

BLADDER INJURIES: EVALUATION AND MANAGEMENT

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ABSTRACT

Bladder rupture is rare and is often associated with other serious injuries and a high mortality rate. The preferred evaluation is by retrograde computed tomography (CT) cystogram to classify the injury as intra or extraperitoneal. Intraperitoneal injuries will always require open repair, while extraperitoneal injuries can be managed with catheter drainage alone in a majority of cases, with some notable absolute exceptions (bone fragment projecting into the rupture, open pelvic fracture, and rectal perforation). Other relative indications for open repair of extraperitoneal ruptures include associated intraperitoneal injuries requiring laparotomy and pelvic fractures requiring open anterior repair, when the bladder can be repaired without subjecting the patient to additional surgery. Acute complications after repair are uncommon (5%), primarily clot retention and infection. Chronic complications after repair are also uncommon (5%), primarily frequency, urgency and dysuria. Patients with extraperitoneal ruptures treated conservatively have higher rates of acute complications (12-26%), and these tend to be more serious (fistula, failure to heal, sepsis). Chronic complications are also more common in this population (21%) and include bladder neck stricture and frequency/urgency.

Key words: bladder, trauma, rupture, evaluation, management, algorithm

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INTRODUCTION

Bladder injuries after blunt or penetrating trauma are rare, constituting less than 2% of abdominal injuries requiring surgery (1). Such rarity owes to the protected position of the bladder deep in the bony pelvis (1). Accordingly, bladder injury is usually associated with other severe injuries (2), and mortality in these patients occurs in an alarming 12-22% (1,3,4). Often a high-energy accident is the cause (e.g., automobile versus pedestrian) (5).

Bladder injuries after blunt trauma are overwhelmingly associated with pelvic fracture: 83-100% (1,2) of such patients have pelvic fracture, and 6-10% (4,5) of patients with pelvic fracture have bladder injuries. Not surprisingly, fracture of the pubic arch is often specifically associated (5). Most (95%-100%) (1,2) of these patients with bladder injury will have gross hematuria, although in some studies a minority (5%) have had only microscopic hematuria

(2). Gross hematuria is felt to be associated with more significant injuries (rupture), while micro-hematuria has been seen more commonly with bladder contusion (2).

Our algorithm for the management of major pelvic trauma is shown in (Figure-1). It underscores the major diagnostic goals in these patients:

A)- Determine if urethral injury is present. If so, avoid urethral catheterization.

B)- Determine if bladder rupture is present, and classify it as intraperitoneal (which requires exploration and repair) or extraperitoneal (which can usually be managed by bladder drainage alone). The American Association for the Surgery of Trauma (AAST) has classified these bladder injuries by severity (Table-1).

C)- Determine if renal injuries are associated and if they require surgical exploration.

Bladder injury can, of course, also be associated with penetrating trauma. Patients with any degree

Pelvic Fracture

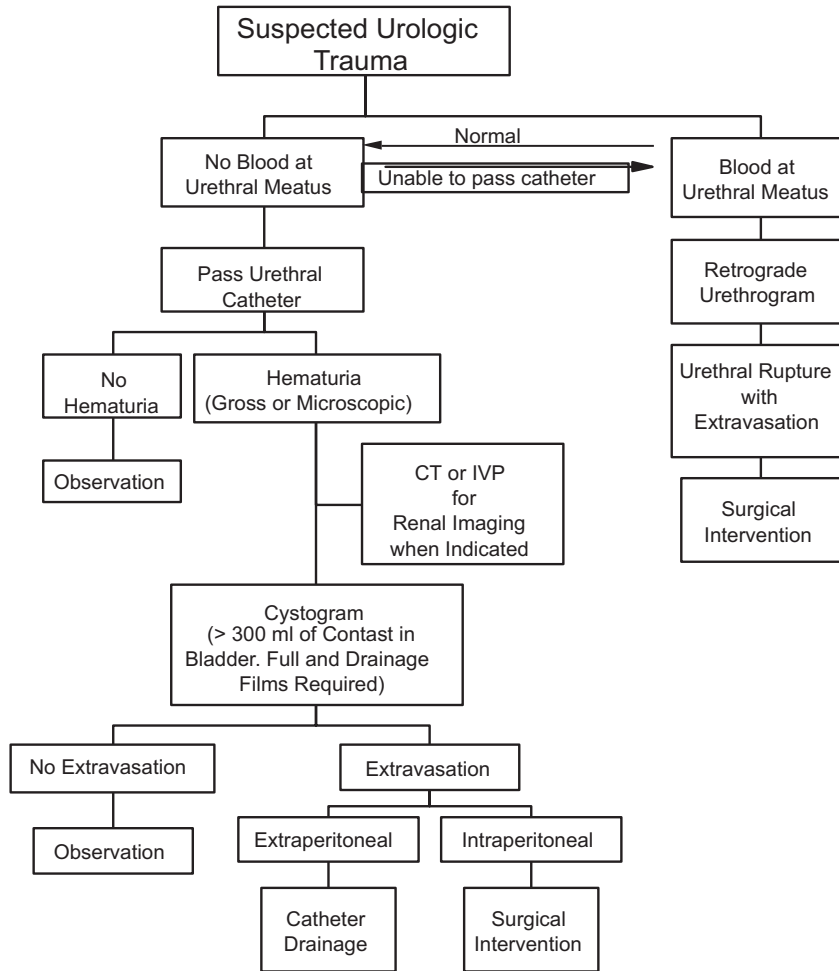


Figure 1 - Algorithm for the management of suspected lower urinary tract trauma associated with pelvic fracture.

Table 1 – American association for the surgery of trauma injury score for the bladder*

Grade*		
I	Hematoma	Contusion, intramural hematoma
	Laceration	Partial thickness
II	Laceration	Extraperitoneal bladder wall laceration < 2 cm
III	Laceration	Extraperitoneal (≥ 2cm) or intraperitoneal (< 2cm) bladder wall laceration
IV	Laceration	Intraperitoneal bladder wall laceration ≥ 2cm
V	Laceration	Intraperitoneal or extraperitoneal bladder wall laceration extending into the bladder neck or ureteral orifice (trigone)

*Advance one grade for multiple lesions up to grade III

*Data drawn from reference 6 (appears online at <http://www.aast.org/injury/injury.html>).

of hematuria after penetrating trauma must be carefully evaluated for kidney, ureteral, bladder, and urethral injury. Usually bladder injury will be implied by the trajectory of the knife or missile wound, and all patients with hematuria at risk for bladder involvement must have formal cystography or intraoperative exploration to rule it out.

STEP-BY-STEP APPROACH

Evaluation

Local Signs and Symptoms

Lower abdominal pain, tenderness, and bruising are often found in patients with bladder injury. However, these signs and symptoms can be difficult to differentiate from the sequelae of pelvic fracture. Some bladder injuries (usually intraperitoneal) are discovered because a urethral catheter does not return urine. In patients with a delayed diagnosis of bladder injury, fever, absence of voiding, peritoneal irritation, and elevated blood urea nitrogen (BUN) can be present. Any patient with this constellation of signs and symptoms should have formal cystography to rule out bladder injury.

Blood at the Urethral Meatus

Inspection for blood at the urethral meatus is mandatory in all trauma patients, as this sign should be present in about half of significant urethral injuries (7). It is our policy not to attempt passage of a urinary catheter (Foley) in these patients, but rather to obtain an immediate retrograde urethrogram to rule out urethral injury.

A significant percentage (10-17%) (4,7) of patients with bladder injuries will have associated urethral rupture. If findings on urethrography are normal, a Foley catheter is placed; if abnormal, the patient is brought to the operating room for placement of a suprapubic urinary catheter, bladder exploration, and repair of bladder injuries. Although we usually place a suprapubic tube when urethral disruption is present, we also often place one in patients with isolated extraperitoneal bladder injury to maximize bladder drainage. We believe that large-caliber suprapubic drainage improves patient outcome, although a single

recent report suggests that this may not be true (8). We typically place a large-bore 20-24F Foley or Malecote catheter suprapubically and opt for 16-20F Foley catheter drainage. We do not usually place small transcutaneous "punch" suprapubic tubes unless the patient's condition is too unstable for formal operation, as these tubes often become clotted with blood acutely or, over the long term, become obstructed with debris or break and require replacement.

Static Cystography

Retrograde cystography with plain abdominal x-ray imaging (including drainage films) has proved 100% accurate in large series (1). Only standard anteroposterior (AP) views of the pelvis are usually needed, although oblique films or fluoroscopy is used in rare cases when standard films are difficult to interpret. The technique has two important aspects: filling the bladder completely; and obtaining a post-drainage film. We infuse 350 ml of 30% contrast (iohexol, Nycomed) by gravity into the urinary catheter. Less than 350 ml is infused only if the patient complains of pain. Others have advocated 400 ml, with the infusion bag elevated to 40 cm, and filling until the patient has pain or the contrast passively stops flowing (9). Series reporting only 250 ml have been associated with false-negative results (4).

Computed Tomography (CT) Cystography

Despite the efficacy of standard plain film cystography, our preferred method entails retrograde placement of contrast material through a urethral catheter followed by CT scanning of the pelvis (Figure-2). Because most of these patients already require CT scans to evaluate pelvic fracture or intraabdominal injury, CT cystography saves time. Our method involves retrograde infusion of 350 ml (or until patient discomfort) 30% contrast (iohexol, Nycomed), diluted 6:1 with saline. Dilution is mandatory because undiluted contrast material is so dense that the CT quality is compromised.

Some have suggested that an adequate CT cystogram can be obtained by clamping the Foley catheter for 20 minutes after injection of intravascular contrast. This relies on urinary excretion of the contrast, followed by bladder extravasation of urine



Figure 2 - CT cystography:

- A)- In a patient with intraperitoneal bladder rupture, intraperitoneal contrast collection is seen in the pouch of Douglas (arrow).
 B)- In a patient with extraperitoneal bladder rupture, contrast extravasation is seen anterior to the bladder.

(10). We do not advocate this method, as we (11) and others (12) have seen examples of missed injuries with this technique.

Associated Renal Injuries

Search for a source of hematuria after significant injury requires that the kidneys be evaluated as well. In the stable patient, we aggressively pursue CT scanning of the abdomen. Because modern helical CT scanners can obtain images before intravenous contrast dye is excreted in the urine, we obtain delayed scans (5-20 minutes after contrast injection) in all cases of suspected renal injury to allow contrast material to extravasate from the injured collecting system, renal pelvis, or ureter. In unstable patients, we advocate intraoperative "one-shot" intravenous pyelogram (IVP), which requires 2 mg/kg of intravenous contrast [Hypaque Sodium 50% (Diatrizoate), Nycomed] 10 minutes before a plain abdominal film is exposed. Open exploration may be required in unstable patients with retroperitoneal hematoma in whom findings are abnormal.

MANAGEMENT

Intraperitoneal Ruptures

Intraperitoneal ruptures alone constitute 25% of all bladder injuries and are combined with extra-

peritoneal rupture in another 12% (1). Intraperitoneal ruptures occur because rapidly rising intraperitoneal pressure causes the bladder to burst (5,13). Evidence for this mechanism is found in the fact that these injuries overwhelmingly involve the dome, suggesting that the bladder is bursting along the area of least resistance (3,5). Extraperitoneal ruptures, in contrast, are thought to result from direct laceration, usually by bone spicules from the fractured pelvis. Some centers have supported this hypothesis by reporting that the location of extraperitoneal ruptures corresponds to the site of pelvic fracture in a majority (35/39) of patients (4). We have only seen this correlation in 35% of our patients (1).

Intraperitoneal ruptures require open operative repair with two-layer closure with absorbable suture (Figure-3). Several factors support this: they are often much larger than suggested on cystography and are unlikely to heal; if conservative management is attempted, persistent urinary leakage can ensue, with consequent and often fatal peritonitis.

Extraperitoneal Ruptures

Extraperitoneal ruptures are found alone in 62% of cases and in combination with intraperitoneal ruptures in another 12% (1). They can most commonly be managed with catheter drainage alone, although some authors have listed several contrain-

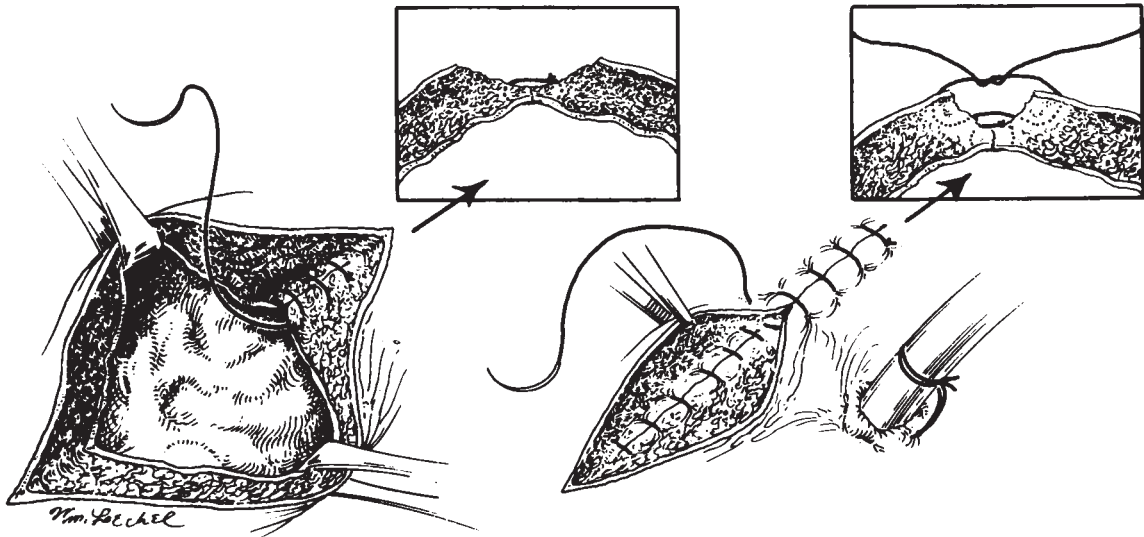


Figure 3 - Two-layer surgical closure with absorbable suture. Note that the suprapubic tube is secured with a purse-string suture.

indications to such conservative management: bone fragment projecting into the rupture (which is unlikely to heal), open pelvic fracture, and rectal perforation. Such cases of bone fragments are rare (14). Open pelvic fracture and rectal perforation are associated with a high risk of serious infection if managed conservatively (15). Others have suggested that, if clots obstruct the urinary catheter within 48 hours of injury, open repair should be undertaken and a suprapubic tube placed (16). These authors cite their concern for pelvic infection as reason for abandoning conservative therapy in these patients.

Another relative indication for repair of extraperitoneal ruptures is found in patients undergoing laparotomy for other reasons (such as open exploration by general surgery for intra-abdominal injuries). Kotkin & Koch (16) report two cases of urethrocutaneous fistula in patients with extraperitoneal rupture who needed laparotomy yet did not have repair of the bladder injury. Careful inspection for associated lower urinary tract injuries is mandatory at open repair so as not to miss urethral disruption, prostate or bladder neck injury, or unexpected intraperitoneal injuries (Figure-4). The bladder is opened at the dome; if desired, the blades of a self-retaining retractor can be used to keep it open (Figure-5). Extraperitoneal lacerations are then closed with absorbable suture in one layer.

Repair at Open Pelvic Fracture Reduction

In some cases, the patient's pelvic fractures will require open reduction and plating. If open plating of the symphysis pubis is planned, the urology team should be alerted and the bladder repaired at the same

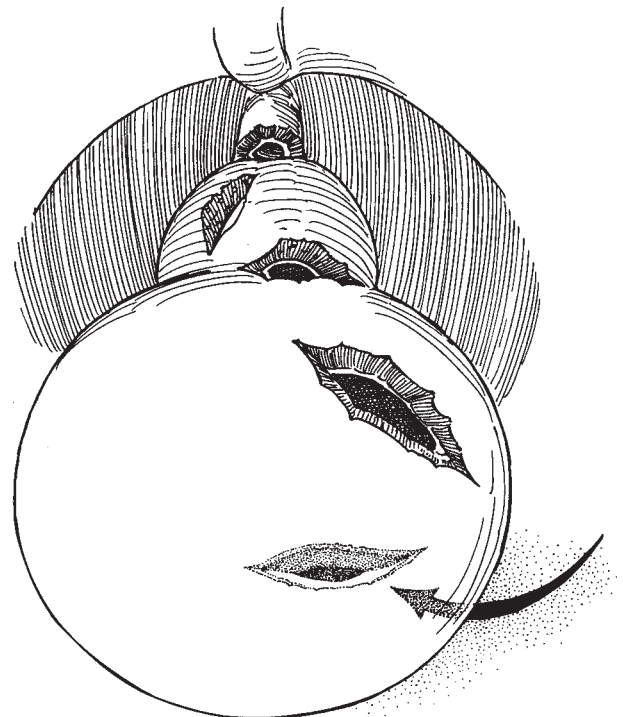


Figure 4 - Main potential sites of lower urinary tract injury: urethra, prostate, bladder neck, and bladder (intraperitoneal and extraperitoneal).

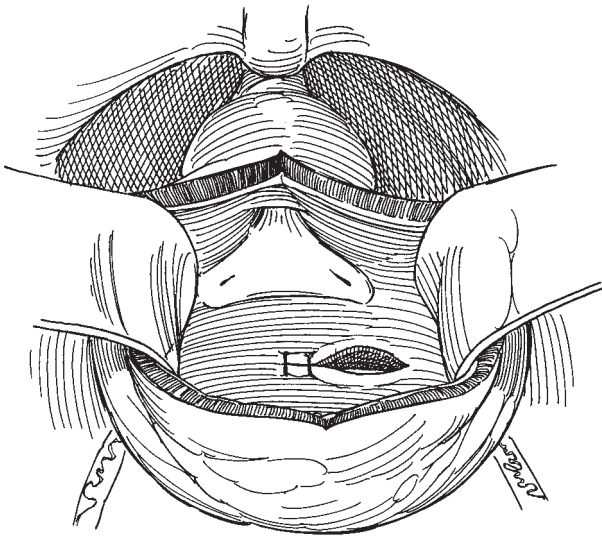


Figure 5 - Exposure for repair of extraperitoneal bladder rupture. The bladder is opened surgically and repaired from the inside.

time, through the same Pfannenstiel incision used by the orthopedic surgeon. Several reasons support this:

- A)- The patient is already undergoing open operation.
- B)- Formal repair is thought to decrease complications by approximately 50% (15).
- C)- Bladder exploration facilitates placement of a large-caliber suprapubic tube, if not already present.
- D)- Repair will stop urinary leakage from the injured bladder onto the orthopedic fixative hardware, thus decreasing the risk of hardware infection.
- E)- Most orthopedic surgeons place large suction drains after plating the symphysis, and these will draw urine through the bladder injuries indefinitely if the bladder is not repaired adequately.

Prophylactic Antimicrobial Agents

In extraperitoneal rupture, antimicrobial agents are instituted on the day of injury and continued until 3 days after the urinary catheter is removed. Some authors have suggested that this decreases complications (16), perhaps by protecting the associated pelvic hematoma from infection. In intraperitoneal rupture, antimicrobials are administered for 3 days, in the perioperative period only. After urinary catheters are removed, it is our policy to resume oral antimicrobial therapy for 3 days,

using agents such as ciprofloxacin. We do this as prophylaxis against bladder infection, although we are aware of no randomized prospective trial that supports this approach.

Follow-up Cystography

If extraperitoneal rupture has not been repaired, a cystogram is obtained at 10-14 days (17). According to some authors, most ruptures 76-87% (16,17) should heal by 10 days, and all by 3 weeks (17). If the cystogram shows no extravasation, the catheter is removed; otherwise, cystography is repeated at 21 days. If bladder repair has been performed, a cystogram is obtained 7-10 days after surgery (17).

COMPLICATIONS

In one large series, complications were significantly lower in patients managed with open repair than in those with catheter drainage: viz., an acute complication rate of 5 vs. 12% (15). Acute complications after repair consisted of clot retention and local infection (15); late complications (occurring in 5%) were urethral stricture and frequency/dysuria. In patients managed with catheter drainage, late complications also were more frequent (21%) and consisted of urethral stricture and bladder hyperreflexia (15). Although urinary frequency is commonly seen after bladder injury, this improves in most patients by 2 months. Persistent frequency is rare (2%) (1).

Most authors advocate nonoperative management of extraperitoneal bladder rupture, and report few complications with this approach. A notable difference was found in the Vanderbilt University experience, published in 1995 (16). This group reported significant (26%) complications in this population, including urethrocutaneous fistula (3%), failure to heal (15%), and sepsis in one case leading to death (16). Poor outcome was most common in patients with severe pelvic fracture. Perhaps our policy of repairing extraperitoneal bladder ruptures in patients undergoing open repair of anterior fractures decreases these injuries, as we have not seen such poor results.

COMMENTS

All patients with intraperitoneal bladder rupture and many patients with extraperitoneal bladder rupture should undergo exploration, repair, and adequate drainage with a suprapubic catheter. After two-layer closure of bladder injuries, most patients will recover without complications. Urinary frequency, which is common after these injuries, should resolve after two months in the majority.

REFERENCES

1. Carroll PR, McAninch JW: Major bladder trauma: Mechanisms of injury and a unified method of diagnosis and repair. *J Urol*, 132: 254-257, 1984.
2. Cass AS: The multiple injured patient with bladder trauma. *J Trauma*, 24: 731-734, 1984.
3. Corriere JN, Jr., Sandler CM: Management of the ruptured bladder: seven years of experience with 111 cases. *J Trauma*, 26: 830-833, 1986.
4. Cass AS, Luxenberg M: Features of 164 bladder ruptures. *J Urol*, 138: 743-745, 1987.
5. Hochberg E, Stone NN: Bladder rupture associated with pelvic fracture due to blunt trauma. *Urology*, 41: 531-533, 1993.
6. Moore EE, Cogbill TH, Jurkovich GJ, McAninch JW, Champion HR, Gennarelli TA, Malangoni MA, Shackford SR, Trafton PG: Organ injury scaling. III: Chest wall, abdominal vascular, ureter, bladder, and urethra. *J Trauma*, 33: 337-339, 1992.
7. Cass AS, Gleich P, Smith C: Simultaneous bladder and prostatic membranous urethral rupture from external trauma. *J Urol*, 132: 907-908, 1984.
8. Volpe MA, Pachter EM, Scalea TM, Macchia RJ, Mydlo JH: Is there a difference in outcome when treating traumatic intraperitoneal bladder rupture with or without a suprapubic tube? *J Urol*, 161: 1103-1105, 1999.
9. Dubinsky TJ, Deck A, Mann FA: Sonographic diagnosis of a traumatic intraperitoneal bladder rupture. *AJR*, 172: 770, 1999.
10. Sivit CJ, Cutting JP, Eichelberger MR: CT diagnosis and localization of rupture of the bladder in children with blunt abdominal trauma: significance of contrast material extravasation in the pelvis. *AJR*, 164: 1243-1246, 1995.
11. Mee SL, McAninch JW, Federle MP: Computerized tomography in bladder rupture: diagnostic limitations. *J Urol*, 137: 207-209, 1987.
12. Haas CA, Brown SL, Spirnak JP: Limitations of routine spiral computerized tomography in the evaluation of bladder trauma. *J Urol*, 162: 51-52, 1999.
13. Peters PC: Intraperitoneal rupture of the bladder. *Urol Clin North Am*, 16: 279-282, 1989.
14. Corriere JN, Jr., Sandler CM: Mechanisms of injury, patterns of extravasation and management of extraperitoneal bladder rupture due to blunt trauma. *J Urol*, 139: 43-44, 1988.
15. Cass AS, Luxenberg M: Management of extraperitoneal ruptures of bladder caused by external trauma. *Urology*, 33: 179-183, 1989.
16. Kotkin L, Koch MO: Morbidity associated with nonoperative management of extraperitoneal bladder injuries. *J Trauma*, 38: 895-898, 1995.
17. Corriere JN, Jr., Sandler CM: Management of extraperitoneal bladder rupture. *Urol Clin North Am*, 16: 275-277, 1989.

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