

Blunt Force Trauma: Liver

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Case

- 38yo Male, Crane Driver
- Involved in crane crash at work 08/07/07
0100
- Chest and abdomen forced against steering
wheel

In A&E

- Patient Complaints
 - Abdominal pain, severe, epigastric, constant
 - One episode of vomiting
 - R wrist pain
 - L hip pain

In A&E

- Doctors Examination
 - Alert, in pain
 - Vital Signs: Bp 75/31, PR 80, RR18
 - Abdo: generalized tenderness, distended, bowel sounds absent.
 - PR: prostate normal no blood
 - CVS: Tachycardic
 - RS: Tacypnoenic

Emergency Treatment

- 1.5L 0.9 Saline in 2 hours BP responds rising to 110/60 and patient becomes non-tachycardic
- On 3L O₂ to treat tachypnoea secondary to blood loss
- Given IM Voltaren

Basic Investigations

- Blood work normal excluding:
 - AST 651 (8 – 40 male)
 - ALT 549 (10-50)
 - LDH 2810 (105-333)
 - Amylase 134 (<120) ⁽¹⁾

Radiographical Investigations

08/07/07

- Wrist Radiogram:NAD
- Pelvic Radiogram: NAD
- CT Abdomen and Pelvis
 - Liver
 - Traumatic Disruption to >75% Rt lobe of liver involving segments 5,6,7,8 and associated subcapsular haematoma.
 - Distal and mid R Hepatic veins not opacified suggestive of vascular injury
 - No active extravasation suggests this is not an arterial bleed
 - Blood clots

CT 08/07/07

Devascularised liver

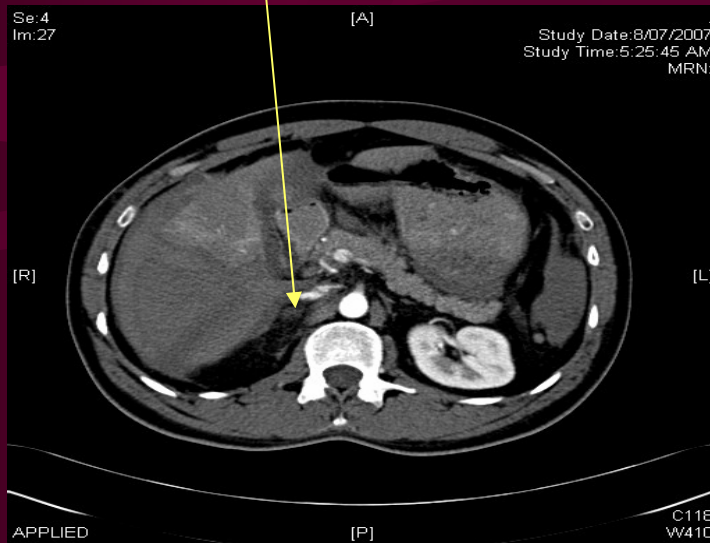
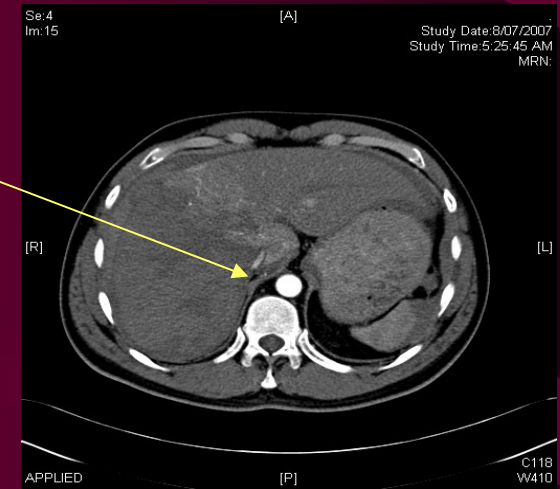


Subcapsular Haematoma

- Also Shows

- IVC flattened consistent with hypovolemia

- Right Adrenal Hematoma



- Lung

- Lingular contusions

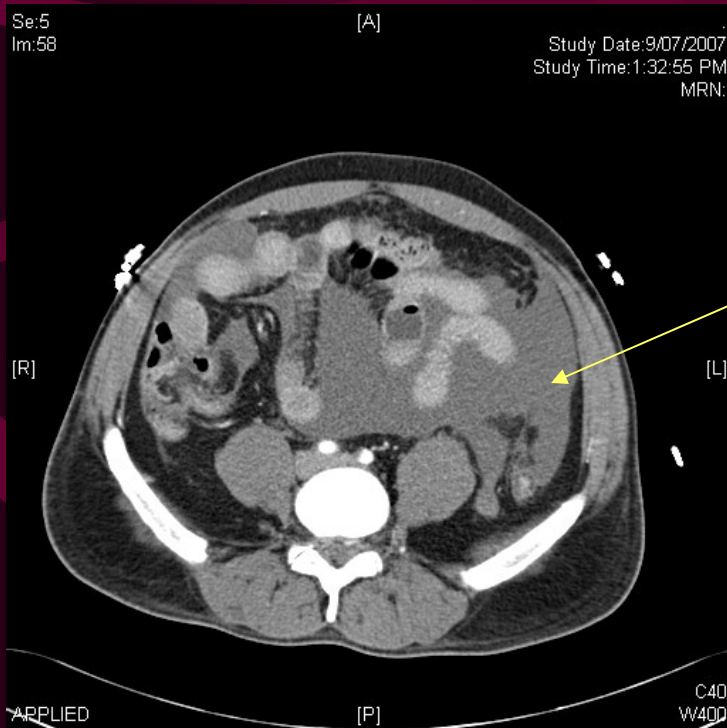
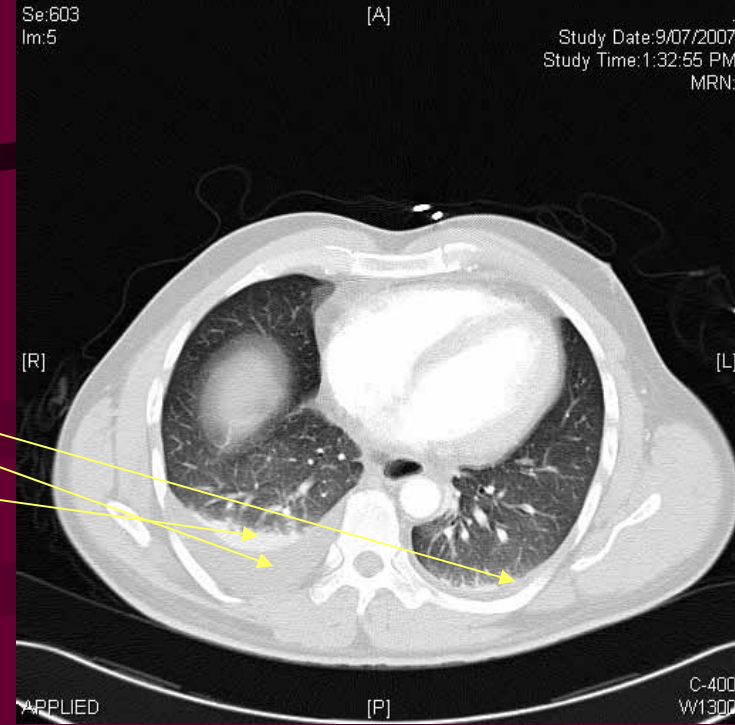
- Kidneys, Spleen and other abdominal viscera: NAD

On High Dependency Unit

- Patient was transferred to HDU 09/07/07
- Repeat CT 09/07/07
 - In comparison with previous CT
 - Large haemopterionium
 - Stable R adrenal haematoma
 - Lingular consolidation and bilateral pleural effusions

CT 09/07/09

- Effusions
- Atelectasis



Haemoperitonium

Worsening Clinical Picture

- Despite transfusions patients Hb falling 10/07/07 Hb 9
- Lactate increasing
- ABG:
 - pH 7.3
 - pCO₂ :43 (35-45 mmHg)
 - pO₂ : 66.8 (75-100 mmHg)
 - Base Excess -2.7 (-2-2)
- Persistent tachycardia
- Decision to perform embolisation

Venogram

- Trans-hepatic venogram
 - Small portal vein punctured
 - No evidence of arterial bleed, slow hemorrhage
 - Confirmed almost complete devascularisation
 - Gelfoam embolisation
 - Embolisation was ineffective.

Venogram 10/07/07



Devascularised
Segment

Catheter

Surgery

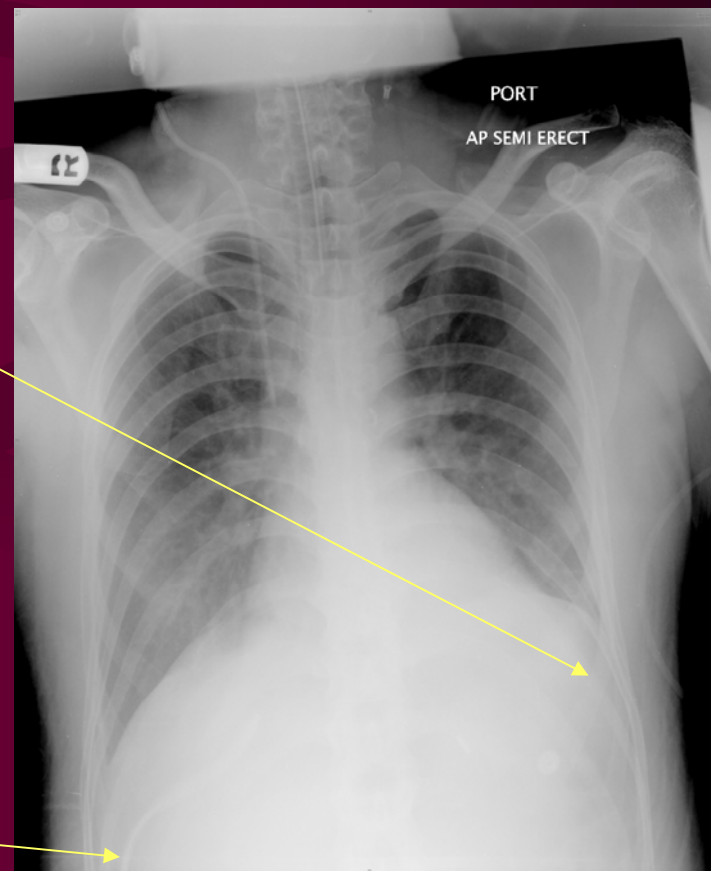
- On 10/07/07
- Patient underwent right hepatic lobectomy
 - Segments 5,6,7,8 removed along with intact gallbladder
 - 2L of stale blood drained from peritoneal cavity
 - No other abdominal injuries found
 - Pathology showed deep stellate laceration between segments 5 and 6 extending to segment 8

Post Op

- Patient moved to SICU, extubated 11/07/07
- 11/07/07 Chest radiogram
 - worsening bilateral effusions
 - Surgical drain in R hypocondrium
- Moved to general ward 13/07/07
 - Receiving chest physiotherapy

Chest Radiogram 11/07/07

Effusions



Drain

General Ward: Recovery

- Serial Chest radiograms (12-15/07/07) showed worsening effusions and patchy shadowing over both lung bases and right lobe midzone.

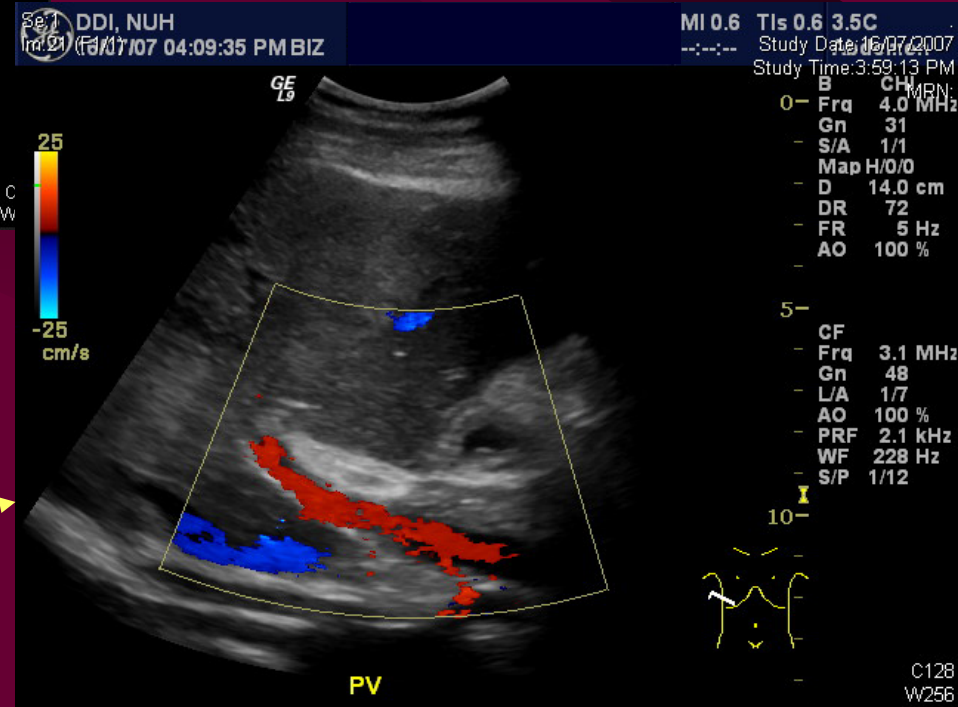
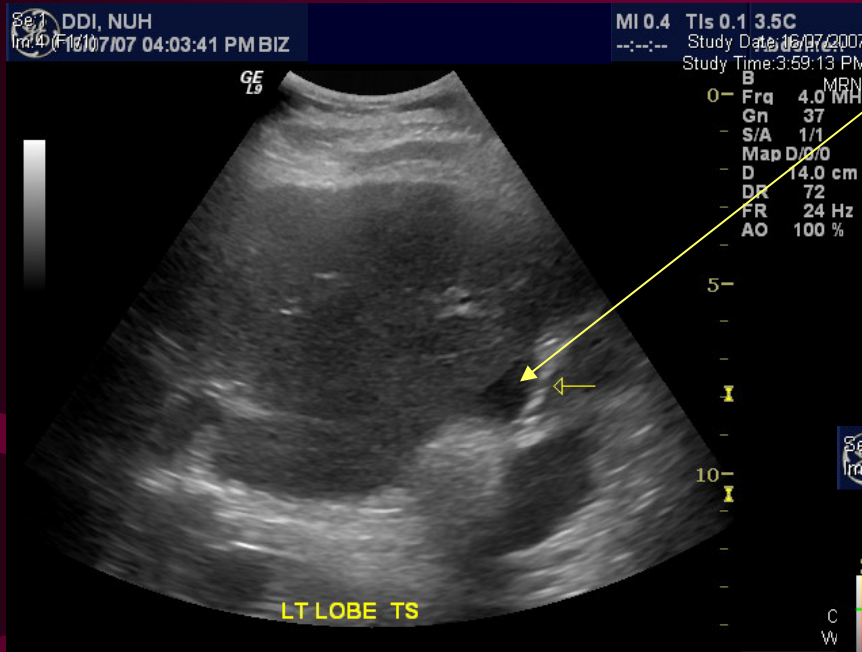


US 16/07/07

- Liver
 - Irregular liver outline post surgery
 - Heterogeneous hyperechoic regions in right lobe representing resolving laceration
 - Portal vein and artery show normal flow
- Small Left pleural effusion
- Ascities

US 16/07/07

Hypodensity



Normal Blood flow

General ward: Recovery

- Patient has hypoalbuminaemia
- Ascites
- Scrotal swelling
- Abdominal drain removed 17/07/07
- Discharged 18/07/07

Outcome and Follow up

- Discharged on
 - Ranitidine 150mg BD
 - Lactulose 10mls TDS
 - Celebrex Capsules 200mg BD
- Hepatic outpatient clinic 1/52
- Surgical MO appointment 2/52
- Urology outpatient clinic 3/52

Abdominal Trauma

- Most blunt force trauma occurs in RTA's
- Blunt liver trauma accounts for 15-20% of abdominal injuries, it is responsible for more than 50% of mortalities
- The size of the liver, its delicate parenchyma, thin capsule, and relatively fixed position make the it prone to blunt injury
- Right lobe is injured more commonly than the left
- Most liver injuries (>85%) involve segments 6, 7, and 8 of the liver (2)

Abdominal trauma

- Children's livers are at greater risk because of the flexibility of the ribs allowing more force to be transmitted
- Liver trauma is often associated with damage to other intra-abdominal organs particularly the spleen (45%)
- Rib fractures are present in 1/3 of cases
- Gallbladder injuries are rare
- Intestinal and pancreatic trauma occur more commonly in conjunction with left lobe damage (2)

Liver Damage

- Liver trauma may result in:
 - Laceration (case)
 - Haematoma
 - Subcapsular
 - Intrahepatic
 - Contusions
 - Vascular disruption
 - Bile duct injury

Liver Lacerations

Revised
1994

(3)

	Grade ^a	Injury Description	ICD-9	AIS-90
I	Hematoma	Subcapsular, <10% surface area	864.01	2
	Laceration	Capsular tear, <1 cm parenchymal depth	864.11 864.02 864.12	2
II	Hematoma	Subcapsular, 10–50% surface area; intraparenchymal, <10 cm in diameter	864.01 864.11	2
	Laceration	1–3 cm parenchymal depth, <10 cm in length	864.03 864.13	2
III	Hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma Intraparenchymal hematoma >10 cm or expanding		3
	Laceration	>3 cm parenchymal depth	864.04 864.14	3
IV	Laceration	Parenchymal disruption involving 25–75% of hepatic lobe or 1–3 Couinaud's segments within a single lobe	864.04 864.14	4
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud's segments within a single lobe		5
	Vascular	Juxtahepatic venous injuries; i.e., retrohepatic vena cava/central major hepatic veins		5
VI	Vascular	Hepatic avulsion		6

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

Blunt Abdominal Trauma: Investigations

- Abdominal X-ray
- Ultrasound
- CT
- Angiography
- Nuclear medicine

Plain X-rays

- Should always be preformed to look for associated skeletal injuries
- particularly
 - Ribs
 - pelvis

Ultrasound

- This is often one of the first imaging investigations performed
- Can be used to assess
 - haematomas
 - contusions
 - Lacerations
 - bilomas
 - haemoperitoneum
- If the ultrasound shows the presence of intra-abdominal fluid, the patient may be transferred to surgery if unstable
- CT is normally the next step in investigation

Common Ultrasound Findings

- Haematoma
 - Initially, hematomas are anechoic, becoming progressively more echogenic by 24 hours,
 - within 4-5 days, the hematoma becomes hypoechoic or anechoic
- Laceration
 - Appearances change with time. Lacerations appear slightly echogenic, becoming hypoechoic or cystic when scanned days after the injury.
- Contusions
 - hypoechoic initially, becoming transiently hyperechoic and then hypoechoic. (2)

Contrast CT

- CT without intravenous contrast enhancement is of limited value in liver trauma, but it can be useful in identifying hemoperitoneum.
- Can be used to localize injury and discover extent.

Common CT Findings

- Haematoma
 - Intrahepatic
 - irregular high-attenuation areas, which represent clotted blood, surrounded by low-attenuating unclotted blood or bile.
 - Over time, the attenuation of the haematoma is reduced, and the hematoma forms a well-defined fluid collection
 - Subcapsular
 - Most anteriolateral to right lobe
 - Deforms shape of underlying liver
 - Non enhanced CT's liver appears hyperattenuating compared with a subcapsular haematoma
 - Enhanced haematoma appears as low-attenuating
 - Attenuation decreases with time

- Haemoperitoneum
 - Irregular areas of extravasation of the contrast agent
- Laceration
 - Non enhancing linear or branching
 - Acute lacerations have sharper edges, over time the laceration can expand and develop a rolled edge
 - Look for communication with vessels and bile ducts (2)

Angiography

- Only in patients who are stable and not in hypovolemic shock!
- Can show
 - Lacerations
 - Contusions
 - Hematomas
 - Discovery of bleeding points
 - Devascualisation

Common Angiographic findings

- Lacerations
 - Extravasation of contrast
 - Contrast may pass into the biliary tree
- Contusions
 - Stretching arterial branches around an avascular area
 - Delay in hepatic blood flow to the involved segments
- Haematomas
 - Arterial displacement and compression of arteries may occur in subcapsular haematomas
- Bleeding points
 - Extravasation (2)

Nuclear Medicine

- hepatic or splenic trauma can be monitored by using ^{99m}Tc sulfur colloid scanning
- Procedure of choice to evaluate bile leaks is ^{99m}Tc IDA scanning
- Bile duct and/or gallbladder injuries occur in 5%



Example:

Technetium-99m iminodiacetic acid (IDA) scan in a 30-year-old man who sustained liver injury in a motor vehicle accident. The scan was obtained 1 month later and shows extravasation of the isotope from the biliary tract; this is consistent with a bile leak (2)

Interventional Radiography

- First angiography is used to identify the possible source of bleeding
- A wire coil or particulate embolic agents can be used
 - Coils: stainless steel, platinum, or titanium wire
 - Particulates: Gelfoam or polyvinyl alcohol (PVA)
These agents are mixed with an iodine-contrast agent for visualization and injected through a catheter. Care should be taken not to reflux the mixture outside the intended area of embolization.

Gelfoam

- Used in the case
- Temporary occlusive
- Induces a thrombotic reaction, occluding the vessel
- Thrombolysis breaks down the clot and Gelfoam, recanalizing the occluded vessel over a period of days to weeks.
- Useful in trauma where a temporary occlusion is needed while awaiting surgery or in the hope of natural healing processes (4)



Surgery Vs Conservative Treatment

- Previously liver injuries were treated surgically. Literature confirms that as many as 86% of liver injuries have stopped bleeding by the time surgical exploration is performed, and 67% of operations performed for blunt abdominal trauma are nontherapeutic
- Now 80% of adults and 97% of children are treated conservatively

Complications

- Immediate concerns principally involve
 - Haemorrhage
 - Infection
 - Postoperative hepatic insufficiency (liver failure)
- Postoperative Hepatic insufficiency (PHI)
 - Studies have shown that “2.8% (of patients postoperatively following major hepatectomy (3 or more liver segments)) died a median 36 days from liver-related causes” ⁽⁵⁾
 - morbidity and mortality related to PHI are the most relevant and important concerns after hepatectomy
 - Risks of hyperbilirubinemia (best prognostic marker of impending PHI)
 - Coagulopathies
- Biliary injuries may not be identified preoperatively or may remain unidentified for weeks or months after trauma.

References

- (1) www.gpnotebook.co.uk
- (2) www.emedicine.com/livertrauma
- (3) Moore, Ernest E, Organ Injury Scaling:Spleen and Liver (1994 Revision) Journal of trauma Volume 38(3), March 1995, pp 323-324
- (4) www.pfizer.com/pfizer/download/uspi_gelfoam_powder.pdf
- (5) J. T. Mullen, D. Ribero, Hepatic Insufficiency and Mortality in 1,059 Noncirrhotic Patients Undergoing Major Hepatectomy, Journal of the American College of Surgeons. Vol 204, May 2007, Pages 854-862