Emergency Radiology Case: Gallbladder Avulsion with Liver Laceration and Hemoperitoneum

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1/30/20

RAD 4001

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Clinical History

- Pt is a 79 year old man with unknown PMH s/p single MVC as a restrained driver.
- Initially reported as unresponsive with GCS of 4 by EMS.
- Pt regained consciousness PTA with subsequent GCS of 14.

Vitals

- BP: 105/51 mmHg
- HR: 93 bpm
- RR: 20 breaths/min
- SPO2: 97%

Physical Exam

- General: Awake, alert, NAD
- GCS 13 (E:4, V:3, M:6) oriented only to self
- HEENT: Excoriations to forehead
- CV: RRR no m/g/r, palpable distal pulses
- Chest: No signs of trauma, no chest wall tenderness
- Abd: No signs of trauma, no tenderness or distension
- Spine: TTP over thoracic spine, possible lumbar step off
- Pelvis: Stable
- Ext: Excoriations to hands and knees

Initial Management

- Pt deemed stable, though altered mental status was concerning in the setting of recent trauma.
- A FAST exam was ordered.
- A trauma radiography series was ordered, as well as Brain/Neck CTA and CT CAP w/ contrast.

ACR Appropriateness Criteria:

Variant 2: **Major blunt trauma. Hemodynamically stable. Not otherwise specified. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
CT whole body with IV contrast	Usually Appropriate	☢☢☢☢
Radiography trauma series	Usually Appropriate	☢☢☢
US FAST scan chest abdomen pelvis	Usually Appropriate	O
CT whole body without IV contrast	May Be Appropriate	☢☢☢☢
Fluoroscopy retrograde urethrography	Usually Not Appropriate	☢☢☢
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O

Clinical Condition: Head Trauma

Variant 7: Suspected intracranial arterial injury.

Radiologic Procedure	Rating	Comments	RRL*
CTA head and neck with IV contrast	9	This procedure is an alternative; either CTA or MRA can be performed, depending on institutional preference.	☢☢☢
MRA head and neck without and with IV contrast	9	This procedure is an alternative; either CTA or MRA can be performed, depending on institutional preference.	O
MRI head without IV contrast	9	This procedure is complementary, in conjunction with MRA.	O
CT head without IV contrast	9	This procedure is complementary, in conjunction with CTA.	☢☢☢
MRA head and neck without IV contrast	7	This procedure is an alternative; either CTA or MRA can be performed, depending on institutional preference.	O
Arteriography cervicocerebral	6		☢☢☢
MRI head without and with IV contrast	3		O
CT head without and with IV contrast	1		☢☢☢
MRI head without IV contrast with DTI	1		O
CT head with IV contrast	1		☢☢☢
X-ray skull	1		☢
Tc-99m HMPAO SPECT head	1		☢☢☢☢
FDG-PET/CT head	1		☢☢☢☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

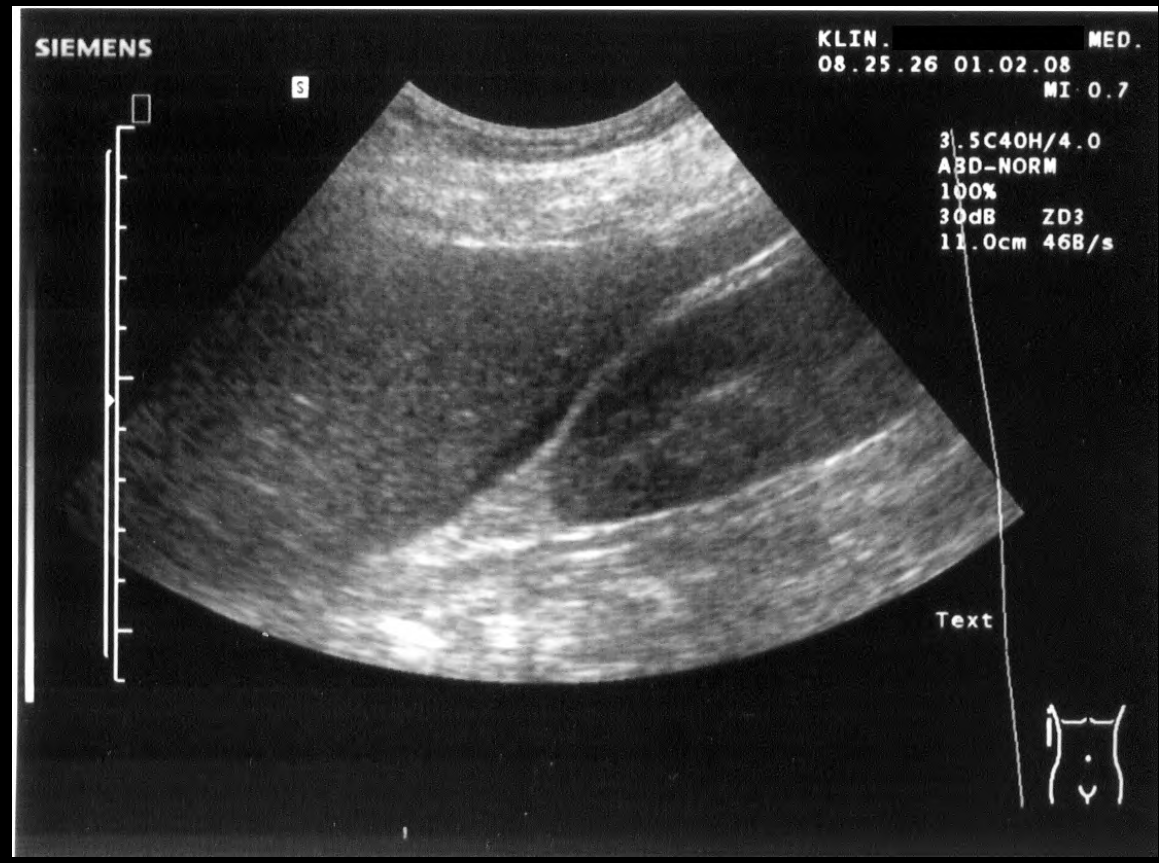
*Relative Radiation Level

ACR Appropriateness Criteria:

- Major Blunt Trauma
  - The FAST exam, radiography trauma series and CT CAP w/ contrast **were appropriate.**
- Head Trauma
  - In the setting of suspected intracranial arterial injury, the CTA Head/Neck **was appropriate.**

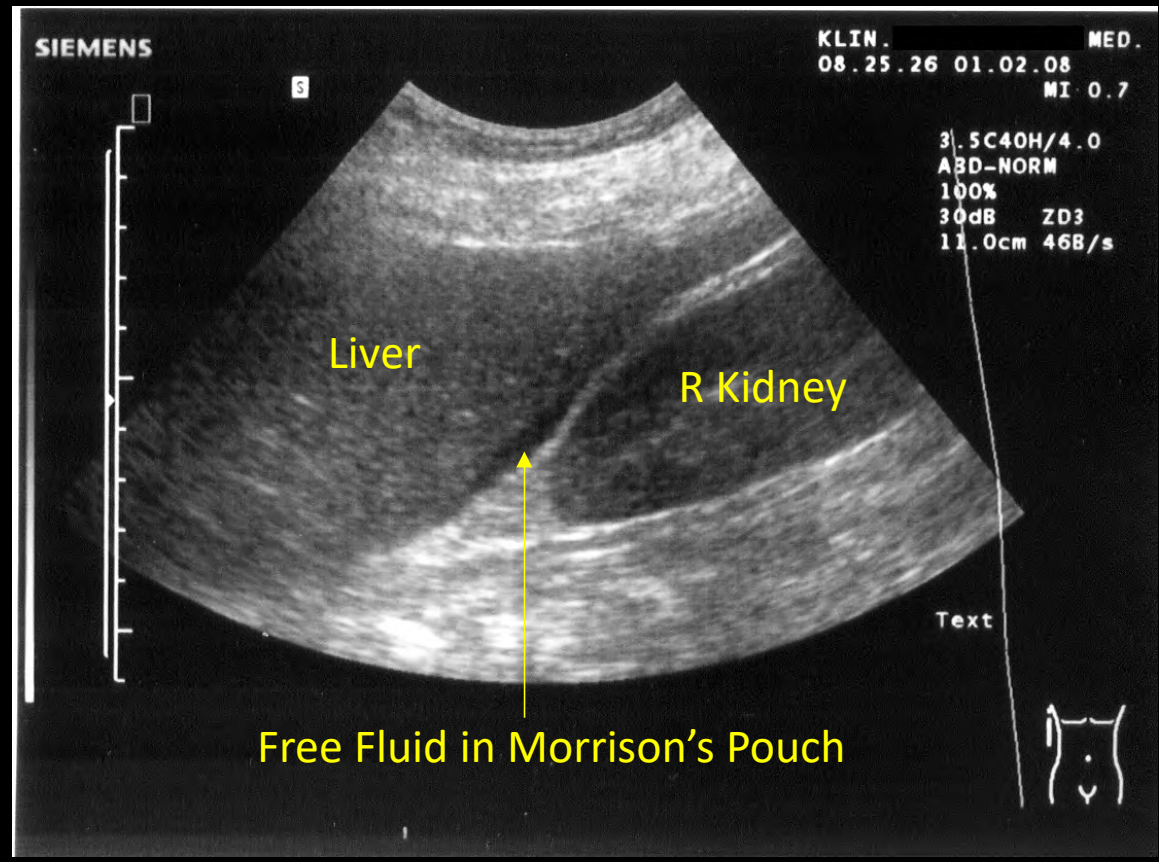
Focused Assessment with Sonography for Trauma (FAST)

- Used to identify free fluid, air or other abnormalities in the pericardial, peritoneal or pleural cavities.
- Standard order of evaluation is usually:
  - Pericardial
  - Hepatorenal (right flank)
  - Perisplenic (left flank)
  - Retrovesical (pelvic)
  - Thoracic



Focused Assessment with Sonography for Trauma (FAST)

- Image to the right is not our patient, just an example.
- For our patient, **FAST exam was ruled as negative.**

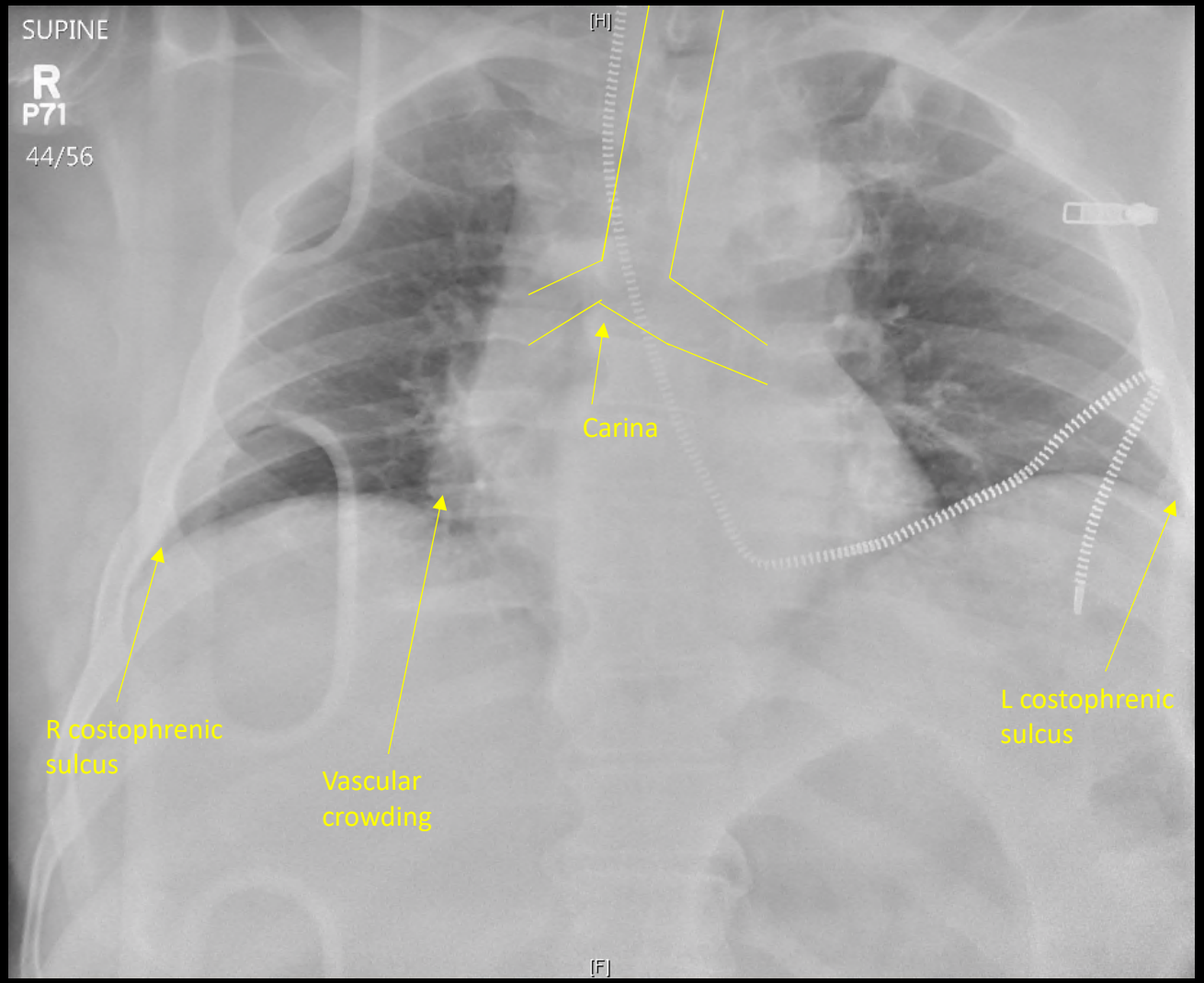


Components of a Trauma Series:

- A standard trauma series traditionally has the following components:
  - AP Chest
  - AP Pelvis
  - Lateral C-Spine (often replaced with C-Spine CT if accessible).

AP Chest

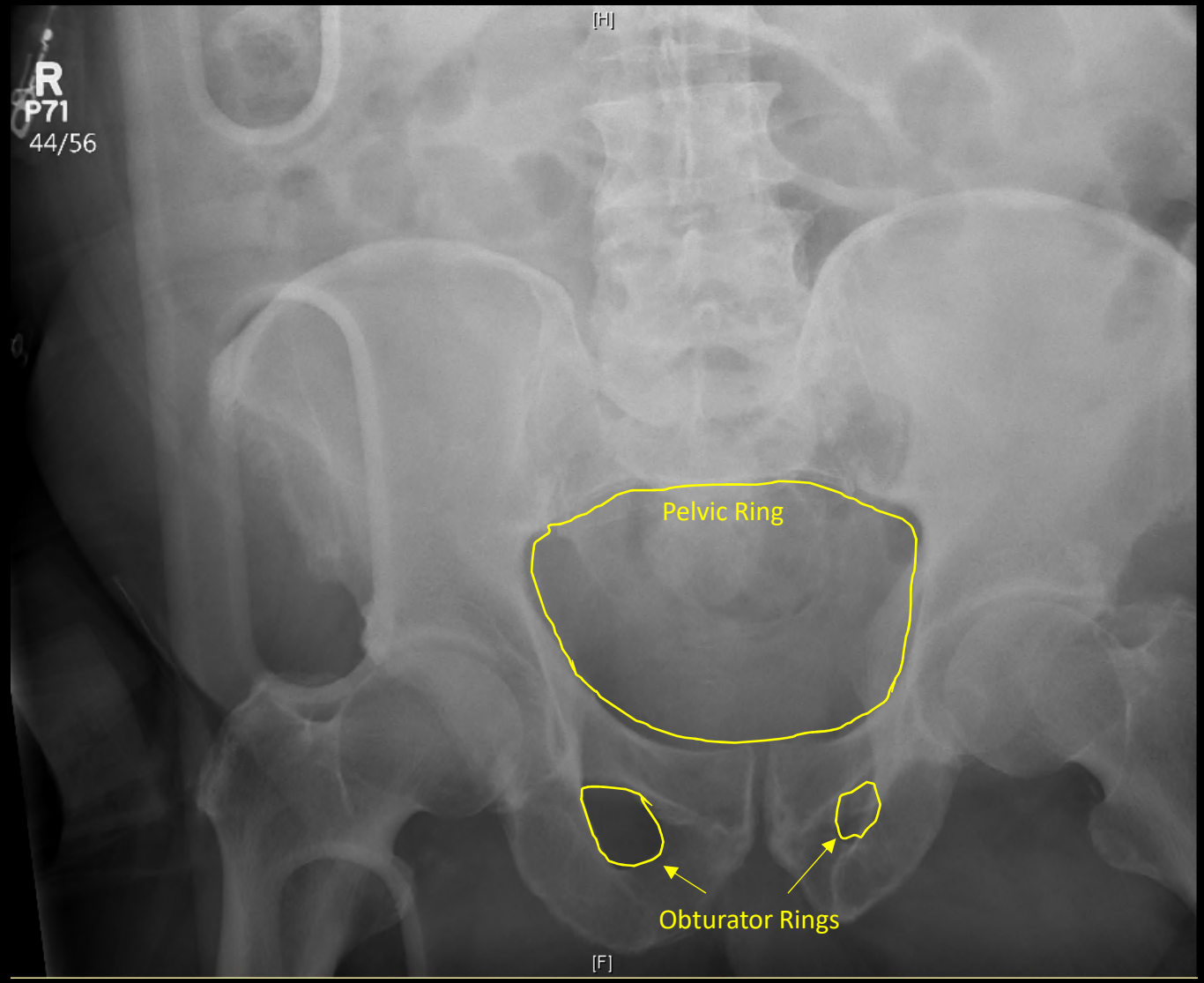
- Used to evaluate for pathology in the pleural cavity or mediastinum.
- CXR should be reviewed for any signs of hemothorax, pneumothorax, pulmonary contusion, fractures or aortic injury.



AP Pelvis

- Used to assess for pelvic fractures, open-book injuries and posterior pelvic injuries.

- Gives some additional information about bowel gas, pelvic organs and hip joints.



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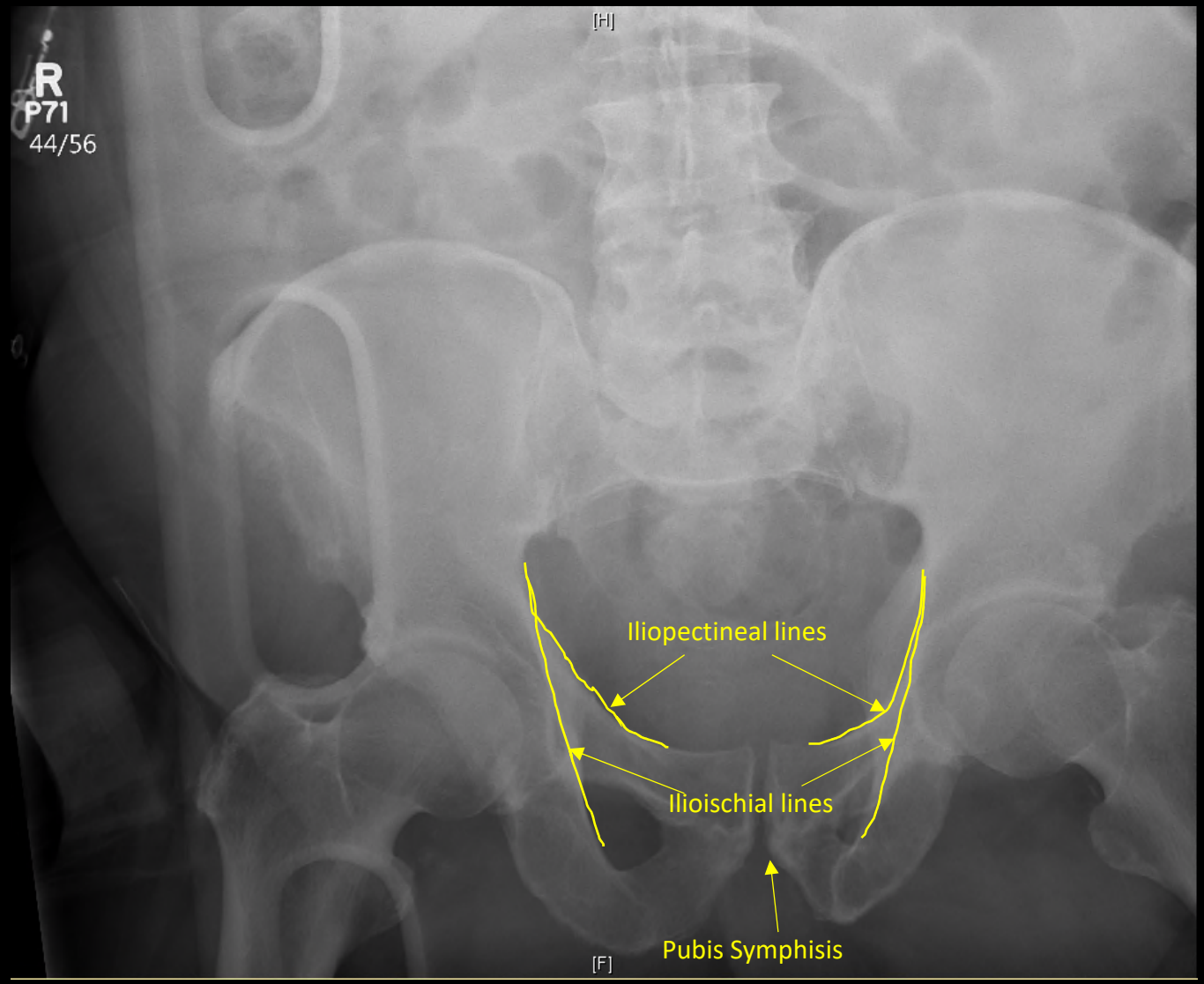
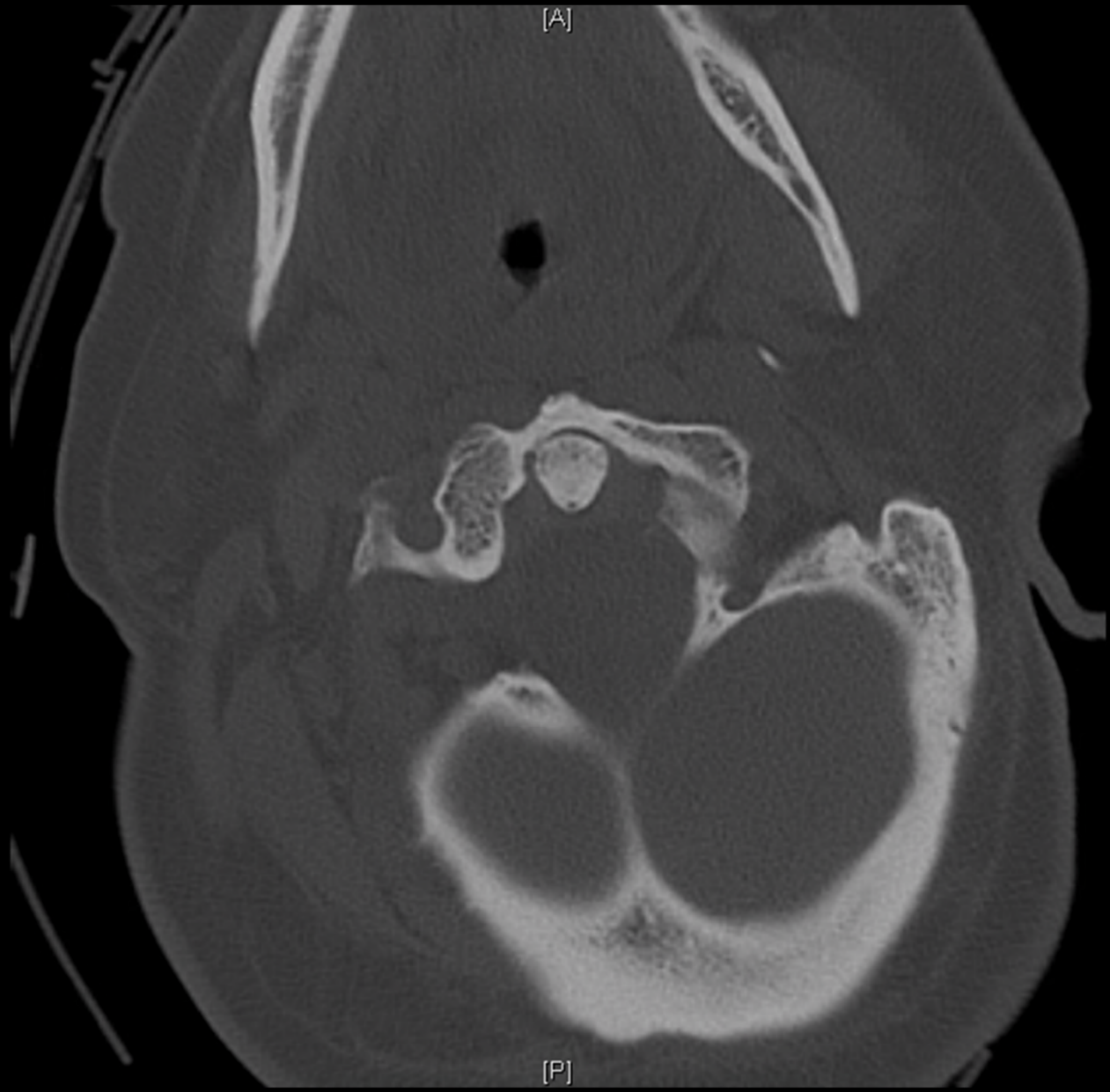


CT C-Spine

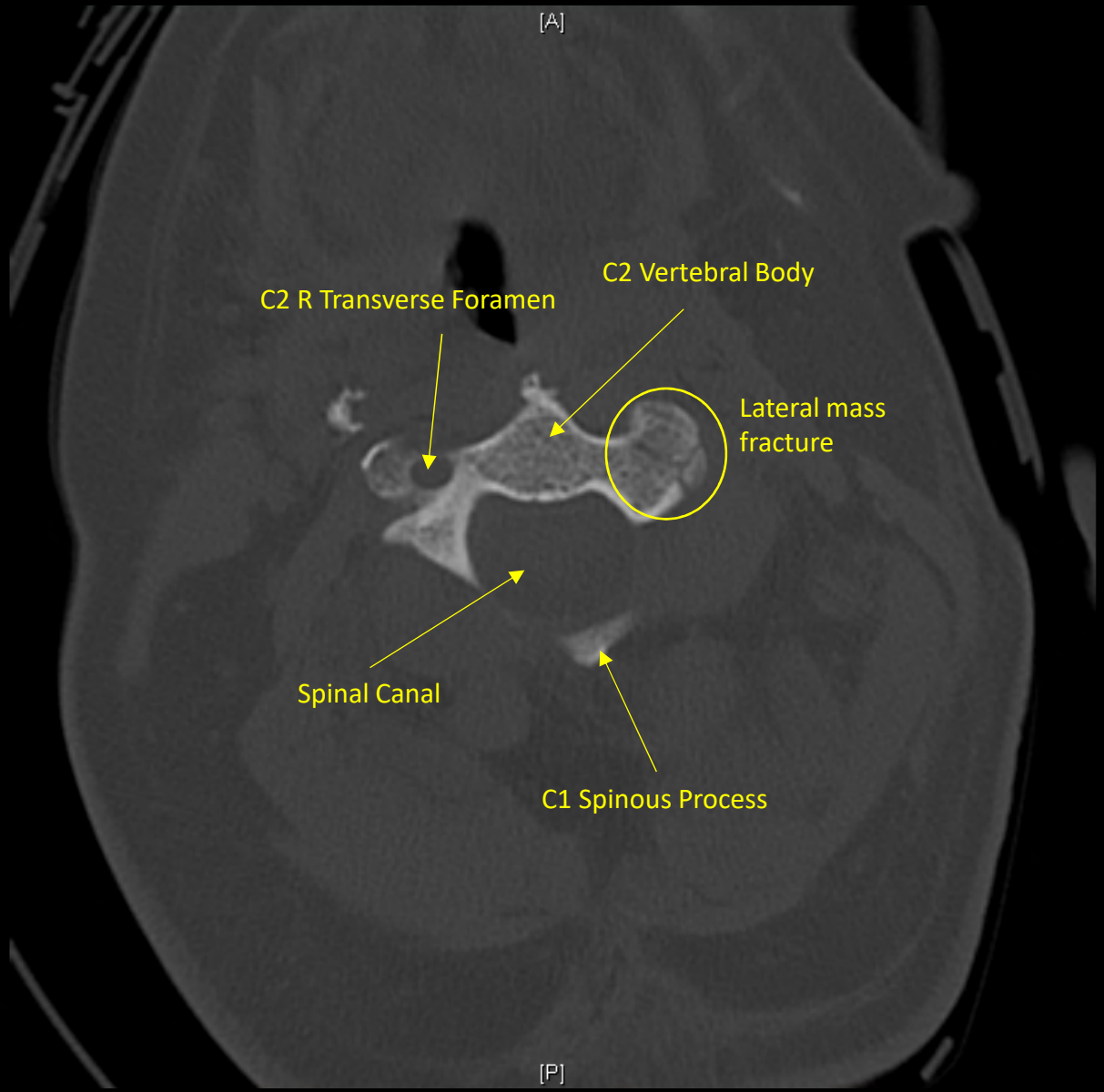
- Gives views from the base of the skull to T3

- Used to check for fracture, spinal alignment, soft tissue injury

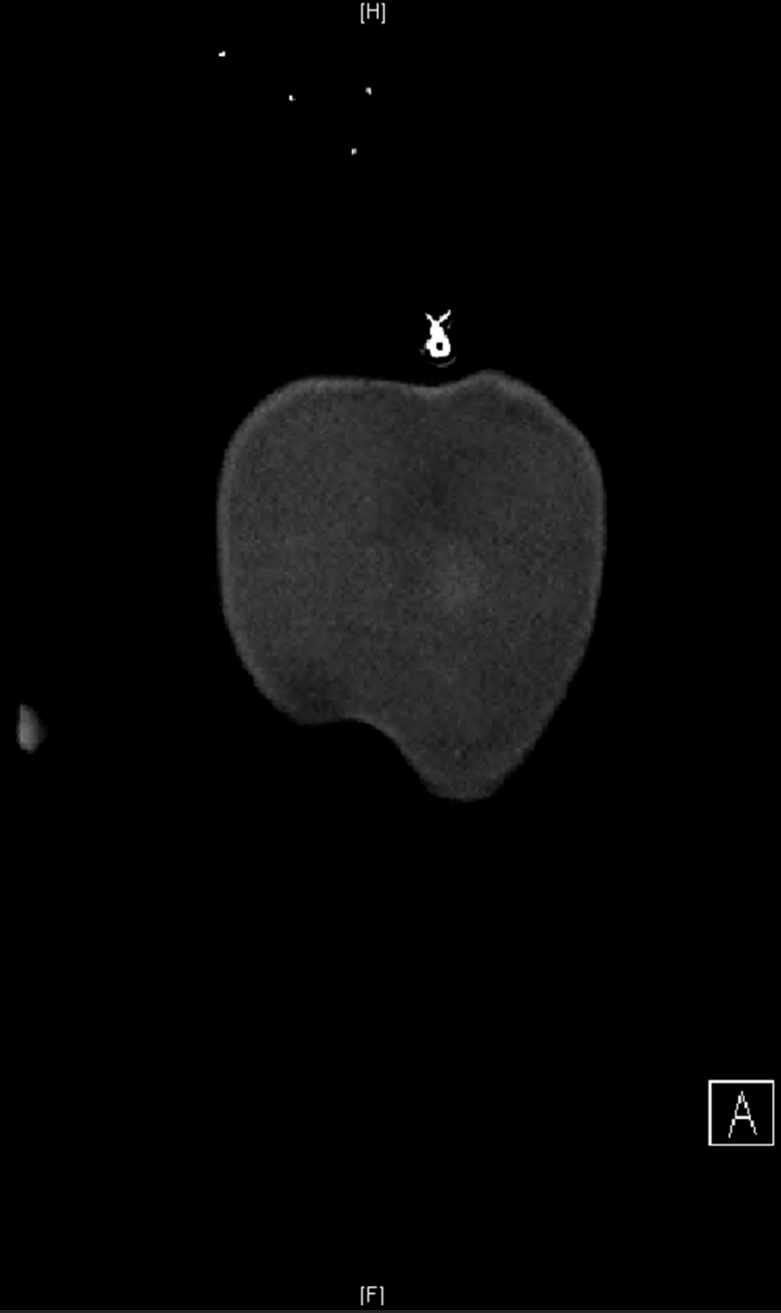


CT C-Spine

- Minimally displaced left C2 lateral mass fracture involving the transverse foramen and C1-C2 articulation



CT Abdomen w/ Contrast, Coronal View



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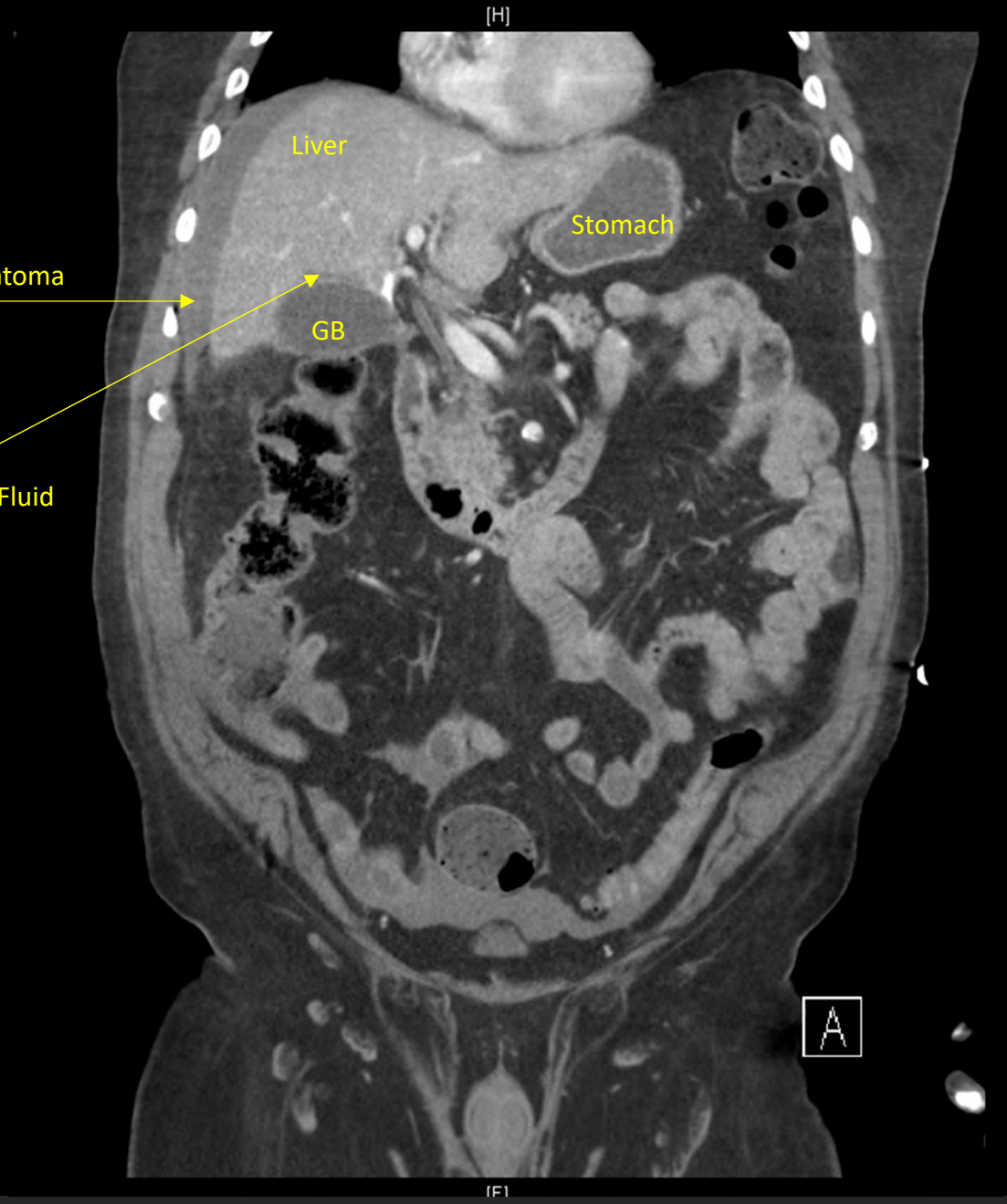

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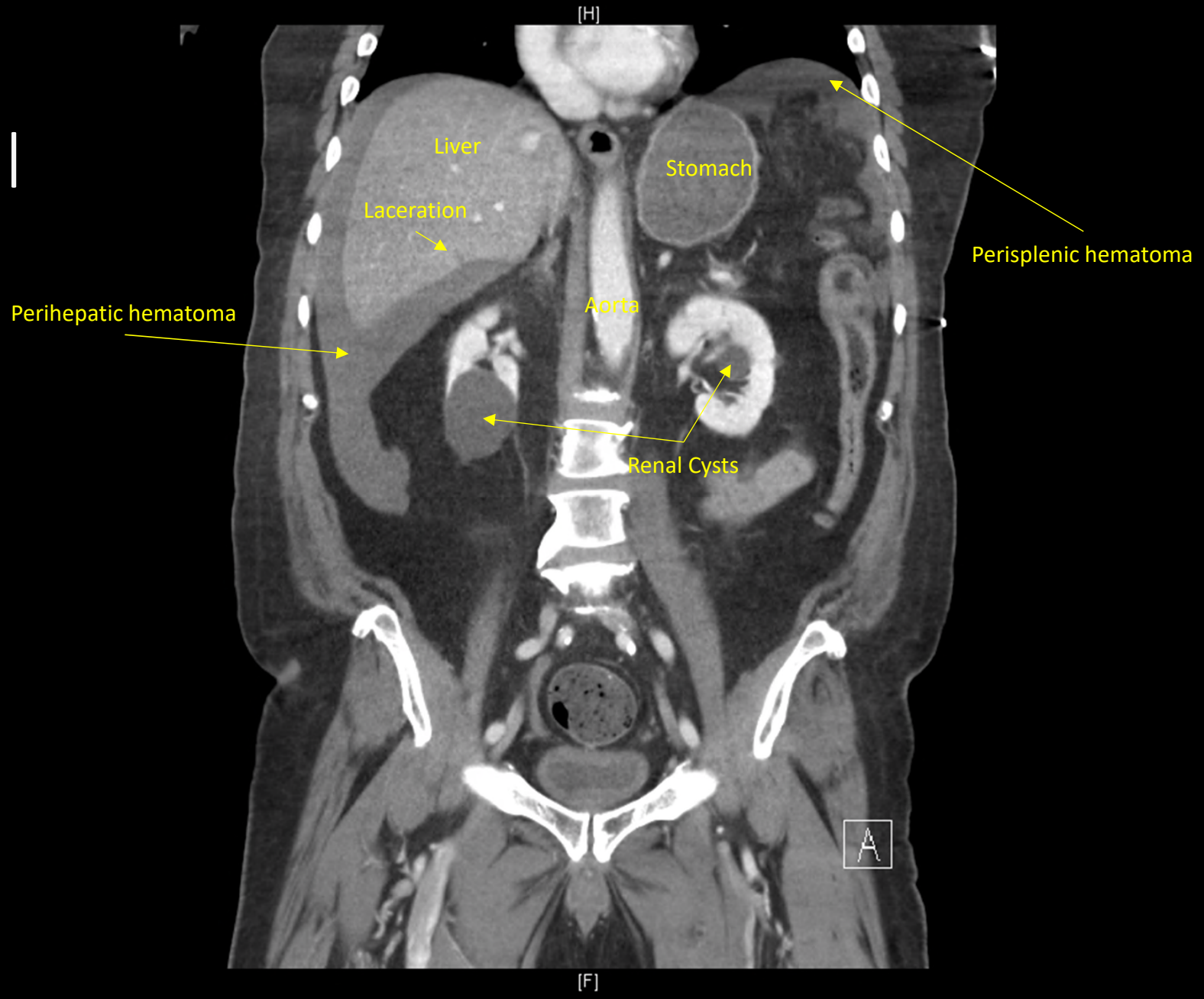
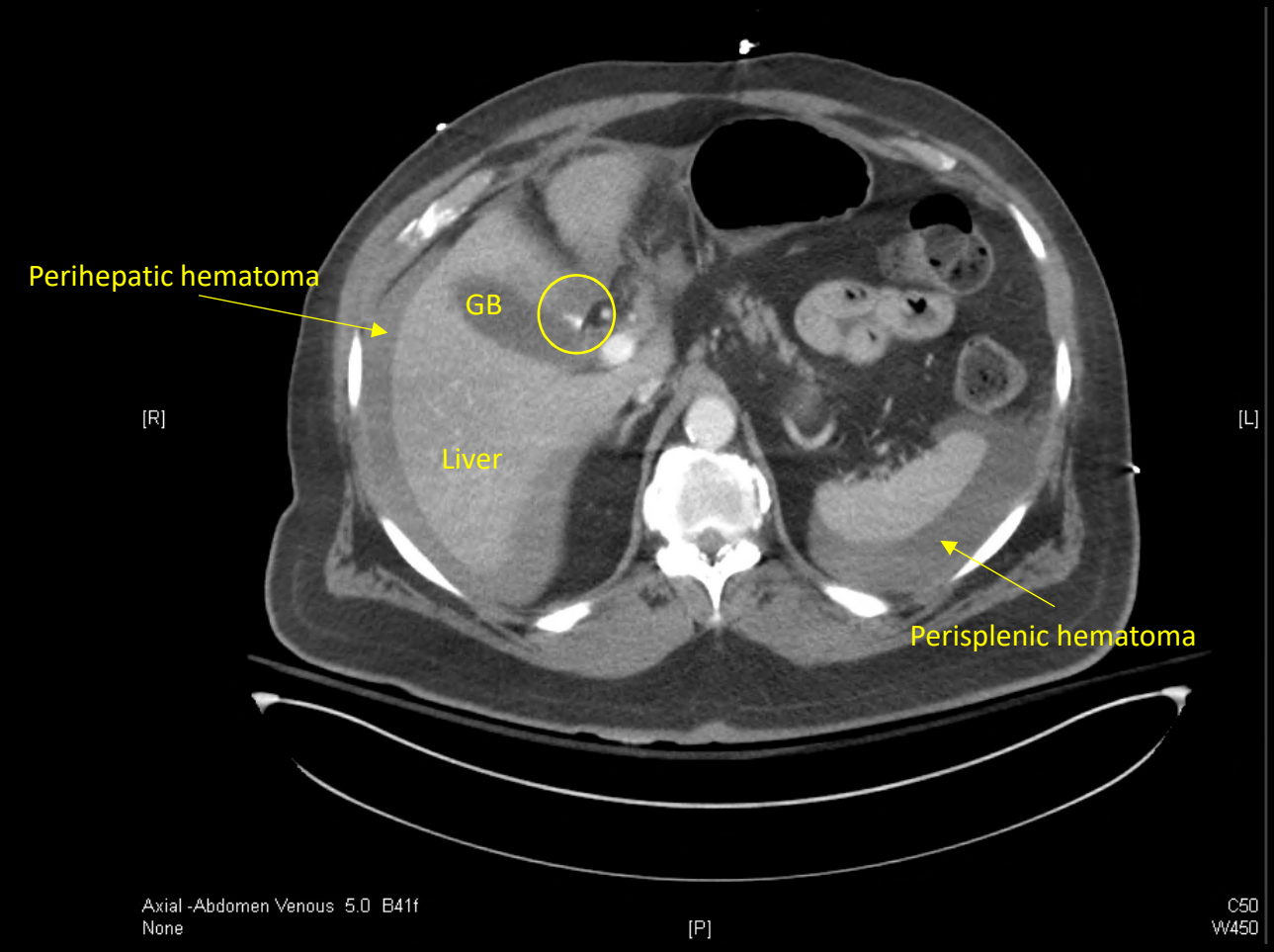
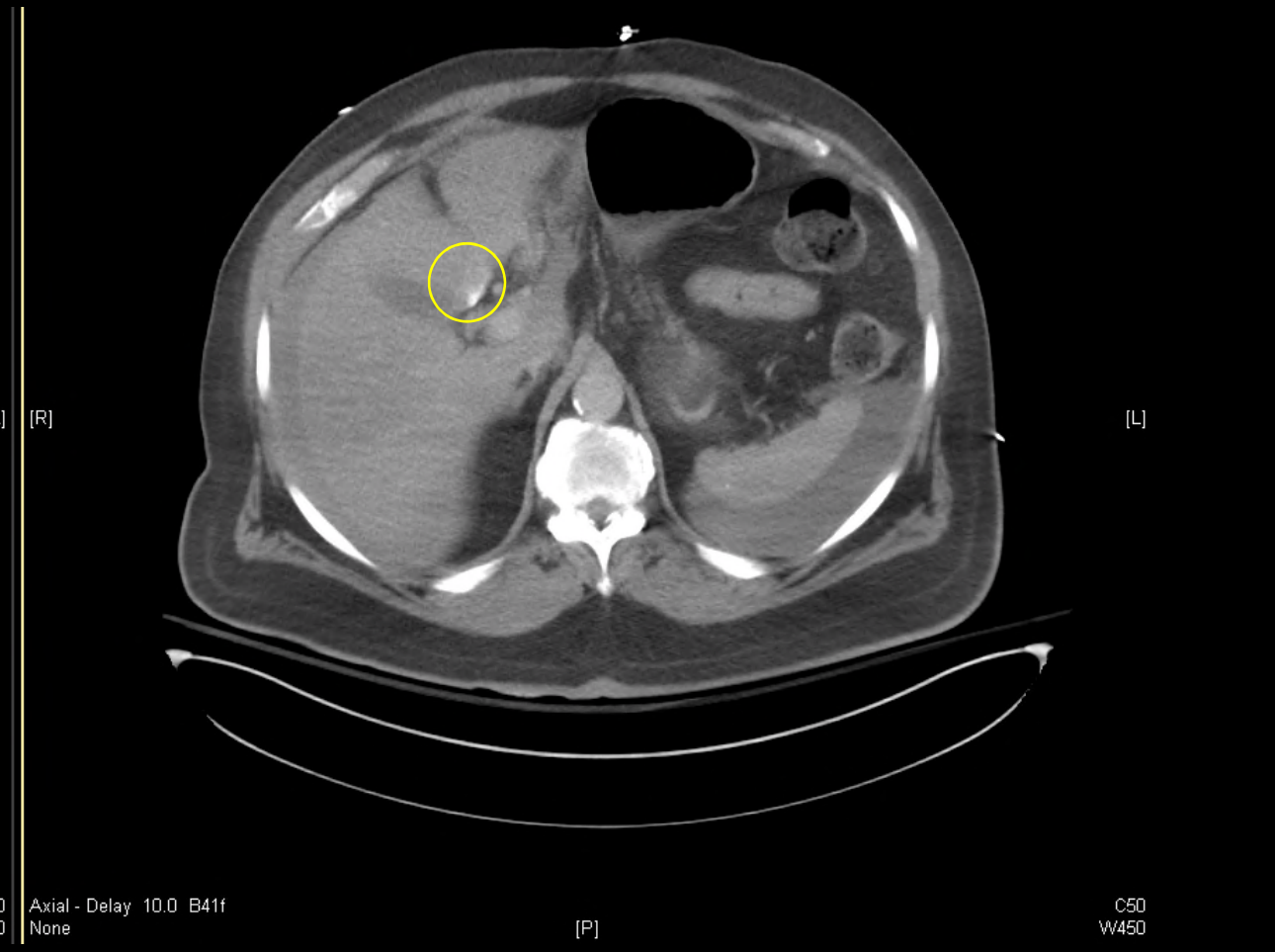


Axial CT Abdomen

Venous Phase



Excretory Phase



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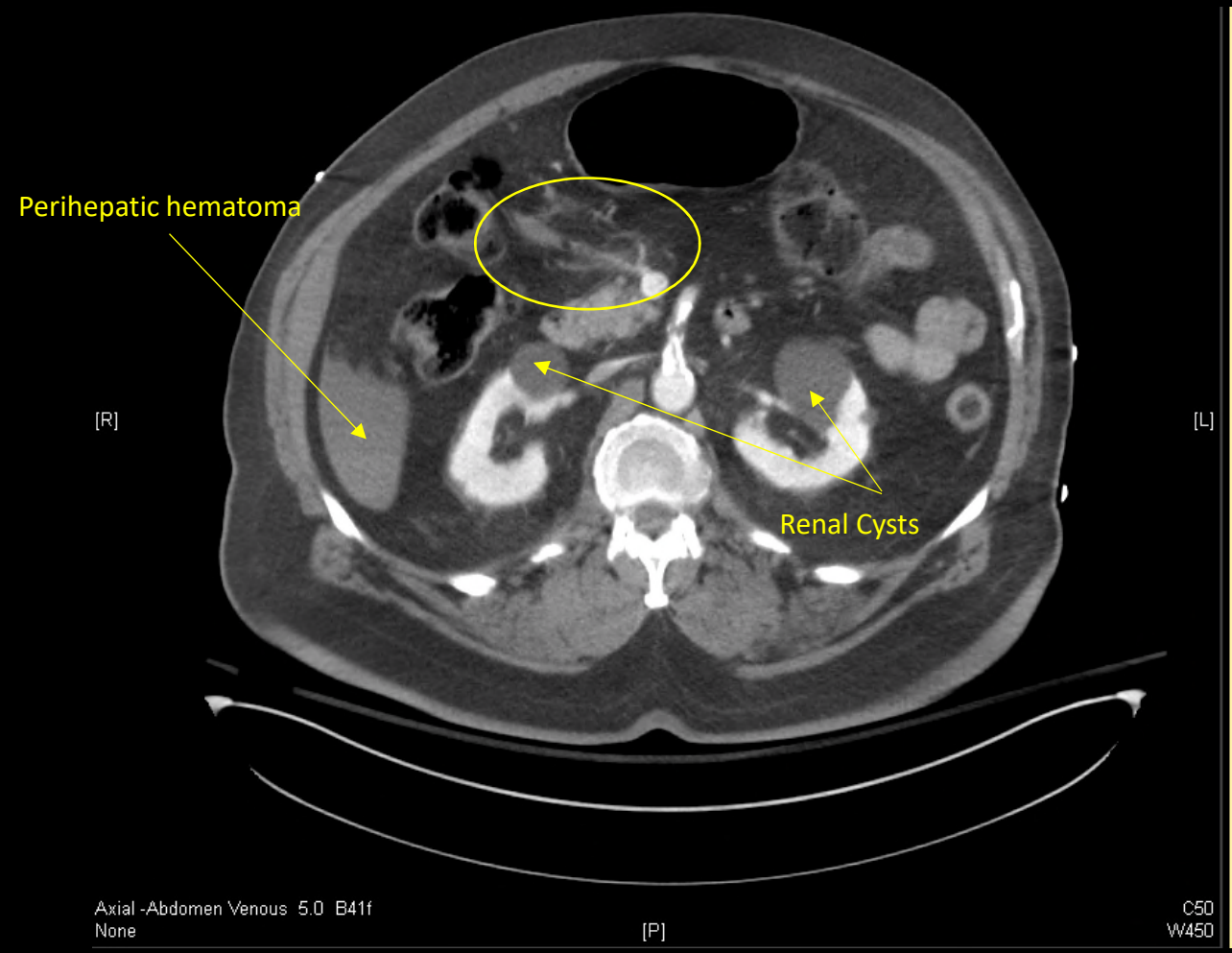

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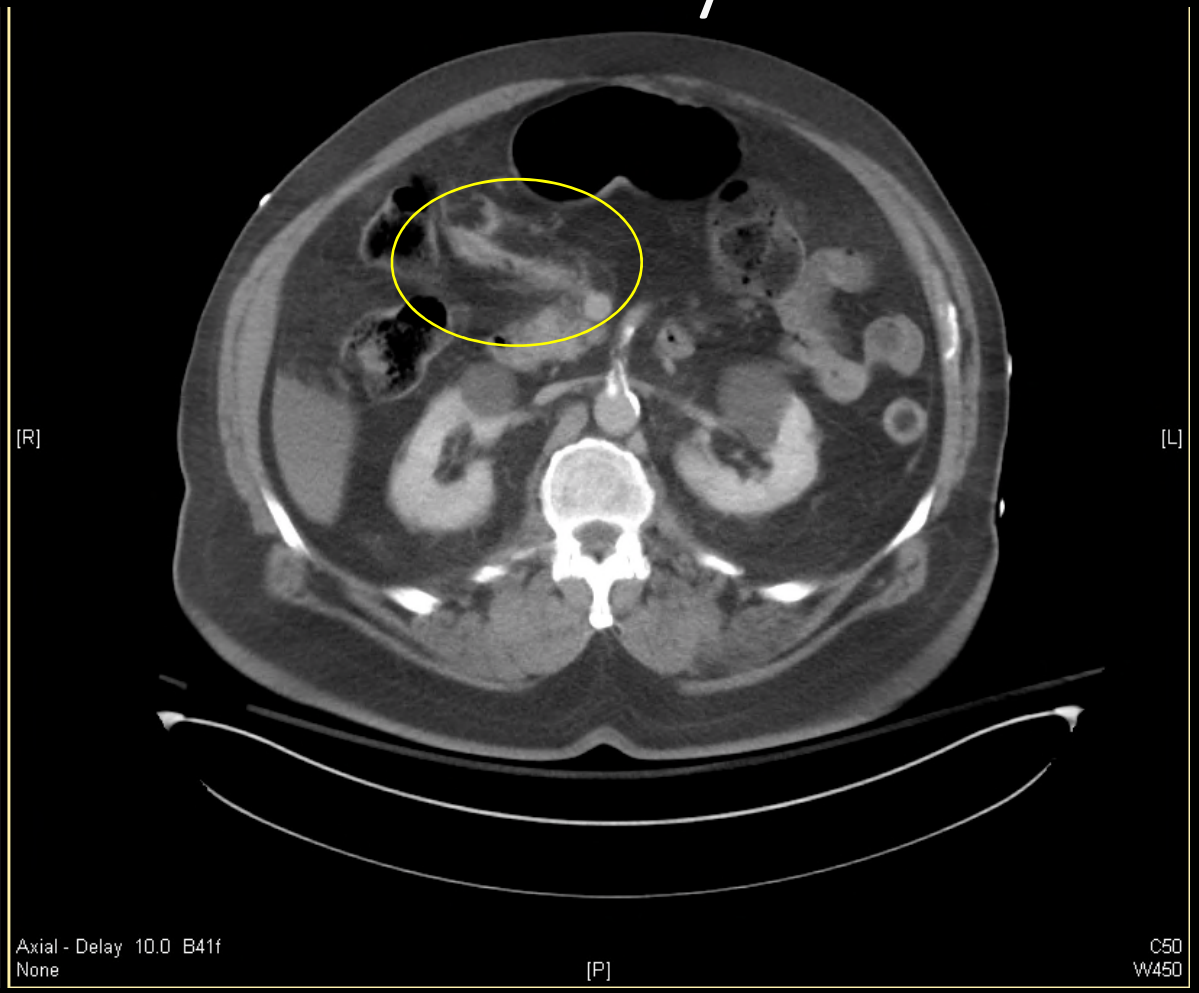

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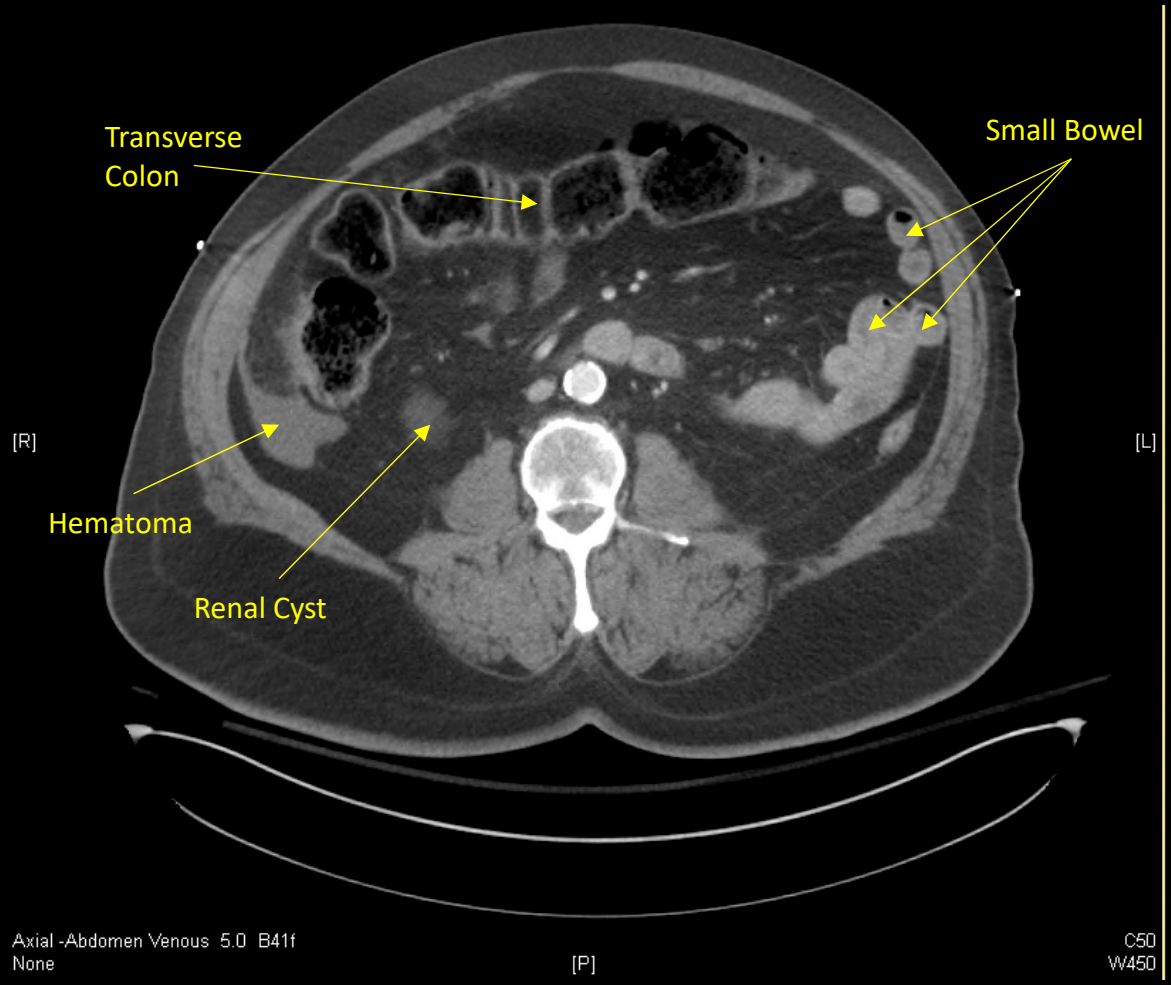

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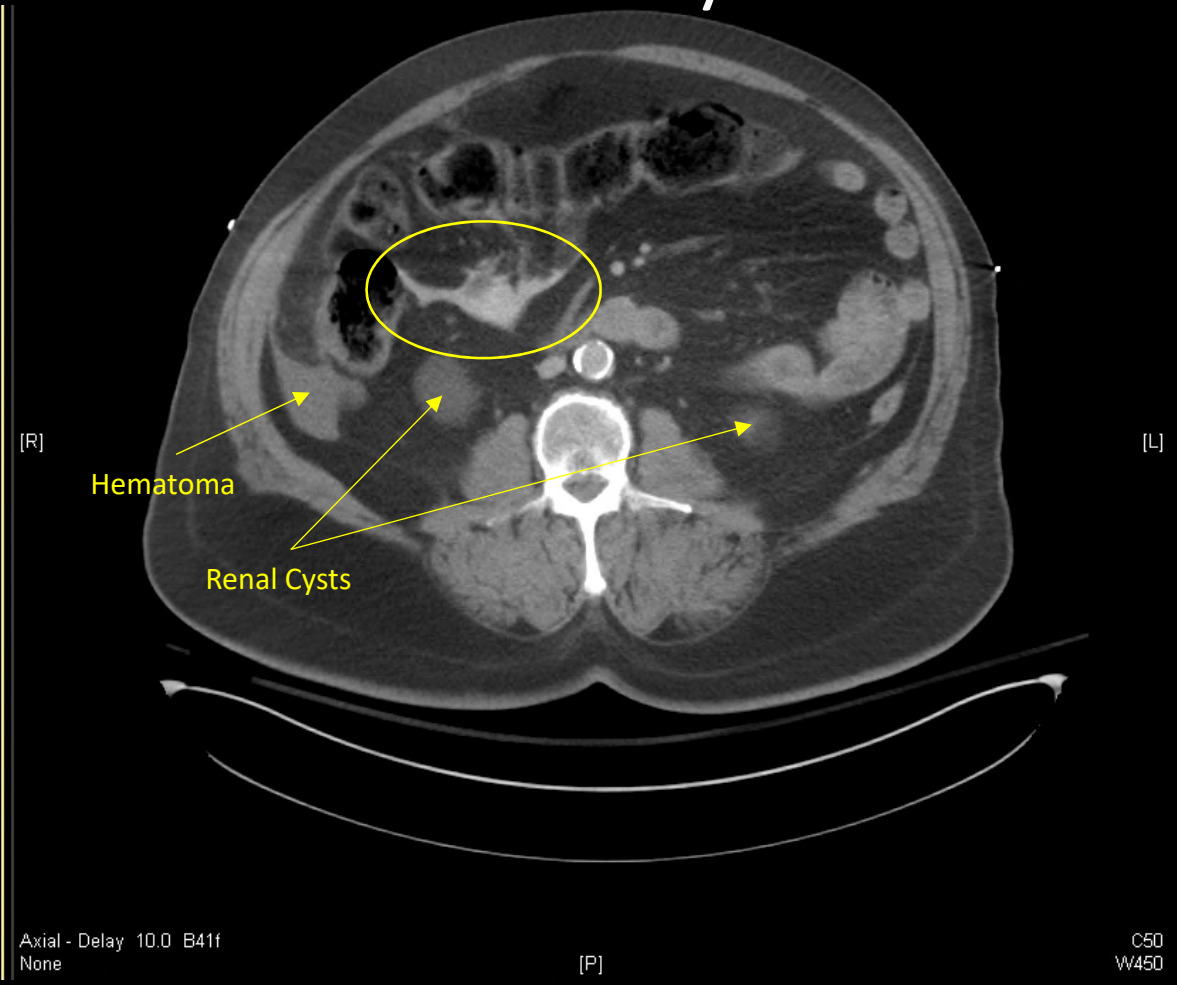


Liver Anatomy

- The Couinaud classification system gives the liver 8 functional segments.
- Middle hepatic vein divides R and L lobes, with the R and L hepatic veins creating medial and lateral segments.
- The portal vein divides the liver into upper and lower segments

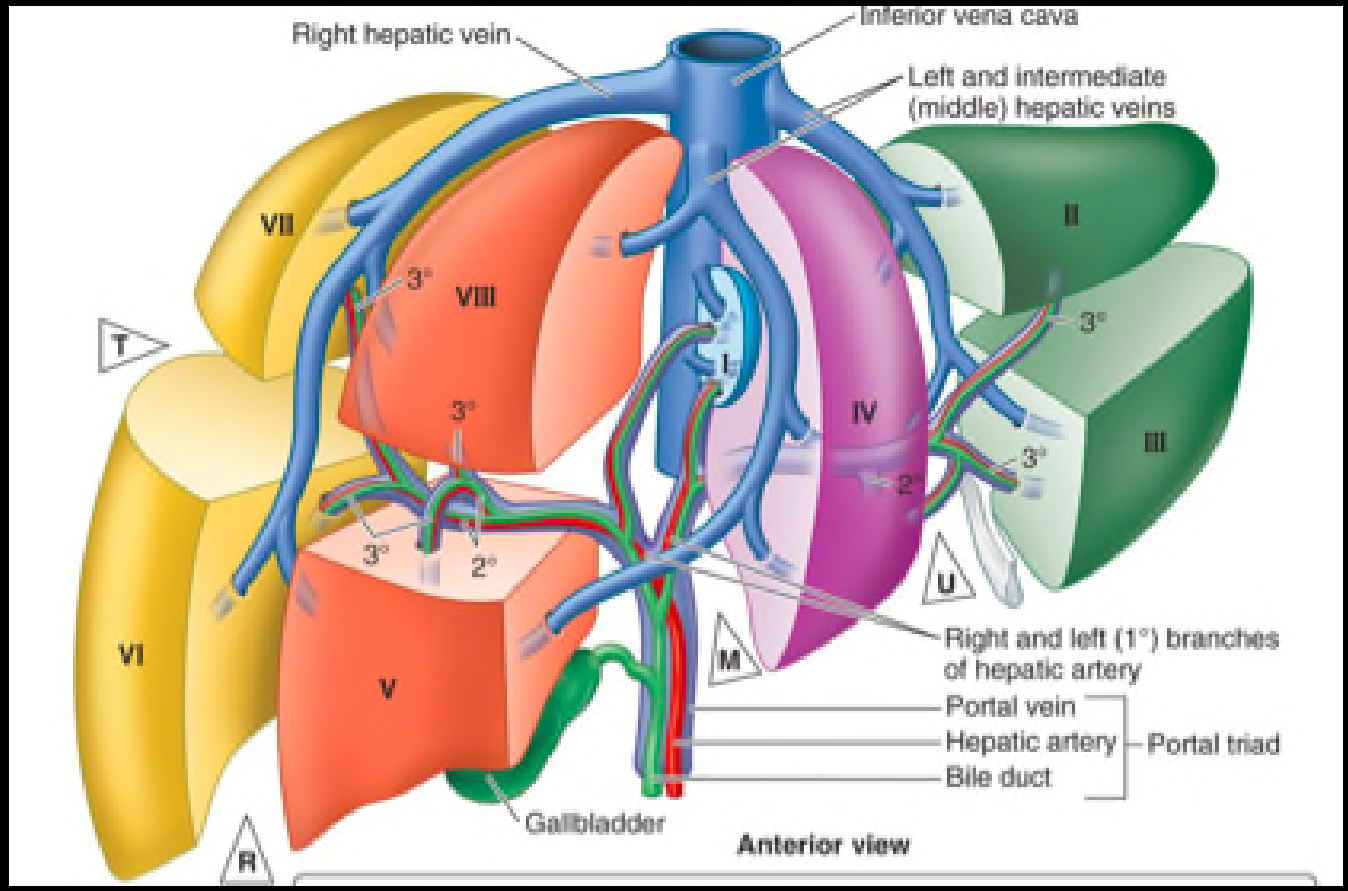


TABLE 2. Liver Injury Scale—2018 Revision

AAST Grade	AIS Severity	Imaging Criteria (CT Findings)	Operative Criteria	Pathologic Criteria
I	2	– Subcapsular hematoma <10% surface area – Parenchymal laceration <1 cm in depth	– Subcapsular hematoma <10% surface area – Parenchymal laceration <1 cm in depth Capsular tear	– Subcapsular hematoma <10% surface area – Parenchymal laceration <1 cm Capsular tear
II	2	– Subcapsular hematoma 10–50% surface area; intraparenchymal hematoma <10 cm in diameter – Laceration 1–3 cm in depth and ≤ 10 cm length	– Subcapsular hematoma 10–50% surface area; intraparenchymal hematoma <10 cm in diameter – Laceration 1–3 cm in depth and ≤ 10 cm length	– Subcapsular hematoma 10–50% surface area; intraparenchymal hematoma <10 cm in diameter – Laceration 1–3 cm depth and ≤ 10 cm length
III	3	– Subcapsular hematoma >50% surface area; ruptured subcapsular or parenchymal hematoma – Intraparenchymal hematoma >10 cm – Laceration >3 cm depth – Any injury in the presence of a liver vascular injury or active bleeding contained within liver parenchyma	– Subcapsular hematoma >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma – Intraparenchymal hematoma >10 cm – Laceration >3 cm in depth	– Subcapsular hematoma >50%-surface area; ruptured subcapsular or intraparenchymal hematoma – Intraparenchymal hematoma >10 cm – Laceration >3 cm in depth
IV	4	– Parenchymal disruption involving 25–75% of a hepatic lobe – Active bleeding extending beyond the liver parenchyma into the peritoneum	– Parenchymal disruption involving 25–75% of a hepatic lobe	– Parenchymal disruption involving 25–75% of a hepatic lobe
V	5	– Parenchymal disruption >75% of hepatic lobe – Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins	– Parenchymal disruption >75% of hepatic lobe – Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins	– Parenchymal disruption >75% of hepatic lobe – Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins

Vascular injury is defined as a pseudoaneurysm or arteriovenous fistula and appears as a focal collection of vascular contrast that decreases in attenuation with delayed imaging, Active bleeding from a vascular injury presents as vascular contrast, focal or diffuse, that increases in size or attenuation in delayed phase. Vascular thrombosis can lead to organ infarction.

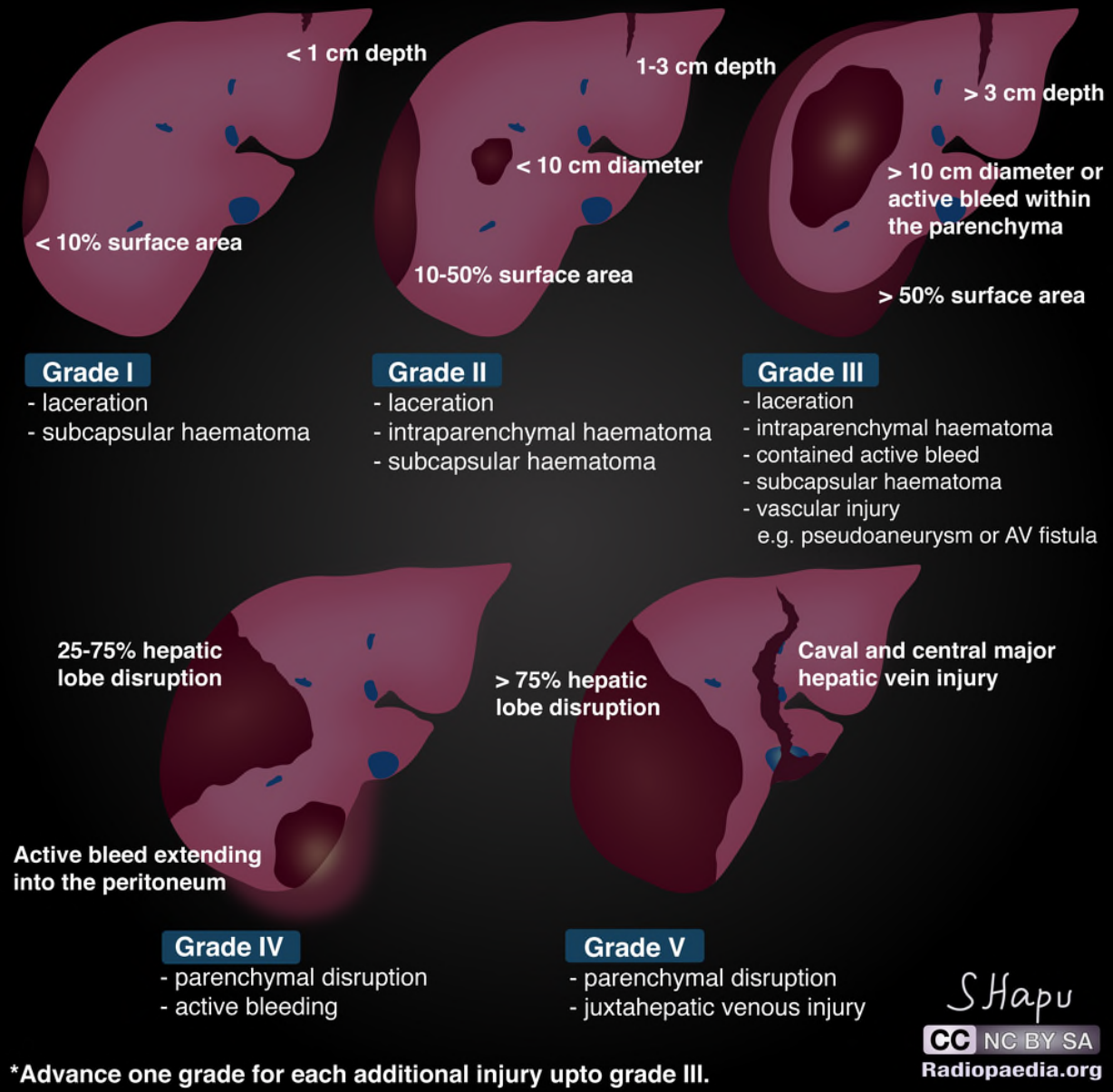
Grade based on highest grade assessment made on imaging, at operation or on pathologic specimen.

More than one grade of liver injury may be present and should be classified by the higher grade of injury.

Advance one grade for multiple injuries up to a grade III.

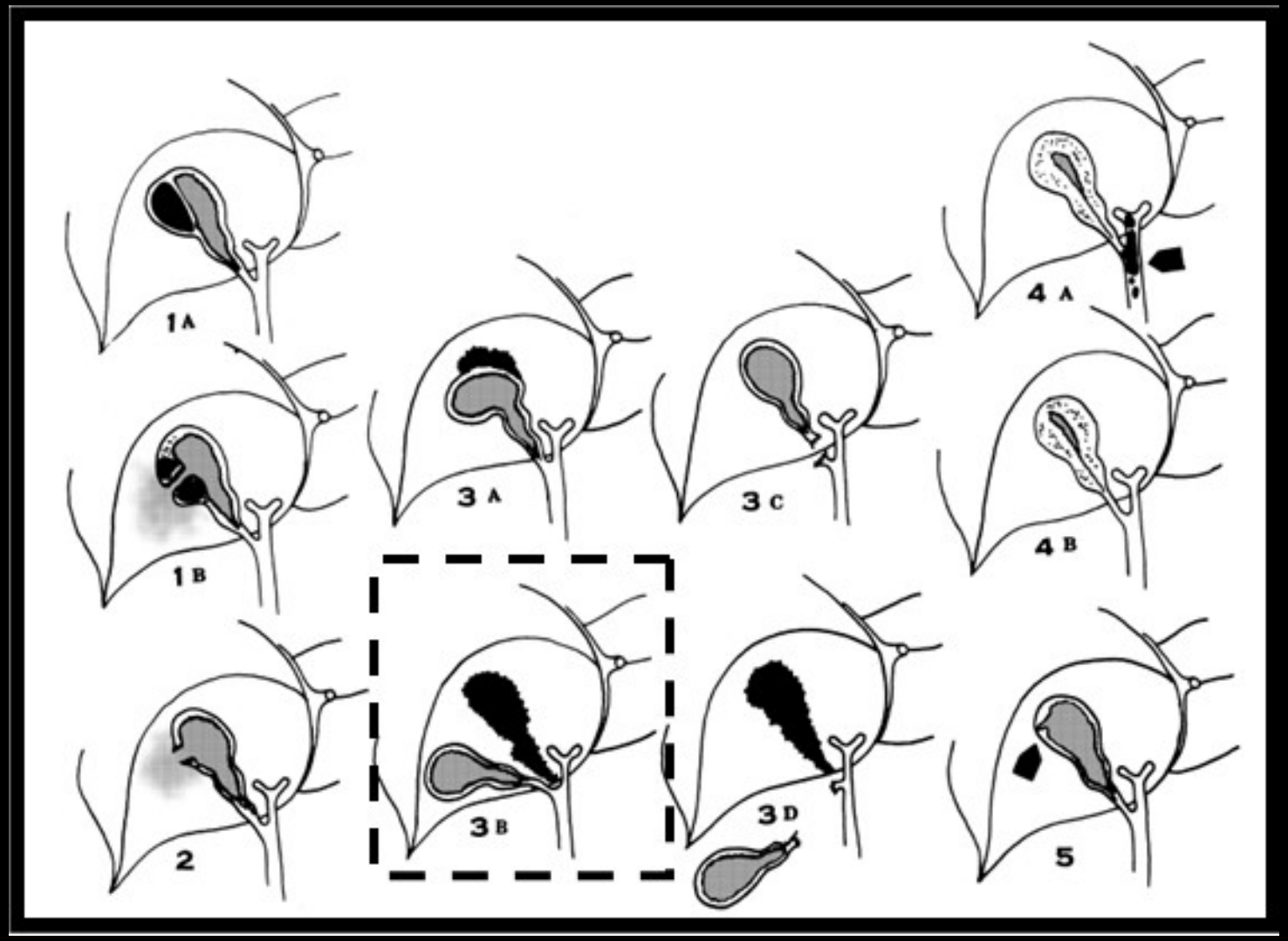
Liver Injury Scale

- AAST livery injury scale
- Useful for predicting the likelihood of success with non-operative management
- Higher chance of success with low-grade injuries (grade I, II, III)



Gall Bladder Trauma

- Classified as contusion, perforation or avulsion.
- Perforation most commonly reported.
- Avulsion can be partial, complete or total.
- MVCs are the predominant cause of blunt gallbladder trauma.
- Concomitant liver, duodenal and spleen injuries are common.



Findings Summary

- C2 lateral mass fracture involving the foramen transversarium and C1-C2 articulation
- Grade 1 liver laceration in segment 5
- Pericholecystic fluid
- Hemoperitoneum with active extravasation

Discussion

- Patient has significant hemoperitoneum with active extravasation.
- Source of the extravasation isn't clear, though bleeding from the liver laceration or possible bowel injury were suspected.
- During workup, pt continued to have intermittent bouts of hypotension.
- Was found to be in hemorrhagic shock (base deficit 6), and lactic acidosis (5.2).
- Decision to operate was made, pt taken to OR for ex lap.

Final Diagnosis

- Intraoperatively the liver laceration was examined but found without active hemorrhage.
- Transverse colon was found to have active hemorrhage from a large vein within the mesentery. Colon didn't appear ischemic.
- Gallbladder was found to have a partial avulsion on the medial side with active hepatic hemorrhage. Open cholecystectomy performed to allow for better visualization as the gallbladder appeared ischemic.
- Small bile leak from the avulsion site also identified and repaired.

Treatment of Gallbladder Avulsion

- Treatment choice depends on the severity of the gallbladder injury and the general condition of the patient.
- Minor injuries such as contusion or partial avulsion can be observed, though monitoring should be close since late necrosis or perforation may occur.
- Severe injuries generally require cholecystectomy. Laparoscopic techniques are reasonable when there is a low risk of associated injuries.

Cost Summary at MHH

Study	Typical Charges	Average Insured Pt Responsibility
AP Chest	670	52
AP Pelvis	719	111
CT C-Spine w/o	4057	298
CT Chest w/o-w	5326	442
CT Abd/Pelv w/o-w	8906	387
CTA Head w/o-w	4460	127
CTA Neck w/o-w	2666	301
Total	26,804	1,718

Take Home Points

- FAST US and trauma radiography series are often the first imaging assessments used in a trauma setting.
- Gallbladder avulsion may be difficult to detect, but has the potential to cause serious harm to the patient.
- Grade I-III hepatic injuries may be managed nonoperatively with close observation, depending on the condition of the patient.

References

- **Trends in nonoperative management of traumatic injuries - A synopsis.**
- **ACR Appropriateness Criteria**
- Isolated complete avulsion of the gallbladder (near traumatic cholecystectomy): a case report and review of the literature
- AAST Liver Injury Scale
- Initial evaluation and management of blunt abdominal trauma in adults
- Management of hepatic trauma in adults


Questions?