Prostate Cancer and Prostatic Diseases (2006) 9, 270–274
 1365-7852/06 $30.00
www.nature.com/pcan

ORIGINAL ARTICLE

The Charlson comorbidity score: a superior comorbidity assessment tool for the prostate cancer multidisciplinary meeting

C Kastner[1,2], J Armitage[1,3], A Kimble[1], J Rawal[1], PG Carter[1] and S Venn[1]

[1]*Department of Urology, St Richard's Hospital, Chichester, UK;* [2]*The Prostate Project, Postgraduate Medical School, University of Surrey, Guildford, UK and* [3]*Clinical Effectiveness Unit, Royal College of Surgeons, London, UK*

Introduction: Multidisciplinary team (MDT) meetings use precise prognostic factors to select treatment options for patients with prostate cancer. Comorbidity is judged subjectively. Recent publications favour the Charlson comorbidity score (CS) for the use in the management of prostate cancer. We assess the feasibility of using the CS by our MDT in planning the treatment of patients with prostate cancer.

Patients and methods: Patients from the histopathology database aged less than 75 years and with a diagnosis of localized prostate cancer between 1993 and 1995 were included in a notes audit. A second group consisted of patients recommended for curative treatment for localized prostate cancer by the local MDT in 2004. Data on comorbidity, prostatic malignancy and survival up to 10 years was collected. The prognostic accuracy of the CS was assessed for those patients offered radical treatment between 1993 and 1995.

Results: Of 1043 patients initially assessed, 37 patients with localized prostate cancer were identified. Using Cox regression, we found the CS to be a statistically significant predictor of survival, following radical treatment for localized prostate cancer ($P = 0.005$). Current practice in 2004 (56 patients) shows a mean (range) Charlson probability of 10-year survival for radical prostatectomy of 0.823 (0.592–0.923) and for radical radiotherapy of 0.653 (0.07–0.936).

Conclusions: Our results support the findings of recent research. We also found the CS easy to calculate and therefore feasible to use in our MDT setting. We propose the introduction of the Charlson score by prostate cancer MDTs to assess age and comorbidity.

Prostate Cancer and Prostatic Diseases (2006) **9,** 270–274. doi:10.1038/sj.pcan.4500889; published online 13 June 2006

Keywords: prostate neoplasm; comorbidity assessment; Charlson score

Introduction

Multidisciplinary team (MDT) management of cancer cases has been incorporated in our practice over the last two decades. In December 2000, the Department of Health delivered an extensive document on the current status of the cancer services. The NHS Cancer Plan[1] highlighted important aspects of cancer care. MDTs incorporate the complete range of knowledge, skills and experience to ensure high-quality diagnosis, treatment and care. Furthermore, they ensure co-ordination and continuity of patient care.

In light of the success of the breast cancer MDT projects, urologists implemented their own MDTs. Treatment decisions by the MDT are dependent on precise thresholds of outcome predictors for prostate cancer: prostate-specific antigen (PSA), clinical or histopathological stage, Gleason grading and results of imaging tests. However, comorbidity is often judged subjectively, despite the proven inaccuracy, imprecision and inconsistency of a clinician's ability to predict survival.[2] This puts in question the value of the MDT decision.

The use of a validated comorbidity score (CS) would ensure more objective decision-making. The 'Report from the [NHS] Working Party on Comorbidity Assessment in Cancer […]' of 2001[3] recommends the use of the Adult Comorbidity Evaluation-27 (ACE-27). However, this is a very extensive score requiring a wide range of information and taking considerable time to calculate.

Recent reviews[4] and publications of comorbidity assessment in prostate cancer favour the Charlson CS or a non-validated modified version[5] and the American Society of Anesthesiologists Physical Status classification (ASA). In the majority of patients with localized prostate cancer, the ASA is 2 and therefore, although overall regarded as slightly superior to the CS, the ASA fails to discriminate survival in this group.[6] The CS was first published in 1987 for the use in longitudinal studies, and modified in 1994 to adjust for age.[7,8] It predicts 10-year survival and its use has been validated in patients with various malignancies, including prostate cancer.[9–14] It has been criticized for ignoring some important morbid-

Correspondence: Dr C Kastner, The Prostate Project, Postgraduate Medical School, University of Surrey, Manor Park, Guildford GU2 7WG, UK. E-mail: ckastner@nhs.net
Received 12 April 2006; accepted 1 May 2006; published online 13 June 2006

ities and for incorporating several malignancies or malignancy-related morbidities. This might give malignancies too much weight in some cases.[4]

The aims of this study were threefold. First, to determine whether the Charlson CS accurately predicts 10-year survival in patients with localized prostate cancer in our hospital. Second, to review our current practice and establish the Charlson score of patients now receiving radical treatments for localized prostate cancer. Third, we review the feasibility of using the Charlson score by the MDT.

Materials and methods

Using the local histopathology database, all patients with a new histological diagnosis of prostate cancer between 1993 and 1995 were identified (Group A) and a retrospective analysis of their case notes performed.

Inclusion criteria

Patients below the age of 75 years at diagnosis with localized prostate cancer were included in a notes audit. We defined localized prostate cancer by three criteria: a PSA of less than 20 ng/ml, low or moderate grade of differentiation (Gleason score $\leqslant 7$) and tumour clinically confined within the prostate on digital rectal examination (DRE).

Data collection and analysis

For each patient, age at diagnosis, DRE findings, PSA, presence of lower urinary tract symptoms, age at death, cause of death, diagnostic tissue type (resection chippings or biopsy material), histological grade, mode of treatment and the presence of relevant past medical history at the time of diagnosis for the CS were recorded.

Charlson score

The Charlson score takes into account the presence of 19 diseases weighted on the basis of their association with mortality. A Charlson sum is calculated according to the number of morbidities affecting an individual (Table 1). For each morbidity, a number of points are allocated and the sum of these points gives an overall score. This sum can be used in conjunction with the patient's age as the Charlson score to calculate a probability of survival. In keeping with previous studies, we did not score prostate cancer as malignancy as the intention was to determine a patient's survival after cure.[7] We adapted described calculation of the CS to ease its use (Appendix A).

Charlson score (X)	$X = A+B$
Comorbidity component (A)	Sum of points for each morbidity (Table 1)
Age component (B)	Age <40 years – 0; age 41–50 years – 1 Age 51–60 years – 2; age 61–70 years – 3 Age 71–80 years – 4.
Charlson probability (Z)	formula: $e^{0.9X} = Y$, $0.983^{Y} = Z$ (10-year survival)

All patients were followed up for 10 years where case notes were available. Actual survival was compared with predicted survival using Cox regression analysis.

To establish a picture of our current practice of selection of patients for radical treatment, we identified patients with localized prostate cancer recommended for curative treatment by the local urological MDT in 2004 using the MDT database (Group B). The same data as above was collected for these patients. In this group, for the age score, the number was increased by 0.1 per year rather than by 1 per decade.

Results

Between 1993 and 1995, the histopathology department at St Richard's Hospital assessed 1043 prostate specimens. Prostate cancer was identified in 194 cases, 144 from analysis of prostate chippings after trans-urethral resection, and 50 from biopsy specimens. Forty-five patients had localized disease and were considered fit for radical treatment (Table 2). Eight case notes were unavailable and so could not be considered in this audit. The mean age at diagnosis was 69.2 years.

Of the 37 patients with localized prostate cancer, 18 died in the 10-year follow-up period (48%) and five (13.5%) as a direct result of the disease.

Statistical analyses were performed using STATA 8 software (StataCorp, College Station, TX, USA). Actual 10-year survival was calculated by the Kaplan–Meier method for each Charlson index group (Table 3). Using

Table 1 Charlson comorbidities and their respective point scores

Points	*1*	*2*	*3*	*6*
Morbidity	MI	Hemiplegia	Moderate–severe liver disease	Metastatic solid tumour
	CCF	Moderate–severe		
	PVD	CRF		AIDS
	COPD	DM (with end-organ damage)		
	DM (without end-organ damage)	Malignancy		
	Cerebrovascular disease	Leukaemia		
	Dementia	Lymphoma		
	Ulcers			
	Connective tissue disease			
	Mild liver disease			

Abbreviations: MI, myocardial infarction; CCF, congestive cardiac failure; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; CRF, chronic renal failure.

Table 2 Patient demographics by treatment type for patients diagnosed with localised prostate cancer between 1993 and 1995

	Treatment		
	Radical prostatectomy	*Radical radiotherapy*	*Surveillance/hormones*
Number of patients	2	12	23
Mean Charlson index	0.775	0.591	0.517
Mean PSA (range)	7 (4–10)	11.5 (5–20)	8.6 (2–15)

Abbreviation: PSA, prostate-specific antigen.

Table 3 Predicted and actual 10-year survival of patients diagnosed with localised prostate cancer suitable for radical treatment between 1993 and 1995

Number of patients	*Charlson probability (10-year survival)*	*Actual 10-year survival (95% confidence interval) (1 = 100%)*
3	0.901	0.67 (0.054–0.945)
12	0.774	0.75 (0.408–0.912)
11	0.534	0.55 (0.229–0.780)
10	0.214	0.20 (0.031–0.475)

Cox regression, we found the Charlson index to be a statistically significant predictor of survival following radical treatment for localized prostate cancer ($P = 0.005$).

In 2004, 146 patients had a new diagnosis of prostate cancer on review of 507 prostate specimens. One hundred and twenty-three patients were diagnosed on the basis of biopsy material and 23 following the analysis of resected prostate tissue. Fifty-six patients were diagnosed at a mean age of 64.8 years with localized prostate cancer suitable for radical treatment (Table 4).

Discussion

Our results support recent findings, which suggest that the Charlson CS can be used to objectively assess comorbidity when planning the treatment of patients with localized prostate cancer.

The small numbers of patients included in this study means that the estimates of 10-year survival lack precision. Our aim was not to validate the CS as this has already been carried out both generally and with specific reference to prostate cancer.[7,11] However, we satisfied by our results that the CS predicts the 10-year survival in patients with localized prostate in our region.

The study was performed retrospectively, which may have introduced bias. Eight patients with a diagnosis of localized carcinoma of the prostate between 1993 and 1995 could not be included in the analysis, as it was not possible to locate their case notes. Although the data collection was retrospective, the outcome of interest was mortality, which was clearly documented and should not therefore have influenced our results.

As we wanted to assess the chance of survival without prostate cancer, we chose not to include prostate cancer when scoring comorbidity. This is in keeping with other studies that have used the Charlson score to predict survival in patients with prostate cancer. Our results show that five of 18 patients who died in the follow-up period did so as a direct result of their prostate cancer. Three of these patients chose active surveillance treatment and two received radical radiotherapy and were eventually started on hormones. Their death can be regarded as treatment failure and the rate of this in our group of patients is in keeping with published data.[15]

The Charlson CS has been extensively validated. It was initially developed for use in longitudinal studies in the general population[7] and later applied to patients with localized prostate cancer.[14] More recently, several studies have investigated the value of the CS to predict the outcome of radical prostatectomy.[5,6,10,11] In all studies, the predictive value of the CS is highly significant with various modes of statistical analysis for the relevant age group. Our results are in keeping with this published data.

Our data provide valuable information on changing trends in the diagnosis and demographics of patients with localized prostate cancer over the past decade in our institution. A greater number of patients are diagnosed with prostate cancer and the mean age at diagnosis is nearly 5 years less than it was a decade ago (mean age 69.2 and 64.8, respectively). This can be explained by a higher level of awareness, more intensive screening and improved technology. New diagnoses of prostate cancer are now most commonly made following needle biopsy where before they were made after analysis of transurethral resection specimens. Treatments have also changed with radical prostatectomy and more recently brachytherapy favoured the options for curative intent in younger patients.

Looking at our current practice (Table 4), we noticed that we performed radical prostatectomies on patients in their sixties with a Charlson 10-year survival probability of 0.6 (60%). A fit and healthy 77-year-old man has the same 10-year survival probability, who clearly would not be considered for this treatment according to current standards.

Current thresholds based on simple age have to be reviewed with this more objective tool.

However, these numbers only reflect our current practice. They should only provide a basis for discussion by MDTs and act as guidance when considering radical treatment for prostate cancer. Audit and accumulation of data of the Charlson score's use in practice should provide the thresholds for the respective treatments in the future.

As a result of our evaluation, the Solent Urology MDT (Portsmouth, Chichester and the Isle of Wight) has adopted the Charlson score for the assessment of comorbidity in patients with prostate cancer.

Table 4 Mean Charlson probability and PSA of patients diagnosed with localised prostate cancer in 2004 and the treatment they went on to receive

	Treatment			
	Radical prostatectomy	*Radical radiotherapy*	*Surveillance/hormones*	*Brachytherapy*
Number of patients	22	21	2	11
Mean Charlson probability (range)	0.823 (0.592–0.923)	0.653 (0.07–0.936)	0.893	0.738 (0.534–0.924)
Mean PSA (range)	8.6 (4.1–16)	10.7 (4–19)	8 (7–9)	7 (5–10)

Abbreviation: PSA, prostate-specific antigen.

Conclusion

The Charlson CS reliably predicts survival of patients with localized prostate cancer under the age of 75 years. It is easy to calculate and therefore feasible for the use in the MDT setting. We believe that the Charlson score should be used by MDT when considering treatment options for men with localized prostate cancer.

References

1 *The NHS Cancer Plan*. DoH: London, 2000.
2 Wilson J, Clarke M, Ewings P, Graham J, MacDonagh R. The assessment of patient life-expectancy: how accurate are oncologists and urologists? *BJU Int* 2005; **95**: 794–798.
3 Report from the working party on co-morbidity assessment in cancer – its role in the national core cancer dataset. www.nhsia.nhs.uk,04 Jul 2001.
4 Singh R, O'Brien TS. Comorbidity assessment in localized prostate cancer: a review of currently available techniques. *Eur Urol* 2004; **46**: 28–41.
5 Froehner M, Koch R, Litz R, Oehlschlaeger S, Wirth MP. Which conditions contributing to the Charlson score predict survival after radical prostatectomy? *J Urol* 2004; **171** (Part 1): 697–699.
6 Froehner M, Koch R, Litz R, Heller A, Oehlschlaeger S, Wirth MP. Comparison of the American society of anesthesiologists physical status classification with the Charlson score as predictors of survival after radical prostatectomy. *Urology* 2003; **62**: 698–701.
7 Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chron Dis* 1987; **40**: 373–383.
8 Charlson ME, Szatrowski TP, Peterson J, Gold J. Validation of a combined co-morbidity index. *J Clin Epidemiol* 1994; **47**: 1245–1251.
9 Tewari A, Johnson CC, Divine G, Crawford ED, Gamito EJ, Demers R *et al*. Long-term survival probability in men with clinically localized prostate cancer: a case–control, propensity modeling study stratified by race, age, treatment and comorbidities. *J Urol* 2004; **171**: 1513–1519.
10 Froehner M, Koch R, Litz R, Oehlschlaeger S, Wirth MP. Which conditions contributing to the Charlson score predict survival after radical prostatectomy? *J Urol* 2004; **171**: 697–699.
11 Froehner M, Koch R, Litz R, Oehlschlaeger S, Hakenberg OW, Wirth MP. Feasibility and limitations of comorbidity measurement in patients undergoing radical prostatectomy. *Eur J Urol* 2005; **47**: 190–195.
12 Post PN, Hansen BE, Kil PJ, Janssen-Heijnen ML, Coebergh JW. The independent prognostic value of comorbidity among men aged <75 years with localized prostate cancer: a population based study. *BJU Int* 2001; **87**: 821–826.
13 Barry MJ, Albertsen PC, Bagshaw MA, Blute ML, Cox R, Middleton RG *et al*. Outcomes for men with clinically nonmetastatic prostate carcinoma managed with radical prostatectomy, external beam radiotherapy or expectant management: a retrospective analysis. *Cancer* 2001; **911**: 2302–2314.
14 Albertsen PC, Fryback DG, Storer BE, Kolon TF, Fine J. The impact of co-morbidity on life expectancy among men with localized prostate cancer. *J Urol* 1996; **156**: 127–132.
15 Holmberg L, Bill-Axelson A, Helgesen F, Salo JO, Folmerz P, Haggman M *et al*. Randomized trial comparing radical prostatectomy with watchful waiting in early prostate cancer. *N Engl J Med* 2002; **347**: 781–789.

Appendix A.
Charlson comorbidity score (adapted for clinical use)

Points	*1*	*2*	*3*	*6*
Morbidity	MI	Hemiplegia	Moderate–severe liver disease	Metastatic solid tumour
	CCF	Moderate–severe CRF		AIDS
	PVD	DM (with end-organ damage)		
	COPD			
	DM (without end-organ damage)	Malignancy		
		Leukaemia		
	Cerebrovascular disease	Lymphoma		
	Dementia			
	Ulcers			
	Connective tissue disease			
	Mild liver disease			

Charlson comorbidity sum (of each morbidity) $A =$ _____

Abbreviations: MI, myocardial infarction; CCF, congestive cardiac failure; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; CRF, chronic renal failure..

Appendix A *Continued*

Age	*Score*	*Age*	*Score*	*Age*	*Score*	*Age*	*Score*	*Age*	*Score*
40	0	50	1	60	2	70	3	80	4
41	0.1	51	1.1	61	2.1	71	3.1	81	4.1
42	0.2	52	1.2	62	2.2	72	3.2	82	4.2
43	0.3	53	1.3	63	2.3	73	3.3	83	4.3
44	0.4	54	1.4	64	2.4	74	3.4	84	4.4
45	0.5	55	1.5	65	2.5	75	3.5	85	4.5
46	0.6	56	1.6	66	2.6	76	3.6	86	4.6
47	0.7	57	1.7	67	2.7	77	3.7	87	4.7
48	0.8	58	1.8	68	2.8	78	3.8	88	4.8
49	0.9	59	1.9	69	2.9	79	3.9	89	4.9

Charlson age score $B =$ _____

A+B	*Z (%)*	*A+B*	*Z (%)*	*A+B*	*Z (%)*	*A+B*	*Z (%)*	*A+B*	*Z (%)*
0–1	>95	2.1	89	3.1	76	4.1	50	5.1	18
1.1–2	90–95	2.2	88	3.2	74	4.2	47	5.2	16
		2.3	87	3.3	72	4.3	44	5.3	13
		2.4	86	3.4	69	4.4	41	5.4	11
		2.5	85	3.5	67	4.5	37	5.5	9
		2.6	84	3.6	65	4.6	34	5.6	7
		2.7	82	3.7	62	4.7	31	5.7	6
		2.8	81	3.8	59	4.8	28	5.8	4
		2.9	79	3.9	56	4.9	24	5.9	3
		3.0	77	4.0	53	5	21	⩾6	⩽2

Charlson 10-year-survival probability (%) $Z =$ _____.
(Formula used: $A+B = X$; $e^{0.9X} = Y$; $0.983^{Y} = Z$).