Lower Urinary Tract Trauma in the Setting of Pelvic Fractures

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Case

- C.S. is a 15 yo M transferred to LeBonheur Children’s Hospital from an outside facility after being involved in a motor vehicle collision
  - Rear seat restrained passenger
  - Poor communication due to history of Autism
  - At the scene of accident, complained of pelvic pain
  - Large R pneumothorax noted on outside CXR
    - Intubated and R chest tube placed prior to arrival
History

- Medical History:
  - Autism

- Surgical History:
  - None

- Allergies: NKDA

- Family History:
  - n/a

- Meds:
  - None

- Immunizations:
  - UTD

- Social History:
  - lives with parents and sibling, all involved in MVC, history obtained from Aunt
Physical Exam

- **Vitals:** Temp 37.0 BP 98/62, pulse 133, RR 20, O2 Sat: 100% on 50% FIO2
- **GEN:** intubated, sedated
- **HEART:** S1/S2 RRR, tachycardic
- **LUNGS:** Clear to auscultation bilaterally, Chest tube on right
- **ABD:** soft, non-distended. Fullness in suprapubic area
- **BACK:** no flank masses or ecchymosis, Right flank tenderness
- **GU:** Normal circumcised phallus with an adequate meatus. He has a 16-French Foley catheter in the urethra with bloody drainage. Testes descended bilaterally, palpably normal without hydroceles, hernias, or injuries. Small amount of ecchymosis in the perineum.
- **EXT:** No edema, warm and well-perfused, Right femoral fracture
- **NEURO:** unable to assess
Labs

U/A
Nitrite - neg
Leuk est – pos
WBC – 10-20/HPF
RBC - TNTC
Imaging

- **CT of Abdomen and Pelvis**
  - Large hematoma within the porta hepatis/right perinephric space. Underlying suspected renal injury is present. In addition, duodenal/pancreatic involvement could be present.
  - Small right-sided pneumothorax with mild pulmonary contusion/hemorrhage within the right lung, chest tube in place.
  - Multiple lateral compression-type pelvic fractures including the sacrum.
  - Right femoral neck fracture.
  - Foley catheter tip positioned outside the urinary bladder, likely indicating urethral avulsion.
Imaging

- Saggital CT images showed the following:
Imaging

- Retrograde Urethrogram
Imaging

- Retrograde Urethrogram
  - Proximal urethral transection with extraperitoneal extravasation of contrast media below base of bladder and extending along extraperitoneal pelvic sidewall bilaterally
Assessment

- 15 yo M s/p MVC with R pneumothorax, Femoral fracture, R renal laceration, Pelvic bone/Sacrum fracture with secondary urethral disruption
Review of Anatomy - Male

B – Bladder
Pu – Pubis
Pr – Prostate
U – Urethra (bulbar)
PPL – Puboprostatic ligaments
EUS – External urethral sphincter
UGD – Urogenital diaphragm
In comparison, the female urethra is much shorter and the posterior urethra less fixed to the pubis due to lack of pubo-prostatic attachments.
Bladder Trauma

- Blunt or penetrating trauma to the pelvis can cause bladder rupture
- Diagnostic imaging is performed based on clinical suspicion
  - Penetrating injury to the area
  - Blunt trauma with pelvic fractures
  - Gross hematuria on foley placement
- After blunt external trauma the absolute indication for immediate cystography is gross hematuria associated with pelvic fracture
  - Approximately 29% with this combination of findings have bladder rupture
  - In patient’s with pelvic fracture and microscopic hematuria or gross hematuria and no pelvic fractures, only 6% will have bladder rupture
Bladder Trauma

- Evaluate with Cystogram or CT cystogram
  - Cystogram vs. CT cystogram.
    - Amount instilled within the bladder should, at a minimum, be equal to one half of the estimated bladder capacity for age (60 cc at birth and 30 cc for each year thereafter)
    - Adult-sized patient, stop at 300 cc or if a bladder contraction occurs.
    - It is not sufficient to plug the catheter and evaluate the bladder at the time of the initial CT scan, even with delayed images
  - Injured patients often have oliguria secondary to hypovolemia, leading to low urine output with inadequate filling of the bladder, often missing the diagnosis of a bladder injury
Bladder Trauma

- Distinction must be made between intraperitoneal and extraperitoneal injuries

Intraperitoneal

Extraperitoneal
Management

- Intraperitoneal injuries require emergent open repair
- Extraperitoneal injuries can usually be managed with an indwelling foley catheter and subsequent cystogram to evaluate resolution of extravasation after approx. 7 days
  - Indications for immediate repair of extraperitoneal bladder rupture include:
    - Bladder neck injury
    - Rectal or vaginal injury
    - Open pelvic fracture
    - Bone fragments projecting into bladder
    - If patient is explored for other injuries
Posterior Urethra
Urethral Trauma

- As with bladder rupture, urethral disruption injuries typically occur in conjunction with multisystem trauma
  - vehicular accidents
  - falls
  - industrial accidents
Urethral Trauma

- Fracture of the anterior pelvic ring or pubic diastasis are almost always present when urethral disruption is encountered
  - A greater degree of displacement has been correlated to a higher risk of urethral injury
  - The highest risk of urologic injury is associated with “Straddle fractures” involving all four pubic rami and fractures resulting in both vertical and rotational pelvic instability
Because the posterior urethra is densely adherent to the pubis via both the urogenital diaphragm and the puboprostatic ligaments, the bulbomembranous junction usually the site of urethral injury.

The membranous urethral sphincter complex tends to remain functionally intact while being avulsed from the underlying bulb.

Typically, patients will remain continent unless the injury extends into the bladder neck (Grade 4) or there is iatrogenic injury during open repair.
Epidemiology

- Urethral injury has been reported to occur in approximately 10% of males and up to 6% of females sustaining pelvic fractures.

- In boys, injuries are more likely to extend proximally to the bladder neck because of the rudimentary nature of the prostate.

- Girls younger than age 17 years – 4x risk of urethral injury compared to adult women owing to greater compressibility of the pelvic bones.
Diagnosis

- Urethral disruption has a typical clinical triad of
  - Blood at the meatus
  - Inability to urinate
  - Palpably full bladder

- “High-riding” prostate or a “butterfly” perineal hematoma may frequently be absent

- Urethral disruption is often first detected when a urethral catheter cannot be placed by the emergency department trauma team

- Females present with vulvar edema and blood at the vaginal introitus
  - Findings are often non-specific and careful vaginal examination is required in all female patients with pelvic fracture
Diagnosis

- In cases of pelvic fracture with gross hematuria, a retrograde urethrogram should be performed.
- Retrograde urethrogram involves placement of a small-bore catheter (16fr. For adults and smaller for children) in the fossa navicularis and retrograde instillation of 25 mL of contrast with a catheter-tip syringe. Films should be oblique or lateral and fluoroscopy is preferred.
- In females, cystoscopy should be performed to evaluate the urethra instead of retrograde urethrogram.
Classification

- Classification System described by Goldman ¹
  - Types 1-5

- Type 1 – Rupture of the puboprostatic ligaments and surrounding periprostatic hematoma stretch the membranous urethra without rupture
Classification

- Type 2 - Partial or complete rupture of the membranous urethra above the urogenital diaphragm or perineal membrane.
  - On urethrography, contrast material is seen extravasating above the perineal membrane into the pelvis
Classification

- Type 3 - Partial or complete rupture of the membranous urethra with disruption of the urogenital diaphragm.
  - Contrast extravasates both into the pelvis and out into the perineum
Classification

- Type 4 - Bladder neck injury with extension into the urethra.

- Type 4a - Extraperitoneal bladder rupture at the bladder base with periurethral extravasation, simulating a Type 4 injury.

- Type 5 - Pure anterior urethral injury.
Management

- Immediate repair in male patients is not recommended due to complications being more common in this setting. They include:
  - Erectile dysfunction
  - Fistula formation
  - Incontinence
  - Increased blood loss

- Female urethral injuries should be repaired or realigned immediately
  - Length of the urethra does not allow for adequate mobilization for repair and anastomosis when significant scarring is present.

- Other indications for immediate exploration and repair include:
  - Bladder neck involvement
Management

- If disruption is not complete, recommendation is for gentle placement of foley catheter
  - Evidence suggests that a gentle attempt to place a urethral catheter will not typically convert incomplete into a complete transection.

- If disruption is complete and catheter cannot be placed, a suprapubic tube should be placed for initial management
  - Ultrasound guidance can be used to aid in placement
Management

- Two options exist in management after suprapubic tube placement
  1. Continued suprapubic tube with delayed repair
     - Traditionally, gold standard in management
     - SP tube is left in place and area is allowed to heal with scar formation
     - After 2-3 months, pt. is reimaged and managed with either endoscopic incision of stricture or open excision of scar and urethroplasty
     - Depending on the cephalad extent of scar, open repair may require partial or complete pubectomy for adequate exposure
     - Success rate of open repair (no recurrence of stricture) is approx. 85%²
Management

2. Primary realignment and management with urethral catheter

- When the patient is stabilized, cystoscopes are used antegrade and retrograde to identify the lumen and wire placement allows catheter to be placed across the defect.
- Catheter is removed after 4-6 weeks (when RUG shows no extravasation)
Delayed Repair vs. Primary Realignment

- Mouraviev et al. retrospectively reviewed patients with traumatic urethral disruption at a single center, 57 had early realignment and 39 had suprapubic tube and delayed repair
  - 100% with SP tube and plan for delayed repair developed clinically significant stricture compared to 49% with early realignment
  - About 50% of patients with strictures were able to be managed endoscopically (with DVIU or balloon dilation) in both groups
  - 24% of primarily realigned patients vs. 49% of SP tube/delayed repair required open reconstruction (p<0.05)
  - Both erectile dysfunction and incontinence rates were significantly lower in patients who underwent early realignment
    - 34% vs 42% and 18% vs 26% respectively (p<0.05)
Delayed Repair vs. Primary Realignment

- Reports of smaller series show stricture rates of 50-80% in patients undergoing primary realignment after posterior urethral disruption
  - All are retrospective and small numbers of patients

- Based on this and other data, the AUA guidelines\(^4\) for urethral disruption are as follows:
  - Clinicians may perform primary realignment (PR) in hemodynamically stable patients with pelvic fracture associated urethral injury.
  - Clinicians should not perform prolonged attempts at endoscopic realignment in patients with pelvic fracture associated urethral injury.
Recent data has been published suggesting that urethroplasty after early realignment is more complicated than in patients treated with only suprapubic tube drainage.

Tausch et al. \(^5\) retrospectively evaluated 38 patients who underwent urethroplasty for posterior urethral disruption.

- 17 underwent early realignment vs. 21 who received suprapubic tube and delayed repair.
- No statistically significant difference in stricture length noted.
- Significantly higher number of endoscopic procedures and more time required to resolution of stricture disease noted in realignment vs. delayed repair group.
  - Median number of endoscopic procedures 4 vs. 1, respectively.
  - Time to resolution of stricture disease 122 vs. 7 months respectively.

This study did not include information on patients who underwent realignment and did not require urethroplasty.
Pediatric Urethral Disruption

- The majority of data available regarding urethral disruption outcomes is in the adult population.

- Once again, some factors to keep in mind in children:
  - Pelvic fracture is more likely to be unstable and associated with a severely displaced prostatic urethra.
  - Displacement of the prostate off the pelvic floor makes a complete posterior urethral disruption more common in pre-pubertal boys.
  - In children concurrent bladder and urethral injuries may occur in up to 20% of the patients.
  - Longitudinal tears though the bladder neck and sphincteric complex is 2x more common in children than adults.
Pediatric Urethral Disruption

- Husman et al. retrospectively reviewed records of 81 male pediatric patients with posterior urethral disruption
  - 64 treated with suprapubic tube and late repair, all of which required open reconstruction
  - 17 patients received early realignment
    - 9 (53%) developed severe strictures requiring urethroplasty (similar to rate in adults)
    - 7 of the 8 remaining patients required at least one endoscopic intervention, but did not require open reconstruction
    - Urethroplasty following primary realignment was not found to be associated with any increase in incontinence or erectile dysfunction
Pediatric Urethral Disruption

- Due to the factors mentioned above, pediatric patients with urethral disruption often experience significant long-term sequelae regardless of how they are initially managed.

- In a cohort study by Boone et al., 24 boys with pelvic fracture and posterior urethral disruption were observed into the post-pubertal period.
  - Long-term complications evaluated included recurrent rates of symptomatic stricture, erectile dysfunction and incontinence.
    - Complications were found to be significantly increased in patients whose injuries extended above the prostato-membranous junction including 25% with urinary incontinence.
    - Although no patients with disruption only at the prostato-membranous junction had incontinence,
      - 31% had erectile dysfunction
      - 12% had intractable stricture disease.
“It’s the gift that keeps on giving, Clark”
Conclusions

- Pelvic fractures are often associated with injuries to the lower urinary tract.

- Once the trauma patient is stabilized, proper imaging evaluation is imperative for appropriate management of genitourinary injuries.

- Management of bladder injuries varies based on location of the injury, whether there is intraperitoneal or extraperitoneal extravasation and other complicating factors.

- Urethral disruption can occur with pelvic fractures and is more common and often more severe in pediatric patients.

- Management of complete disruption often requires initial suprapubic tube placement, but can then be managed with early realignment or delayed open repair.

- In up to ½ of cases, early realignment can preclude the need for open reconstruction, although endoscopic management of recurrent strictures may be required.

- Long term sequelae of urethral disruption include incontinence, erectile dysfunction and recurrent symptomatic stricture disease. These are more common when the injury extends cephalad toward the bladder neck.
References


QUESTIONS

1. All of the following statements are true EXCEPT:
   - A. Cystography is required in patients with microscopic hematuria associated with pelvic fracture.
   - B. Patients with intraperitoneal bladder rupture usually require emergent surgical repair.
   - C. Extra-peritoneal bladder rupture may often be managed with indwelling urethral catheter without surgical exploration.
   - D. CT cystogram is performed by capping the indwelling urethral catheter allowing the bladder to fill prior to the initial CT survey of the abdomen and pelvis.
2. Regarding urethral injuries, which of the following statements is false?

A. Approximately 90% of males with pelvic bone fractures secondary to blunt force trauma will sustain a concomitant urethral injury.

B. Males are more likely than females to sustain urethral injury with pelvic fracture due to the pubo-prostatic ligament.

C. Vaginoscopy and cystoscopy should be considered in lieu of urethrography in female patients with pelvic fracture and suspected urethral injury.

D. Retrograde urethrography is required in male patients with pelvic fracture and suspected urethral injury.
3. Management of urethral disruption injuries may include all but which of the following?

- A. Immediate placement of suprapubic cystostomy tube.
- B. Attempt at early realignment of urethra using endoscopic technique.
- C. Perineal exploration and urethroplasty within 7-10 days of injury in hemodynamically stable patients.
- D. Endoscopic incision of recurrent urethral stricture 6 months after urethral repair.
QUESTIONS

4. Which of the following statements is false regarding PEDIATRIC patients with urethral injury and pelvic fracture?

- A. Boys are two times more likely than adult patients so sustain longitudinal tears through the bladder neck and sphincter complex.
- B. Girls often sustain concomitant vaginal injuries and present with vaginal bleeding.
- C. Potential long term complications of urethral disruption injuries include recurrent urethral stricture, urinary incontinence, and erectile dysfunction.
- D. Associated injuries are less likely in children than in adult patients.
Thanks!

HA HA, I DID IT!