

# Outline

1. Definitions
2. Diagnoses
3. Modalities with Normals
4. Cases !
5. Resources
6. Sim Lab Cases ! Think Pair Share

## References:

1. UNC Health Care Administrative Manual  
Critical Tests and Values/Findings
2. Emergency Radiology: The Requisites.  
Soto and Lucey (2017)  
<http://guides.lib.unc.edu/Radclerks>

# UNCH Critical Tests

Critical Tests are those tests that will always require rapid communication of the results, even if normal.

Turnaround time on Critical Tests at  
UNCH  $\leq$  45 min

## 2 Critical Tests

- Radiology CT Scan for s/s of stroke in ED or inpatient unit
- Radiology CXR s/s of stroke in ED or inpatient unit

# UNCH Critical Value/Result Definition

A critical value/result is defined as any value/result or interpretation where a delay in reporting may result in a serious adverse outcome for the patient

All critical values/results will be reported to the appropriate LIP or responsible licensed caregiver within one hour of the generating area determining the final value/result

# Critical Results Diagnoses Radiology

- Aortic Dissection, Acute
- Ectopic Pregnancy
- Pulmonary Embolism, Acute
- Aneurysm Rupture
- Acute or unexpected Bowel perforation
- Cervical fracture with significant displacement
- Acute Epiglottitis
- Tension Pneumothorax
- Brain or Cord tumor with significant Mass effect
- Intracranial Hemorrhage
- Ovarian or Testicular Torsion
- Life Threatening misplaced tube or line

These diagnoses must be communicated directly to the patient's licensed independent practitioner or licensed caregiver. ie CALL THE DOC!

# Modalities: AAS

Acute abdominal series (AAS) - 3 views

AP supine abdomen

AP upright abdomen

PA upright chest

Common indications:

Bowel perforation/free air

Obstruction

Effective radiation dose: 0.1-1 mSv

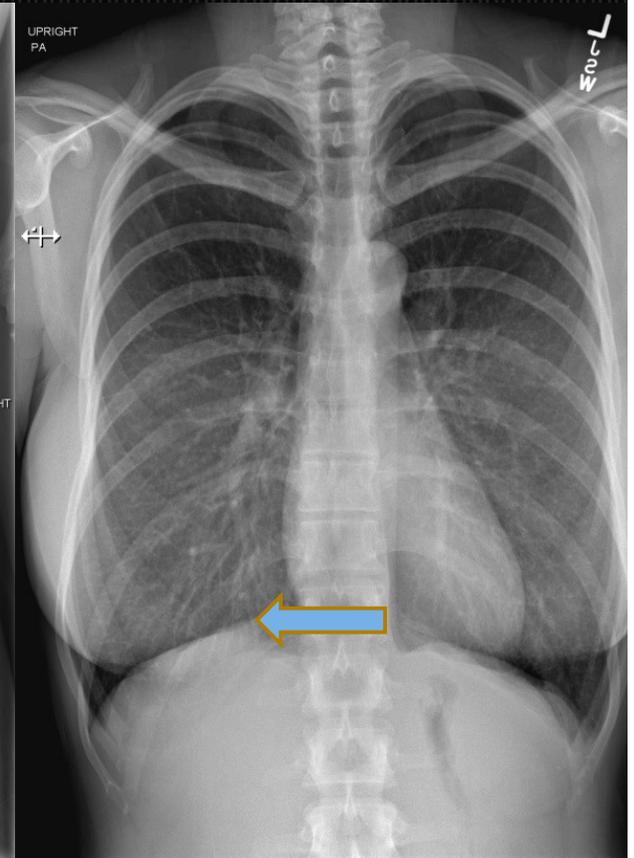
# Modalities: Normal AAS



AP supine abdomen



AP upright abdomen



PA chest

# Modalities: CT Basics



Ionizing radiation (x-rays)

Basically CT is an x-ray tube that rotates around the patient with detectors on opposite side

Multidetector

8, 16, 64, 128, 320 rows of detectors

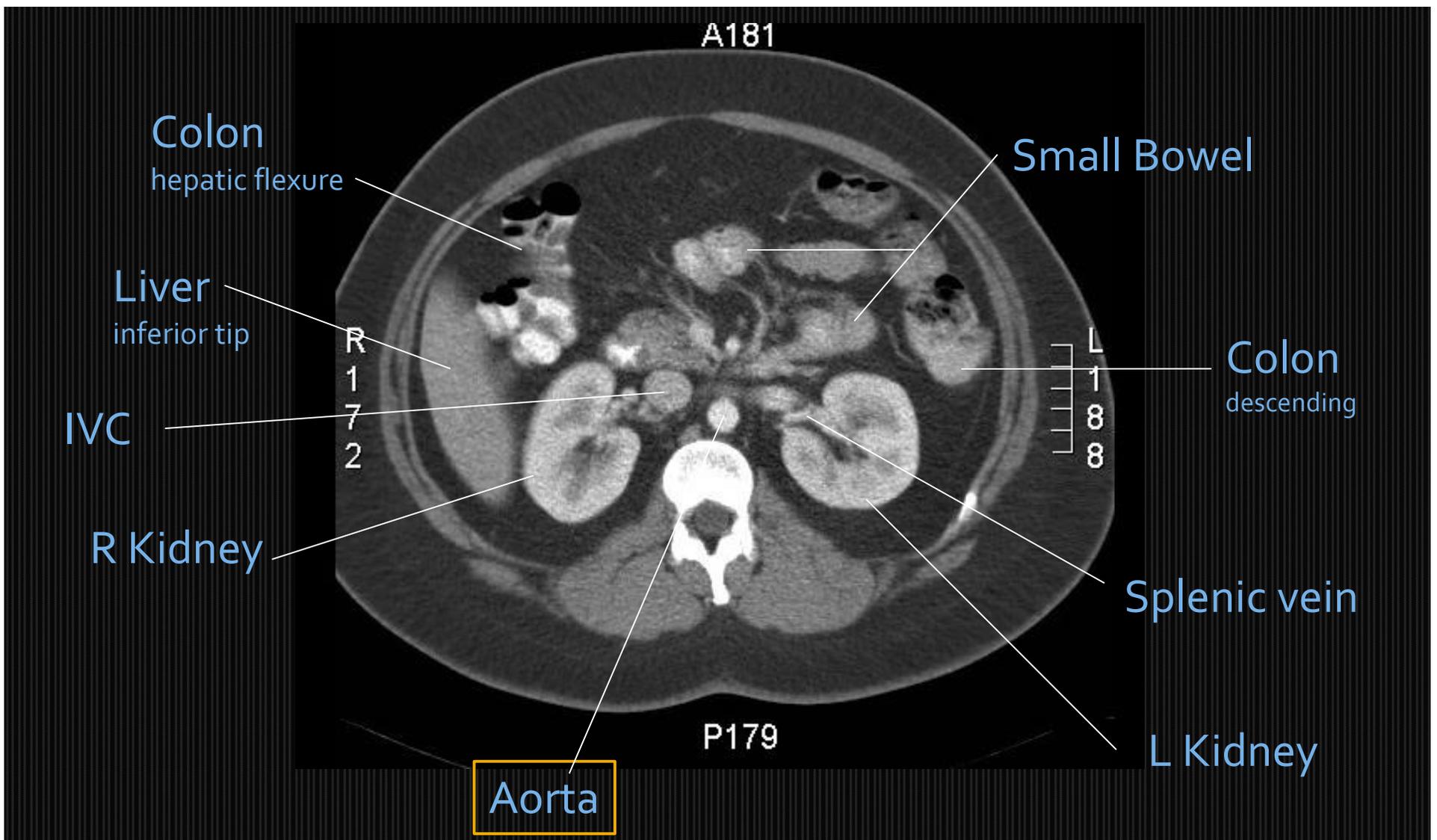
Faster scans than single row

more detectors helpful for breath hold, non cooperative, cardiac imaging

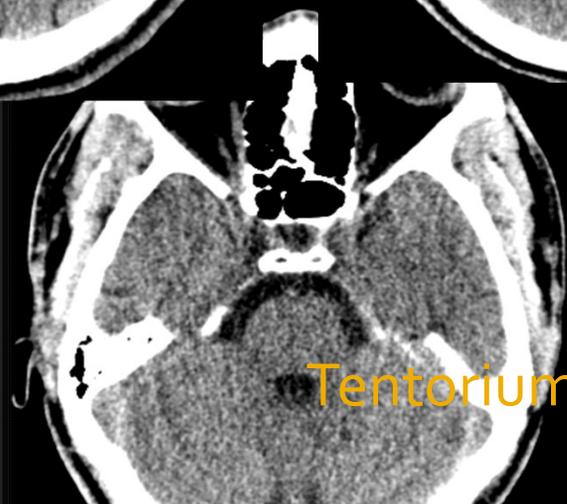
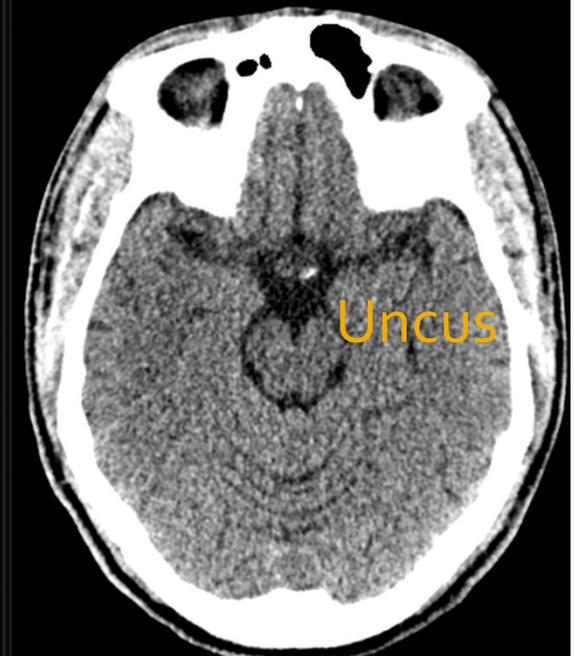
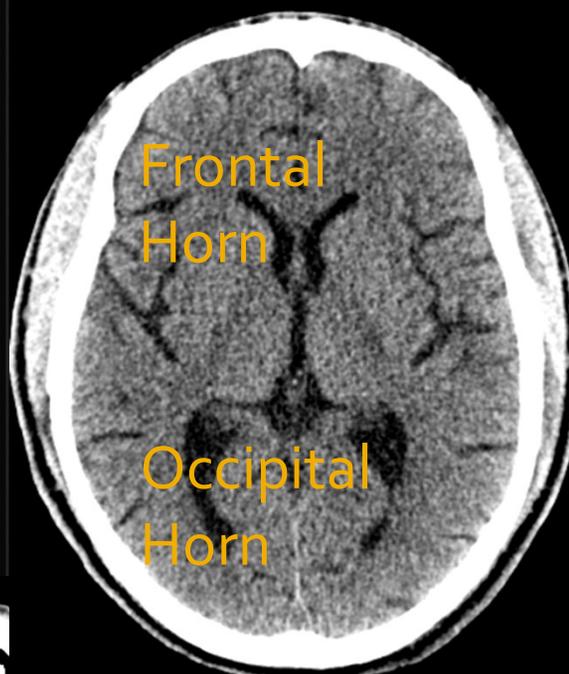
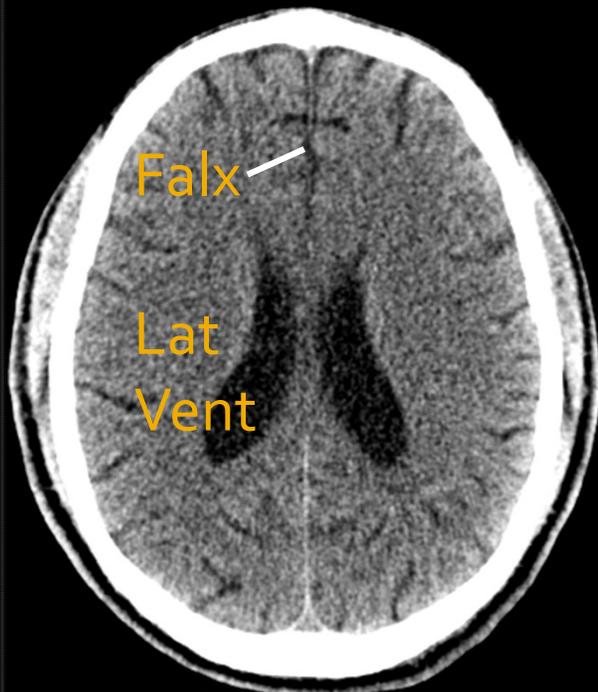
Pros: Fast and High detail

Cons: Radiation, Contrast reactions, and Expensive

# Modalities: Normal CT



# Modalities: Normal CT



# Modalities: Ultrasound

Uses sound waves (rather than ionizing radiation)

## Indications:

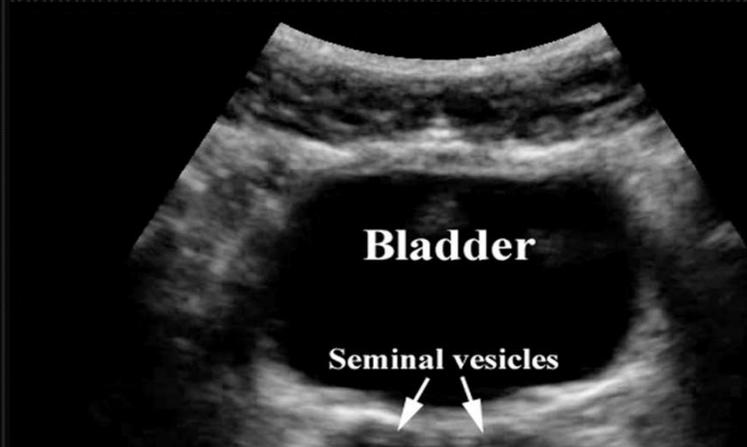
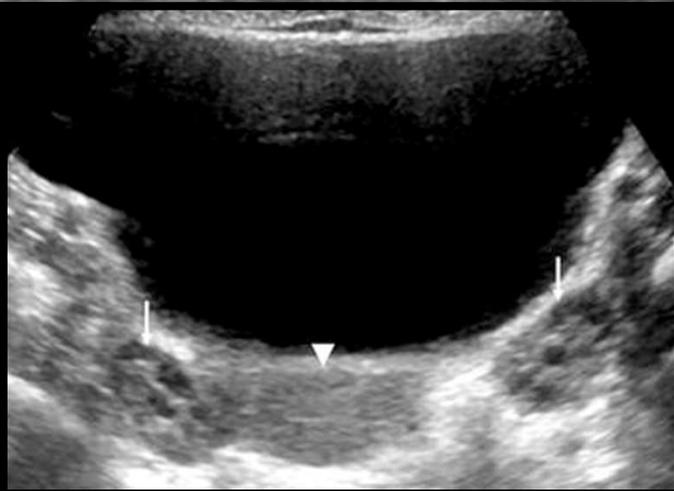
RUQ pain: gallstones/cholecystitis/bile duct stones

Appendicitis in kids/pregnancy

Kidney stones

Pelvis US for torsion/adnexal pain

# Modalities: Ultrasound



# Outline

1. Definitions

2. Diagnoses

3. Modalities with Normals

4. Cases !

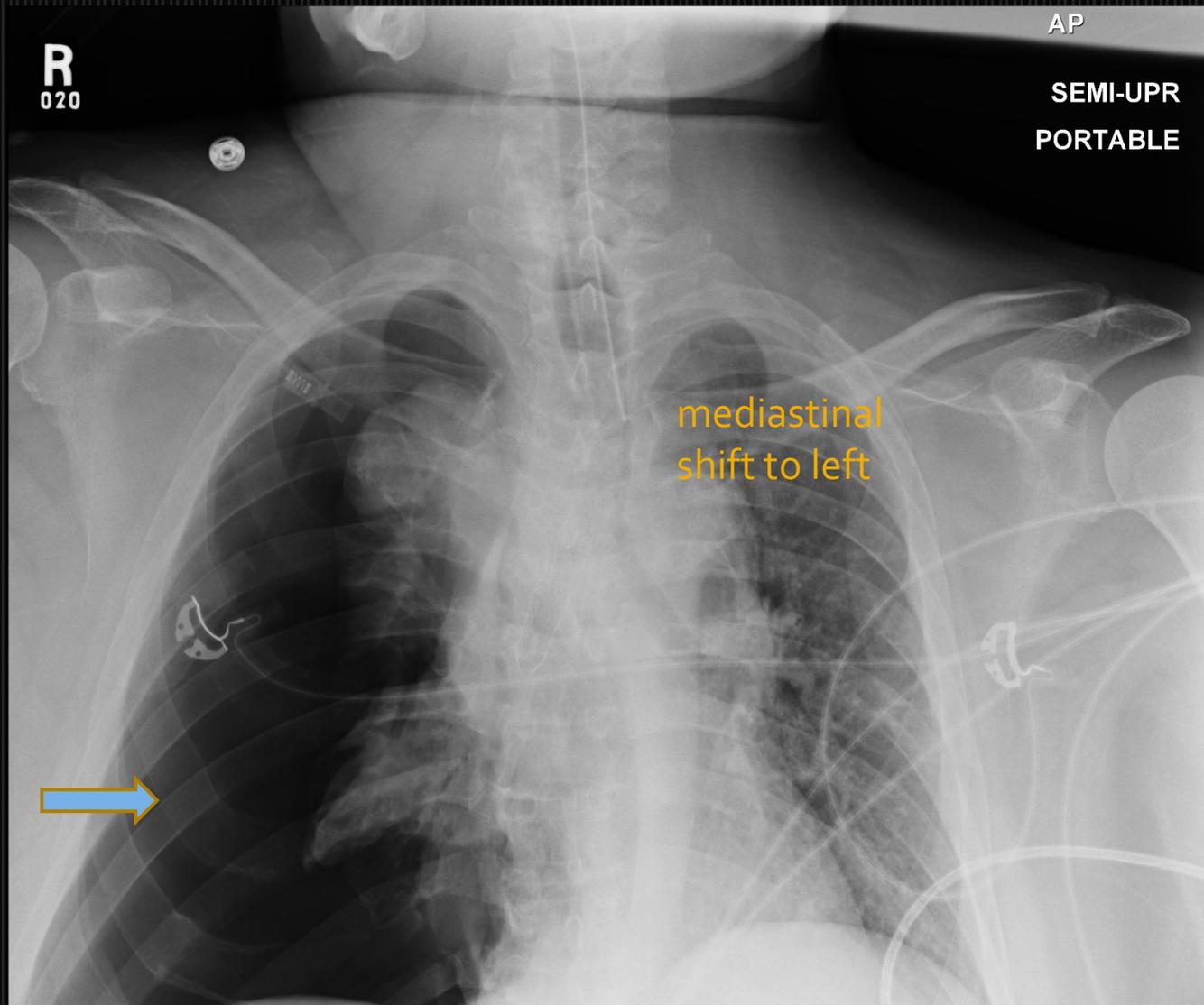


Illustrative cases are organized by organ system

5. Resources

6. Sim Lab Cases ! Think Pair Share

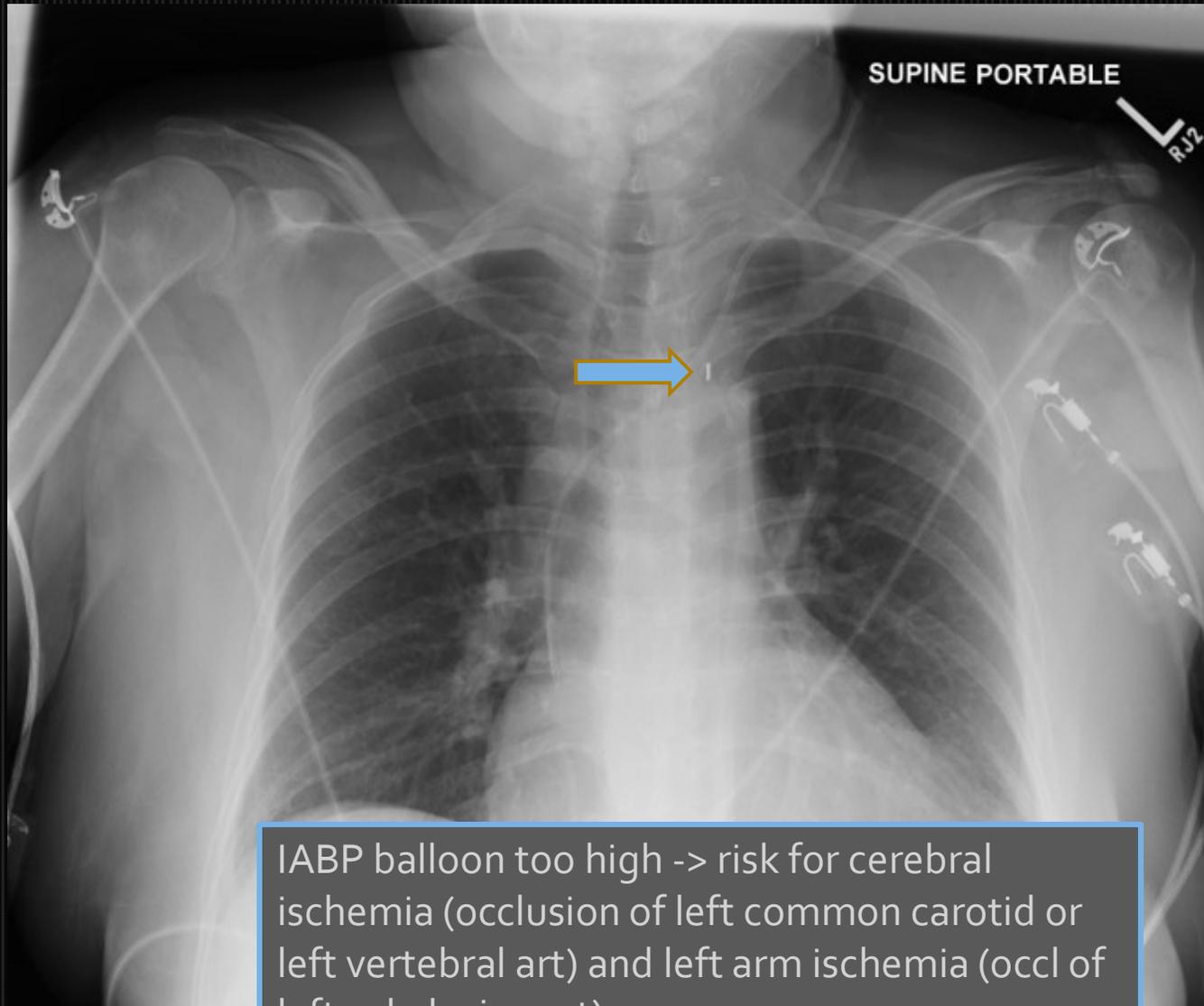
# Case 1: Tension Pneumothorax



Ptx air in the pleural space may occur as result of: **Trauma** penetrating, blunt, or barotrauma; **Iatrogenic** biopsy, surgery, line placement, thoracentesis, mechanical ventil, bronchoscopy

**Tension pneumothorax** mass effect from ball valve mechanism may yield displaced mediastinum with poor venous return to the heart -> cardiovascular collapse and death

## Case 2: Life Threatening Malposition



IABP balloon too high -> risk for cerebral ischemia (occlusion of left common carotid or left vertebral art) and left arm ischemia (occl of left subclavian art)

### CHECKLIST:

- Technique
- Rotation
- Lung volumes
- Lung parenchyma
- CP angles
- Heart size
- Bones & soft tissues

### PLUS

- ETT
- NG enteric tubes
- CV support devices
- Thoracostomy tubes

[ICU Portable CXR](#)

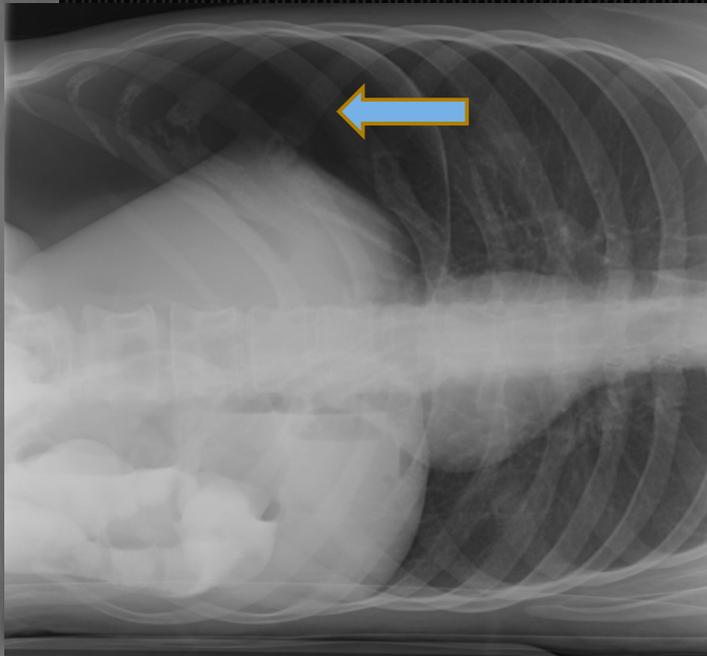
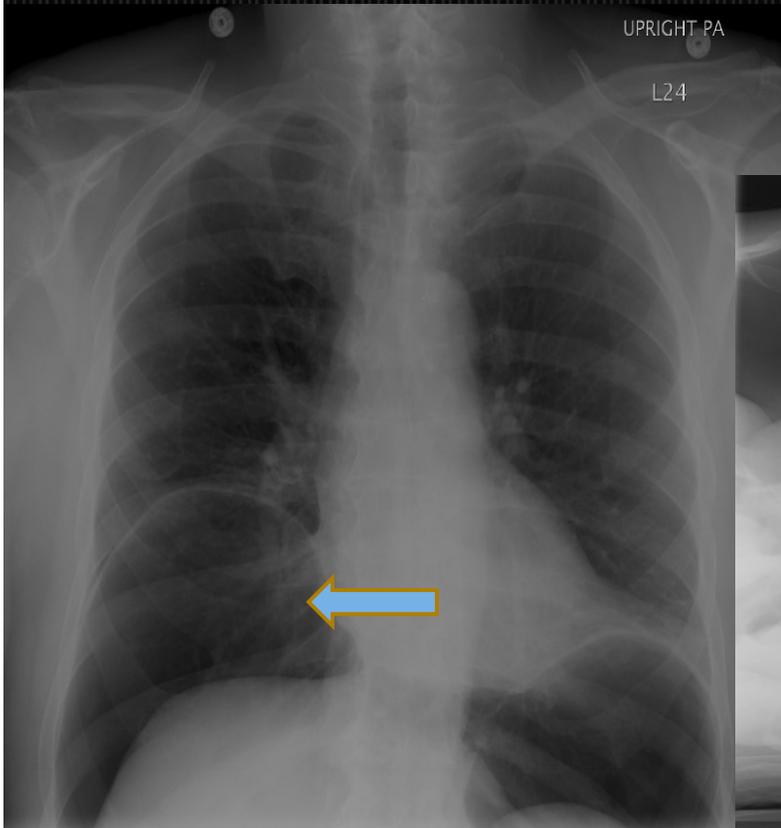
# Case 3: Bowel Perforation

## Pneumoperitoneum

Free air within the peritoneal cavity

Abdominal pain, peritonitis symptoms

Plain radiographs often utilized -> lucency beneath the diaphragm. To improve sensitivity, assure the central ray of the x-ray beam is at highest level of the peritoneal cavity. On supine films: Rigler's, falciform, football, inverted V signs. CT more sensitive!



Massive pneumoperitoneum implies bowel perf unless recent surgery

# Case 4: Displaced Cervical Fracture



On sagittal and axial cervical spine CT, grade II-III anterolisthesis of C6 on C7, posterior elements fractures (C6), bilateral jumped and locked facets with fractures = Traumatic C6-7 spondylolisthesis with bilateral locked facets

Bilateral Locked Facets as example of **Unstable Cervical Fracture**

Anterior dislocation of vertebral body

Jumping of inferior articular process over the superior articular process of vertebral body below – locked in this position

Can be uni- or bilateral

Extreme flexion type injury of head/neck

High risk of cord damage

**UNSTABLE**



SCHOOL OF MEDICINE  
Radiology

## Case 5: Acute Epiglottitis



### Acute Epiglottitis

Now uncommon in pediatric population due to childhood *H. influenzae* immunization, may be seen in non-immunized children and also adult population.

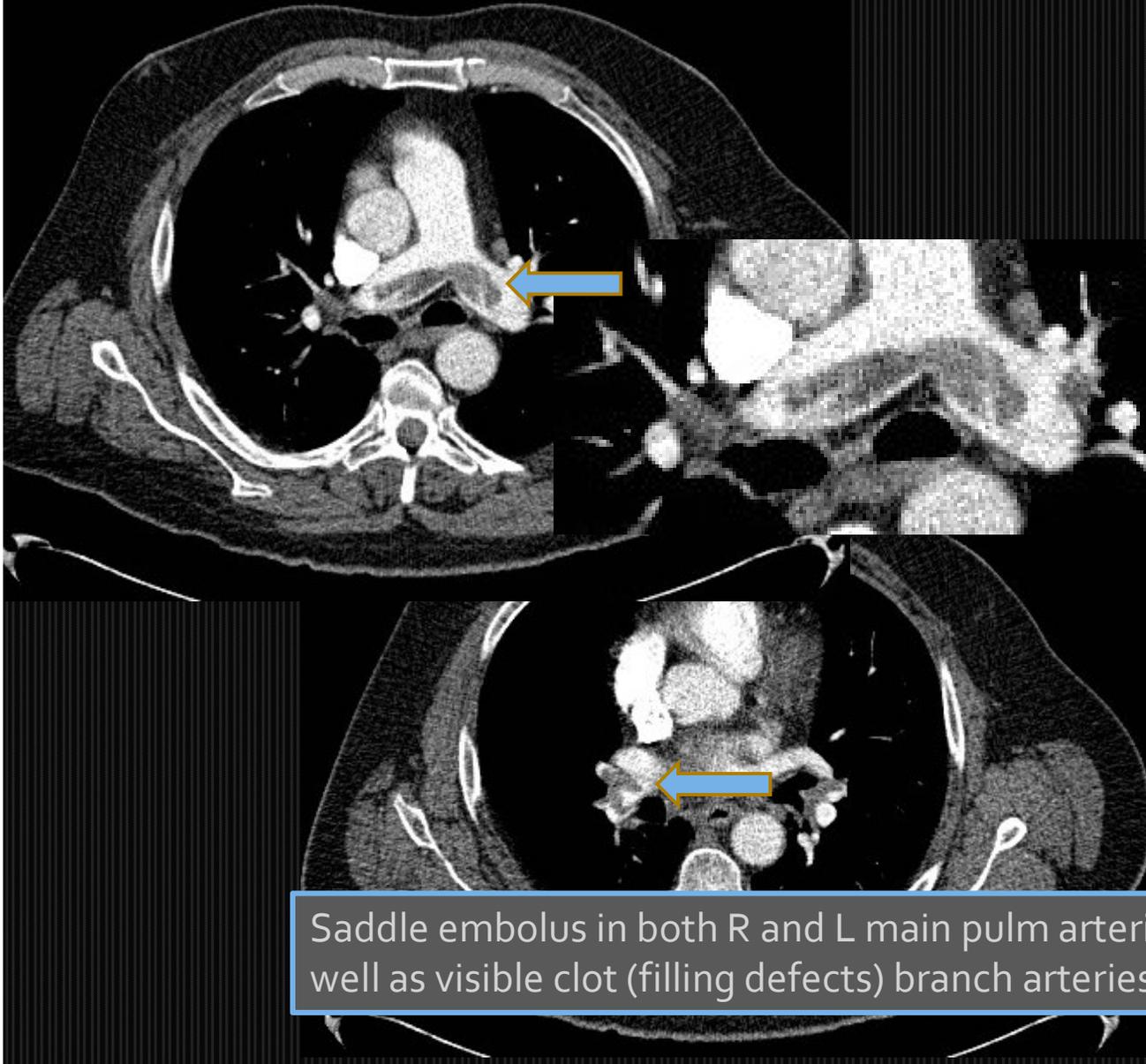
Lateral film -> inflamed thickened epiglottis. Clinical and radiographic findings classic and CT not typically needed

# Case 6: Acute Pulmonary Embolism

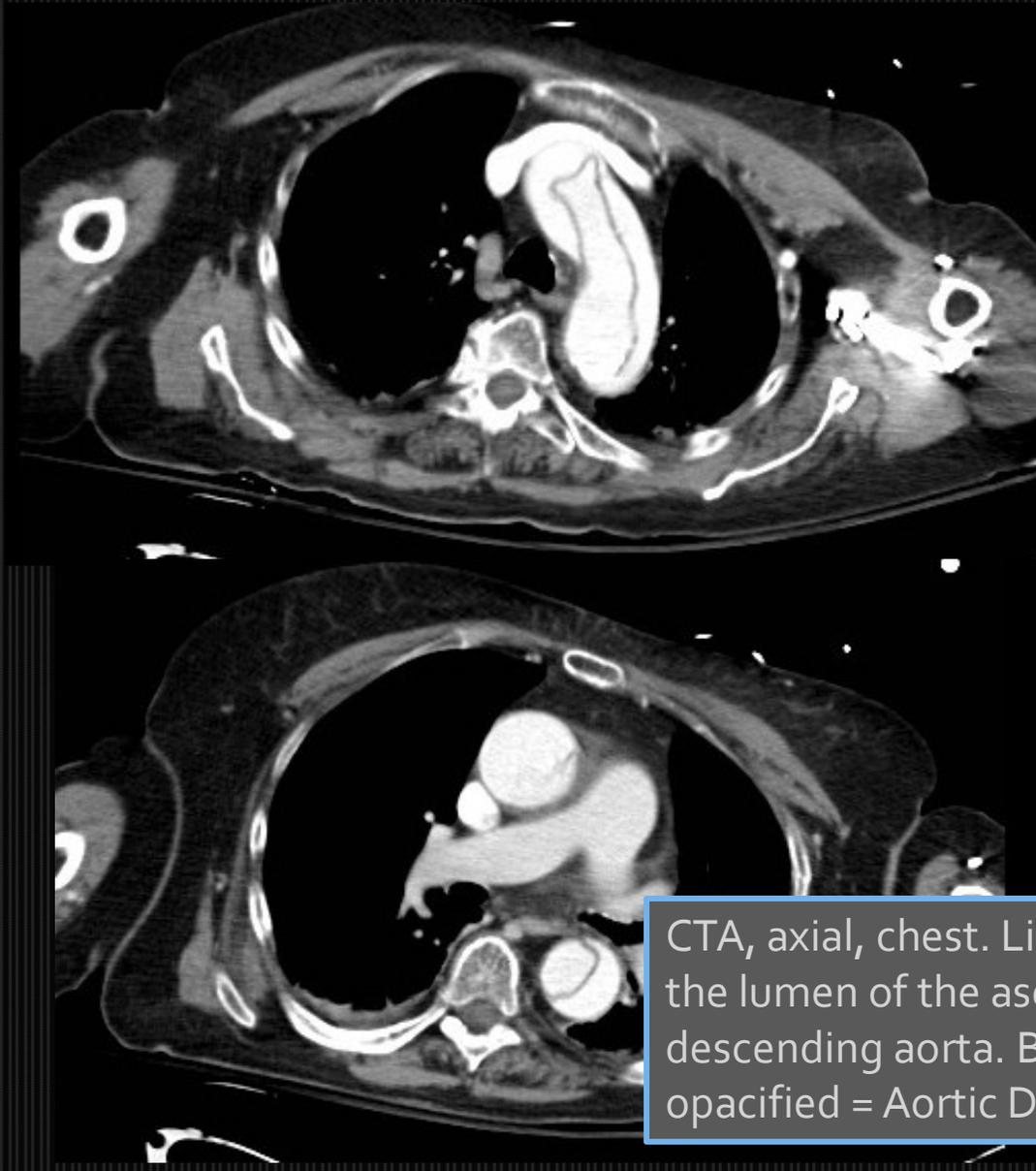
## Pulmonary Embolism

CTPA (CT Pulmonary Angiography) have high sensitivity and specificity for dx of PE.

Acute Dx: a. Arterial occlusion by thrombus with lack of enhancement of lumen, +/- vessel enlrg, b. Partial filling of vessel surrounded by contrast, c. peripheral intraluminal filling defect that forms acute angle with arterial wall. Can also see peripheral wedge-shaped lung infarct and linear bands



# Case 7: Acute Aortic Dissection



## Aortic Dissection

Stanford classification

Type A: proximal to left subclavian: surgery

Type B: distal to left subclavian: medical management

Imaging findings:

Dissection flap

+/- aneurysmal

dilatation of aorta

Differential

opacification of

true/false lumen

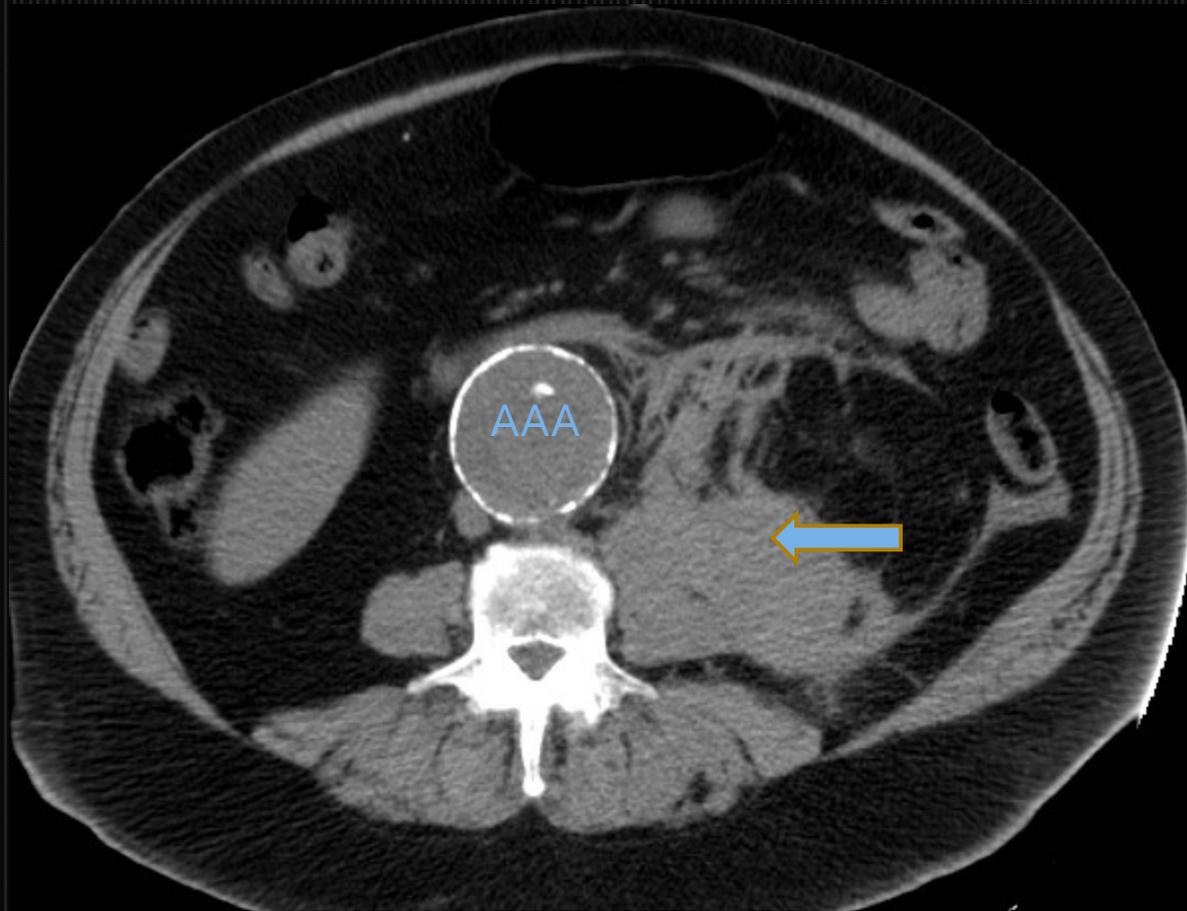
Thrombosed false

lumen

+/- aortic rupture

CTA, axial, chest. Linear hypodense structure in the lumen of the ascending, transverse, and descending aorta. Both true and false lumens opacified = Aortic Dissection

## Case 8: Aneurysm Rupture



Axial CT without contrast: aortic aneurysm with active retroperitoneal extravasation = ruptured AAA. Call Surgery!

### AAA Rupture

AAA fusiform or saccular dilatation of the abdominal aorta  
Rupture is catastrophic complication w mortality up to 90%.  
Usu posterolateral aspect of the aorta -> retroperitoneal hemorrhage. May also rupture anterolateral -> peritoneal exsanguination. Grey-Turner is ecchymosis of the flanks. Lifetime risk of rupture if AAA > 5cm = 20%, > 6cm = 40%, > 7cm = 50%+.

# Case 9: Ectopic Pregnancy



Note empty uterus, normal left ovary, echogenic trophoblastic tissue + gestational sac and yolk sac in left adnexa

## Ectopic Pregnancy

Responsible for up to 15% of maternal deaths

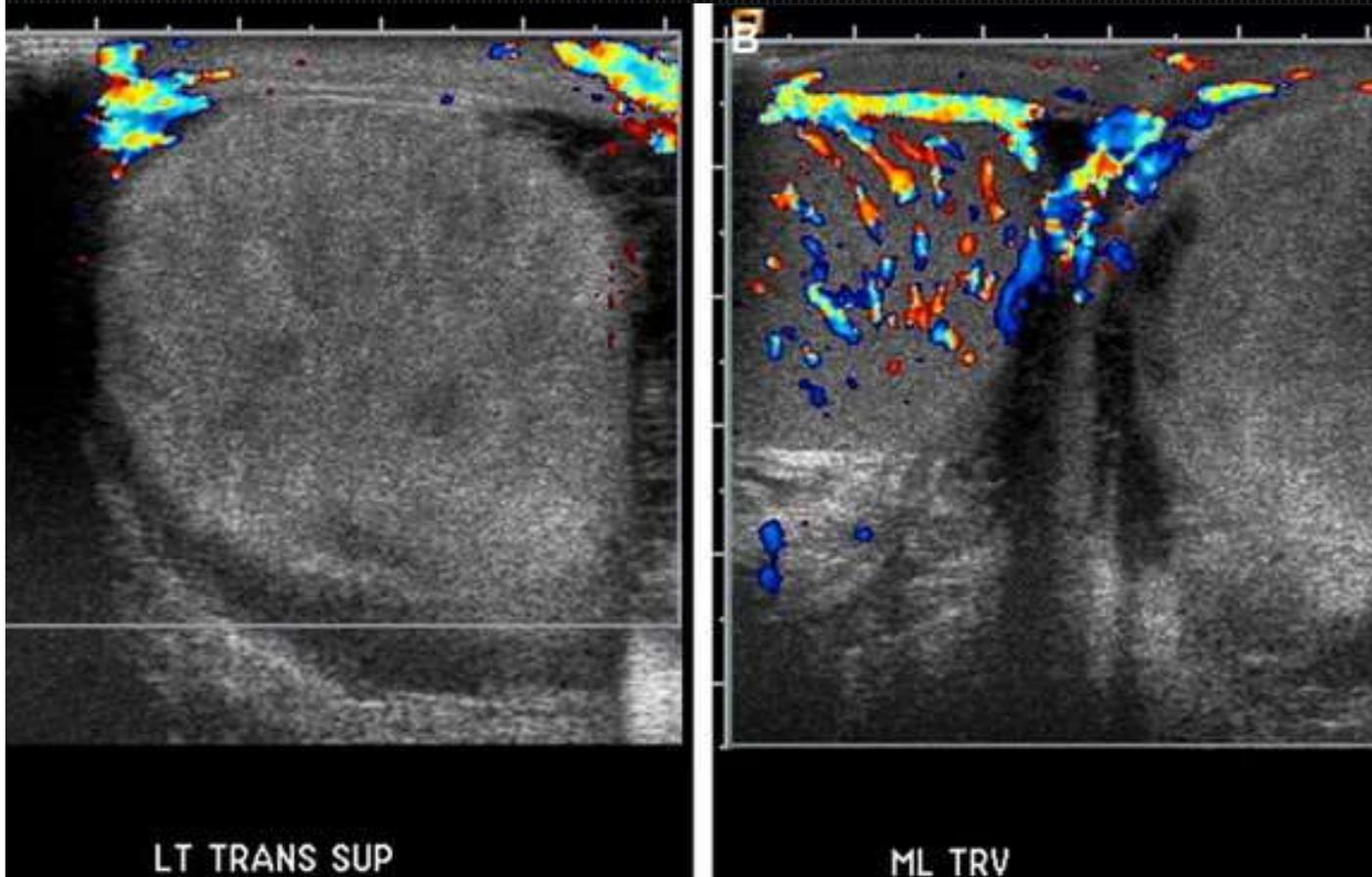
Usual symptoms: pelvic pain, vaginal bleeding, positive pregnancy test, empty uterus

To exclude ectopic, demonstrate an appropriately positioned IUP (intrauterine gestational sac)

Most specific sign is live embryo outside uterus, usually in the adnexa but only seen in 20-25% of cases

Look for complex free fluid

# Case 10: Testicular Torsion



Color Doppler views of the left testicle and paired views of both testicles. Heterogeneous swollen left testis without internal vascularity = TORSION. Right testis has normal flow and size

## Testicular Torsion

Acute scrotal pain  
Testicular salvage rates are greatest when surgery performed within 6 hrs of sx onset. Can not be salvaged after 24 hrs.  
Gray scale findings may be normal or there may be a small hydrocele, scrotal wall thickening, epididymal and testis enlargement and hypoechoic. Color Doppler crucial! Lack of demonstrable flow to affected testis

## Cases 11 & 12: Intracranial Hemorrhage



# Subdural Hemorrhage



**Subdural hemorrhage** (SDH) collects in the potential space between the inner dura and the arachnoid layer

Result from bridging vein tear in a MVA or fall

On CT: hyperdense crescentic shape when acute, then isodense to hypodense when subacute and chronic. Mass effect -> altered mental status

# Epidural Hemorrhage

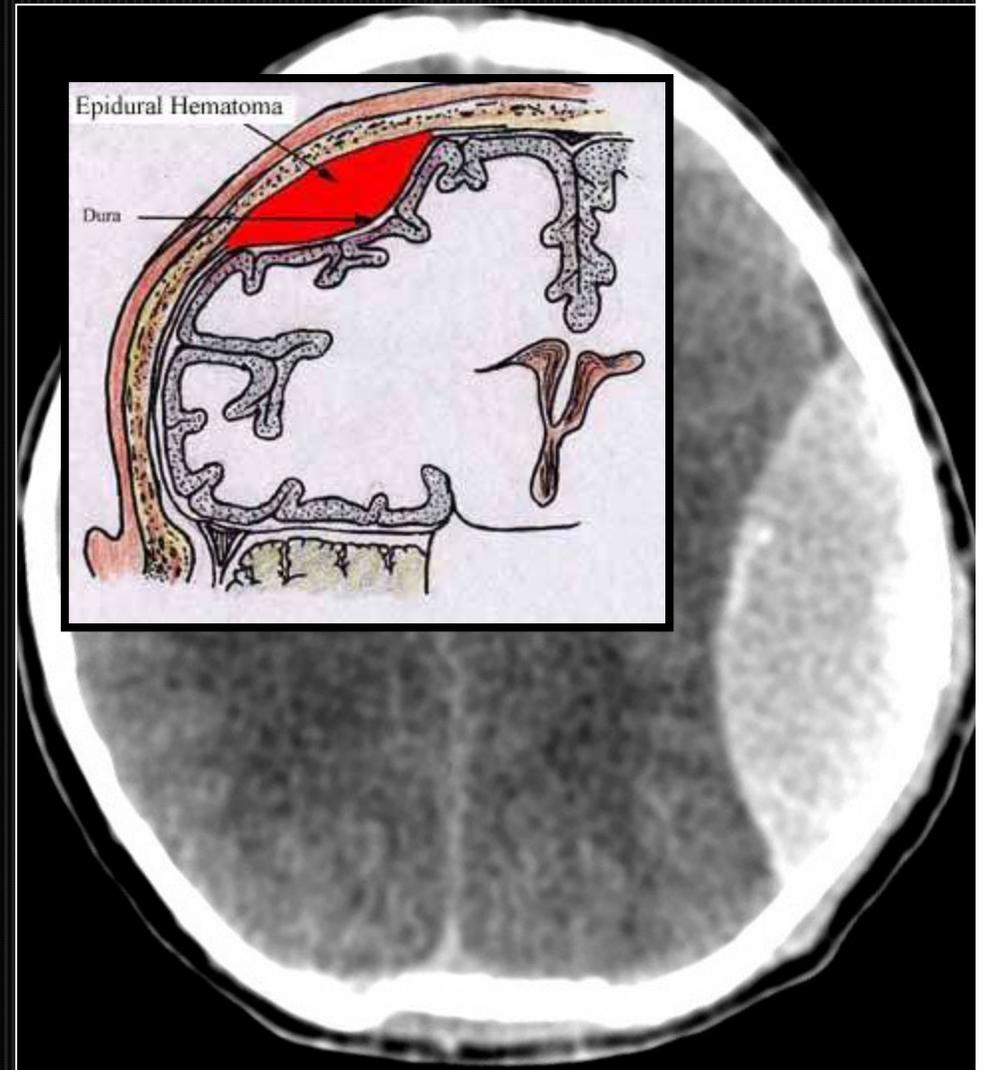
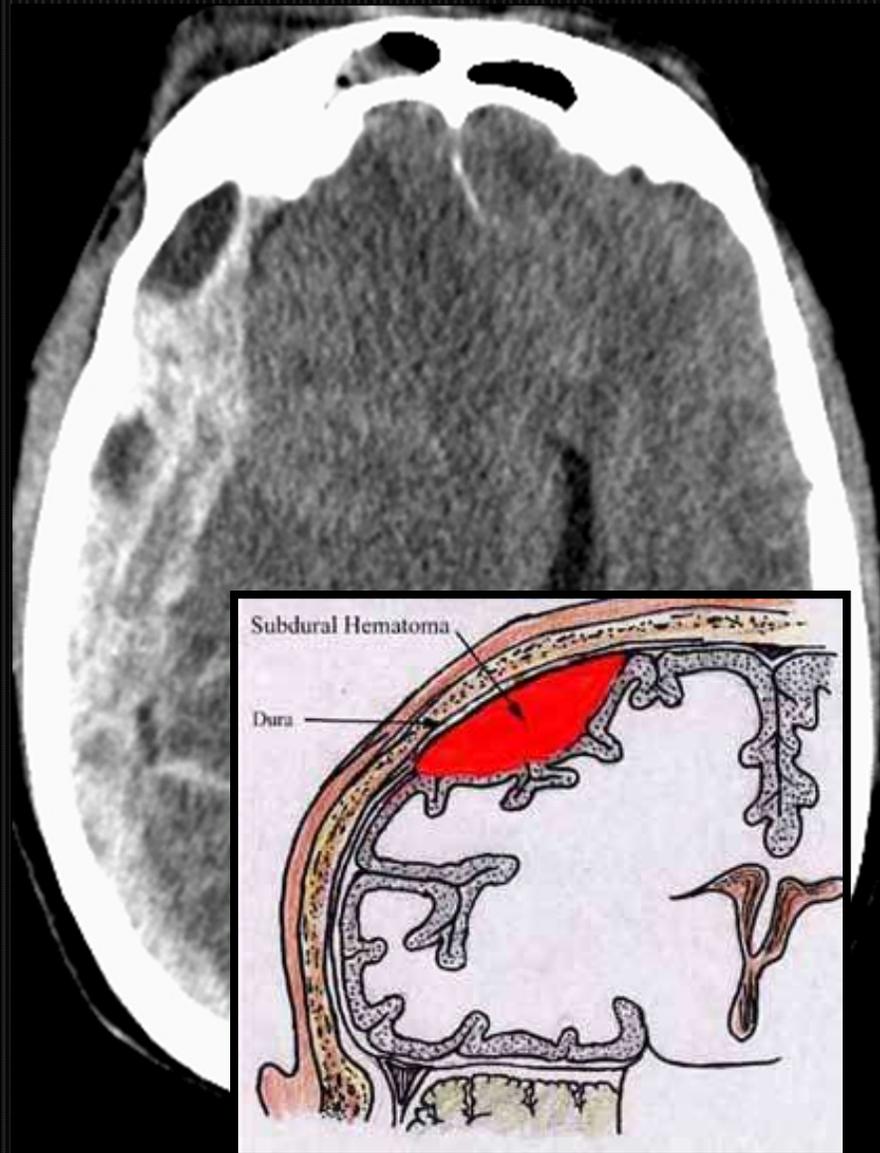


**Epidural hemorrhage** forms between inner table of calvarium and outer layer of the dura, results from middle meningeal arterial tear.

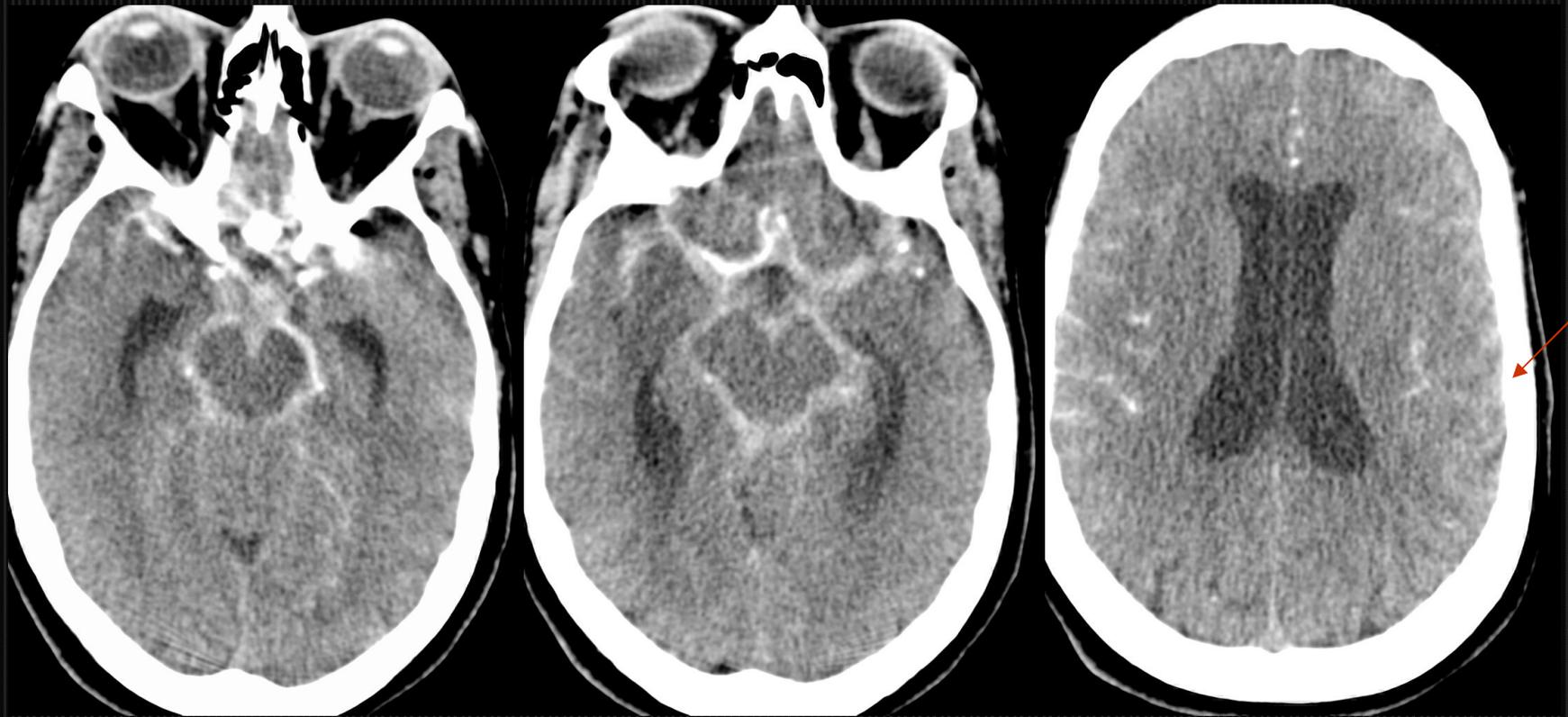
>90% are assoc with skull fx usu temporoparietal bones, also frontal and parieto-occipital regions.

On CT: hyperdense biconvex lens shape, mass effect. Early identification critical to guide evacuation vs early reevaluation

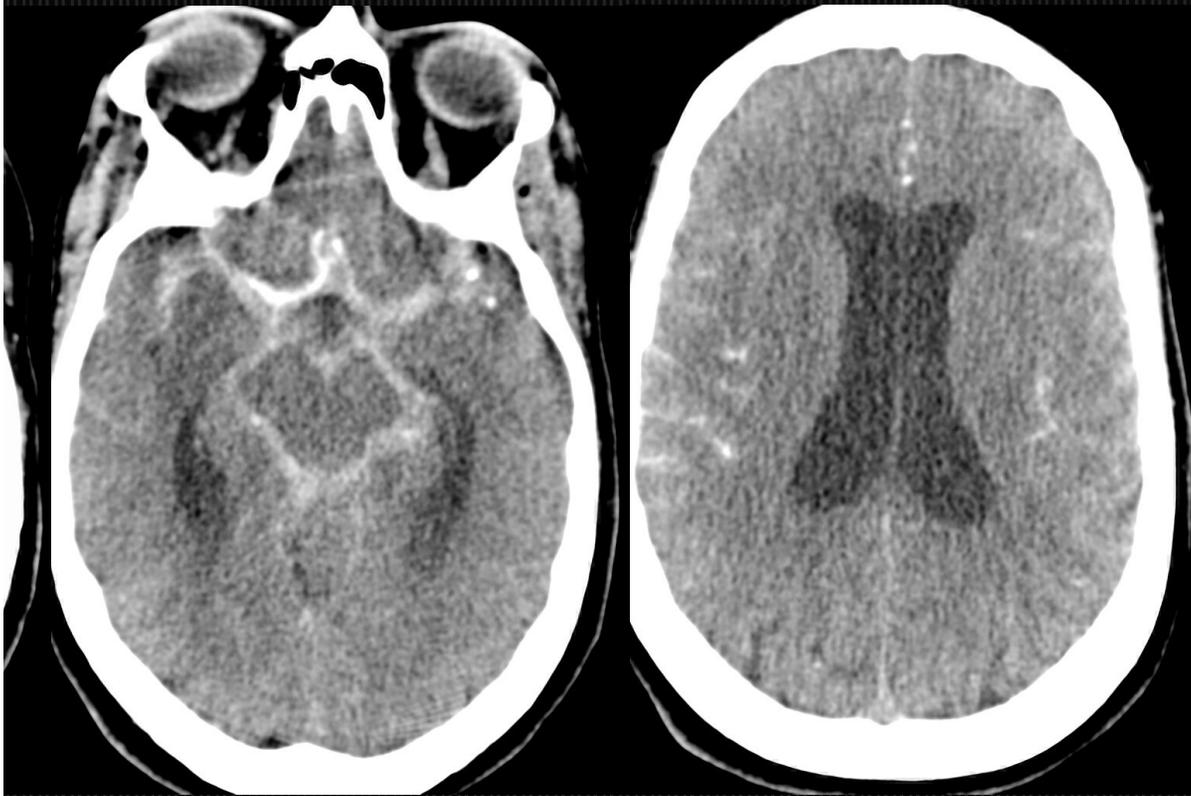
# Cases 11 & 12: Intracranial Hemorrhage



## Case 13: Worst HA of Life



# Case 13: Subarachnoid Hemorrhage

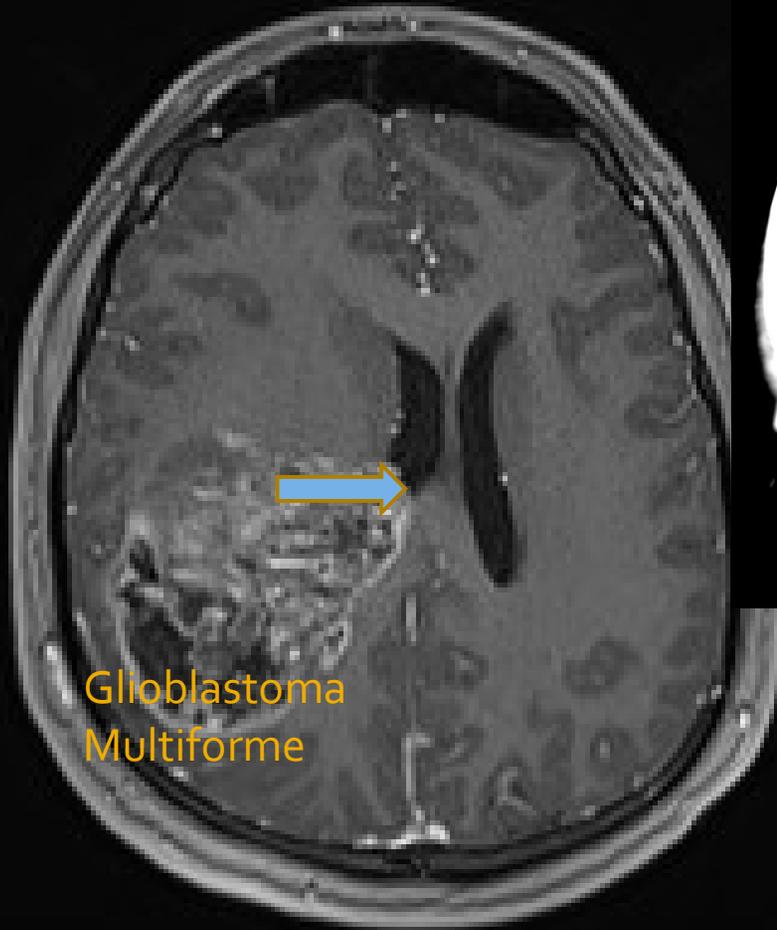


**Subarachnoid hemorrhage** that collects in the space between the pia and the arachnoid membrane

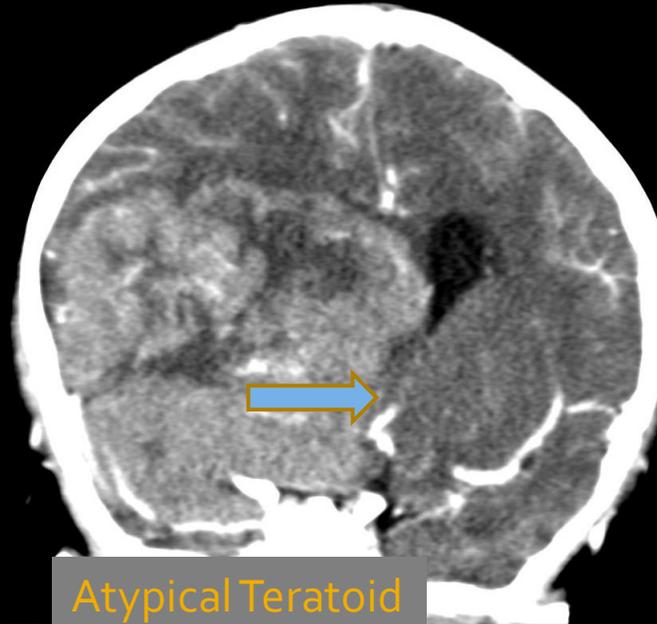
Think trauma, aneurysm, HTN, AVM

On CT: hyperdensity outlining the sulci and basilar cisterns, usu does not cause mass effect or edema

# Case 14: Brain Tumor with Mass Effect



Glioblastoma  
Multiforme



Atypical Teratoid  
Rhabdoid Tumor

- A. Right GBM with subfalcine herniation Rt->Lt
- B. Right ATRT with uncal herniation Rt->Lt

## Brain Herniation

Complication of increased intracranial pressure. Brain tumor joins intracranial hemorrhage and cerebral edema from stroke/anoxia as most common cause. Shift of brain from one compartment to the other = herniation places parenchyma, brainstem, intracranial vessels and cranial nerves at risk. Types are subfalcine, transtentorial, tonsillar, and extracranial

# We Made It!

- Any questions?
- <http://guides.lib.unc.edu/Radclerks>  
Emergency Radiology: The Requisites. Soto and Lucey (2017)
- Video shorts:  
[ICU Portable CXR](https://heelstream.med.unc.edu/Playlist/r5PRe7y3)  
<https://heelstream.med.unc.edu/Playlist/r5PRe7y3> - Dr  
Renner's Cervical Spine video