Don’t Be Fooled!
Pre-Existing Pathology in Trauma

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LEARNING OBJECTIVES:

1. Understand fundamental principles of trauma imaging with computed tomography (CT), encompassing both standard imaging protocols and advanced techniques.
2. Review pathologic conditions that can mimic trauma on CT, focusing on those conditions that can mimic critical trauma.
3. Learn helpful strategies to correctly differentiate trauma from pre-existing pathology.

TARGET AUDIENCE:

Radiology residents, emergency radiology faculty

RELEVANT FINANCIAL RELATIONSHIPS: Ryan Key: Nothing to Disclose | Joseph Graves: Nothing to Disclose | Tarek Hanna: Nothing to Disclose | Krystal Archer-Arroyo: Speaking fee, Siemens Medical Solutions | Keith Herr: Nothing to Disclose

Epidemiology of Trauma and Review of CT Protocols

- ✓ **26.9 million:** people in the United States treated in an emergency department every year.
- ✓ **$671 billion:** total costs of traumatic injuries in the United States in 2013.
- ✓ **59% of deaths:** among people aged 1-44 years old are caused by trauma.
- ✓ **Every 3 minutes:** frequency (in 2014) at which one person died from traumatic injuries (1).

Trauma is a huge public health issue!

Image with CT!

Contrast-enhanced CT is the primary imaging modality in the management of blunt abdominal trauma; however, there is **no consensus regarding an optimal CT trauma protocol and this varies with institution.** Regardless of the CT imaging protocol, **patient preparation is key**. Arms should be elevated above the patient's head for abdominal and chest imaging and metallic monitoring devices should be removed or positioned remote from the body.

Portal Venous phase

+++ liver or splenic parenchymal injures

Limitations: Lack of arterial phase imaging can miss or misdiagnose vascular injuries

60-80 sec delay

Arterial phase

+++ Vascular injuries

Limitations: Lack of optimal parenchymal enhancement limits detection of solid organ injuries

20-30 sec delay

Portal venous & arterial phase

Two separate CT acquisitions following a single contrast bolus or "split-bolus" technique (see below) which obtains both phases in a single CT.

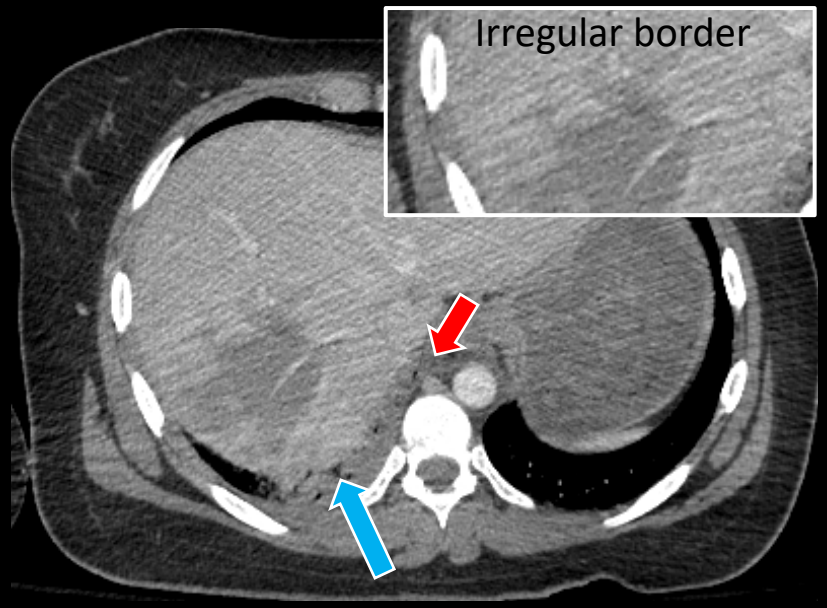
- ❑140 cc of contrast in total
- ❑75 cc contrast injection at 3 cc/sec
- ❑14 sec delay
- ❑65 cc contrast injection at 4 cc/sec
- ❑30 cc saline at 4 cc/sec
- ❑CAP acquisition at 70 secs from start of the injection sequence

Portal Venous phase

Arterial phase

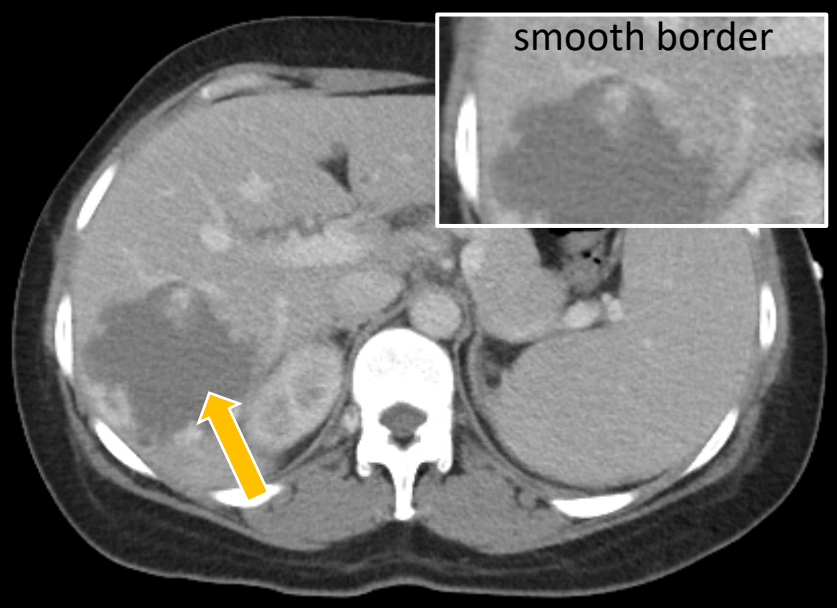
Split-Bolus Technique

Hepatic Trauma and Mimic



TRAUMA

MVC with hepatic laceration and local parenchymal disruption: mass-like region of hypoattenuation in the right hepatic lobe with irregular margins (*magnified image*). Note the presence of other features of trauma, with right lung base pulmonary contusion (arrow) and small amount of blood products around the aorta (arrow). This lesion may be described as a pseudohemangioma. Notice the photon poor image due to arms at sides.



MIMIC

MVC without hepatic trauma, but with pre-existing large hepatic hemangioma: Note the region of hypoattenuation in the right hepatic lobe with discontinuous peripheral nodular enhancement (arrow). There are no regional findings of trauma. The non-enhancing borders are smooth (*magnified image*). The foci of peripheral enhancement are brighter then background parenchyma.

Hepatic parenchymal trauma consists of:

- Subcapsular hematomas
- Parenchymal lacerations
- Intra-parenchymal hematomas
- Larger regions of parenchymal disruption (a mix of de-vascularized parenchymal, extra-cellular blood products, and larger amorphous lacerations)
- Any combination of the above findings!

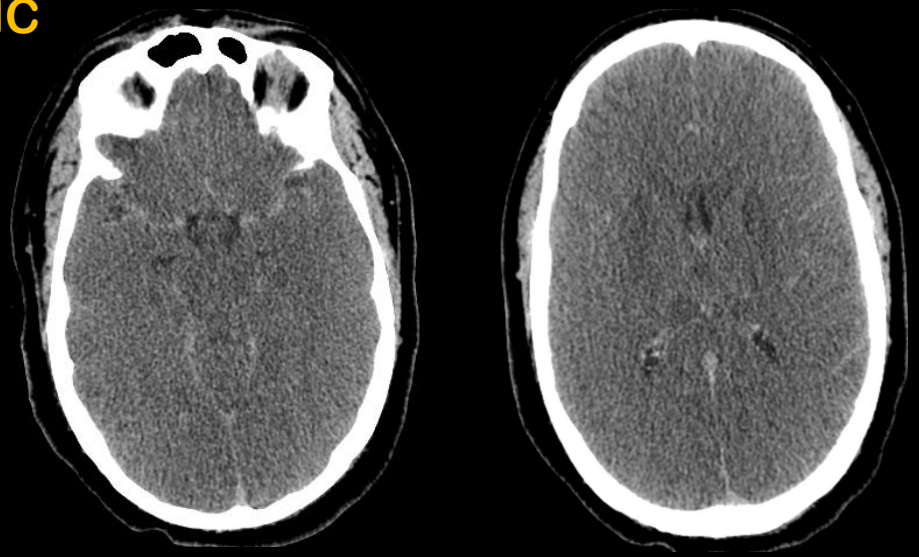
TEACHING POINT: The morphology and attenuation of hepatic parenchymal trauma can be variable, leading to many pathologic mimickers.

TEACHING POINT: Use the presence of other trauma pathology to help you. Perihepatic blood, right rib fractures, right basilar pulmonary contusion, right colonic or mesenteric injury, even right anterior body wall contusions.

Neuro Trauma and Mimic

MIMIC

1



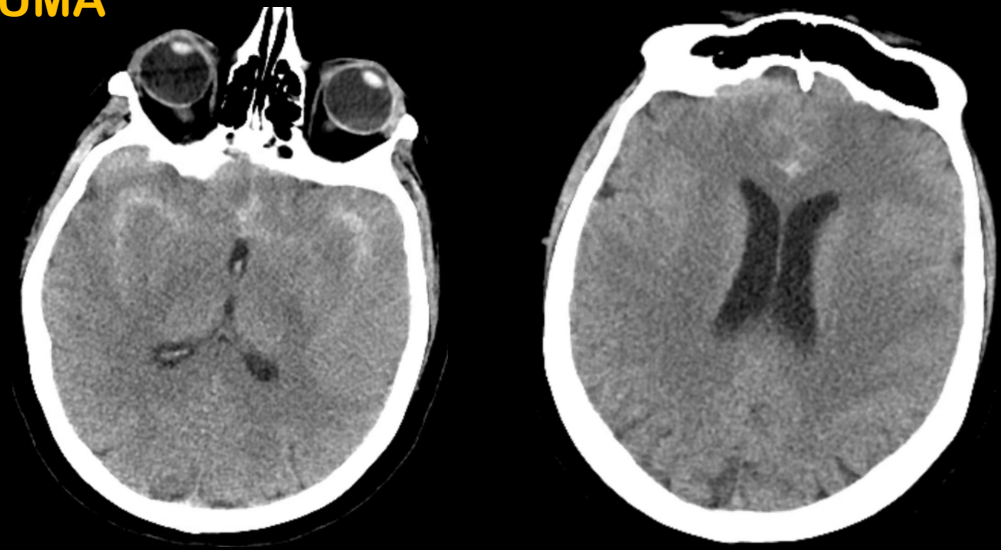
Non-contrast head CT shows abnormal hyperdensity within the basilar cisterns, Sylvian fissures, and cerebral sulci. There is diffuse cerebral edema, poor gray-white differentiation, and decreased basal ganglia attenuation.

2

Interpretation: The findings are characteristic for diffuse hypoxic-ischemic injury, a diagnosis supported by the clinical history of cardiac arrest. The abnormal hyperdensity is **pseudo-subarachnoid hemorrhage (SAH).** Diffuse cerebral edema causes hypoattenuation of the parenchyma, displacement of CSF from the subarachnoid space, and distention of superficial veins. Pseudo-SAH can also be seen in meningitis, due to accumulation of proteinaceous material in the subarachnoid space.

TRAUMA

3



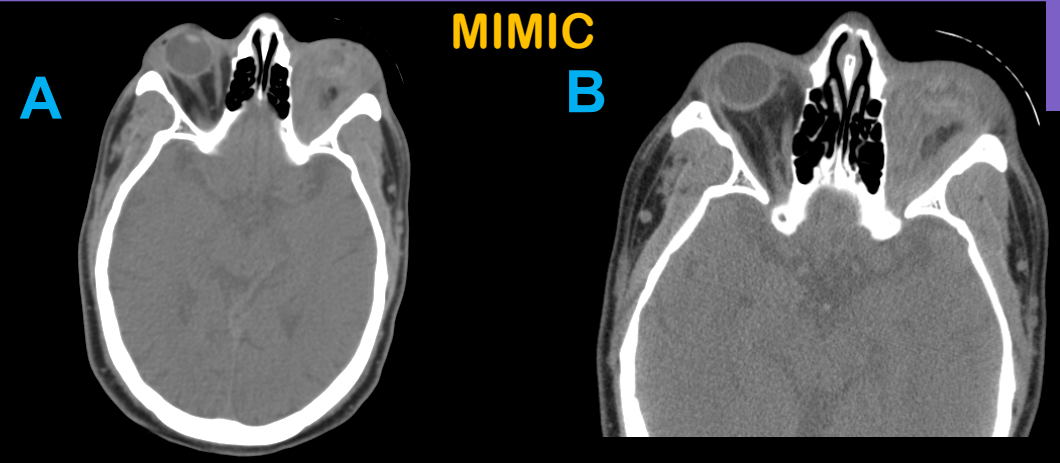
Non-contrast head CT demonstrates an acute subarachnoid hemorrhage. Hyperdense blood products are present in the suprasellar cistern and Sylvian fissures. Gray-white differentiation is preserved.

Take Home Points: Trauma or Not?

4

- Pseudo-SAH can be caused by hypoxic-ischemic injury and meningitis, and may resemble traumatic or aneurysmal SAH.
- When present, concomitant imaging findings such as loss of gray-white differentiation can help make the diagnosis.
- Patients who are "found down" often have soft tissue injuries after falling, and little supporting clinical history. It is important to not mistake pseudo-SAH for traumatic SAH in such cases.

Neuro Trauma and Mimic

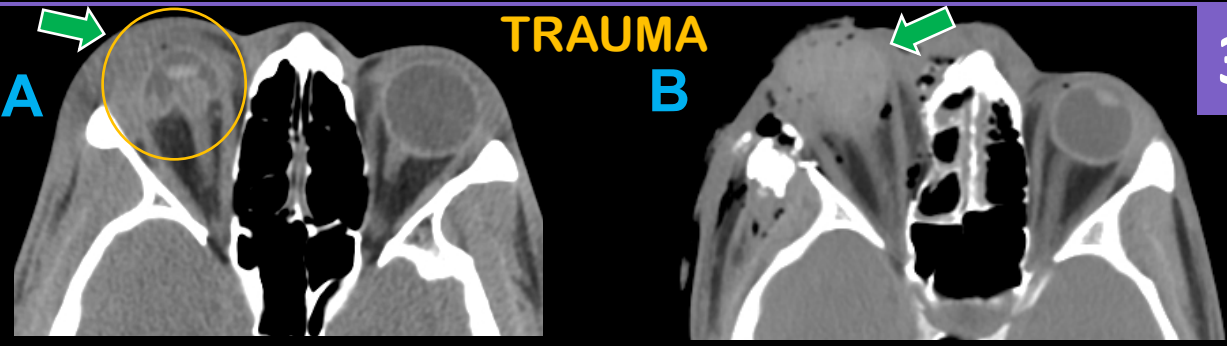


1

Head (A) and face (B) CTs without IV contrast demonstrate extensive high density material within the left orbit, with obliteration of the normal rectus muscles, and loss of the normal globe contour/morphology.

Interpretation: The radiologist was concerned about globe rupture, given the presence of mandibular fractures and facial contusions (not shown). Findings were phoned to the trauma team, and open direct inspection, the left eye was deformed and appeared non-functional, but there was no hemorrhage or active bleeding from this area. **Mimic Diagnosis: Orbital pseudotumor**

2



3

Companion cases of true traumatic globe rupture in two different trauma patients. A) Note the deflated globe contour (circle) with primarily pre-septal hemorrhage (arrow). B) High density within the globe compatible with vitreous hemorrhage (arrow).

SUMMARY

- Pre-existing pathology can mimic traumatic pathology in the emergency setting
- Imaging features, which may be subtle, can help distinguish between trauma and trauma mimics
- History and physical exam findings may be required in certain cases to make the diagnosis

Take Home Points: Trauma or Not?

4

- Unlike other areas, the globe/orbit is amenable to direct inspection; when unsure, call the trauma team!
- In the absence of penetrating trauma, be suspicious of extensive intra-conal and extra-conal abnormality without orbital fractures.
- Calcifications suggestion chronicity; look for phthisis bulbi, a chronic collapsed partially calcified globe.

Reference: 1. “Injury Prevention & Control.” Centers for Disease Control, www.cdc.gov/injury/wisqars/overview/key_data.html.

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