

Guidelines

The Japanese Urological Association's clinical practice guidelines for urotrauma 2023

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Abbreviations and Acronyms

AAST = American Association for the Surgery of Trauma
IVR = interventional radiology
JAST = Japanese Association for the Surgery of Trauma
NOM* = nonoperative management
NTDB = National Trauma Data Bank
OIS = organ injury scale
OM = operative management
PFUI = pelvic fracture urethral injury
PR = primary realignment
PV = pedicle vessel
SPC = suprapubic catheter
TAE = transcatheter arterial embolization

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*NOM includes TAE and procedures such as ureteral stenting and nephrostomy for urinary extravasation in addition to appropriate fluid replacement and bed rest.

Abstract: The Japanese Urological Association's guidelines for the treatment of renal trauma were published in 2016. In conjunction with its revision, herein, we present the new guidelines for overall urotrauma. Its purpose is to provide standard diagnostic and treatment recommendations for urotrauma, including iatrogenic trauma, to preserve organ function and minimize complications and fatality. The guidelines committee comprised urologists with experience in urotrauma care, selected by the Trauma and Emergency Medicine Subcommittee of the Specialty Area Committee of the Japanese Urological Association, and specialists recommended by the Japanese Association for the Surgery of Trauma and the Japanese Society of Interventional Radiology. The guidelines committee established the domains of renal and ureteral, bladder, urethral, and genital trauma, and determined the lead person for each domain. A total of 30 clinical questions (CQs) were established for all domains; 15 for renal and ureteral trauma and five each for the other domains. An extensive literature search was conducted for studies published between January 1, 1983 and July 16, 2020, based on the preset keywords for each CQ. Since only few randomized controlled trials or meta-analyses were found on urotrauma clinical practice, conducting a systematic review and summarizing the evidence proved challenging; hence, the grade of recommendation was determined according to the 2007 "Minds Handbook for Clinical Practice Guidelines" based on a consensus reached by the guidelines committee. We hope that these guidelines will be useful for clinicians in their daily practice, especially those involved in urotrauma care.

Key words: external injury, guideline, iatrogenic injury, urotrauma.

INTRODUCTION

Although deaths due to road traffic accidents have been decreasing in Japan,¹ trauma remains a major cause of death among young people.² In an aging society, the younger generation comprises a significant proportion of the working-age population; thus, it is extremely important to improve trauma care. Urotrauma is relatively rare, albeit inevitable, in the daily practice of urologists. Although urotrauma is not fatal in most cases, depending on the nature of the trauma and the treatment chosen, patients may experience varying degrees of functional impairment. Furthermore,

iatrogenic urotrauma, which commonly occurs in the ureter and urethra, due to surgery and other procedures often impairs patients' quality of life, prolongs the treatment duration, increases medical costs, and possibly leads to medical lawsuits.

In 2016, the Japanese Urological Association (JUA) published guidelines for the treatment of renal trauma, the most common type of urotrauma. Guidelines for overall urotrauma have already been published by the American Urology Association and European Association of Urology,^{3,4} highlighting the need for establishing new urotrauma guidelines that are concordant with the Japanese medical system. Consequently, the Japanese Urological Association decided to publish updated guidelines for overall urotrauma in conjunction with the revision of the renal trauma guidelines. These guidelines aim to provide standard clinical practice recommendations based on the current global evidence on urotrauma, in the context of the Japanese medical system. The guidelines committee comprised urologists with experience in urotrauma care, selected by the Trauma and Emergency Medicine Subcommittee of the Specialty Area Committee of the Japanese Urological Association, and specialists recommended by the Japanese Association for the Surgery of Trauma (JAST) and the Japanese Society of Interventional Radiology, all of whom are experienced in urotrauma care.

TARGET AUDIENCE

Urologists, emergency physicians, general surgeons, trauma surgeons, and general practitioners involved in urotrauma care.

METHOD OF PREPARATION

The guideline committee established the domains of renal and ureteral, bladder, urethral, and genital trauma, and determined the lead person for each domain. A total of 30 clinical questions (CQs) were established for all domains; 15 for renal and ureteral trauma and five for each of the other domains, based on the existing JUA guidelines for renal trauma. An extensive literature search was conducted, conjointly with the Japan Medical Library Association, in the Iqaku Chuo Zasshi and PubMed databases for studies published between January 1, 1983 and July 16, 2020, based on preset keywords for each CQ. Each committee member selected relevant studies from the titles, formats, and abstracts of the obtained literature (primary screening). In addition, each committee member searched for relevant literature that had been published after the search period. The full texts of all primary screened articles were carefully read to select the final articles (secondary screening). The results were summarized and included as clinical answers. Only few randomized controlled trials or meta-analyses in urotrauma clinical practice were available; hence, conducting a systematic review and summarizing the voluminous evidence proved difficult. Therefore, the grade of recommendation was determined according to the 2007 "Minds Handbook for Clinical Practice Guidelines" following a consensus reached by the guidelines committee. The classification of recommendations is as follows: A: Strong scientific evidence exists and is strongly recommended; B: Scientific evidence exists and is recommended; C1: Scientific evidence is not clear but is

recommended; C2: Scientific evidence is not clear and is not recommended; D: Scientific evidence of ineffectiveness or harm exists and is not recommended. Nevertheless, some CQs could not be assigned a grade of recommendation.

CHAPTER 1. RENAL AND URETERAL TRAUMAS

CQ1. What are the characteristics of the renal trauma mechanism in our country?

Answer. In Japan, road traffic accidents are the most common cause of renal trauma, followed by falls and sports-related injuries.⁵ Most injuries are due to blunt trauma such as contusions and penetrating trauma such as stabbing and cuts; gunshot wounds account for only a meager percentage of all renal trauma cases.⁶ The incidence of iatrogenic renal trauma is 1.8%–15%; vascular injuries are most common of these, and procedures such as percutaneous nephrostomy and lithotripsy are the most common injury mechanisms.⁷

CQ2. What are the characteristics of renal trauma management and the appropriate hospital requirements?

Answer. The kidneys are retroperitoneal organs surrounded by Gerota's fascia; hence, blunt trauma rarely results in major bleeding or requires emergency surgery.^{5,8} If the injury extends into the renal pelvis, urinary extravasation and infection may occur.⁹ Current treatment strategies are mostly minimally invasive procedures owing to advances in diagnostic imaging and endovascular surgery.¹⁰

Hospitals should be able to provide transcatheter arterial embolization (TAE), drainage for urinary extravasation, and surgeries for renal trauma, and emergency care for head, chest, and abdominal injury-related complications (Table 1).¹¹

CQ3. What is the incidence and severity of renal trauma in Japan?

Answer. The incidence of renal trauma in Japan is approximately 2.06 cases/100 000 person-years.⁶ Males account for 72%–74.2% of such cases, and the median age is 41–43 years.^{5,6} Approximately 48%, 21%, 25%, and 6% of the

TABLE 1 Protocol to be followed when transferring patients with renal trauma.

- 1 General condition must be stable after initial resuscitation.
- 2 An indication that treatment is not possible at the referring hospital clearly exists.
- 3 It must be ensured that patients receive appropriate treatment at the referred hospital to improve patient outcomes.
- 4 Doctors and/or nurses can accompany the patient in the ambulance and manage any incidents that arise during the transfer.
- 5 Provide information to the referred hospital in advance to shorten the patient's waiting time for treatment.

cases are subcapsular renal, superficial, deep, and renal pedicle injuries, respectively.¹² The incidence of severe renal trauma is high among children.¹³ Approximately 6.9 cases/million person-years of sports-related renal trauma occur among youth, with skiing, snowboarding, and cycling having a higher risk than contact sports.¹⁴

CQ4. What is the frequency and severity of concomitant organ injuries in renal trauma?

Answer. Concomitant organ injuries are present in 26%–91% of renal trauma cases,⁵ including liver, spleen, head, and chest injuries and pelvic and extremity fractures.⁵ Few cases of renal trauma due to sports-related injuries are associated with other organ injuries.¹⁵ Renal trauma itself is rarely the cause of death. Injuries to the head, chest, and abdomen and/or pelvic fractures may be the cause of trauma-related death; hence, interdepartmental collaboration is important in urotrauma care.¹¹

CQ5 what are the classifications of renal trauma and what are their advantages and problems?

Answer. The JAST (Table 2) classification for renal trauma is mainly used in Japan,¹⁶ while the American Association for the Surgery of Trauma (AAST) (Table 3) is used in Europe and the United States.^{12,17} Both classifications correlate with treatment outcomes and are useful and valid in determining treatment options.^{5,12} The JAST and AAST classifications were revised in 2008 and 2018, respectively; hence, further validation is needed regarding their continued effectiveness.¹⁸

CQ 6. What are the clinical findings that are useful in renal trauma management?

Answer. Medical interviews on the trauma history and comorbidities, physical examination, hemodynamics, and urine findings are crucial in renal trauma management.^{4,19,20} Hemodynamics is particularly essential for determining further testing and treatment strategies (Figure 1).^{4,20} A systolic blood pressure of ≤ 90 mmHg is borderline; however, its significance is slightly less in pediatric cases.^{4,20} Although gross or microscopic hematuria is observed in many cases, false-negative and

false-positive findings are not uncommon.^{20,21} (Recommended Grade B).

CQ7. What are the laboratory findings that are useful in renal trauma management?

Answer. Blood tests are useful in the evaluation and follow-up of patients with renal trauma.⁷ Although hematuria is a significant indicator of renal trauma, its absence does not rule out renal trauma.²¹ The degree of hematuria does not correlate with the injury severity.²² Contrast-enhanced computed tomography (CT) is a key imaging modality in the assessment of renal trauma. It can reveal the morphology of renal trauma, the presence of vascular damage, and damage to the renal pelvis and ureters from the early (arterial phase) to the excretory phase (and delayed phase, if necessary).^{4,20,22} (Recommended Grade B).

CQ8. Which imaging modalities are useful in renal trauma management?

Answer. Contrast-enhanced CT is most useful in renal trauma evaluation. In addition to plain CT, contrast-enhanced CT late arterial (corticomedullary phase), renal parenchymal, and excretory phases can evaluate kidney, ureter, bladder, and urethra, and other organ injuries.^{23–25} In Japan, blunt trauma is more common; hence, conservative management is often chosen in the absence of other organ injuries. However, some cases require TAE or immediate nephrectomy; hence, contrast-enhanced CT is indispensable in determining the treatment strategy in such cases (Figure 1).^{25,26} Although ultrasonography is unreliable for initial treatment decisions, it is useful for follow-up without radiation exposure^{25,27} (Recommended grade C1).

CQ9. What are the indications and methods of nonoperative management for renal trauma? What are the types, frequency, diagnosis, and treatment of complications?

Answer. Conventionally, NOM is the first choice for all patients, including children, regardless of the degree or cause of injury, if the patient is hemodynamically stable (Figure 1).^{4,22,28} However, NOM is less likely to be continued in patients with injuries to other abdominal organs or in those with more severe renal trauma; hence, cautious management of these patients is necessary.^{29,30} Complications such as urinary extravasation, hypertension, delayed bleeding, renal insufficiency, and renal infection should be considered.^{31,32} (Recommended Grade B).

CQ10. Does renal trauma-associated urinary extravasation require drainage?

Answer.

- In the absence of other organ or vascular injuries, and if the patient is hemodynamically stable, spontaneous resolution can be expected in the early stages.^{33,34} If clinical symptoms such as fever and abdominal pain persist, extravasated urine should be drained based on CT findings (Figure 1).^{33,35,36} (Recommended Grade C1).

TABLE 2 Japanese Association for the Surgery of Trauma (JAST) Classification—2008.

	JAST classification 2008
Type I	Subcapsular injury
	1 Subcapsular hematoma
	2 Intraparenchymal hematoma
Type II	Superficial injury
Type III	Deep injury
	1 Simple
	2 Complex

Note: Appendix (PV) renal pedicle vessel injury. (H1) hematoma contained within Gerota's fascia. (H2) hematoma extended outside Gerota's fascia. (U1) urinary extravasation contained within Gerota's fascia. (U2) urinary extravasation extended outside Gerota's fascia.

TABLE 3 Comparison of the 1989 and 2018 American Association for the Surgery of Trauma (AAST) Kidney Injury Scales.

AAST 1989			AAST 2018	
Grade	Injury description		Grade	Imaging criteria (CT findings)
I	Contusion	Microscopic or gross hematuria; urologic studies normal	I	Subcapsular hematoma and/or parenchymal contusion without laceration
	Hematoma	Subcapsular, nonexpanding without parenchymal laceration		
II	Hematoma	Nonexpanding perirenal hematoma confined to renal retroperitoneum	II	Perirenal hematoma confined to Gerota fascia
	Laceration	<1.0 cm parenchymal depth of renal cortex without urinary extravasation		
III	Laceration	>1.0 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation	III	Renal parenchymal laceration >1 cm depth without collecting system rupture or urinary extravasation Any injury in the presence of a kidney vascular injury or active bleeding contained within Gerota fascia
IV	Laceration	Parenchymal laceration extending through the renal cortex, medulla, and collecting system	IV	Parenchymal laceration extending into urinary collecting system with urinary extravasation Renal pelvis laceration and/or complete ureteropelvic disruption Segmental renal vein or artery injury Active bleeding beyond Gerota fascia into the retroperitoneum or peritoneum Segmental or complete kidney infarction(s) due to vessel thrombosis without active bleeding
	Vascular	Main renal artery or vein injury with contained hemorrhage		
V	Laceration	Completely shattered kidney	V	Main renal artery or vein laceration or avulsion of hilum Devascularized kidney with active bleeding Shattered kidney with loss of identifiable parenchymal renal anatomy
	Vascular	Avulsion of renal hilum which devascularizes kidney		

- 2 Ureteral stenting or percutaneous drainage should be performed after careful consideration of each case and the advantages and disadvantages of each procedure.^{37–42} (Recommended Grade B).

CQ11. What are the indications and complications of TAE in NOM of renal trauma? What are the types, frequency, diagnosis, and treatment of complications?

Answer. The indication for TAE is based on the assumption that the patient is hemodynamically stable (Figure 1). When contrast-enhanced CT reveals extravascular leakage of the contrast medium, angiography is considered in cases of deep renal injury and/or with thick hematoma.^{40,43,44} TAE is useful and has a low complication rate.^{45–47} In case of rebleeding, TAE should be attempted initially.⁴⁸ The main complication is renal dysfunction, which often resolves spontaneously⁴⁹ (Recommended Grade B).

CQ12. What are the indications and techniques for operative management (OM) of renal trauma? What are the types, frequency, diagnosis, and treatment of complications? What are the indications for renal exploration during laparotomy for other organ injuries?

Answer.

- 1 The primary indications for OM for renal trauma are persistent hemodynamic instability, AAST Grade V vascular injury or penetrating trauma, unstable hemodynamics after

NOM including TAE, and ureteropelvic junction disruption (Figure 1)^{50–52} (Recommended Grade B).

- 2 A pulsating and/or expanding perirenal hematoma is an indication for renal exploration in immediate laparotomy for severe abdominal organ injury (Figure 1)^{53,54} (Recommended grade C1).
- 3 Regarding early OM for hemorrhage from renal trauma, renal sparing techniques (renal suturing, partial nephrectomy, omental coverage, etc.) should be attempted if hemostasis is achievable; if not, nephrectomy is necessary.⁵⁵ Regarding OM for ureteropelvic junction disruption, immediate repair is preferable if the patient is hemodynamically stable.^{54,56} (Recommended grade C1).
- 4 High mortality (0%–29%) and complication (10%–76%) rates have been reported in patients who underwent OM. Typical complications include urinary tract infection, renal failure, urinary extravasation, bleeding, urinoma, and perirenal abscess.^{31,50,57}

CQ13. What are the differences in the management of renal trauma for children and adults?

Answer. Owing to the anatomic fragility of the perirenal region in children, renal trauma is more severe in children than in adults.^{32,58} Even in children, blunt renal trauma accounts for most cases, with the majority being AAST grade I–III injuries.⁵⁸ In pediatric renal trauma, NOM is often successful even for severe injuries (AAST grade IV/V).⁵⁹ NOM, including TAE, is strongly recommended for persistent or delayed bleeding if the patient is hemodynamically stable.^{32,60} (Recommended Grade B).

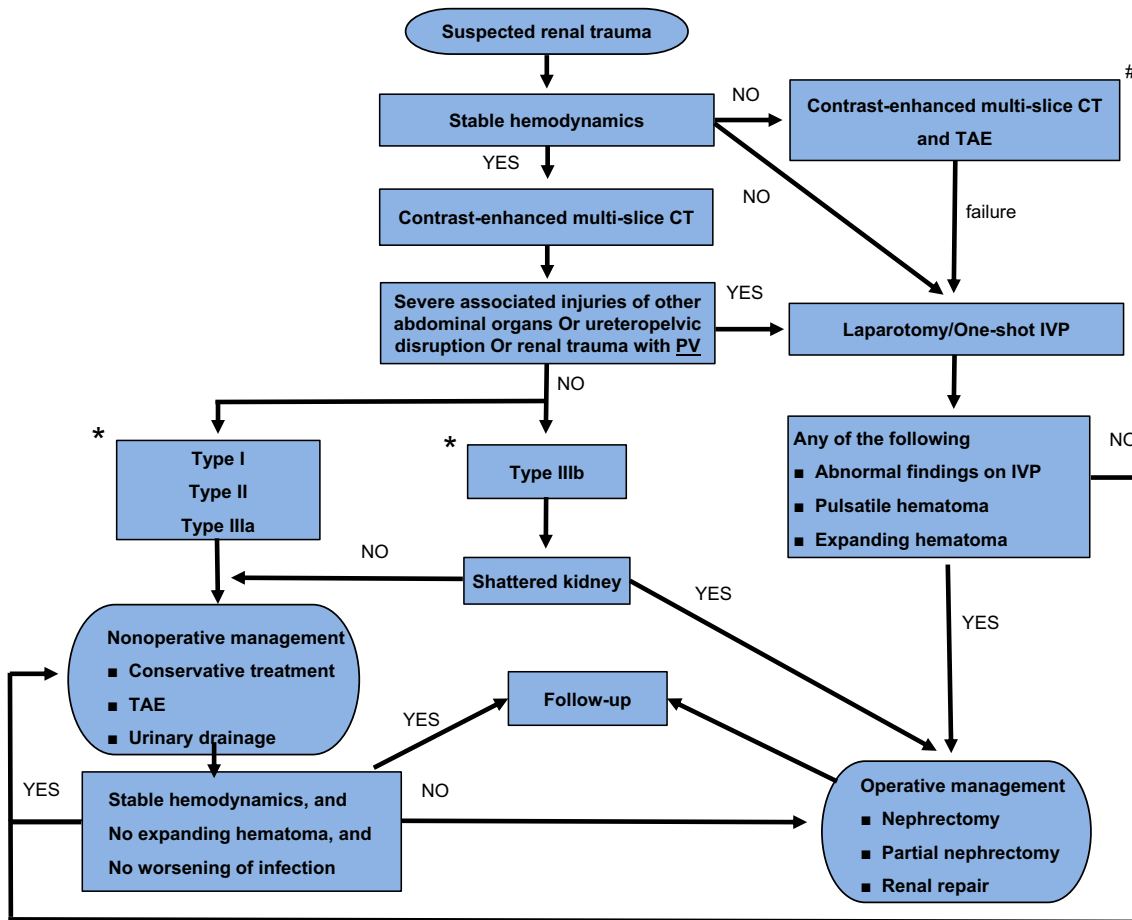


FIGURE 1 Algorithm for the treatment of renal trauma. This algorithm is intended for typical cases; for atypical cases, the optimal treatment should be considered on an individual basis. * Classification according to the Japanese renal trauma guidelines. # The decision should be based on the patient's general condition and the facility's equipment and staffing. Relevant clinical questions are CQ6, CQ7, CQ8, CQ9, CQ10, CQ11, and CQ12.

CQ14. What are the characteristics of the ureter trauma mechanism and what are the useful clinical, laboratory, and imaging findings for diagnosis?

Answer. In most cases, ureteral trauma is iatrogenic, occurs intraoperatively, and is often missed.⁶¹⁻⁶³ Intraoperative cystoscopy is useful to confirm any ureteral injury.⁶⁴ Postoperative abdominal or back pain, vomiting, fever, or elevated serum creatinine levels suggest possible ureteral injury.^{62,65} Ultrasonography and CT are useful for its diagnosis.^{65,66} In cases of ureteral injury due to external trauma, gross or microscopic hematuria may be present.⁶⁷⁻⁷¹ Ureteral injury should be considered when an exploratory laparotomy is performed for other abdominal injuries.⁶⁷⁻⁷¹

CQ15. What are the initial and delayed treatments for ureteral trauma?

Answer.

- 1 The initial treatment for intraoperatively diagnosed ureteral injuries is immediate repair (Figure 2) (Recommended Grade B).

- 2 The initial treatment for postoperatively diagnosed ureteral injuries includes ureteral stenting, nephrostomy, or repair surgery. Delayed repair is recommended when the ureter does not heal spontaneously,^{72,73} (Figure 2) (Recommended grade C1).
- 3 Ureteral reconstruction includes uretero-ureteral anastomosis, ureteroneocystostomy (if the length of the ureter is insufficient, the Boari flap or psoas hitch techniques may be added), uretero-ureteral anastomosis, and pyeloplasty.^{62,68,74,75} If the ureteral injury is extensive, ileal ureter or autologous renal transplantation may be considered.⁷⁶⁻⁷⁹ In cases of renal dysfunction or poor infection control, nephrectomy may be performed.^{62,80}

CHAPTER 2. BLADDER TRAUMA

CQ16. What is the mechanism of bladder trauma?

Answer. Bladder trauma is classified as iatrogenic and non-iatrogenic trauma. Iatrogenic bladder trauma is classified into external (caused by open abdominal or laparoscopic surgeries) and internal (caused by transurethral surgery) trauma. Non-iatrogenic bladder trauma is classified into blunt and penetrating trauma.^{7,81} According to the site of injury,

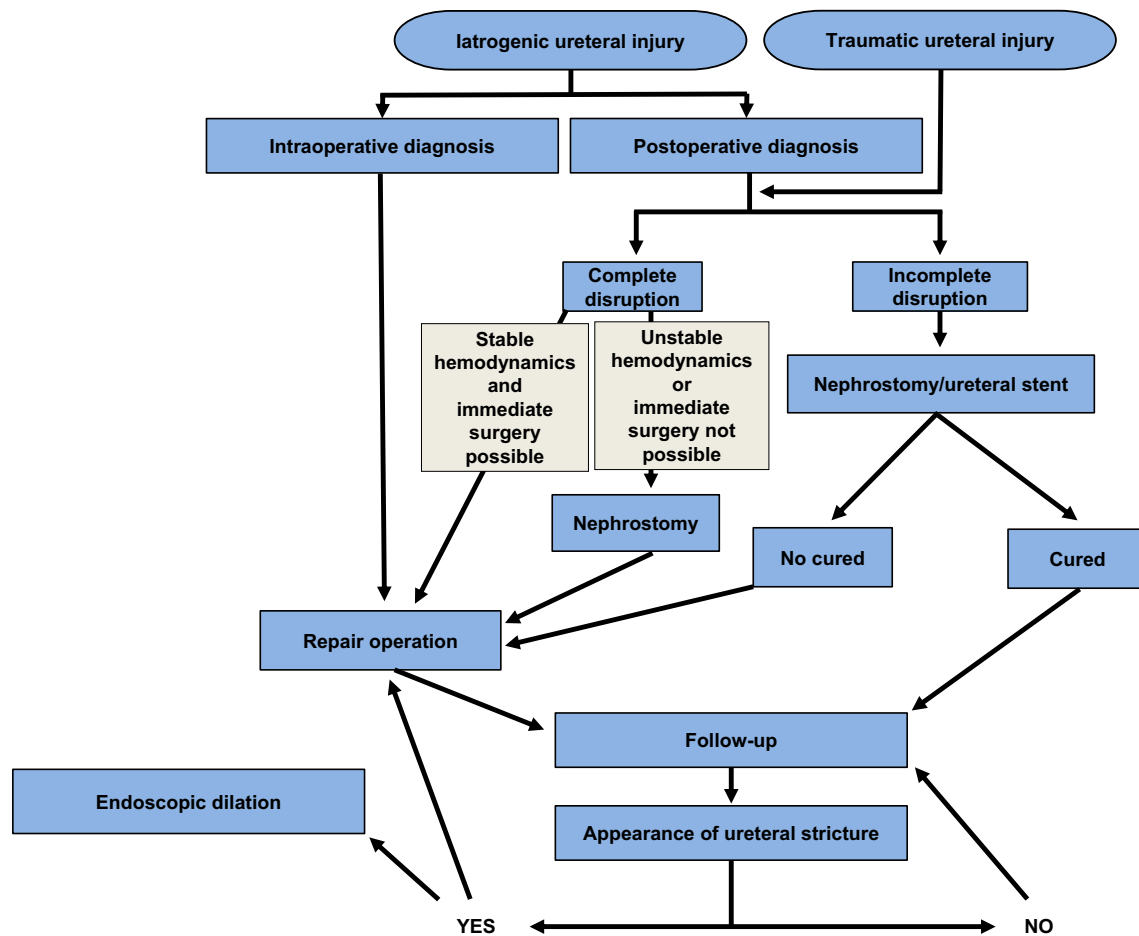


FIGURE 2 Algorithm for the treatment of ureteral trauma. This algorithm is intended for typical cases; for atypical cases, the optimal treatment should be considered on an individual basis. Relevant clinical questions are CQ14 and CQ15.

bladder trauma is classified as intraperitoneal, extraperitoneal, and intra- and extraperitoneal rupture, which is important to determine management strategies.

CQ17. What is the incidence and severity of concomitant organ injuries in patients with bladder trauma?

Answer. Blunt bladder trauma is more frequently associated with pelvic fractures and urethral trauma.⁸² Penetrating bladder trauma is often associated with penetrating injuries of the small intestine, colon, and rectum.⁸³ The incidence of concomitant organ injuries bladder trauma in children is similar to that in adults. Ureteral trauma is the most common complication of iatrogenic bladder trauma during cesarean sections, hysterectomies, and other pelvic surgical procedures; however, reports on the incidence of such complications are limited.⁸⁴

CQ18. Which clinical findings, examinations, and imaging modalities are useful in diagnosing bladder trauma?

Answer. Gross hematuria is the most common clinical finding. The combination of gross hematuria and pelvic fracture

in blunt or penetrating trauma is an absolute indication for cystography.⁸⁵ Both retrograde and CT cystography have high sensitivity and specificity in diagnosing bladder trauma, and the choice of either depends on the hospital’s equipment availability and the physician’s diagnostic skills.⁴ Retrograde injection of diluted contrast is mandatory for diagnosis via CT cystography. Intraoperative cystoscopy is useful when iatrogenic bladder trauma is suspected.

CQ19. What are the indications and methods of conservative management for bladder trauma?

Answer.

- 1 In cases of extraperitoneal rupture due to blunt or iatrogenic trauma, conservative management (urethral catheterization) is indicated if no other complications are present.⁴ (Recommended Grade C1).
- 2 In cases of intraperitoneal rupture, OM is the rule, although successful conservative management of such cases has been reported⁸⁶ (Recommended Grade B).
- 3 For conservatively treated patients, cystography should be performed to confirm healing of the injury. OM should

be considered if the patient continues to have urinary extravasation 4 weeks post-injury.⁴

CQ20. What are the indications and methods of OM for bladder trauma?

Answer. As a rule, OM is recommended for intraperitoneal bladder rupture, because intra-abdominal urinary extravasation may cause fatal peritonitis, sepsis, or uremia.⁸⁶ Moreover, OM is advisable in cases of penetrating trauma to search for concomitant injuries. Even in cases of extraperitoneal bladder rupture, surgical repair is recommended in the following cases: bladder neck injury, presence of foreign bodies such as bone fragments in the bladder, when consequent complications to other organs are suspected, and when internal fixation of pelvic fractures is required.⁷ (Recommended Grade B).

CHAPTER 3. URETHRAL TRAUMA

CQ21. What is the mechanism of injury for urethral trauma?

Answer. Urethral trauma is classified into external and iatrogenic trauma. External urethral trauma is often caused by road traffic or industrial accidents, and most patients are younger adults (age: <50 years).^{87–89} Iatrogenic urethral trauma, is mainly caused by urethral manipulation such as urethral catheter insertion, prolonged indwelling catheter, or transurethral surgery, and most patients are older adults.⁸¹ Both types of urethral trauma are more common in males.⁸¹

CQ22. Which clinical findings, tests, and imaging studies are useful in diagnosing urethral trauma?

Answer. Characteristic physical findings of urethral trauma include blood at the external urethral meatus, gross hematuria, dysuria or urinary retention, bladder distention, and a “butterfly” perineal hematoma.^{89–92} Urethral trauma should be suspected in cases of difficult urethral catheterization.⁹³ Retrograde urethrography is the gold standard in the diagnosis of urethral trauma.^{94,95} (Recommended Grade C1).

CQ23. What is the appropriate initial management for urethral trauma?

Answer.

- 1 For patients with pelvic fracture and unstable hemodynamics, retrograde urethrography may be omitted and a skilled physician may attempt a single urethral catheter insertion.⁹⁵ However, if urethral catheterization is not possible, a suprapubic catheter (SPC) should be placed (Figure 3). (Recommended grade C1).
- 2 For patients with pelvic fracture and stable hemodynamics, retrograde urethrography should be initially performed. If extravasation of contrast media is noted, an SPC or a urethral catheter (via primary realignment [PR])

can be placed for urine drainage⁹⁶ (Figure 3). (Recommended grade C1).

- 3 SPC placement rather than PR is recommended as the initial management of urethral trauma due to straddle injury^{97,98} (Figure 4). (Recommended grade C1).
- 4 Urethral or suprapubic catheterization is recommended for patients with iatrogenic urethral trauma^{99,100} (Figure 5). (Recommended grade C1).
- 5 Immediate repair is recommended for penetrating urethral trauma.⁹⁶ (Recommended grade C1).

CQ24. What are the complications of urethral trauma?

Answer. Urethral stricture is a major complication of both iatrogenic and external urethral trauma (especially blunt trauma such as straddle injury or pelvic fracture).^{94,98,101} Additionally, urinary incontinence and erectile dysfunction are major complications in patients with pelvic fracture urethral injury (PFUI).⁹⁴ Urethral trauma is less common in females and the complications are different from those in males.⁹¹ In pediatric cases, long-term effects such as psychological problems and sexual dysfunction should be considered.¹⁰²

CQ25. What is the appropriate treatment for urethral stricture secondary to urethral trauma?

Answer.

- 1 The incidence of recurrent stricture after a transurethral procedure is high. Transurethral procedures are acceptable only in non-traumatic, untreated, short, and single bulbar urethral strictures¹⁰³ (Recommended Grade B).
- 2 No standard preventive treatments are available for recurrent strictures after transurethral procedures. Intermittent self-urethral dilation may be effective for preventing recurrent stricture in patients who are not suitable or do not opt for urethroplasty.^{104,105} (Recommended Grade B).
- 3 Urethral stents should not be used in patients for whom urethroplasty can be performed.¹⁰³ (Recommended grade C2).
- 4 Anastomotic urethroplasty is the standard procedure for traumatic bulbar and membranous urethral strictures^{4,94} (Figure 6). (Recommended Grade B).
- 5 In patients with PFUI, cavernosal arterial flow may be evaluated before delayed urethroplasty.¹⁰⁶ (Recommended grade C1).
- 6 Urethroplasty with preservation of spongiosal blood flow may be considered for patients with bulbar urethral strictures and mild spongiofibrosis.¹⁰⁷ (Recommended Grade B).
- 7 Substitution urethroplasty is indicated for any length of penile/peno-bulbar stricture and long (>2 cm) bulbar urethral stricture¹⁰⁸ (Figure 7). (Recommended grade C1).

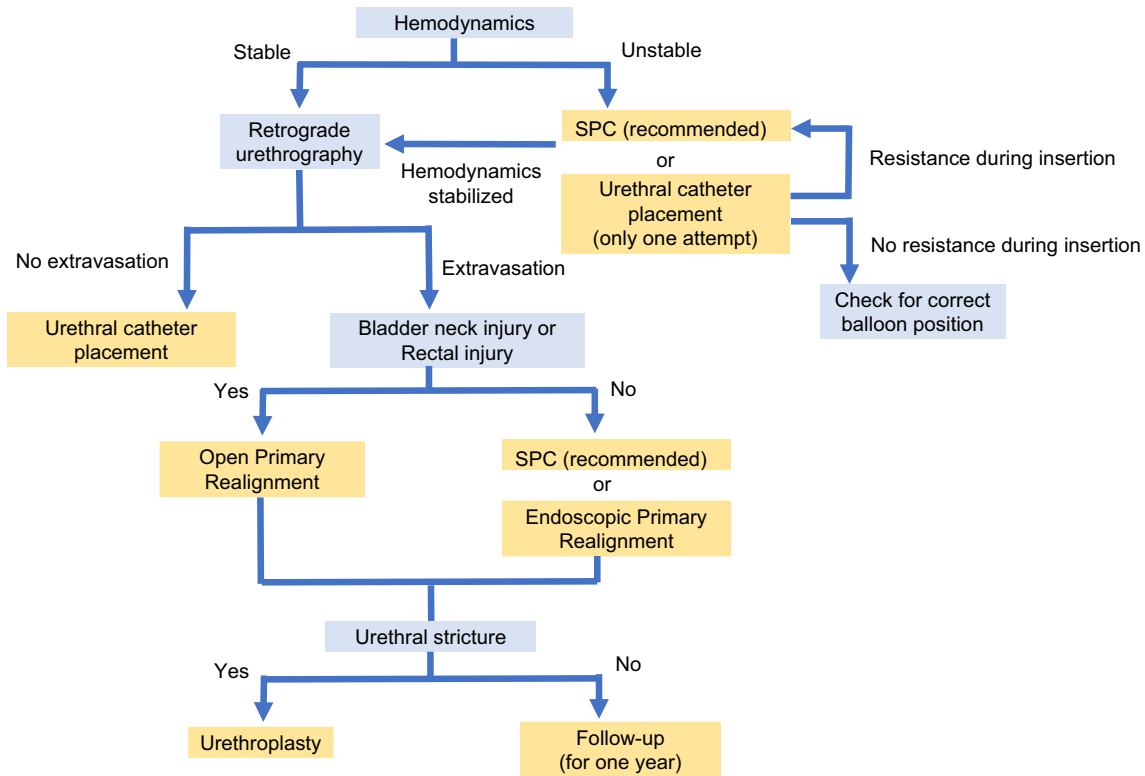


FIGURE 3 Algorithm for initial management of pelvic fracture urethral injury. Relevant clinical questions are CQ22 and CQ23.

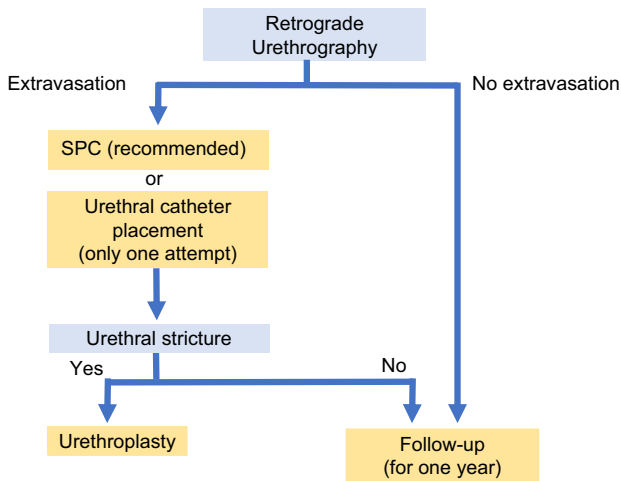


FIGURE 4 Algorithm for initial management of straddle injury. Relevant clinical questions are CQ22 and CQ23.

- 8 Buccal mucosal grafts are the first choice of tissue for substitution urethroplasty.¹⁰⁸ (Recommended grade C1).
- 9 A period of urethral rest is necessary before urethroplasty.¹⁰⁹ (Recommended grade C1).
- 10 Patients with bulbomembranous strictures due to benign prostatic hyperplasia surgery must be informed about the risk of postoperative incontinence before urethroplasty. (Recommended grade C1).

CHAPTER 4. GENITAL TRAUMA

CQ26. Which clinical findings and imaging modalities are useful in diagnosing penile fracture?

Answer. Penile fracture can be diagnosed by the following characteristic clinical symptoms and findings: tearing (or rupturing) sound at the time of injury, pain, sudden decrease in penile erection and difficulty in continuing sexual activity, discoloration, swelling, and penile curvature due to hematoma.¹¹⁰ Concomitant urethral injury should be suspected when bleeding from the external urethral meatus, gross hematuria, urinary symptoms, or pain on urination are noted.¹¹⁰ Ultrasonography or magnetic resonance imaging (MRI) may be useful if the diagnosis cannot be confirmed by clinical findings.⁴

CQ27. What is the appropriate treatment for penile fracture and what are the late complications?

Answer. When penile fracture is diagnosed, the torn tunica albuginea should be repaired using absorbable sutures.⁴ Post-operative complications include nodules at the repair site, penile curvature, and erectile dysfunction.¹¹⁰ (Recommended Grade B).

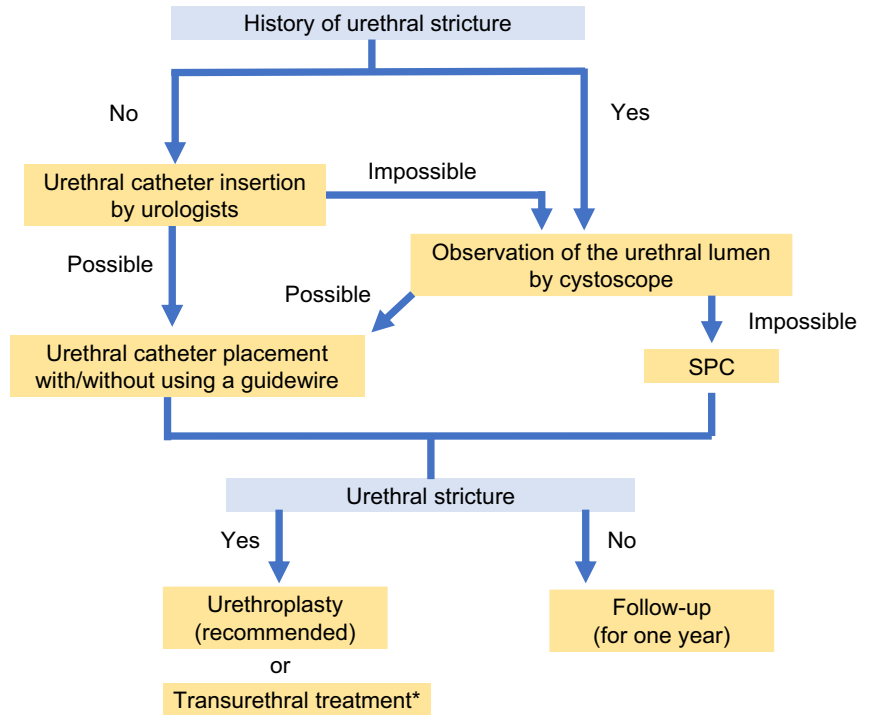


FIGURE 5 Algorithm for initial management of iatrogenic urethral injury. Relevant clinical questions are CQ22 and CQ23.

*Limited to a single, short (<2 cm) bulbar urethral stricture without history of prior treatment

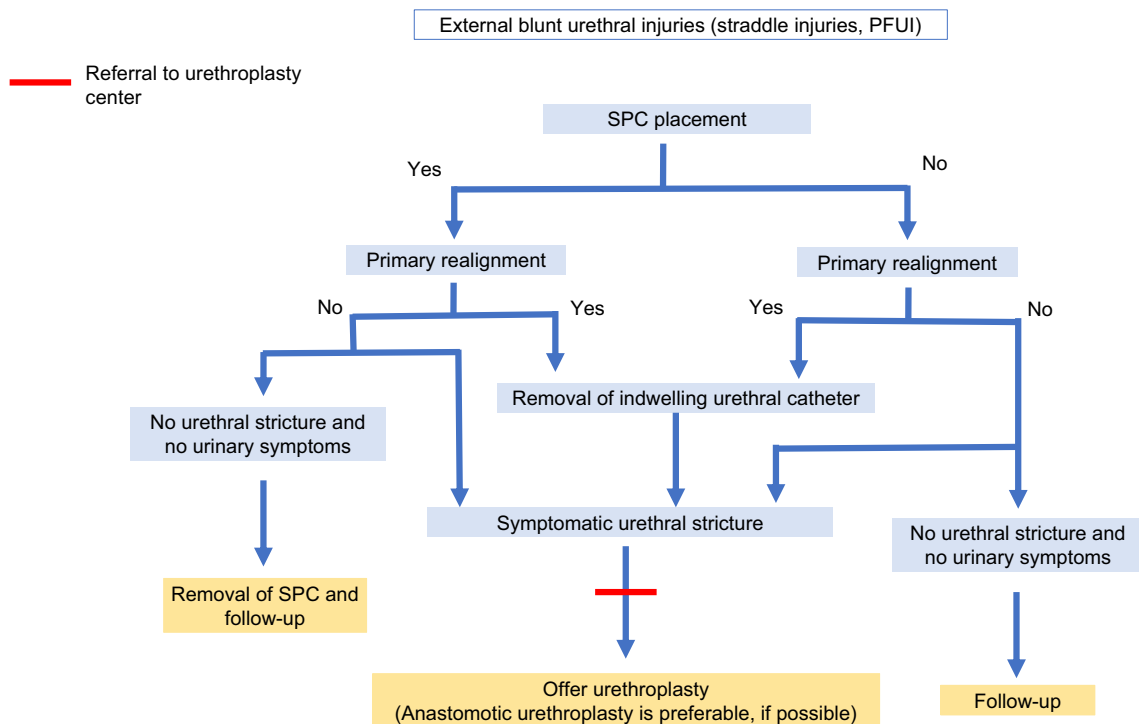


FIGURE 6 Algorithm for delayed management of external blunt urethral injury. Relevant clinical questions are CQ24 and CQ25.

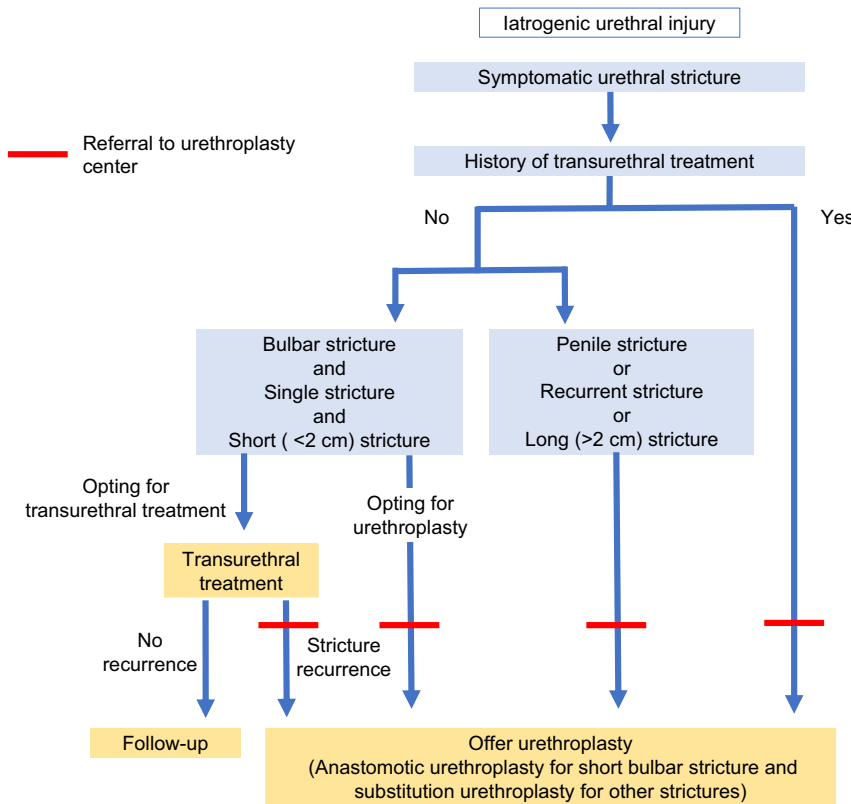


FIGURE 7 Algorithm for delayed management of iatrogenic urethral injury. Relevant clinical questions are CQ24 and CQ25.

CQ28. Which clinical findings and imaging modalities are useful in diagnosing testicular rupture?

Answer.

- 1 In testicular rupture due to blunt trauma, scrotal swelling and tenderness may be observed. However, since these are unspecific, a diagnosis cannot be made based on clinical findings alone.¹¹¹
- 2 Ultrasonography is the first choice for diagnosing testicular rupture due to blunt trauma.⁴ Typical findings are discontinuity of tunica albuginea and heterogenous parenchyma. Color Doppler or contrast-enhanced ultrasonography and MRI may be useful as well. Ultrasonography may have limited utility for penetrating scrotal trauma. (Recommendation Level C1).

CQ29. OM For testicular rupture: Sparing or excision?

Answer.

- 1 Early surgical exploration for testicular rupture due to blunt trauma may prevent ischemic or infection-induced testicular atrophy, and debridement and repair of the tunica albuginea, if possible, is recommended.¹¹² If the tunica albuginea cannot be closed, a flap or graft of tunica vaginalis may be used. If testicular repair is not possible, a simple orchiectomy should be performed. (Recommended level C1).

- 2 In cases of penetrating trauma, open inspection is necessary to assess the extent of damage, wash the wound, and control bleeding. If the tunica albuginea is damaged, resection of necrotic tissue and repair should be performed.⁴ (Recommended level C1).

CQ30. OM For penile amputation: Replantation or transection?

Answer. If the amputated penis is viable, replantation should be considered. Since simple replantation without revascularization is associated with a high rate of complications such as necrosis of the skin and glans, microsurgical replantation with revascularization, if possible, is recommended.¹¹³ Ideally, the patient should be treated at a facility where urologists emergency physicians, microsurgery specialists, and psychiatrists can collaborate.¹¹⁴ In case of issues that preclude replantation, such as a problem with the preservation of the amputated penis, closure of residual penile stump should be performed. (Recommended grade C1).

AUTHOR CONTRIBUTIONS

Akio Horiguchi: Writing—original draft; Conceptualization. **Masayuki Shinchii:** Project administration. **Kenichiro Ojima:** Project administration. **Kazuyoshi Iijima:** Writing—original draft. **Koji Inoue:** Writing—original draft. **Takamitsu Inoue:** Writing—original draft. **Naoyuki Kaneko:** Writing—original draft. **Akihiro Kanematsu:** Writing—

original draft. **Daizo Saito:** Writing—original draft. **Tatefumi Sakae:** Writing—original draft. **Toru Sugihara:** Writing—original draft. **Kazuhiko Sekine:** Writing—original draft. **Tetsuya Takao:** Writing—original draft. **Tadashi Tabei:** Writing—original draft. **Yoshimi Tamura:** Writing—original draft. **Tomohiro Funabiki:** Writing—original draft. **Yusuke Yagihashi:** Writing—original draft. **Masato Yanagi:** Writing—original draft. **Satoru Takahashi:** Project administration. **Yosuke Nakajima:** Supervision; Conceptualization; Writing—original draft.

CONFLICT OF INTEREST STATEMENT

None declared.

APPROVAL OF THE RESEARCH PROTOCOL BY AN INSTITUTIONAL REVIEWER BOARD

N/A.

INFORMED CONSENT

N/A.

REGISTRY AND THE REGISTRATION NO. OF THE STUDY/TRIAL

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ANIMAL STUDIES

N/A.

DATA AVAILABILITY STATEMENT

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