



Chapter 47 - Genitourinary Trauma

Episode Overview

1. List 6 general indicators of genitourinary trauma?

Lower urinary tract and external genitalia

1. What are the four parts of the male urethra?
2. What is the mechanism of an anterior urethral injury (at least 5 causes)? What is the mechanism of a posterior urethral injury?
3. List 4 indications for retrograde urethrogram before foley placement?
4. Describe the technique for a retrograde urethrogram?
5. Classify bladder injuries and describe the mechanism of injury.
 - a. Differentiate between extraperitoneal and Intraperitoneal bladder rupture
6. Describe the indications and technique for retrograde cystogram?
7. Outline the management of the different types of bladder injuries.
8. List 3 clinical findings of a penile fracture
9. Describe the management of penile
 - a. Constricting devices
 - b. Superficial hematoma
 - c. Superficial lacerations
 - d. Degloving injury
 - e. Penile Fracture
 - f. Penile amputation
 - g. Blunt scrotal trauma
 - h. Bites

Upper urinary tract

1. What is the presentation of a ureteric injury?
2. What are the indications for renal imaging in an adult trauma patient? In a pediatric trauma ?
3. Describe the management of renal injuries:
 - a. Blunt
 - b. Penetrating

Wisecracks:

1. What is the most common site of urethral injuries?

Rosen's in Perspective

- People rarely die from renal injuries in the ER (unless their kidney gets pulverized!)
 - There is a reason why we don't say "ABC...U"
- Usually the signs and symptoms are subtle, but missing them can lead to long term:
 - Kidney Disease
 - HTN, incontinence, sexual dysfunction
- Diagnosis of urinary tract trauma is done in a retrograde way



A note on female trauma:

- Watch for vaginal lacerations in the female with pelvic #'s, but urethral injuries are VERY rare.
 - Protected because of the symphysis pubis and its shorter length
- Retrograde urethrography is NOT recommended in the ER
 - Speak with your urologist if you are concerned

Digital Rectal Exam (DRE)

- “A palpably abnormal (high riding) prostate is an insensitive indicator of urethral injury”
- A DRE still may be worthwhile in the tertiary survey to look for sphincter tone integrity, bones, gross blood, etc.

1) List 6 general indicators of genitourinary trauma?

- I. Flank / abdominal / rib / back / pelvic / scrotal pain
 - A. Worry in cases of pelvic #'s
 - B. Anyone with pelvic/suprapubic tenderness
- II. Urinary retention
- III. Penile/scrotal ecchymosis
- IV. Gross hematuria = urologic injury until proven otherwise
 - A. “Microhematuria” is not a reliable indicator of significant pathology
 - B. Make sure that its not just rhabdomyolysis - leading to myoglobinuria (no RBCs on urinalysis)
- V. Blood at the urethral meatus

Delayed signs:

- Renovascular hypertension
- Incontinence
- Sexual dysfunction

Lower urinary tract and external genitalia

1. What are the four parts of the male urethra?

- I. Pendulous urethra
- II. Bulbous urethra
- III. Membranous urethra
- IV. Prostatic urethra

- Anterior urethra (#1-2) and posterior urethra (#3-4) are divided by the urogenital diaphragm

See figures 47:1-3 for more visual aids.

2. What is the mechanism of an anterior urethral injury (at least 5 causes)?

- Straddle injuries (crushing of the bulbous urethra by falling astride an object)
 - The urethra gets crushed in between the metal bar and the pubic symphysis leading to blood and urine seeping out)
- Falls
- Gunshot wounds



- Self instrumentation
- Amputation

What is the mechanism of a posterior urethral injury?

- Pelvic fractures involving the ischiopubic rami
 - Straddle #
 - Malgaigne #

3. List 4 indications for retrograde urethrogram before foley placement?

- RUG:
 - History of urethral trauma (straddle injury)
 - Scrotal or penile hematoma
 - Blood at the urinary meatus
 - High risk pelvic fracture
- Caveat...
 - That being said: Rosen's mentions that a Foley should NEVER be placed with any suspicion of urethral injury until a RUG is performed.
 - Thought is that this will convert a partial tear into a complete one.
 - This teaching is not supported or clearly refuted in the literature.
 - "A small retrospective case review of 13 cases showed no damage with *careful* blind insertion Foley catheter insertion attempts"

4. Describe the technique for a retrograde urethrogram?

- This is **not** an emergency procedure
- Steps to a retrograde urethrogram:
 - Prepare, position supine
 - Shoot a pre-injection KUB film
 - Use a 60 mL syringe (+/- Christmas tree adapter) and snugly fit it into the urethral meatus (index and thumb)
 - Inject 60 mL of contrast over 30-60 seconds (firm, slow)
 - Take second X-Ray during injection of the last 10 mL
- A normal study would show contrast entering the bladder
- A partial injury has extravasating contrast and some contrast in the bladder
 - May not be safe to pass a foley
- A full injury = no contrast in the bladder
 - Use a suprapubic catheter (e.g. peel-away sheath, or others).

HUGE caveats:

- RUG is deferred if pelvic CT and angiography is anticipated because the contrast will obscure the imaging and attempts to control pelvic hemorrhage with angiography.



Management of urethral injuries:

- No injury = drop that foley!
- Partial injury = *carefully* try passing a 12-14 Fr Foley
 - Probably needs a stent by Urology
- Complete tear =
 - Insert a suprapubic to measure urine output or evacuate the bladder (e.g. if osmotic agents are used!)
 - Probably needs a stent / endoscopic repair
- Female patients:
 - Proximal urethral injuries need immediate surgical exploration and repair to avoid serious fistulae formation
 - Distal injuries can be treated with a foley catheter
 - Vaginal lacerations need transvaginal repair

5. Classify bladder injuries and describe the mechanism of injury.

- Bladder at highest risk when full
 - $\frac{2}{3}$ from blunt trauma, 90% from MVC ejection/seat belt
 - 80% of ruptures are associated with pelvic #s
 - Occasionally injured in penetrating stab or missile trauma
- Bladder has three layers with blood supply from the internal iliac artery/vein
 - Muscle contracts via parasympathetic stimulation
- Three injury types:
 - Contusions
 - Intra-peritoneal ruptures
 - Extra-peritoneal rupture
- Diagnostic clues:
 - Lower abdominal / suprapubic pain
 - Pelvic #s
 - Unable to urinate
 - **Gross hematuria** - present in 95% of cases! Especially in the presence of pelvic #'s

a. Differentiate between extraperitoneal and Intraperitoneal bladder rupture

- **Not** mutually exclusive!
- Intraperitoneal
 - Blunt lower abdominal trauma with a distended bladder
 - The blunt forces stretch the weaker dome of the bladder
 - Leads to intraperitoneal urinary contamination
- Extraperitoneal
 - Usually in the setting of pelvic fractures (shear force) where the anterolateral wall gets torn at its fascial attachments
 - Urine then may fill the:
 - Perivesical space
 - Penis, scrotum, thigh, anterior abdominal wall, obturator foramen
 - Retroperitoneum



6. Describe the indications and technique for retrograde cystogram?

- Indications
 - Any suspicion of bladder injury
 - Gross hematuria without pelvic #
 - Microhematuria with pelvic #
 - **“Grossly clear urine in a blunt trauma patient with a pelvic # virtually eliminates the possibility of bladder rupture”**
- Technique
 - Virtually everyone gets a CT
 - Don't do a anterograde cystogram - because it will give incomplete findings
- Conventional retrograde cystogram:
 - Steps:
 - Shoot a conventional KUB xray, and keep the patient supine
 - Fill the bladder
 - Use a large “Toomey” syringe to connect to the foley catheter and then pour the full strength contrast material into the syringe chamber and allow the bladder to fill via GRAVITY
 - Careful not to let the contrast leak around the patient and spill on the genitalia!
 - Instill at least
 - 100 mL with immediate x-ray post
 - 300-400 mL in any patient >11 yrs
 - Although unless the bladder gets fully distended, a true injury to the bladder may be missed!
 - Instillation of <100 mL which initiates a bladder contraction (the syringe is filled retrogradely) , and then a second forceful injection of 50 mL followed by an X-ray
 - Extraperitoneal ruptures: the contrast stays in the pelvic outlet
 - Intraperitoneal ruptures:the material highlights loops of bowel/liver/spleen
- CT RCgram
 - Usually the person has had a CT abd/pelvis already
 - Then fill the bladder with contrast
 - Shoot the CT again
 - No need to do post-void because of the high detail on a CT
 - Goal is to see if there is “contrast ascites - intraperitoneal bladder rupture”

7. Outline the management of the different types of bladder injuries.

- Bladder contusions (no extravasation) = foley catheter
- Extraperitoneal bladder ruptures =
 - Uncomplicated injuries: observation with foley drainage
 - **Complicated injuries needing operative repair:**
 - **Concomitant rectum/vagina**



- Bladder neck injury
- Need for laparotomy
- Intraoperative bladder ruptures:
 - All NEED OR repair (non-urgently) If otherwise:
 - Lower urinary tract contamination will lead to bacterial peritonitis

8. List 3 clinical findings of a penile fracture

A rupture of the corpus cavernosum - due to a tearing of the tunica albuginea
Due to vigorous activity in masturbation/sexual activity/otherwise

1. **Slowly progressive penile hematoma**
2. **“Snapping sound” followed by immediate pain and detumescence**
3. **“Egg plant” deformity - swelling and ecchymosis localized to the shaft of the penis**
If Buck’s fascia is torn the swelling may progress to the scrotum, perineum and pubis

Penile # can be associated with urethral injury (10-38%) of fractures. Signs of this include:

- Gross hematuria
- Blood at the meatus
- Inability to void

Imaged with corpus cavernosography¹, ultrasound, and **MRI**

9. Describe the management of penile injury

Anatomy review (see fig 47-24):

- Penis:
 - Three masses of erectile tissue (dorsal corpora cavernosa x 2, ventral corpora spongiosum x 1 where the urethra lies) enclosed each with the tunica albuginea and all within Buck’s fascia.
 - Each mass of erectile tissue has an artery, and there are two additional dorsal arteries, a superficial and deep dorsal vein and dorsal nerve.

Clinical knowledge:

- Mechanism of injury
- State of the penis at time of injury (flaccid / erect)
- Tetanus status
- Kids:
 - Look for hair tourniquet in children vs. idiopathic foreskin
- Physical examination useful for penile injury

Diagnostic imaging:

- Need a consulting urologist to guide us!
 - Consider:
 - Retrograde urethrography if concerned about urethral injury

a. Constricting devices

- i. “...promptly identified and removed, a procedure that can test the ingenuity of even the most experienced ER physician”
- ii. Saws, metal cutters, etc.

¹ <http://pubs.rsna.org/doi/abs/10.1148/radiology.144.4.7111726?journalCode=radiology>



- iii. Each corpora has its own blood supply, so surgery can be delayed to see what tissue is viable even though penile skin may slough off...
- b. Superficial hematoma**
 - i. Must rule out rupture of the tunica albuginea (i.e. no immediate detumescence of the erect penis)
 - ii. Treatment: Ice, NSAIDS
- c. Superficial lacerations of penis / scrotum**
 - i. Approximate with 4-0 chromic gut or vicryl **absorbable suture**
- d. Degloving injury**
 - i. Anything with skin loss should be treated by a urologist / plastic surgeon
 - ii. May need skin grafting or flaps
- e. Penile Fracture**
 - i. NEED urgent **24-36 hr** surgical repair of the tunica albuginea
- f. Penile amputation**
 - i. Violence, psychiatric disorder
 - ii. Treatment:
 - 1. Reimplantation - even up to 24 hrs post
 - a. Carefully wrapped in sterile, saline moistened gauze in a plastic bag, then in a second bag of ice.
 - b. The bleeding stump - direct pressure
 - 2. Local reshaping
- g. Blunt scrotal trauma**
 - i. Tough tunica albuginea surrounds the testicles and cremasteric reflex
 - ii. 85% of injuries happen during sporting events (kicks, falls, strikes)
 - 1. Testicular rupture: happens in 40% of blunt scrotal trauma who come to ER
 - iii. Symptoms:
 - 1. Pain, faintness, N/V, urinary retention
 - iv. Physical assessment is of limited helpfulness
 - 1. **Need imaging with ultrasound:**
 - a. 95% sensitive for testicular rupture (heterogenous echo pattern in the testicular parenchyma with a "loss of contour definition")
 - 2. Consider a wider ddx: testicular rupture, scrotal hematoma, hematocele, intratesticular hematoma, traumatic torsion, testicular avulsion, testicular displacement, epididymal injury.
 - v. Treatment:
 - 1. Testicular rupture, large hematocele, traumatic torsion, testicular dislocation = surgical exploration
 - 2. **Surgical exploration needs to happen within 72 hrs for maximal salvage** (urgency guided by ultrasound findings!)
 - 3. Testicular contusions: bed rest, ice packs, NSAIDS, Urology f/u
 - vi. Penetrating trauma generally all need surgical evaluation!
- h. Bites**
 - i. Human:
 - 1. *Eikenella corrodens*, viral infections, hepatitis, HIV
 - ii. Animal (dogs/cats):
 - 1. *Pasteurella multocida*, aerobic organisms
 - 2. Rabies



- iii. Simple bites:
 1. 6-12 hrs old and no gross contamination: irrigation and primary closure
 2. Broad spectrum ABx: amoxicillin-clav.
- iv. Complicated bites (contaminated/infected)
 1. Irrigated, covered, and passed to the urologist
- v. Human bites:
 1. In an immunocompromised patient:
 - a. Admission, and broad spectrum IV abx (pip-tazo)
 2. Immunocompetent:
 - a. Outpatient broad spectrum ABx, NSAIDs, re-examination in 48 hrs.
- i. Female external genitalia injury:
 - i. Etiology: pelvic #s, sexual assault, straddle injury, interpersonal violence
 - ii. Types:
 1. Hematomas, lacerations.
 - iii. Physical examination:
 1. Assessment for associated injury: vaginal, urethra, bladder, rectum
- j. Childhood injury:
 - i. Blunt or penetrating trauma
 1. Straddle injuries, sharp object puncture
 - ii. Consider non-accidental trauma!
 1. Pinches, cigarette burns, penile injury from a “falling toilet seat” in a child who doesn’t walk

Upper urinary tract

These injuries are subtle! (barring the shocky bleeding pedicle avulsion)

- May have NO hematuria!
- If you're damaging the kidney, chances are high that some other more life-threatening injuries are present as well!
 - Kidney trauma - < 0.1% of trauma deaths
- Anatomy:
 - We only need $\frac{1}{3}$ of normal renal function to sustain life.
 - Retroperitoneal.
 - At the level of T11ish-L1-4ish.
 - They are mobile and move with the diaphragm.
 - Have their own arteries, veins, adipose tissue and are covered with *Gerota's fascia (the renal fascia)*
 - All the vessels and the ureter make up the **renal pedicle**, and enter and exit at the **hilum**
 - Renal structure: cortex - medulla - columns of Bertin → renal pelvis (funnels called calyces)
 - Perfused with 1200 ml of blood per minute (25% of cardiac output!) - 90% goes to the cortex
 - When the blood flow is reduced the kidney produces renin:
 - → the Renin-Angiotensin-Aldosterone system then gets activated leading to arteriolar vasoconstriction, aldosterone release. (net increase of blood pressure and blood volume)
- Epidemiology
 - Renal injury - most commonly injured structure in the GU tract.



- Blunt trauma from MVCs/falls/direct blows to the flank account for 90% of injuries
 - High energy injury damages all the structures that coalesce at the UPJ
- Penetrating trauma - often leads to nephrectomy
- Renal vein injuries → much more common than renal artery injury
 - (if artery injured they have reflexive protective vasospasm)
 - Veins often are partially torn and continue slowly bleeding
 - IV contrast CT will find arterial blush, but the renal vein injuries assumed to be present with large hematomas adjacent to the kidney
- Complications from trauma:
 - Urinary extravasation (more common in penetrating ~15% than blunt ~9%)
 - Hypertension, after trauma, is rare unless renal artery is occluded.

1. What is the presentation of a ureteric injury?

- Anatomy & physiology
 - They live in the retroperitoneal space as they exit the kidney
- 80% are iatrogenic!
 - From abd/pelvic surgery
- Trauma cases are rare - because they are well protected by psoas, vertebrae, pelvis
 - GSW's most common traumatic injury mechanism
 - *Massive blunt trauma force can disrupte the ureter at the UPJ (ureteropelvic junction)*
- Signs:
 - No reliable acute symptoms/signs
 - gross/microscopic hematuria - (absent in 25% of cases)
 - With hypotension (in blunt trauma)
 - Suspect injury in penetrating trauma that passes along the ureter's course
 - Delayed symptoms/signs:
 - Fever, n/v, hematuria, flank pain, palpable flank mass (urinoma)
- Diagnosis:
 - CT with delayed (10min) IV contrast is most accurate and practical in acute trauma
 - Retrograde pyelography - more sensitive than CT but less practical
 - Intravenous pyelography - may be done in the OR. IV contrast is given; 10 mins later a KUB x-ray is performed.
 - Can be used to identify delayed injuries that present as urinomas
- Treatment:
 - Operative repair is required to prevent persistent urinomas, sepsis, renal failure.

2. What are the indications for renal imaging in an adult trauma patient?

- Imaging options:
 - CT
 - With contrast is the best choice for identifying upper tract injuries:
 - Contusions, lacerations, renal pedicle injury, segmental necrosis, urinary extravasation
 - Delayed phase (post contrast) will increase sensitivity
 - Allows for grading of renal injuries



- Angiography can help dx and treat artery thrombosis, lacerations and pseudoaneurysms
 - IVP
 - Used before CT was available
 - No longer recommended routinely
 - U/S
 - Low sensitivity
 - Up to 65% of isolated renal injuries won't have any free intraperitoneal fluid.
- Key point: Presence, absence, and degree of hematuria doesn't correlate well with the degree of renal injury
 - *Especially in penetrating trauma.*
- Rosen's uses a 10yr prospective hallmark study published in 1989 to guide the need for renal imaging in trauma
 - In penetrating trauma the presence or absence of hematuria doesn't help in determining who needs imaging
 - In blunt trauma reasons to obtain imaging if any of the following are present:
 - Gross hematuria
 - Microscopic hematuria WITH shock (systolic BP < 90)
 - A history of sudden deceleration injury (even in the absence of hematuria/shock)

a. In a pediatric trauma ?

- i. "In children the kidney is the most commonly injured GU organ"
- ii. Current guidelines:
 1. Kids <16 yrs post blunt trauma with any of the following should get a CT with contrast:
 - a. Gross hematuria
 - b. Microhematuria with > 50 RBCs/hpf
 - c. "Significant" deceleration injuries

3. Describe the management of renal injuries:

Grading system (from Trauma.org)

Classified according to the Organ Injury Scaling (OIS) Committee Scale

Minor	I	Contusion	Microscopic or gross haematuria, Urological studies normal
		Haematoma	Subcapsular, non-expanding without parenchymal laceration.
	II	Haematoma	Non-expanding perirenal haematoma confined to renal retroperitoneum.
		Laceration	<1cm parenchymal depth of renal cortex without urinary extravasation.
Major	III	Laceration	>1cm depth of renal cortex, without collecting system rupture or urinary extravasation
	IV	Laceration	Parenchymal laceration extending through the renal cortex, medulla and collecting system (urine leakage usually).



	Vascular	Main renal artery or vein injury with contained haemorrhage.
V	Laceration	Completely shattered kidney.
	Vascular	Avulsion of renal hilum which devascularizes kidney.

a. Blunt

- i. Patients without any indication for renal imaging, even if they have isolated hematuria may be discharged home, ideally with Urology f/u till microhematuria resolves
- ii. **Management principles** vary based on:
 1. Type and severity of injury
 - a. Grade 1 - 0% need for surgery/nephrectomy
 - b. Grade 5 - 85-93% need for nephrectomy/surgery
 - i. Any main renal artery injury older than 2-6 hours may have lead to complete renal ischemia needing a nephrectomy
 2. Hemodynamics!
 - a. Operative intervention for life-threatening hemorrhage
 3. Other associated trauma
- iii. 80-90% of injuries are Grade 1-2:
 1. Managed expectantly with bedrest until gross hematuria clears
 2. Follow-up imaging to track healing and follow-up on renal function
- iv. Very skilled interventionalists may be able to perform super selective peripheral embolization rather than complete arterial embolization (risk of infection and post-op hypertension)

b. Penetrating

- i. Location of trauma determines need for imaging
- ii. "Significant injuries to the kidney and ureter can occur without hematuria!"
- iii. Almost all penetrating renal injuries need OR

Wisecracks:

What is the most common site of urethral injuries?

1. Two most commonly injured sections (much, much more common in men than women):
 - Membranous urethra (posterior urethra): occurring with pelvic fractures such as straddle injuries or "Malgaigne" fractures (from a vertical shear injury).
 - Bulbous urethra (anterior urethra): from a straddle injury where the urethra is compressed between the object and the symphysis pubis.