Misses, Misinterpretations, and Updates of GU Trauma

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Disclosures

Relevant Financial Relationships

None

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Learning Objectives

- Updated AAST (American Association for the Surgery of Trauma) classification systems of renal trauma (2018)
- What the radiologist, trauma surgeon and urologist are looking for and how the CT findings affect treatment
- How to avoid common mistakes in GU trauma

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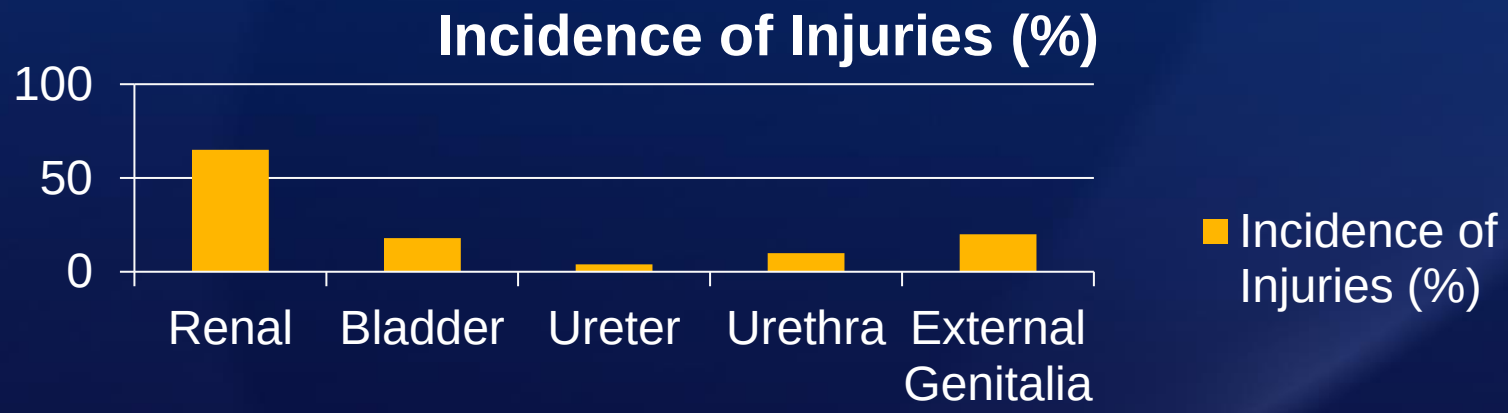
Background

- Urinary tract injuries 8% to 10% of traumatic injuries to the abdomen
- Majority are blunt injuries and 10% penetrating



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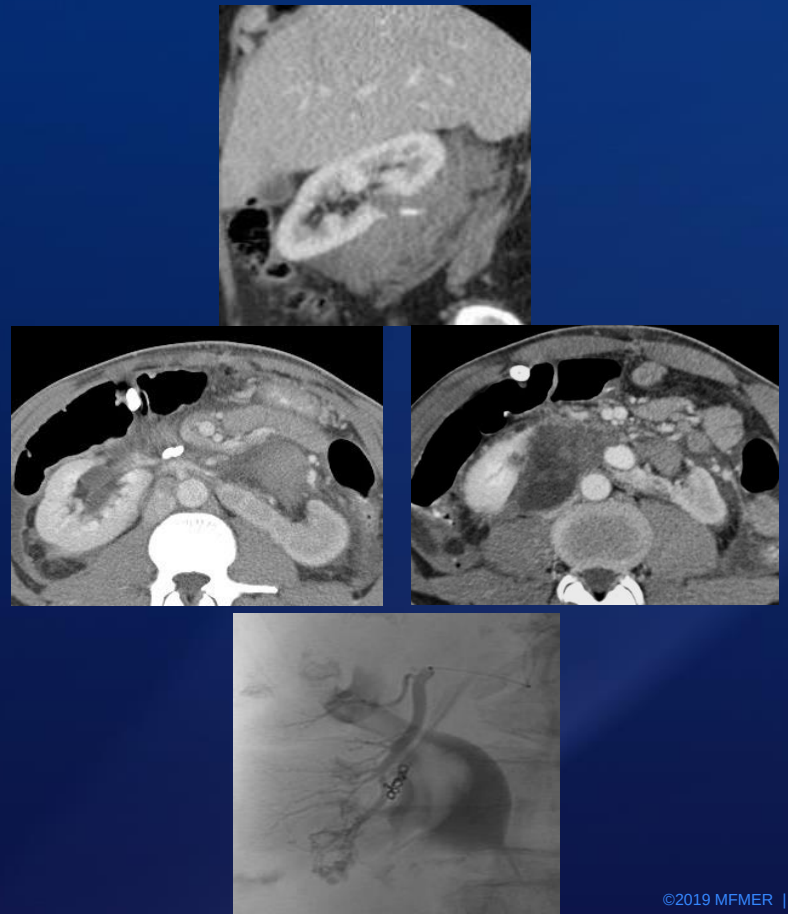
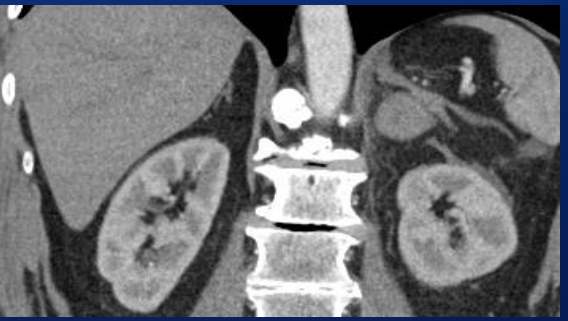
Role of Imaging

- Accurately assess the severity and extent of injury
- Evaluate the injured organ for underlying disorders
- Guide the appropriate management

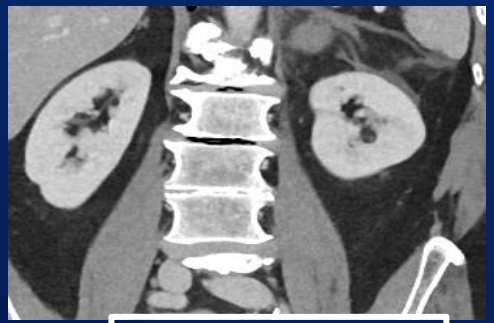


Trauma CT Protocol

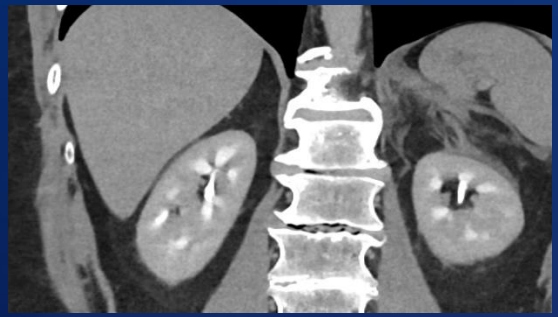
MDCT with IV contrast is the gold standard



Late arterial



Portal venous



Delayed

Cystogram

* **Look at thin images for Renal vascular injuries**

What has changed with new AAST Kidney injury scale

- Organ injury scale is valuable in risk stratification and management decisions
- Nonsurgical management has become the standard of care in hemodynamically stable patients
- Vascular injuries, such as pseudoaneurysm or arteriovenous fistula, and active bleeding have been associated with higher failure rates of non-operative management
- These findings are incorporated for the first time in the 2018 update

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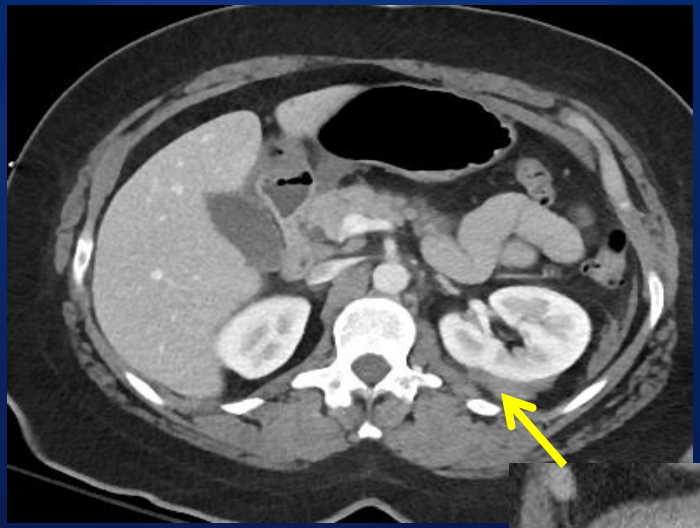
New Vascular Imaging Criteria:

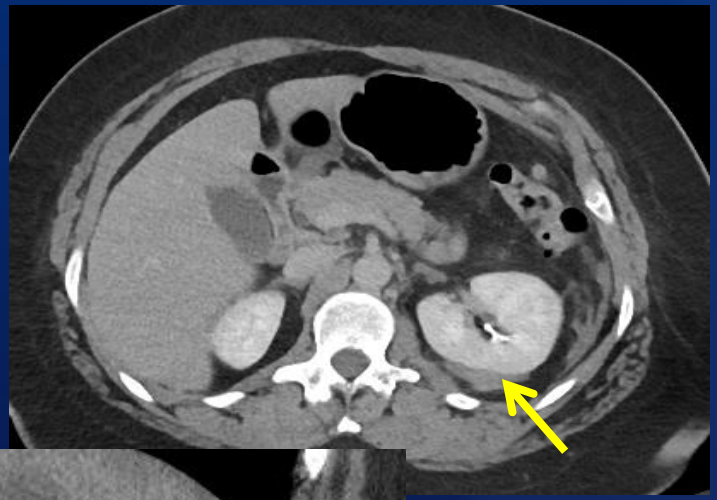
- ✓ Any injury in the presence of vascular injury or active bleeding contained within the organ parenchyma: Grade III injury
- ✓ Active bleeding beyond the organ parenchyma into the peritoneum: Grade IV injury
- ✓ Segmental or complete kidney infarction due to vessel thrombosis and segmental renal vein or artery injury→ Grade IV injuries.
- ✓ Collecting system injuries: Grade IV injury

AAST Kidney Injury Scale-Imaging features

Grade	Description of injury
I	Subcapsular hematoma/ contusion without parenchymal laceration
II	Perirenal hematoma confirmed to Gerota fascia Parenchymal laceration <1.0 cm depth without urinary extravagation
III	Deeper lacerations > 1 cm not involving the collecting system **Vascular injury or active bleeding confined to kidney/perirenal fascia**
IV	**Laceration extending to collecting system, UPJ disruption** **Vascular injury to segmental renal artery or vein** **Segmental infarction or active bleeding extending beyond perirenal fascia**
V	Shattered kidney Avulsion of renal hilum or main renal artery/vein injury which devascularizes kidney

Grade I Injury- Subcapsular Hematoma





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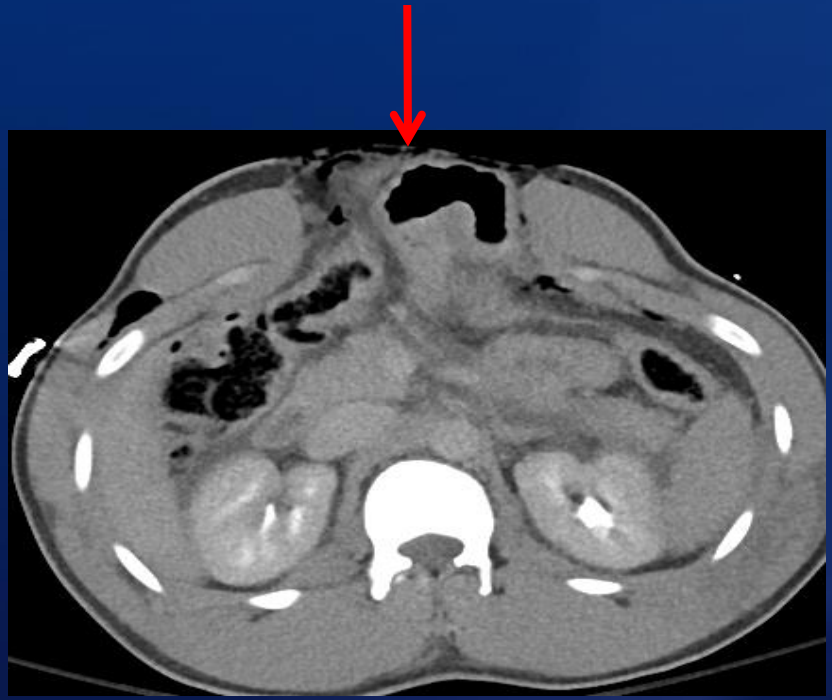
Grade I Injury- Renal contusion



Grade II- Cortical lacerations <1.0 cm

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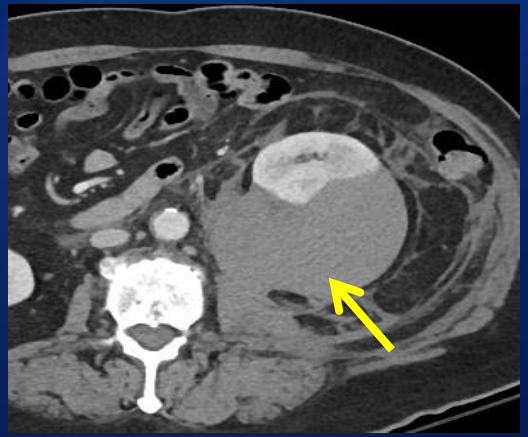
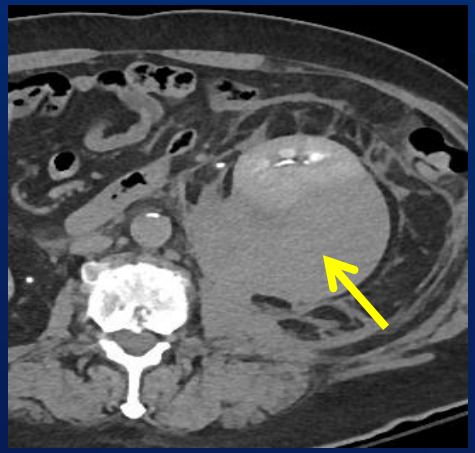
Grade II- Nonexpanding perirenal hematoma





No active bleed

69/M, Mechanical fall from standing height

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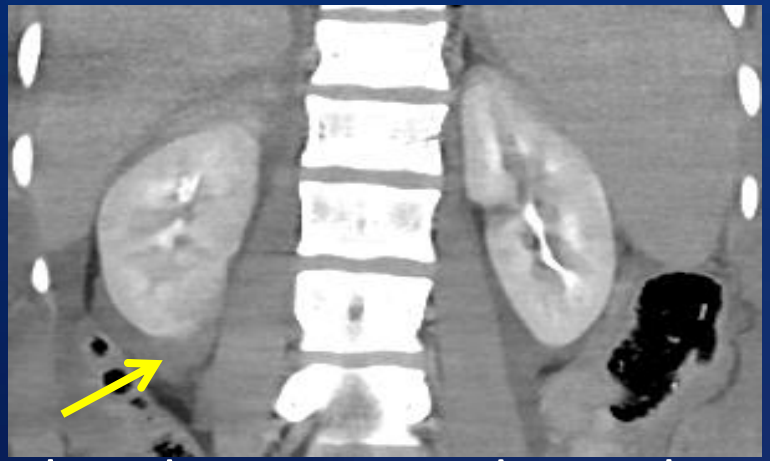
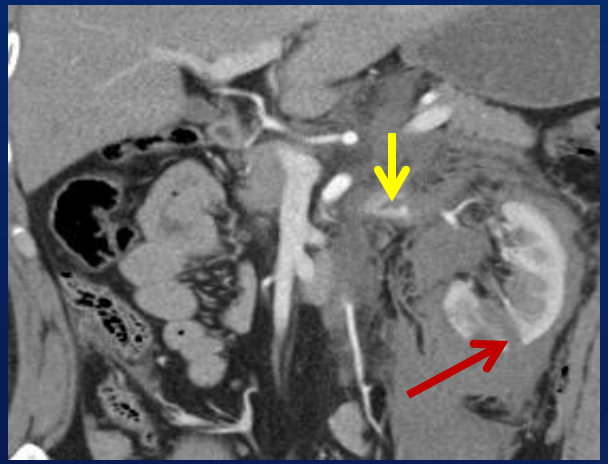
Grade III- Laceration

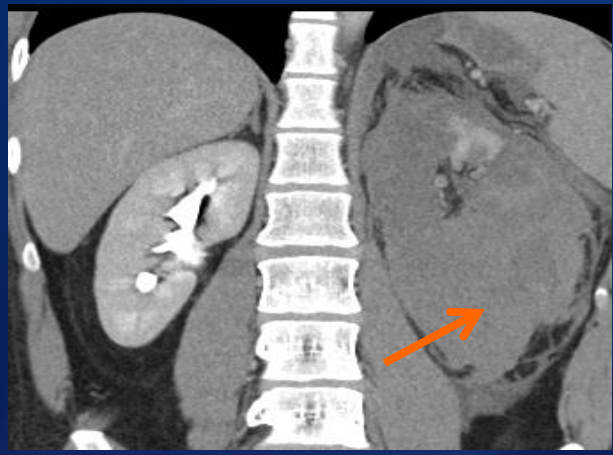


Deeper lacerations > 1 cm deep, that do not extend into the collecting system, and perinephric hematoma without extravasation

Grade IV Injury-Vascular

27/M with snowmobile accident, handlebars rolled into his upper abdomen





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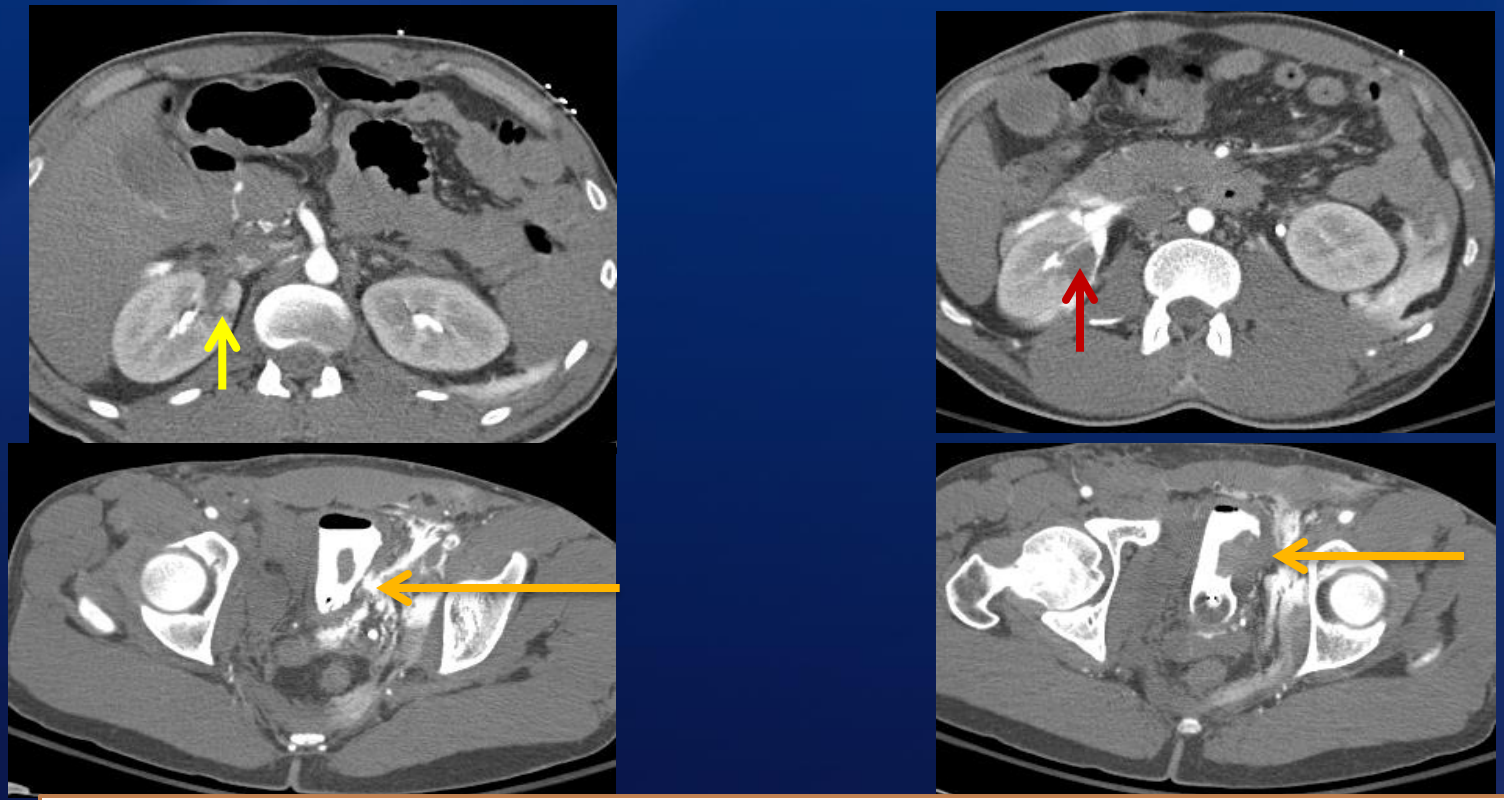
33/M unbelted truck driver traveling about 50mph that swerved to avoid another vehicle



Grade IV Injury - Laceration extending to collecting system

Same person 4 years later…

- Intoxicated unhelmeted driver of a motorcycle involved in crash at highway speeds

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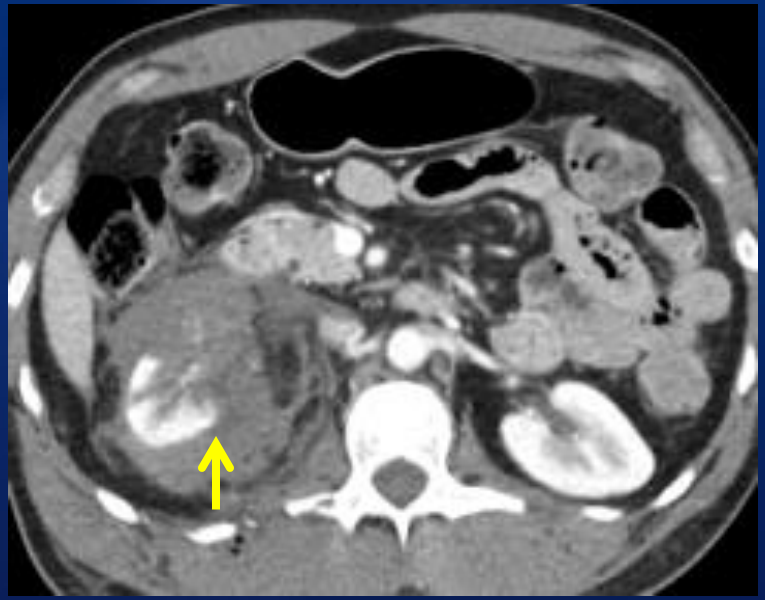
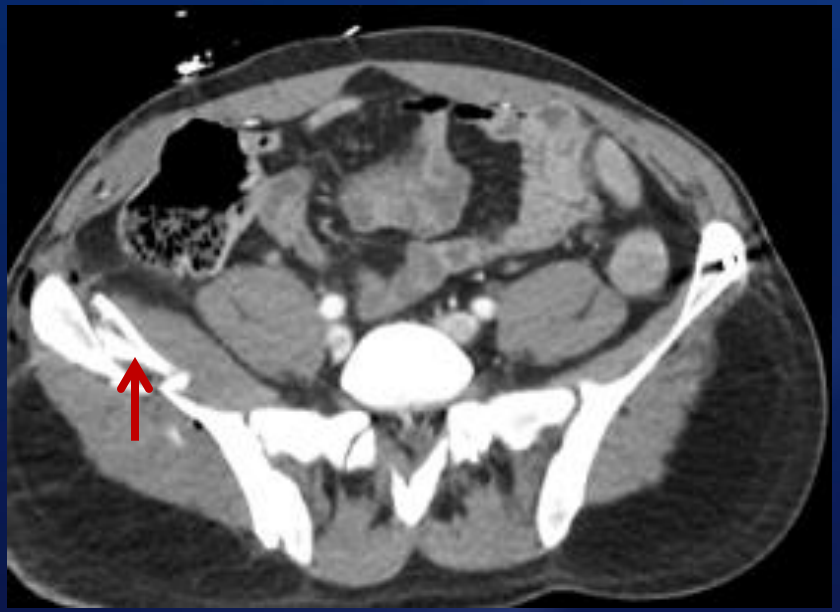
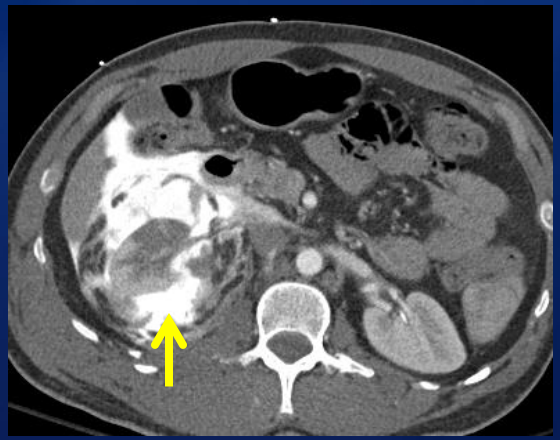
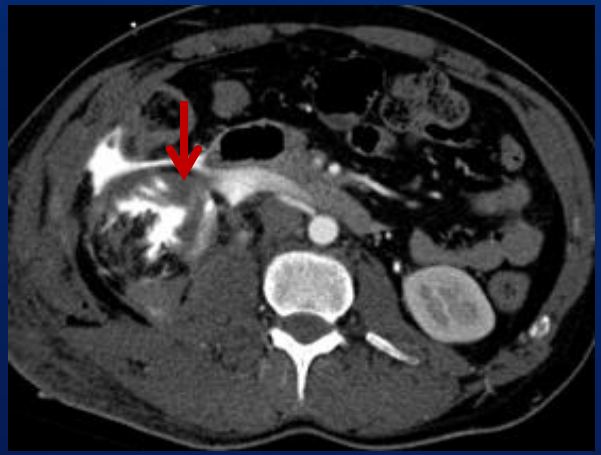
OSH



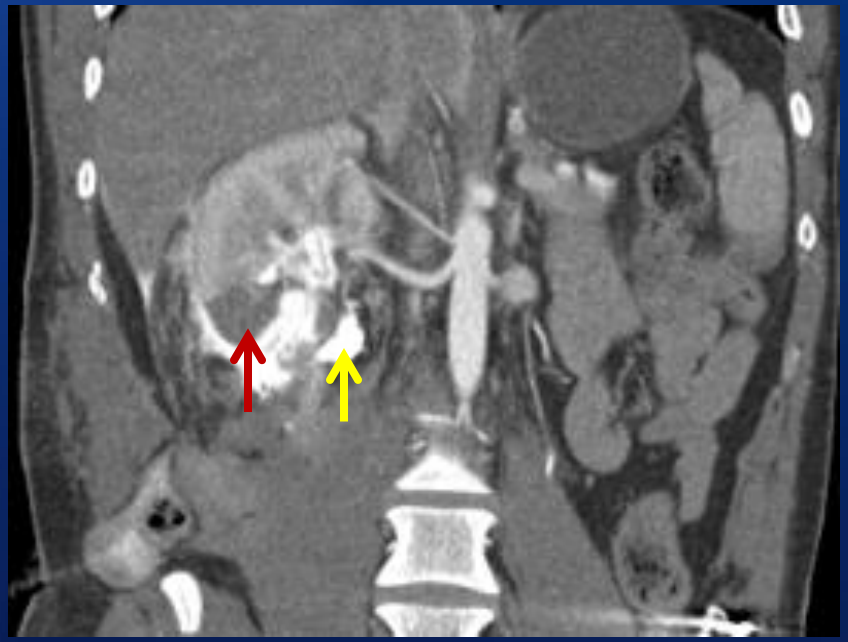


Repeat CT at our hospital 4 hours later





Urine leak can be missed if delayed phase images are not obtained



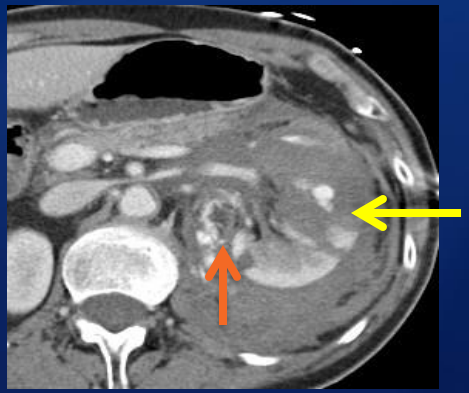
UPJ Disruption

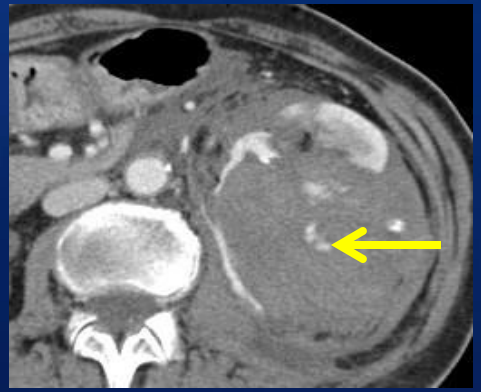
Right lower pole infarct

??? AAST Grade

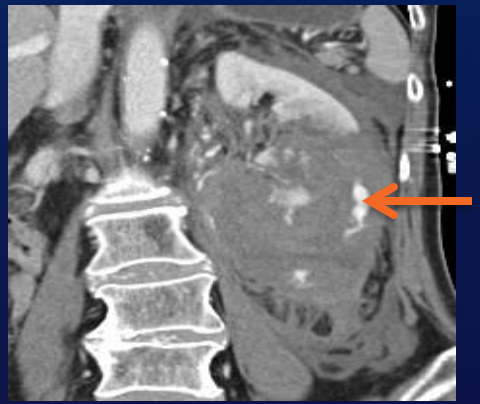
Vascular injury with infarct misinterpreted as laceration

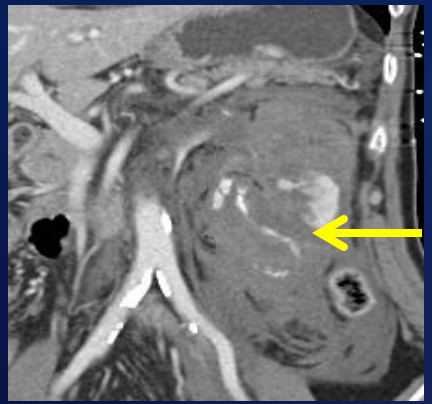
Older Gentleman, Fell working on Christmas tree…

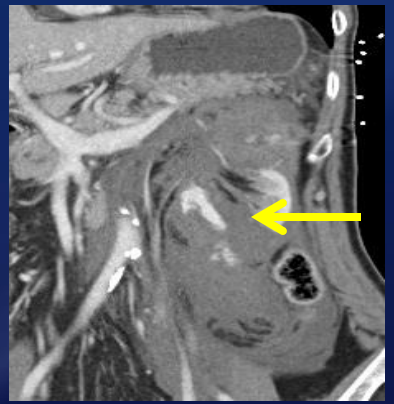




Radial lacerations, bleeding







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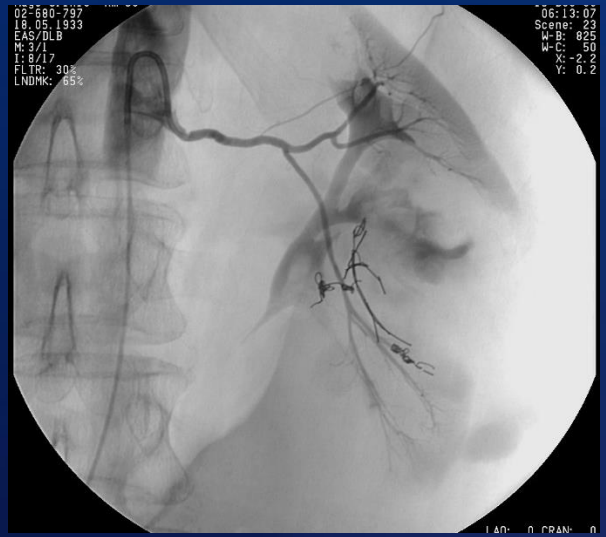
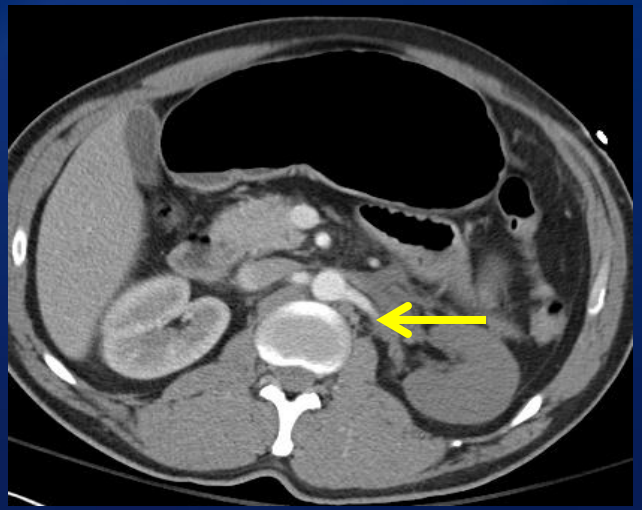
Grade V Injury, Shattered Kidney - Embolized…



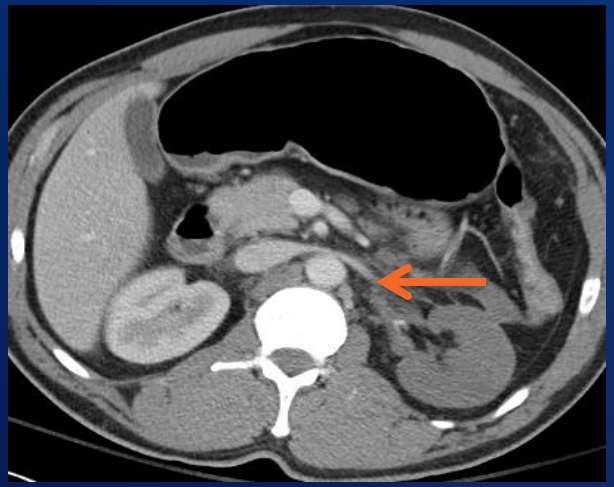
5 Months later

Grade V –Renal Pedicle Injury

43/M motorcross lost control at highway speeds



Renal artery occlusion



Retrograde renal vein filling

? Renal artery dissection
vs
Renal artery avulsion

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Renal Abnormalities

- Underlying renal parenchymal abnormalities predispose the kidney to injury

- Cyst, tumors, chronic hydronephrosis, congenital anomalies and polycystic kidneys

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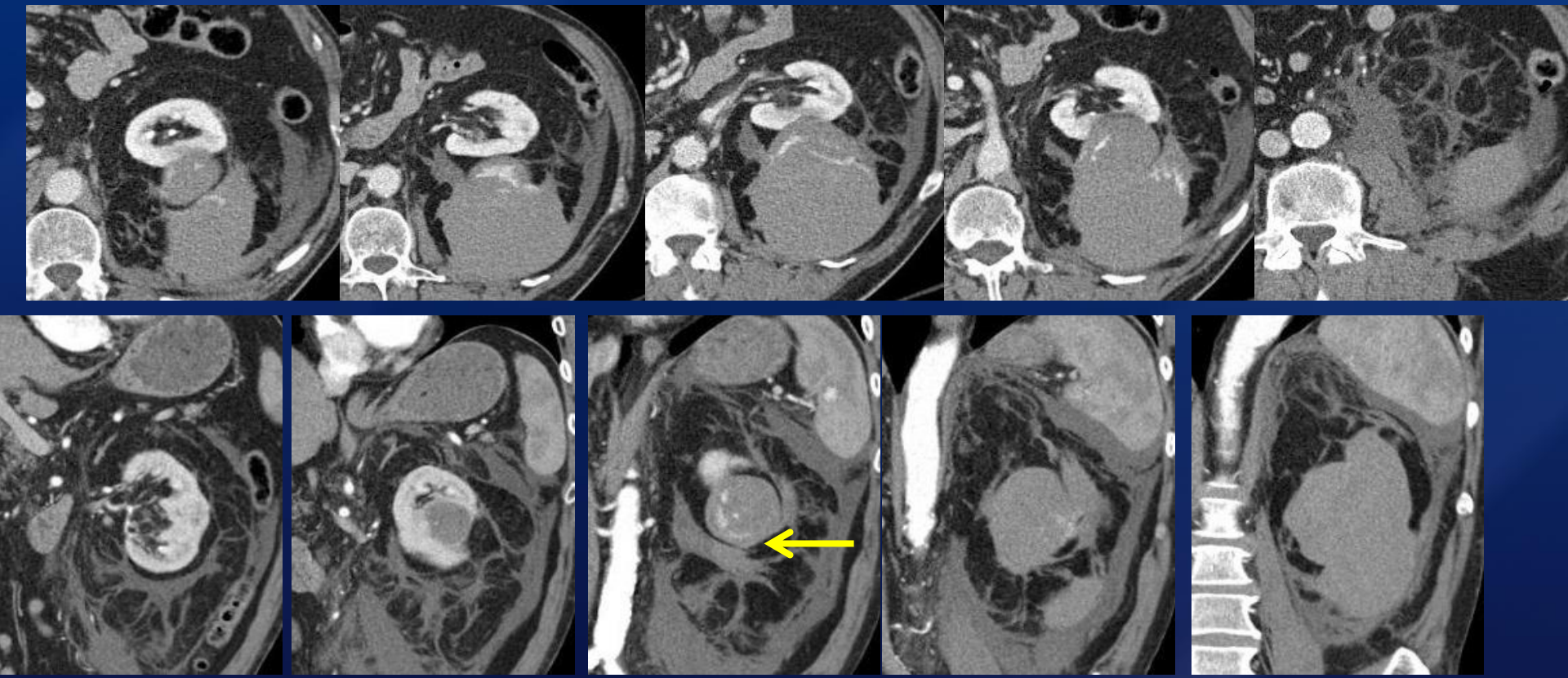
73 y/o trimming tree branches, fell 20 feet - slowly developed left flank pain, episodes of blacking out



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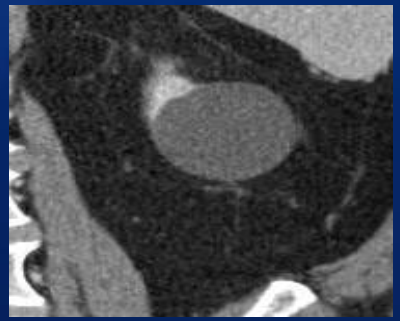
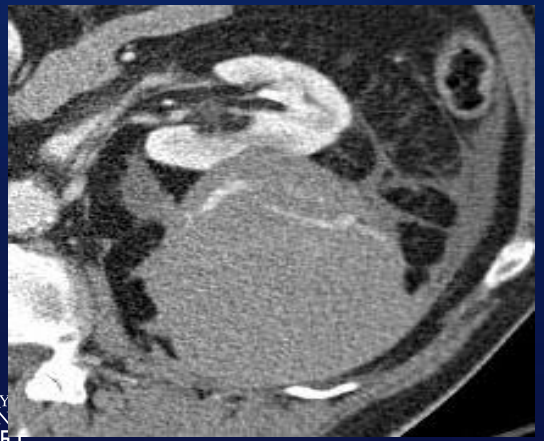
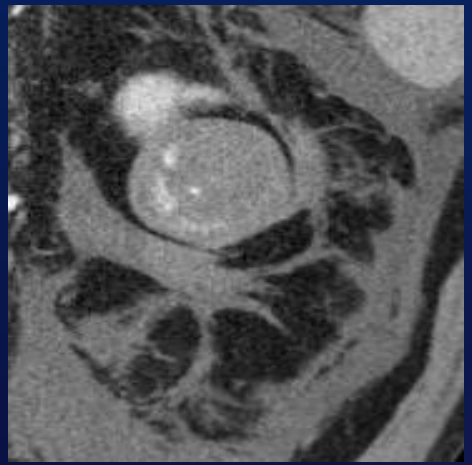
Renal Cyst Rupture & Bleed…



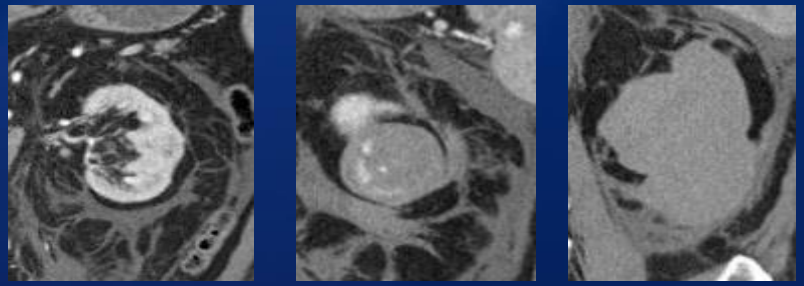
- << Comparison from 16 months earlier





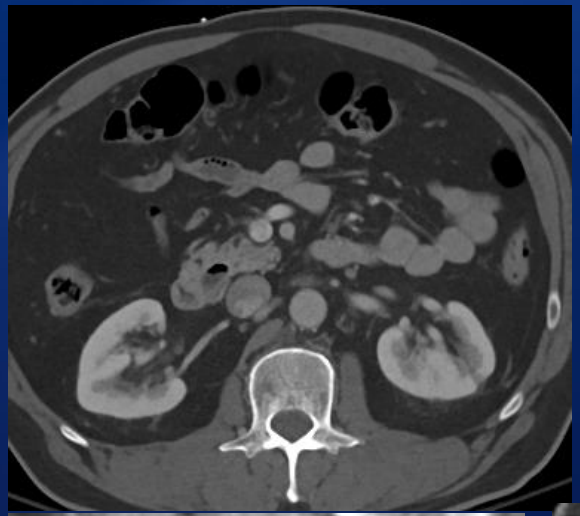
Day of injury

Renal Cyst Rupture & Bleed, continued

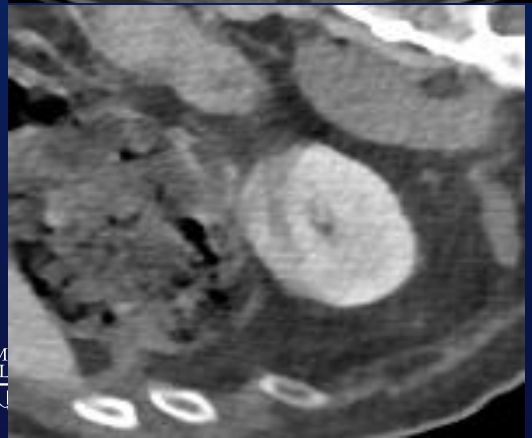


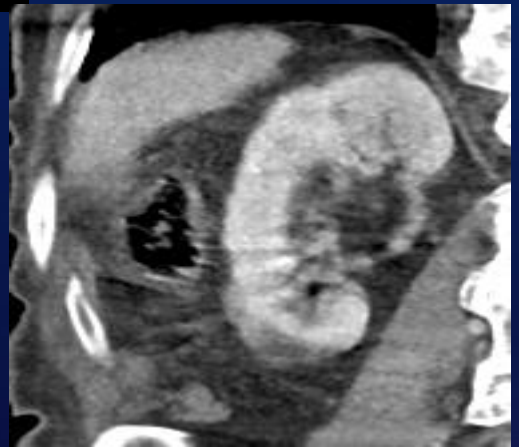
- Embolized

Additional Pitfalls



Cortical scars vs contusion





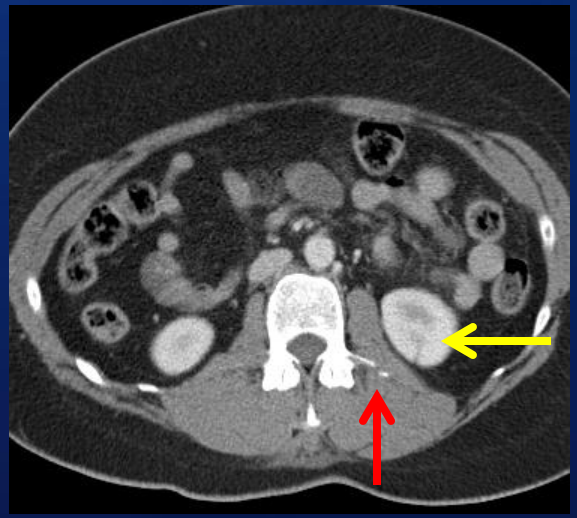
Motion artefact

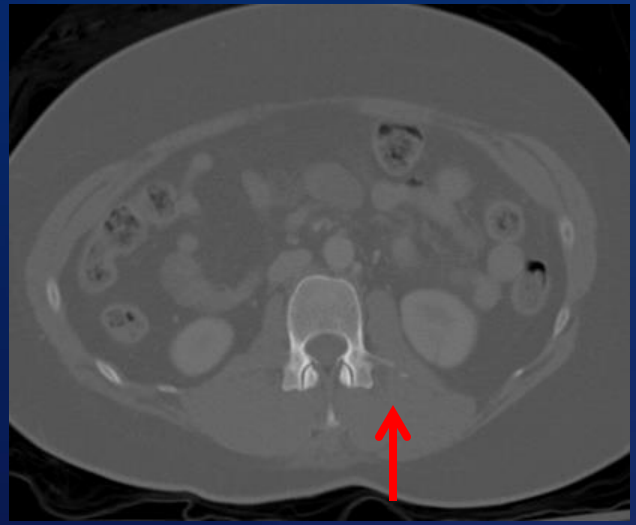
Missed Associated Injuries

- Other visceral lacerations
- Rib and vertebral fractures
- 15 to 22% of patients with missed injuries have clinically significant missed injuries

Geyer LL et al. Incidence of delayed and missed diagnoses in whole-body multidetector CT in patients with multiple injuries after trauma. Acta Radiol. 2013 Jun;54(5):592-8.

Missed lumbar Fracture





Management

Grade	Type	Treatment
I-III	Every	Non-operative (NOM), wait and see
IV	Parenchymal Vascular	NOM/Endourology NOM/IR
V	Parenchymal Vascular	NOM /Surgery NOM/IR
???	Vascular	NOM/IR

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Principles

- Hemodynamically stable patients can be safely treated conservatively by means of a simple wait-and-see treatment
- Surgical exploration should be reserved for hemodynamically unstable patients
- Endovascular and/or endourological treatments for patients showing blood and/or urine extravasation

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Ureteral trauma

- More commonly associated with penetrating injuries
- Blunt trauma often affects UPJ
- Iatrogenic injuries involve pelvic ureters

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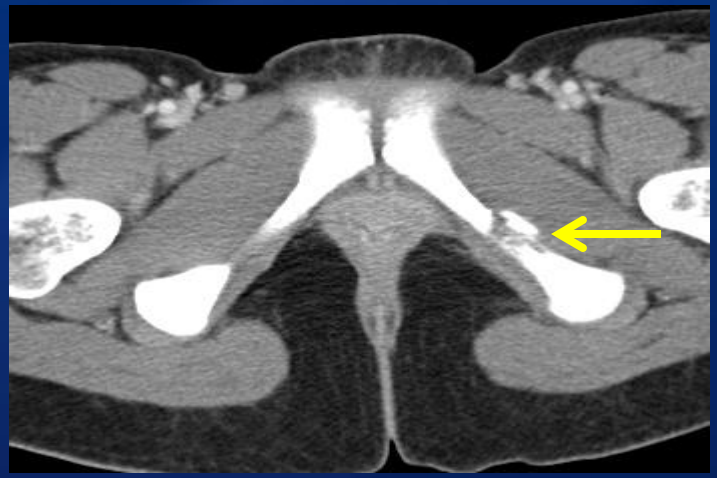
Role of CT in Ureteral Trauma

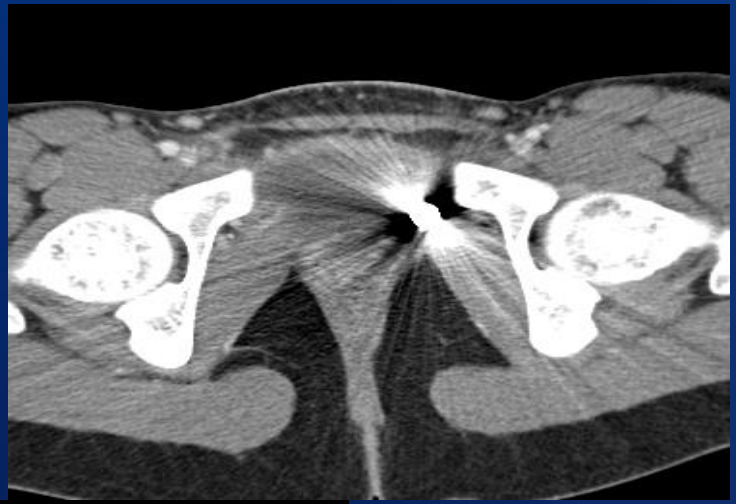
Ureteral laceration

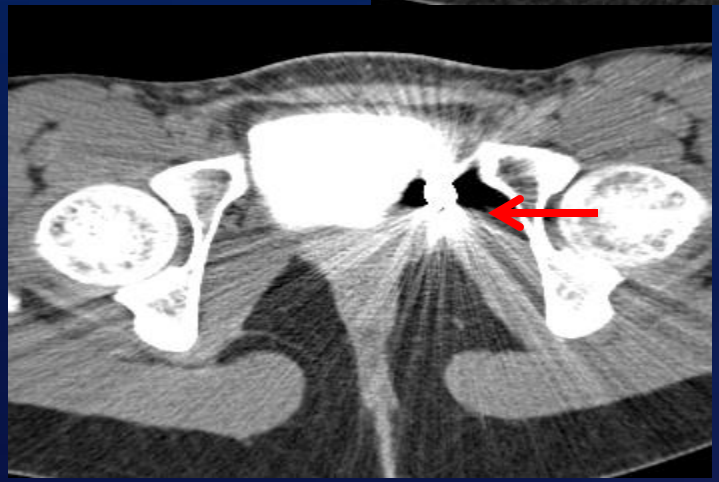
Ureteral stent

Uteretal Transection

Surgery



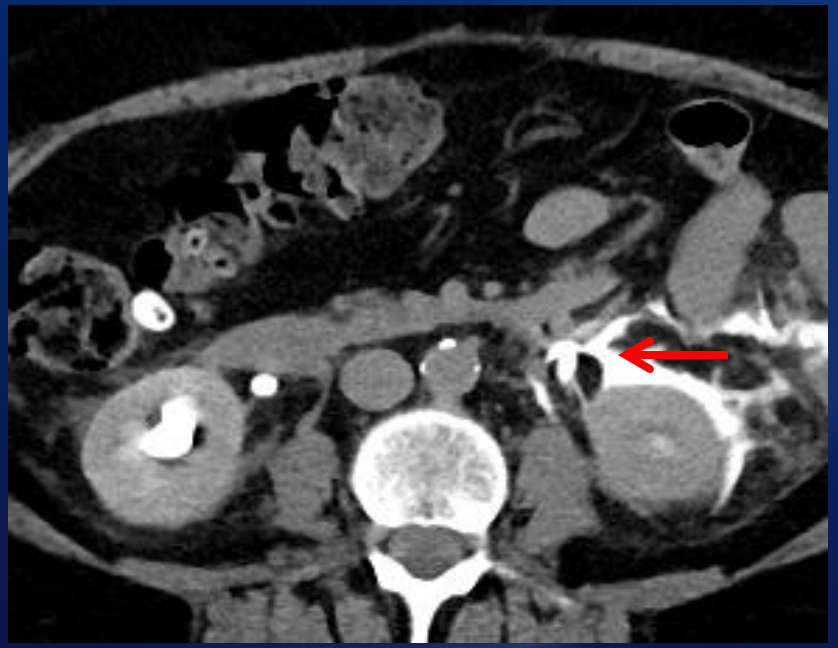




17 year old with bullet injury

Active contrast extravasation

Defect in ureter



Lower GU trauma cases

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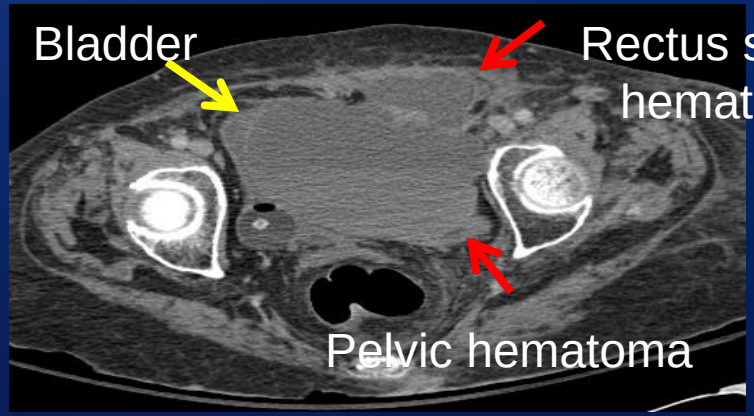
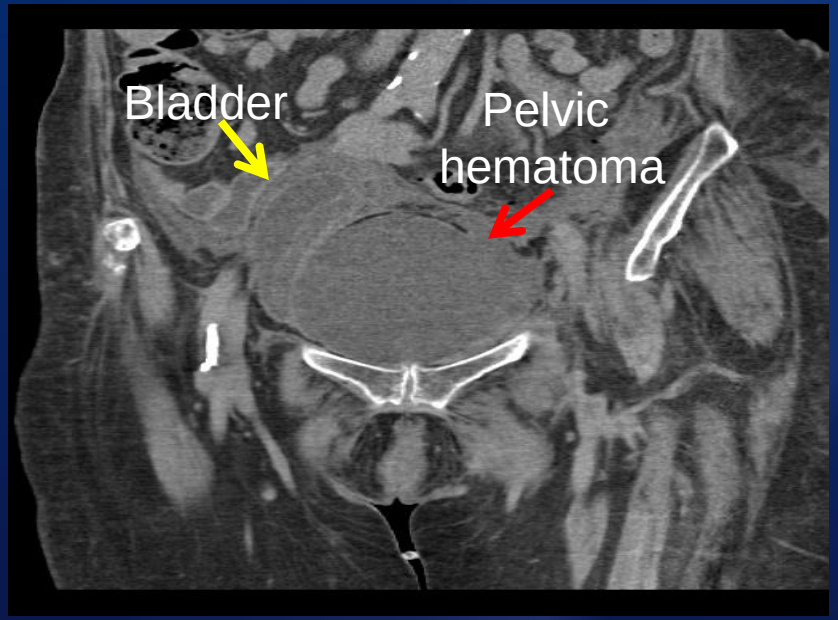
CASE 1 - Bladder

72 yo female presenting after a fall from standing height, INR 4.4





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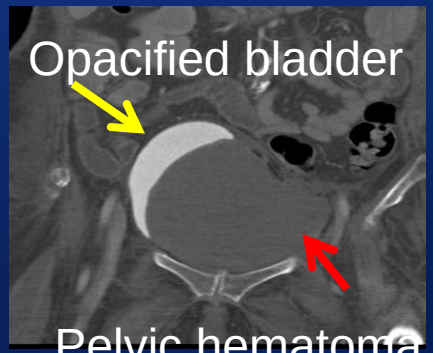
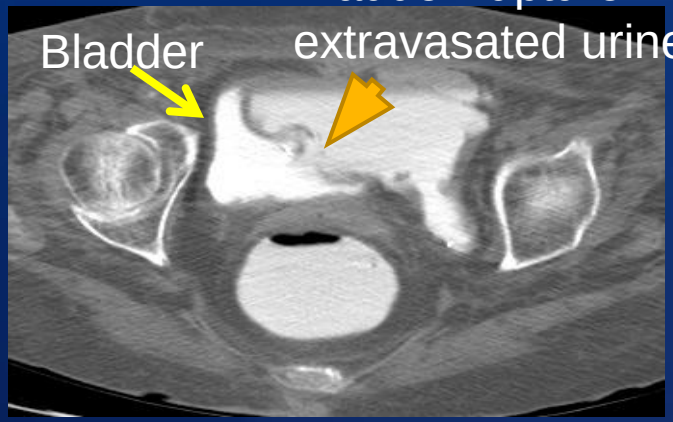
CASE 1 - Bladder

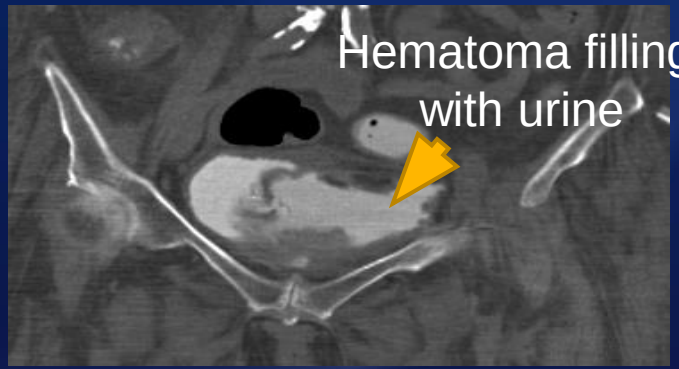
Hospital day 3, CT cystogram for hematuria
Interpreted as negative



Hospital day 12, CT cystogram for persistent hematuria

Extraperitoneal bladder rupture, unmasked by the decreased size of the pelvic hematoma





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CASE 1 - Bladder

- ~10% of traumatic bladder ruptures will not have concurrent pelvic fractures
- Gross hematuria is almost always seen with significant bladder injury
- Large pelvic hematomas can mask bladder perforation
- Other false-negative exam causes include detrusor muscle contraction, intravesicular blood clot, a small tear, and the Foley balloon
- When appropriate, report impression should include caveat for potential false-negative exam

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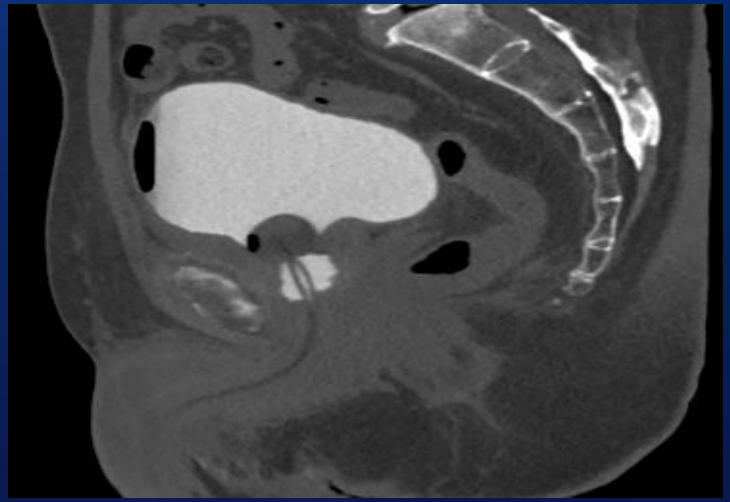
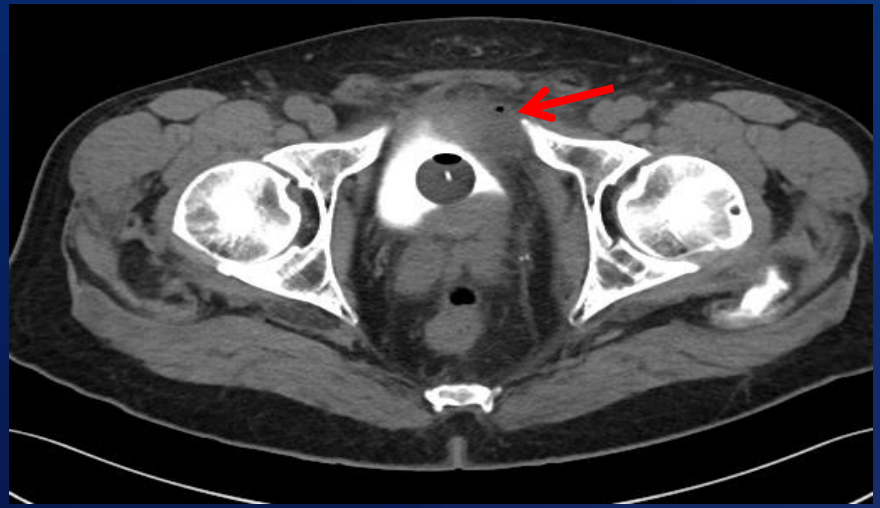
Companion Case

74 yo male presenting with severe pelvic pain 3 months post laser PVP of prostate





Initial CT cystogram showed small pelvic fluid collection but no bladder leak

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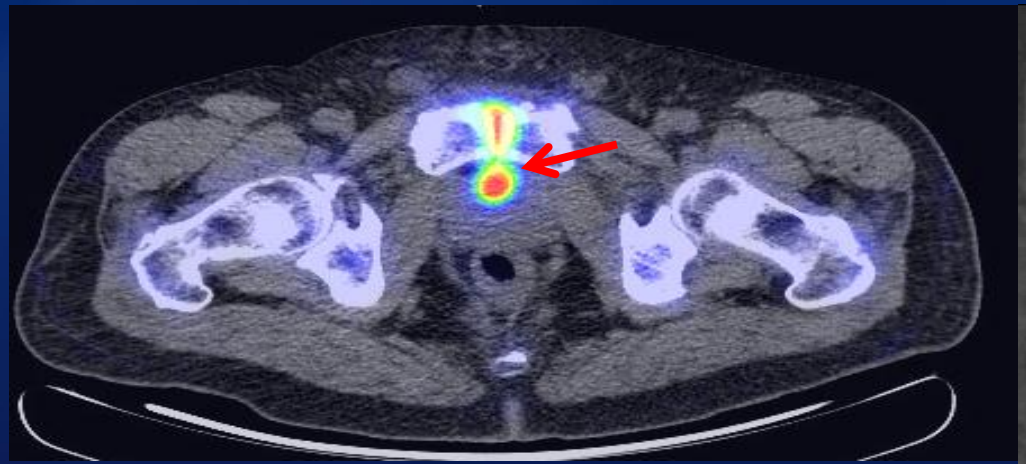
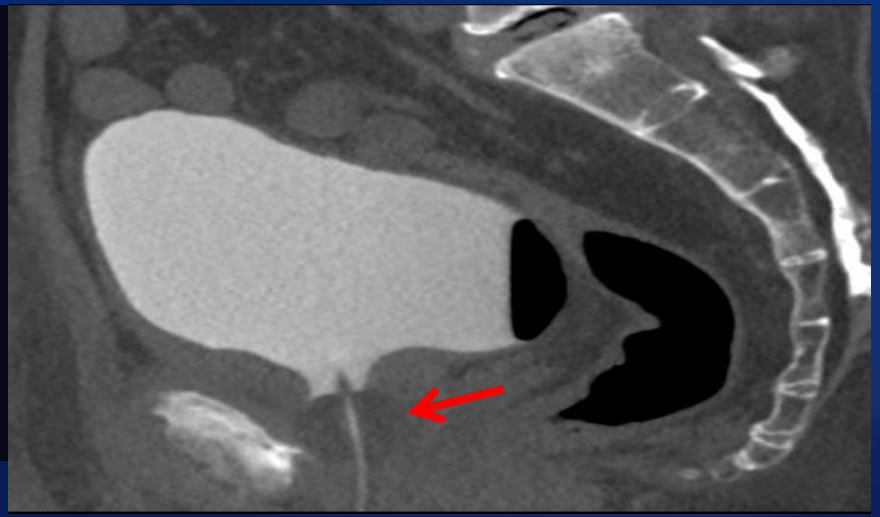
Companion Case





Tc99 MDP Bone Scan with SPECT/CT increased activity in pubic symphysis contiguous with the TURP defect

Repeat CT cystogram with Foley in the TURP defect – no obvious bladder leak

Performed in ER by trainee overnight

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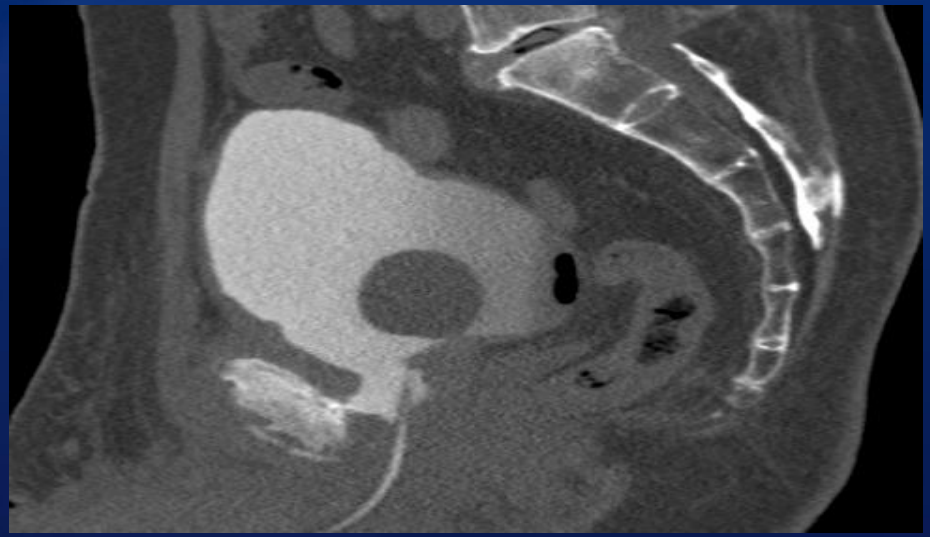
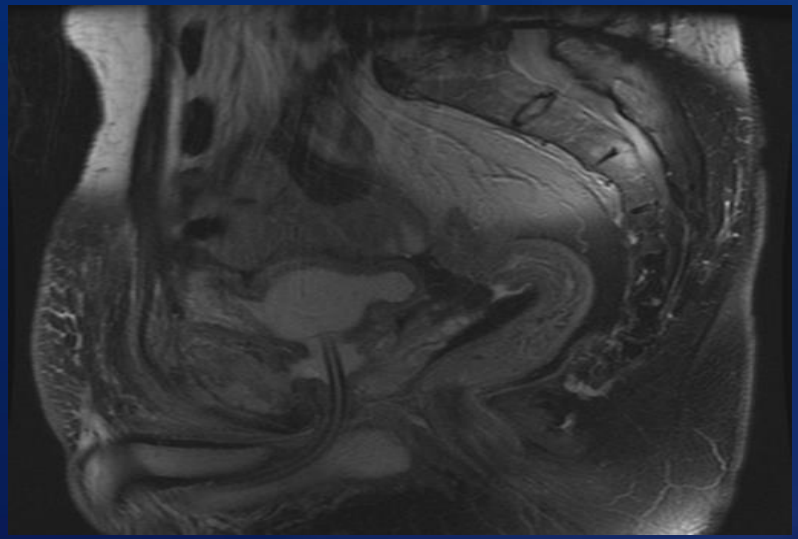
Companion Case



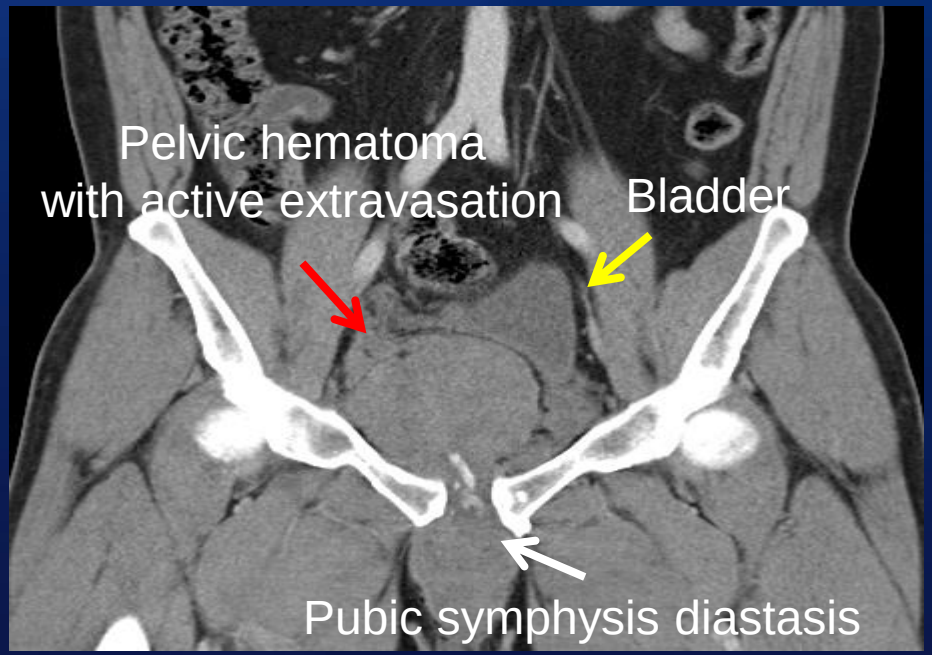
Repeat CT Cystogram with Foley advanced into the bladder demonstrating the obvious leak from anterior prostatic urethra



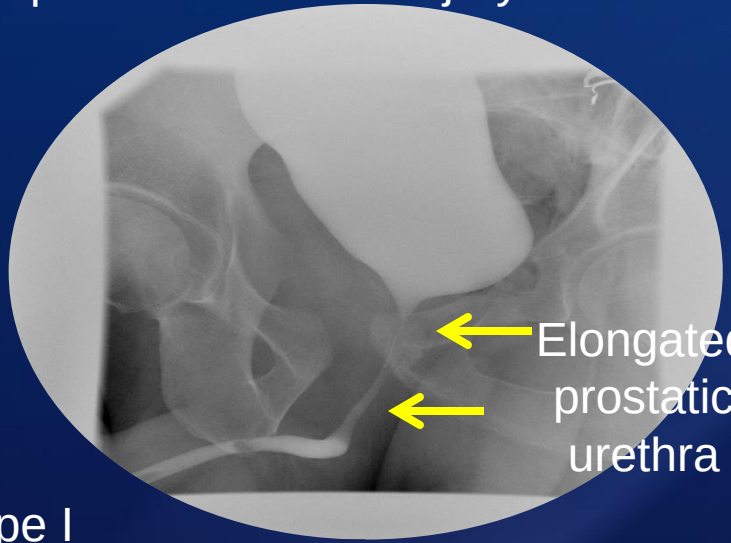
Sag T2FS MR demonstrating anterior prostatic uretheral defect

CASE 2 - Urethra

49 yo male, fell while water skiing, struck water with legs split



Colapinto and McCallum classification of posterior urethral injury:



Type I

- Rupture of the puboprostatic ligaments
- Prostatic urethra is stretched but maintained

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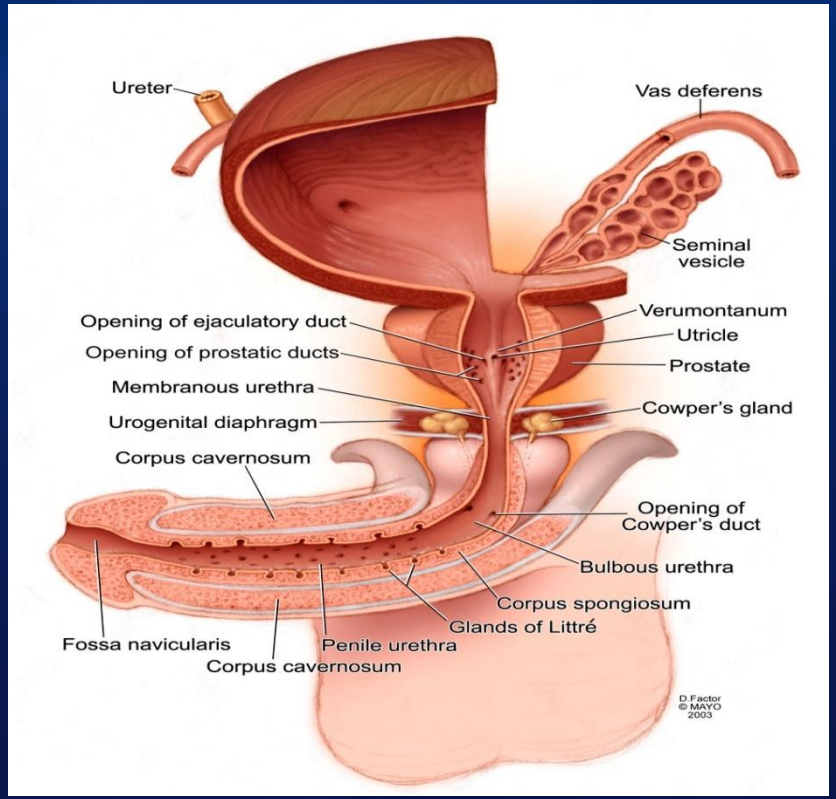
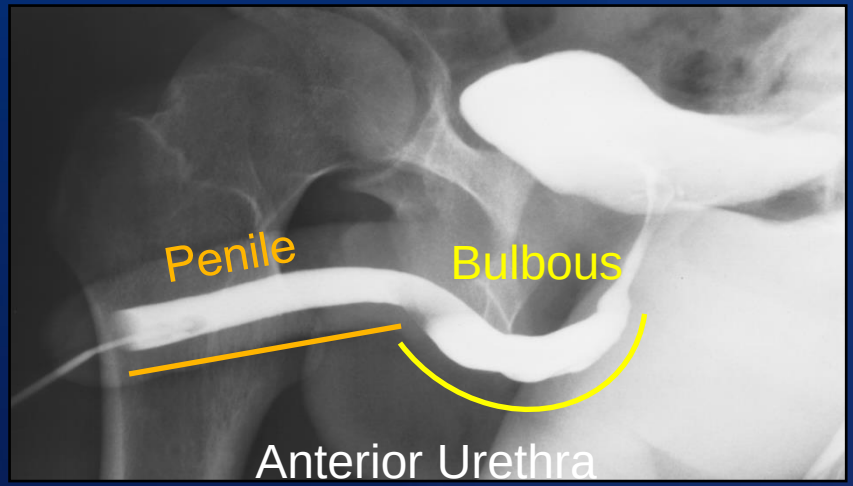
CASE 2 - Urethra



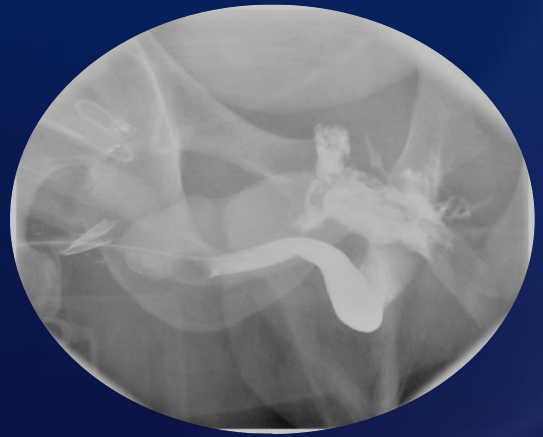


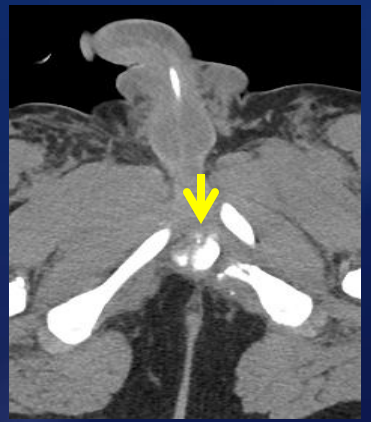
RUG images compliments Dr. Akira Kawashima

CASE 2 - Urethra

Type II
- Membranous urethra torn above an intact urogenital diaphragm
- Prevents contrast extravasation into the perineum

Type III
- Membranous urethra injured with extension into the bulbous urethra due to laceration of the urogenital diaphragm





CT Cystogram

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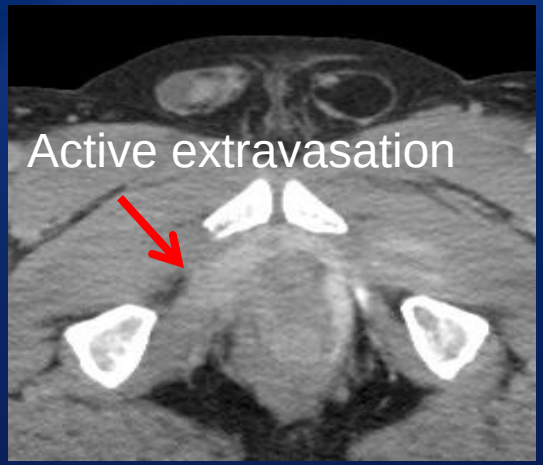
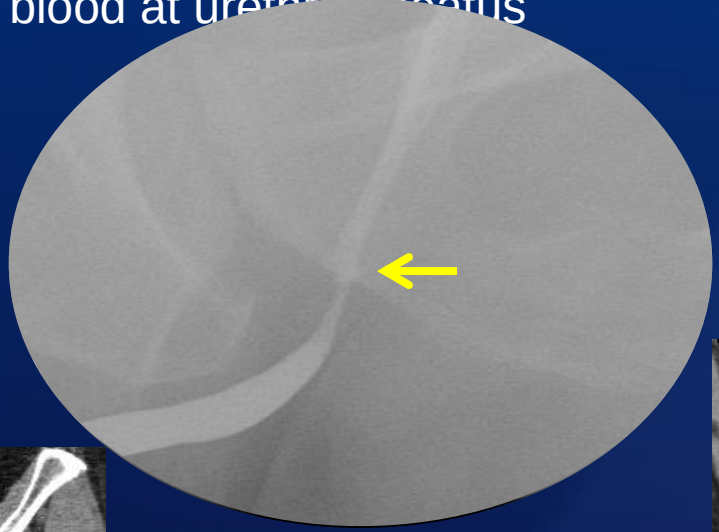
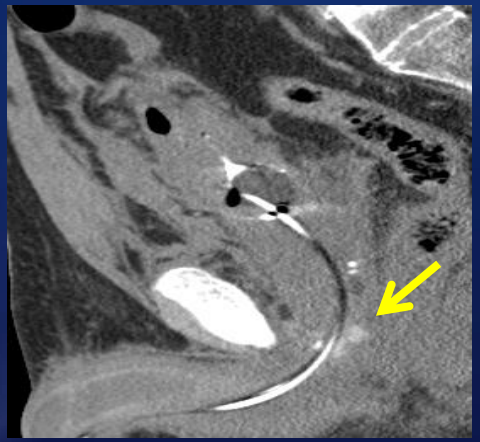
CASE 2 - Urethra

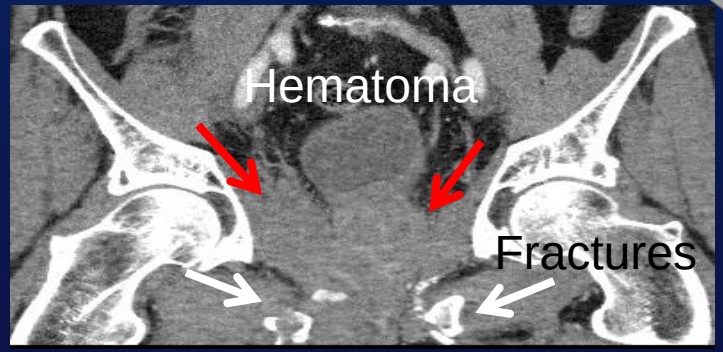
71 yo male with traumatic pelvic fractures and blood at urethral meatus





Type II injury





CT Cystogram

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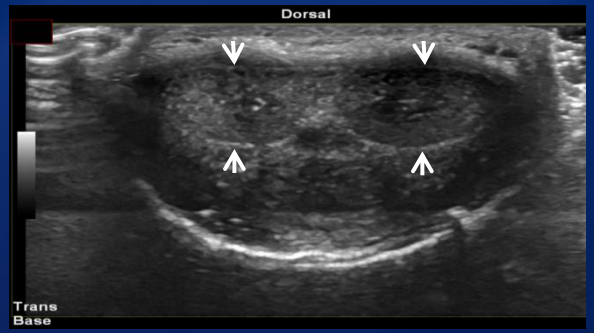
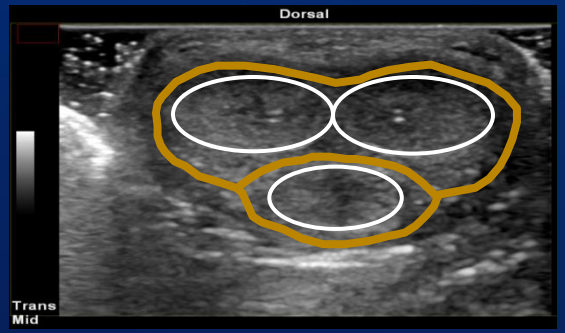
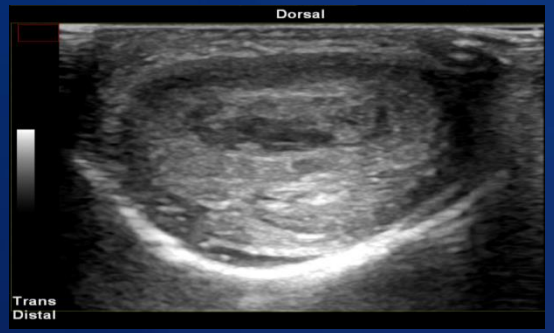
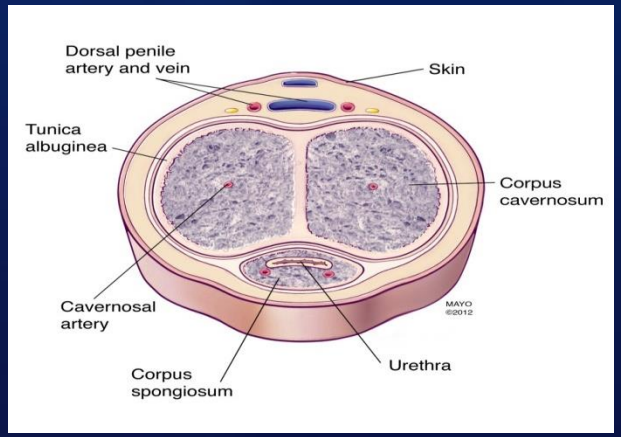
CASE 3 - Penis

47 yo male heard a “pop” during intercourse

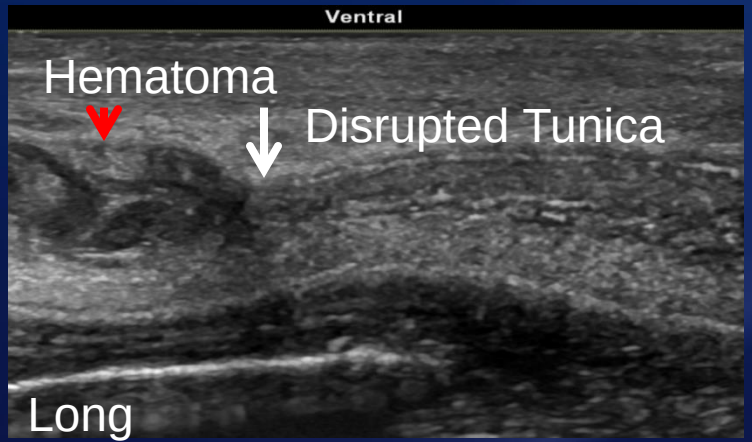




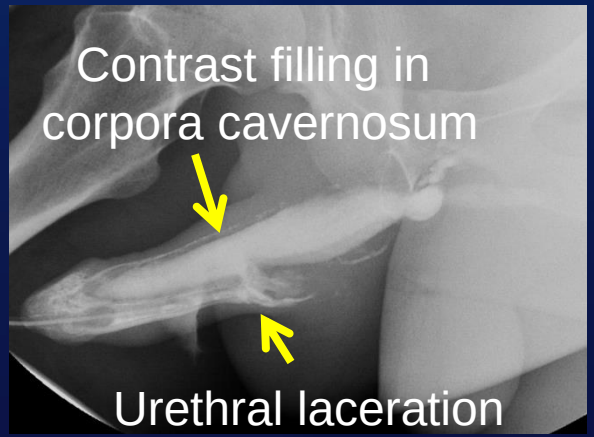


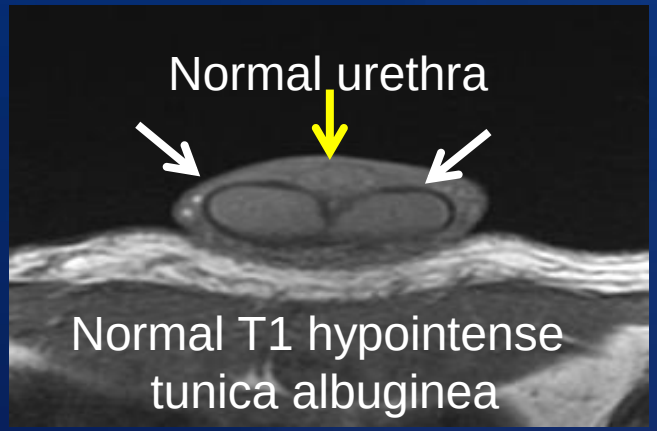


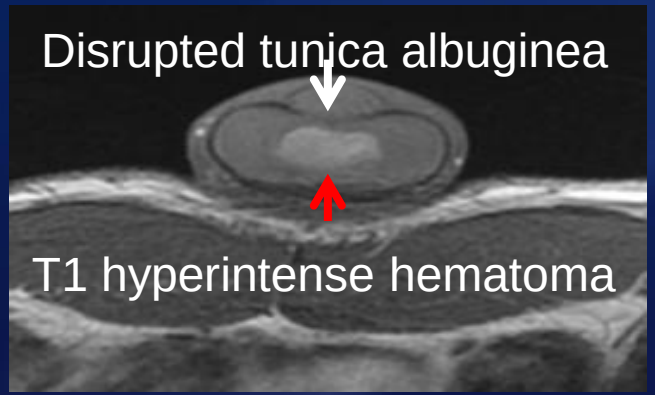
Ventral



CASE 3 - Penis







RUG image compliments Dr. Akira Kawashima

CASE 3 - Penis

Penile Fracture

- US and MRI are reliable imaging modalities for diagnosis
- Look for defect of the tunica albuginea
  - Tunica is echogenic on US and T1 and T2 hypointense on MRI. Contrast enhanced MRI does not add much value
- MRI has superior soft tissue contrast compared to US and can be useful in difficult US cases
- Concomitant urethral injury may be present

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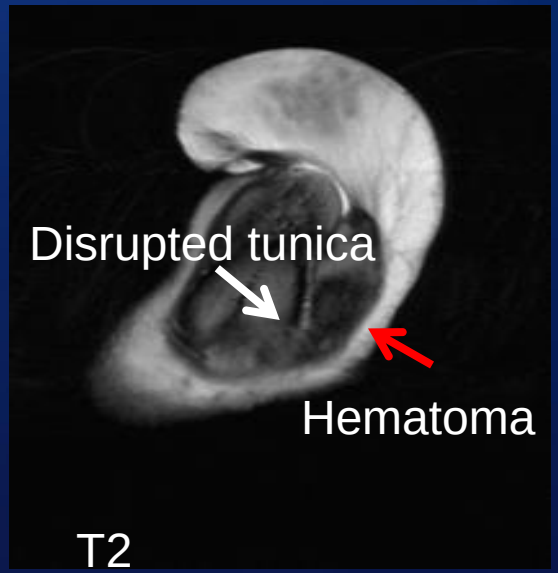
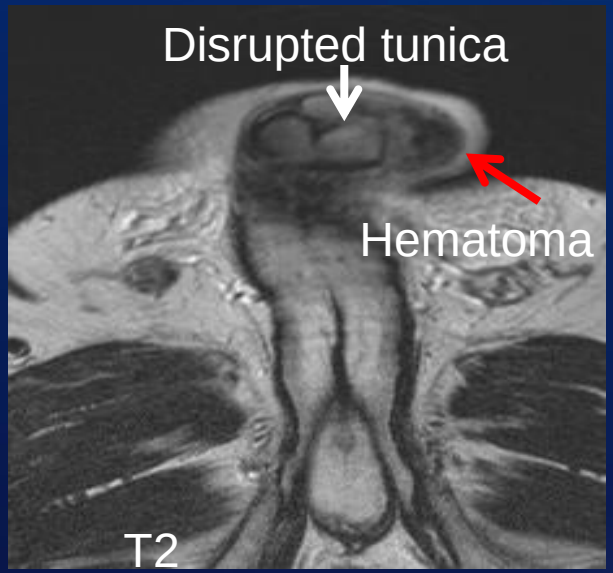
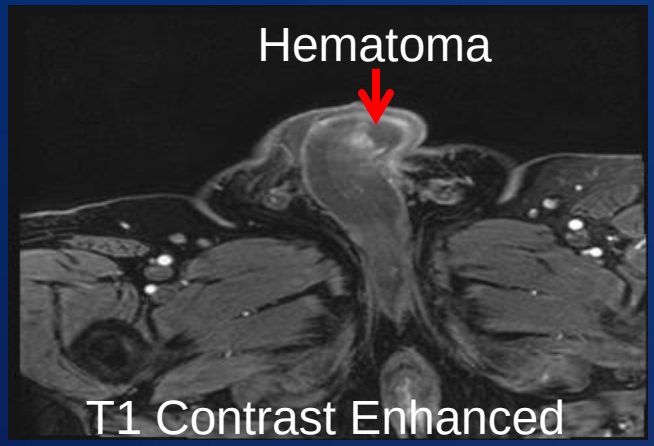
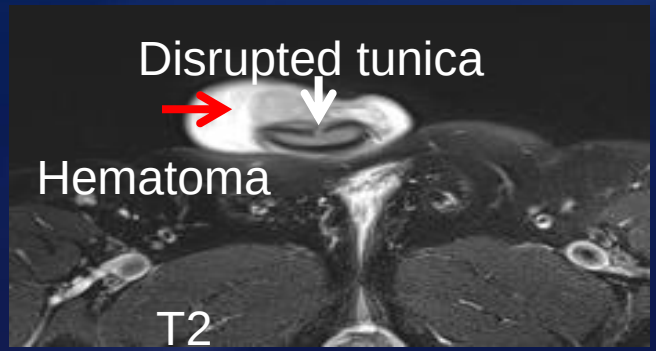
CASE 3 - Penis

Additional MRI examples of penile fracture









Finding the hematoma can help
show you where to look for the fracture

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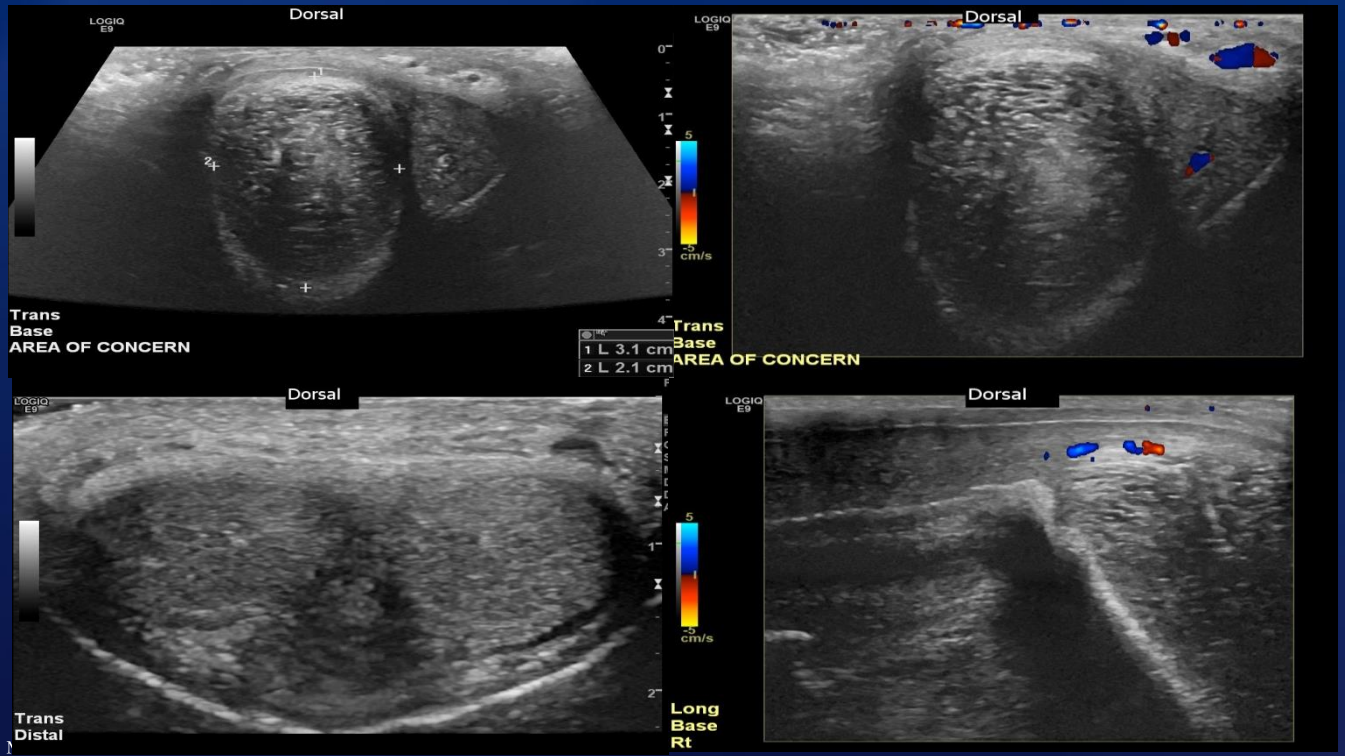
CASE 3 – Penis – Companion Case

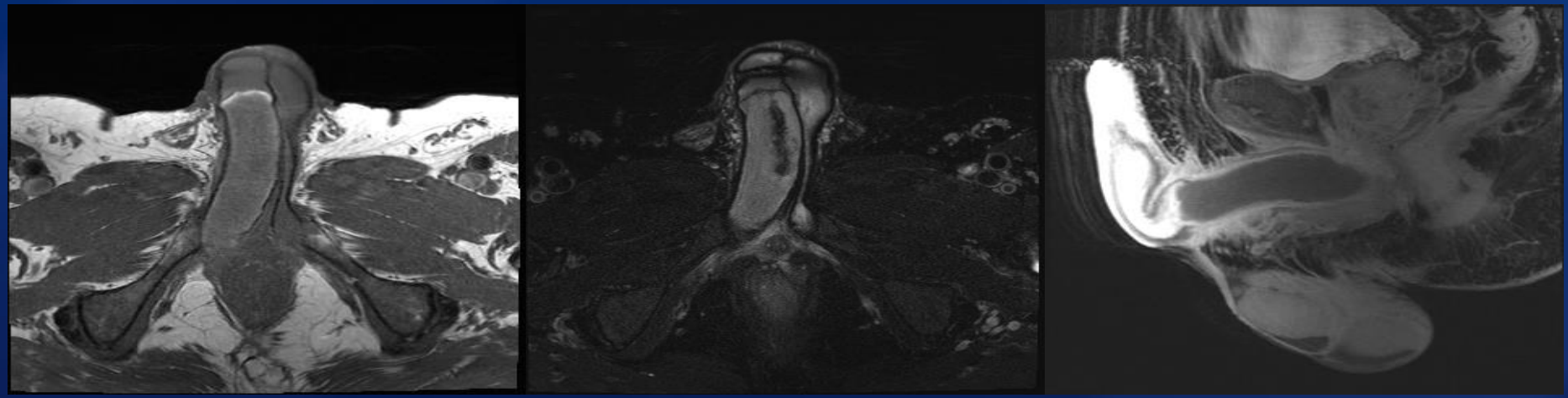
66 yo male with history of trauma to the penis with an erection after rolling over in bed



US demonstrates hetereogenous mass like expansion of the right corpus cavernosum without significant Doppler flow.

No definite penile fracture was seen

CASE 3 – Penis – Companion Case



Axial T1, axial T2FS and sagittal post contrast MRI demonstrating intermediate T1 and T2 intensity masslike lesion with no contrast enhancement. Most likely hematoma/thrombosis

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CASE 3 – Penis – Companion Case

Partial Priapism

- Very rare ~40 case reports
- Thrombosis within proximal segment of single corpus cavernosum
- Association with trauma or bicycle riding ?
- Treatment typically conservative

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SUMMARY

- Recognize the potential for a false-negative CT cystogram
- Type I urethral injuries can be missed without knowing normal urethral anatomy on a RUG
- MRI is very helpful in assessing for penile fracture when US is limited

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Questions & Discussion

Thank you

- Khandelwal.Ashish@mayo.edu

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