (; 1 1 1 ; 4); | ` / | ND | DI I |
| USA Placebo: NR Terazosin: dosage NR Total I-PSS: 12 months Placebo Terazosin: NR | Lowe FC, 1999 | | | NK | |
| Terazosin: dosage NR Total I-PSS: 12 months Placebo Terazosin: NR | TICA | analysis of BP) | | | related side effects |
| 12 months Placebo Terazosin: NR | USA | T ND | | | |
| | 12 months | | | | |
| Dlagaba: MD | 12 months | Placedo | Placebo: NR | | |
| | Subgroup analysis of | | | | |
| Subgroup analysis of Qmax: HYCAT trial included in NR Terazosin: NR | | NID | | | |
| prior report Placebo: NR | | INIX | 1 | | |
| phot report | prior report | | 1 Iaccoo. IVIX | | |

^{*} Number of patients randomized

Data are reported as mean (standard deviation) unless otherwise indicated.

Table 3.4b: Withdrawal and adverse event rates for terazosin randomized, controlled trials

| Author, Year Study duration | Overall withdrawal rate | Treatment (number of patients randomized) | Withdrawal by treatment group | Withdrawal due to adverse effects | Percent of patients with 1 or more treatment-emergent adverse effects |
|-----------------------------|---|--|----------------------------------|--|--|
| Terazosin compare | d with placebo | | | | |
| Johnson TM, 2003 | Original RCT: 151/1229 | Terazosin: 262 Finasteride: 252 | NA (completers only reported) | NA (completers only reported) | NR |
| 12 months | Only 1-y completers were examined in this secondary analysis | Combination: 272 Placebo: 254 | | | |
| Lowe FC, 1999 12 months | NR | Terazosin: 951 Placebo: 945 | NR | On hypertensive treatment: terazosin: 4.5%; placebo: 2.6% (P=0.26) | On hypertensive treatment: terazosin: 14.3%; placebo 9.3% (P=0.06) |
| | | | | Not on hypertensive treatment: terazosin: 4.2%; placebo 2.1% (P=0.02) | Not on hypertensive treatment: terazosin: 13.5%; 5.9% (P<0.01) |

Table 3.4c. Characteristics of terazosin single-group cohort studies

| Author, Year | Intervention | Demographic characteristics at baseline | Total withdrawal rate |
|---------------------|--|--|--|
| Country | Inclusion criteria | | Withdrawal rate due to adverse events |
| Study duration | Sample size | | |
| | | | Subject with one or more treatment emergent adverse events |
| Cohort with compa | rison group | | |
| Intervention: Teraz | zosin; Finasteride | | |
| Islam AK, 2005 | Terazosin: 1mg QD for 3 days 2mg QD for 7 days | Age: Ter 63(50-70); Fin 62(52-70) | 3/60(5%) |
| Bangladesh | 5mg QD for 6 months | Total IPSS: Ter 17.47(1.38); Fin 17.07(1.41) | NR |
| 6 months | Finasteride: 5mg QD for 6 months | Qmax: Ter 10.7(0.92); Fin 11.7(0.96) | NR |
| | IPSS 8-19; A Qmax > 10mL/s for a voided volume of at least 150 mL; PVR 50-100 mL | | |
| | 60 | | |

Table 3.4d. Adverse events in terazosin single-group cohort studies

| Author, Year | No. of patients | Mortalit y | Cardiovascular | | | | | Central Nervous System | | | | Gastrointe stinal | IFIS | Sexual function | n |
|--|-------------------------|---------------|--------------------------------|--------------------|--|-----------------------------|---------|------------------------|-------------------------------|---------|------------|-------------------|------|----------------------|-----------------------------|
| Dose | assessed Study duration | | Dizzine ss | Dro wsin ess | Hypote nsion | Postural Hypotensi on | Syncope | Asthenia/ fatigue | Headache | Malaise | Somnolence | | | Abnormal ejaculation | Erectile dysfunctio n |
| Intervention: To | erazosin | | | | | | | | | | | | | | |
| Islam AK, 2005 Terazosin: Img QD for 3 days 2mg QD for 7 days 5mg QD for 6 months | Ter: 30 Fin: 30 | NR | Ter: 4(13.3. %) Fin: 1(3.33 %) | NR | Supine hyperte nsion Ter: 1(3.33 %) Fin: 0 | Ter: 1(3.33%) Fin: 0 | NR | NR | Ter: 2(6.6%) Fin: 1(3.33%) | NR | NR | NR | NR | NR | NR |
| Finasteride: 5mg QD for 6 months | | | | | | | | | | | | | | | |

Table 3.5. The risk of intraoperative floppy iris syndrome with the use of various alpha blockers (adapted from Cantrell, 2008)

| | | | | | Risk of IFIS in | with: | | |
|---|---|---------------------|--|---|-----------------------|---------------------|--|---|
| Reference | Design | Population | Overall prevalence or incidence of IFIS (%) | Exposure to systemic α ₁ AR Antagonist (%) | Tamsulosin (%) | Alfuzosin (%) | Doxazosin, Prazosin, or Terazosin (%) | Notes |
| Chang (2005) ² , clinical study #1 | retrospective chart review | 511 pts 706 eyes | 10/511 pts (2.0%) | 27/511 pts (5.3%) | 10/16 pts (62.5%) | NA | 0/11 pts | |
| Chang (2005) ² , clinical study #2 | prospective case series | 741 pts 900 eyes | 16/741 pts (2.2%) | NA | NA | NA | NA | 15/16 pts with IFIS were exposed to tamsulosin |
| Cheung (2006) ⁸ | prospective, nonrandomized observational study | 2390 eyes | NA | 17/2390 eyes | 11/17 eyes (64.7%) | NA | NA | 5 eyes all 3 criteria for IFIS, 6 eyes partial criteria |
| Blouin (2007) ⁴ | retrospective chart review | 332 pts 461 eyes | 61/461 eyes (13.2%) | 64/332 pts (19.3%) | 19/22 pts (86.4%) | 2/13 pts (15.4%) | NA | |

| | | | | | Risk of IFIS in | patients treated | l with: | |
|------------------------------------|--|-----------------------|---|---|-------------------------|-------------------|--|--|
| Reference | Design | Population | Overall prevalence or incidence of IFIS (%) | Exposure to systemic α ₁ AR Antagonist (%) | Tamsulosin (%) | Alfuzosin (%) | Doxazosin, Prazosin, or Terazosin (%) | Notes |
| Chadha (2007) ⁶ | prospective, nonrandomized observational study | 1786 pts 1842 eyes | 29/1842 eyes (1.6%) | 74/1842 eyes (4%) | 12/21 eyes (57%) | 0/2 eyes (0%) | 1/51 eyes (2%) | |
| Chang (2007) ⁷ | prospective, multicenter, nonrandomized observational series | 135 pts 167 eyes | NA | 135/135 pts (100%) | 150/167 eyes (89.8%) | NA | NA | 10% no IFIS 17% mild IFIS 30% moderate IFIS 43% severe IFIS |
| Oshika (2007) ¹⁰ | prospective, interventional case series | 1968 pts 2643 eyes | 29/2643 eyes (1.1%) | 134/2643 eyes (5.1%) | 25/58 eyes (43.1%) | NA | 0/55 eyes* (0%) | 4/21 eyes (19%) taking naftopidil |
| Srinivasan (2007) ¹¹ | retrospective chart review | 1298 pts 1612 eyes | 13/1298 pts (1.0%) | 65/1298 pts (5.0%) | 10/18 pts (56%) | 0/1 | 3/49 pts (6.1%) | |
| Takmaz (2007) ¹² | prospective, nonrandomized observational study | 774 pts 858 eyes | 16/858 eyes (1.9%) | 24/858 eyes (2.8%) | 14/18 eyes (77.8%) | 1/2 eyes (50%) | 1/4 eyes (25%) | |

| | | | | | Risk of IFIS in | | | |
|---------------------------------|---|-----------------------|---|---|---------------------|---------------|--|-------|
| Reference | Design | Population | Overall prevalence or incidence of IFIS (%) | Exposure to systemic α ₁ AR Antagonist (%) | Tamsulosin (%) | Alfuzosin (%) | Doxazosin, Prazosin, or Terazosin (%) | Notes |
| Amin (2008) ³ | prospective, nonrandomized observational study | 1267 pts 1462 eyes | 13/1462 eyes (0.9%) 11/1267 pts (0.9%) | 23/462 eyes (5%) 16/1267 pts (1.3%) | 13/23 eyes (57%) | NA | NA | |
| Keklikci (2008) ⁹ | prospective, nonrandomized observational study | 579 pts 594 eyes | 15/594 eyes (2.5%) | 23/579 pts (4%) | 12/23 pts (52%) | NA | NA | |

^{*} Including urapidil and silodosin users as well (numbers on individual agents not specified).

Table 3.6. Outcomes data for transurethral microwave treatment devices

| Author, Year | TUMT | Number of | % Change | % Change | % Change in | % Change in | % Change in | % Change in QOL | Use in | Study Length |
|-------------------|-------------|------------|-----------|------------|-----------------|-----------------|---------------|-----------------|----------|--------------|
| | Modality | Patients | in Qmax | in PVR | IPSS | AUA Symptom | Madsen- | | Retentio | (mo) |
| | | | | | | Score | Iverson score | | n | |
| Albala, 2003 | TMx- | 119 | 58.1% | N/A | N/A | -47.1% | N/A | -49.1% | No | 48 |
| | 2000тм | | | | | | | | | |
| | 1 | I | I | | I | I | l | L | | |
| Lau,1998; Hallin, | Prostatron® | 64 to 323 | -18.8 to | -21.6 to - | -24.5 to -55.8% | N/A | -36.9 to - | -27.6 to -49.1% | No | 8.8 to 60 |
| 1998 | 2.0 | | 32% | 46.7% | | | 55.8% | | | |
| | | | | | | | | | | |
| D'Ancona,1998; | Prostatron® | 31 to 388 | 55.3 to | -44.6% | -50.8 to -56.8% | N/A | -56.4% | -51.3% | No | 12 to 30 |
| Laguna,2002 | 2.5 | | 62.4% | | | | | | | |
| Laguna, 2002; | Prostatron® | 129 to 388 | 55.3% | N/A | -43.4 to -50.8% | N/A | N/A | -51.3 to -60.5% | No | 12 to 30 |
| Vesely, 2005 | 3.5 | | | | | | | | | |
| Floratos, 2001 | Prostatron® | 78 | 29.3% | N/A | -40.0% | N/A | N/A | N/A | No | 36 |
| | 1 | | | | | | l | | | |
| Djavan, 2001; | Targis® | 20 to 429 | -71.1% to | -84.1 to - | -39.8 to -87% | -39.0 to -56.1% | N/A | -38.6 to -52.0% | Yes | 2.5 to 60 |
| Thalmann, 2002; | | | 116.7% | 91.9% | | | | | | |
| Osman,2003; | | | | | | | | | | |
| Miller, 2003; | | | | | | | | | | |

| 1 | | • | 1 | 1 | | 1 | l | -1 | 1 |
|------------------------|-------------|---------------------|----------------------------------|---|--|---|--|--|---|
| CTC | 40 | 29.6% | N/A | N/A | -67.0% | N/A | -67.3% | No | 12 |
| | | | | | | | | | |
| CoreTherm | 33 to 180 | 50 to | -5.2 to - | -64.8% to -69.4% | -38.9% | N/A | N/A | Yes | 5.6 to 60 |
| ® | | 111.9% | 40.6% | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 1 | | <u>I</u> | <u> </u> | | | 1 | <u>l</u> | | <u> </u> |
| Prolieve TM | 94 | N/A | N/A | N/A | N/A | N/A | N/A | No | 12 |
| | CoreTherm ® | CoreTherm 33 to 180 | CoreTherm 33 to 180 50 to 111.9% | CoreTherm 33 to 180 50 to -5.2 to - 111.9% 40.6% | CoreTherm 33 to 180 50 to -5.2 to64.8% to -69.4% 111.9% 40.6% | CoreTherm 33 to 180 50 to -5.2 to64.8% to -69.4% -38.9% | CoreTherm 33 to 180 50 to -5.2 to64.8% to -69.4% -38.9% N/A 111.9% 40.6% | CoreTherm 33 to 180 50 to -5.2 to64.8% to -69.4% -38.9% N/A N/A 111.9% 40.6% | CoreTherm 33 to 180 50 to -5.2 to64.8% to -69.4% -38.9% N/A N/A Yes |

Please note that changes in Qmax and PVR were not statistically significant for studies involving Prostatron® 2.0.