A CLINICAL STUDY OF FOCUSED ABDOMINAL SONOGRAPHY FOR TRAUMA (FAST) IN BLUNT ABDOMINAL TRAUMA

A Dissertation submitted to

The Tamilnadu DR.M.G.R. Medical University,

Guindy, Chennai

In partial fulfillment for the degree of

MASTER OF SURGERY

In

GENERAL SURGERY

APRIL 2015

DEPARTMENT OF GENERAL SURGERY

TIRUNELVELI MEDICAL COLLEGE

TIRUNELVELI-627011

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I hereby declare that the dissertation entitled “CLINICAL STUDY OF FOCUSED ABDOMINAL SONOGRAPHY FOR TRAUMA (FAST) IN BLUNT ABDOMINAL TRAUMA” is a bonafide and genuine research work carried out by me under the guidance of Dr.R.MAHESWARI M.S. Professor, Department of General Surgery, Tirunelveli Medical

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clinical study of FAST in Blunt Abdominal Trauma

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ABSTRACT

The aims of study to evaluate the ability of FAST in BAT

And correlation with laparotomy findings as in India BAT is leading cause of

Mortality and morbidity hence to improve surgeon’s precision to arrive early

Intervention

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Methods:

The present clinical study is a prospective study conducted on 100 patients with history of blunt abdominal trauma.

Inclusion criteria:

- All patients with blunt abdominal trauma irrespective of age and sex.

Exclusion criteria:

- Penetrating abdominal injuries.
- Dead on arrival.

USG with 3.5 -12 MHz transducer used this study

Results:

In this study a total number of 100 patients of BAT were evaluated by FAST

Road traffic accident was the major cause for BAT. FAST was able to identify free fluid or Haemoperitoneum, and solid organ injuries (lacerations, contusions, hematomas and rupture)

The overall sensitivity of FAST in evaluation of BAT was 90.9%and specificity was 75%.

The sensitivity of in detecting free fluid in our study was 90%.

Amongst the solid organs; spleen, liver, and kidney were the most commonly injured with incidence of 17%, 10% and 3% respectively.

Interpretation and conclusion:

Thus the ability of FAST to accurately detect the presence of free fluid and to locate the injured organ, helps the surgeon to deside early intervention in BAT

Key words:

Blunt abdominal trauma, Focused abdominal sonography for trauma

CONTENTS

INTRODUCTION

INTRODUCTION

Blunt abdominal trauma constitutes those cases where there is injury to on or more viscera without any external penetrating injury.

The most common causes of blunt abdominal trauma (BAT) are: Road traffic accidents, assault injuries to the abdomen, accidental fall, fall of heavy objects over the abdomen, crush and blast injuries.

Since the world population has increased, the incidence of road traffic accidents and assaults has increased. This has led to the popular quote “civilization and violence seem to advance hand in hand”.

Blunt abdominal trauma is a frequent diagnostic problem in a patient with multiple injuries. Any delay in diagnosis substantially increases morbidity and mortality in trauma patients due to bleeding from solid organ or vascular injury, or infection from perforation of a hollow viscus. Physical examination is often unreliable especially when there is associated head injury, spinal cord injury, or drug ingestion and intra-abdominal injuries may be missed in 16 to 45% of patients. [1, 2, 3]

The amount of imaging used to evaluate a trauma victim must be inversely proportional to severity of injuries, so that diagnostic studies do not interfere with resuscitation.

The most important pre-operative step in patients with BAT is to Ascertain the need for laparotomy. Thus the screening test must be highly sensitive and quick.

It is clear advantage to the operating surgeon if the same test is sensitive enough for citing the organ of injury, especially when conservative approach towards trauma is being popularized today.

Root et al was the one who first introduced a procedure called Diagnostic Peritoneal Lavage (DPL) in the year 1965.[4,5] It is sensitive in detecting the presence of any free fluid including intraperitoneal haemorrhage, but it is invasive and has a significant rate of non-therapeutic laparotomies.

Computed tomography (CT) scan is non-invasive and accurate but it is costly, time consuming, requires injection of contrast, exposure to radiation and patient transport thereby limiting its use.[6,7]

With FAST (Focussed Abdominal Sonography for Trauma) it is possible to evaluate and help in the management of patients with Blunt Abdominal Trauma. In recent years USG has taken big leaps in accuracy and acceptance by the clinical community since it is easy to perform, quick, cost-effective, and non-invasive, no ionizing radiation or toxic contrast material is needed and can be repeated as often as required. [8, 9, 10]

FAST combines the advantages of DPL (Fast) with those of CT (Non-invasive and accurate). [11]

However, evidence exists that the sensitivity and specificity of FAST also depends on the expertise of the radiographer. FAST results have been shown to be highly variable and dependent on technical expertise of the examiner. [9, 12]

Unnecessary deaths and complications can be minimized by improved Resuscitation, evaluation and treatment.

Rapid resuscitation is necessary to save the unstable but salvageable patient with abdominal trauma. Accurate diagnosis and avoidance of needless surgery is an important goal of evaluation. ‘As the surgeon directs these activities he must seek the answers to two questions. First, does the patient need an abdominal operation?

Second, will the patient tolerate the time required for diagnostic manoeuvres before surgery is performed? However, most avoidable deaths result from failure to resuscitate and operate on surgically correctable injuries.

When the diagnosis is in doubt and clinical judgment suggests surgery, exploration provides definitive treatment as well as diagnosis; moreover, the risks of negative exploration have become acceptable.

The new techniques and diagnostic tools available ate important in the management of abdominal trauma. These improved methods, however, still depend on experience and clinical judgment for application and determination of the best care for the injured patient.

This study is based on 100 cases of abdominal injuries, admitted to our hospital, and outlines the role of FAST in the evaluation of BAT and to assess the diagnostic validity of FAST imaging, thus helping the surgeons in making an accurate diagnosis and proper management of cases.

AIM OF THE STUDY

AIM OF THE STUDY

- To evaluate the ability of FAST in detecting hemoperitoneum and solid organ injury in BAT.
- Correlation of laparotomy findings with FAST data to predict its sensitivity.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Ultrasound:

Ultrasound is defined as the sound above the range of human hearing, i.e., above the frequency of 20,000 Hz (normal human hearing frequency range being between 20 Hz to 20,000 Hz).

History of ultrasound:

In 1794, the existence of ultrasound was first demonstrated by Spellanizine on bats. [13]

In 1880, the use of diagnostic ultrasound based on the piezoelectric effect was discovered by Pierre and Jacques curie. [14]

In 1912, ultrasound was used to search the sunken Titanic in North Atlantic but the attempt was unsuccessful. [15]

In 1915, Langevia of France, was, however, the first to use it for detection and destruction of ‘submarines’ during First World War when it was named SONAR (SO-Sound; N-Navigation; A-And; R-Ranging). [13]

In 1929, Russian scientist Sergel SoKolven emphasized the potential importance of SONAR and is regarded as father of ultrasound.

In 1930, it was used in industries for detection of flaw in metals and metallic structures like beams, bridges etc. [13]

In 1942, Dussik did the first medical use of US for visualization of cerebral ventricles, a procedure he termed as ‘hyper phonogram’. But his technique was crude and it used very high-energy ultrasound, which was positively harmful for tissues. [13]

Professor Ian Donald of Glasgow firmly reintroduced US in medicine with several modifications to make it easy and safe. He designed a control scanner, which is still used. He is regarded as the father of modern ultrasound. [13]

HISTORICAL PERSPECTIVE IN BAT:

Aristotle was the first one to have recorded visceral injury from blunt abdominal trauma. Hippocrates and Galen are said to have given apt description about abdominal injury. A sharp blow over the region of spleen was used as a method of assassination by ancient Chinese.

Most of the lessons that we have learnt about abdominal injury have been gained through military experience. Winston Churchill had pointed out, ‘War is an epidemic of trauma’.

Prior to the introduction of DPL in 1965, the diagnosis of intraperitoneal injuries from blunt trauma was almost entirely based on physical examination, hemodynamic parameters and serial hematocrits. Not surprisingly this resulted in a high rate of surgical misdiagnosis.

DPL may however still be indicated as a complementary investigation after US to elucidate the nature of the fluid, if there is any suspicion of bowel rupture or to assess the possibility of occult pancreatic trauma.[16]

Gray scale imaging technique was introduced in 1972, with the development of B scanners (static). And so, evaluation of BAT started. With the introduction of real time bright (B) scans in the1980s, a more extensive and comparative study of BAT has been carried out since then.

When it was first proposed, the trauma USG examination consisted of a single intercostal, subcostal longitudinal view of the pouch of Morrison. If a black stripe was identified between the liver and the kidney, it was interpreted as a positive study. Sonographers did no checking of parenchymal organ injury. [17, 18]

In a study performed for ultrasonography of epigastric injuries after blunt trauma, they found that pancreas and second part of the duodenum are most commonly involved in blunt epigastric injuries. They observed that USG is very helpful to demonstrate these lesions and thus help in clinical management. [19]

In a study for evaluation of upper abdominal trauma in children, 100 children with BAT were evaluated prospectively and the roles of CT scan, liver-spleen scintigraphy and USG were compared. They concluded that CT is more accurate in demonstrating traumatic lesions, but ultrasonography is equally accurate in demonstrating free intraperitoneal fluid, easy to operate and can be done at bedside in highly critical patients.[20]

In an examination of blunt abdominal trauma and acutely ill patients with ultrasonography and CT, they found that USG plays an important role in the evaluation of patients having BAT or presenting with renal failure or bleeding during pregnancy. They concluded that USG and CT are invaluable diagnostic tools in the radiological evaluation of traumatic patient. [21]

In a study of childhood blunt abdominal trauma by using FAST as the initial diagnostic modality, during a 5 year retrospective study, a total of 170 children with BAT were investigated with ultrasonography, intravenous urography and scintigraphy. The results of radiological investigations were compared with clinical outcome and laparotomy. During the study period, FAST became the first line screening tool and was combined with intravenous urography in suspected renal trauma. Inspite of permanent accessibility of CT, it was used only in complex diagnostic problem or in multiple injuries. [22]

Comparing the role of diagnostic peritoneal lavage and FAST in blunt abdominal trauma, the reliability of FAST and DPL in assessing the need for immediate surgical intervention in BAT was examined in 71 patients as a prospective study. The study suggested that the performance of FAST as a screening method is justifiable. DPL is a complimentary examination which is indicated in cases with equivocal clinical or sonographic examination. Thus both FAST and diagnostic peritoneal lavage are not competing procedures but rather complimentary in the evaluation of patients with BAT. [23]

In a study of the reliability of ultrasonographic detection of haemoperitoneum in blunt abdominal trauma in a prospective study of 72 patients, they concluded that FAST is a quick, safe screening method in the evaluation of BAT to detect haemoperitoneum and FAST might take over a great part of the role of diagnostic peritoneal lavage. [24]

The reliability of FAST in detecting haemoperitoneum in patients with multiple trauma was evaluated prospectively in 291 patients. According to authors, in cases of multiple traumas there is a need for imaging modality that not only provides a rapid diagnosis for blunt abdominal trauma but can also be used repeatedly with a high reliability to follow the patients' course and FAST meets these conditions. They confirm that FAST has a high specificity and sensitivity in the diagnosis of BAT. In their department FAST has replaced DPL. DPL is time honoured and is reserved for selected cases only. [25]

The validity of FAST in the evaluation of patients with BAT was investigated in a prospective study. 140 patients with suspected BAT were included in the study. They found that FAST is a suitable test for screening patients with BAT, since it is highly sensitive and specific, complication free and easy to master.[26]

Evidence exists that appropriate training is very important in determining the sensitivity and specificity of FAST. Sonographic results have been shown to be highly variable and dependent on technical expertise of the examiner. They pointed out that differences in ultrasonographic detection of free fluid or parenchymal organ injury varied with the experience of the examiner. The sensitivity of sonographic detection of free fluid varied from 96 to 100% depending on the examiner's experience; sensitivity of detection of parenchymal organ injury varied from 36 to 45%, depending on examiner experience. [9]

In an examination of the practical value of FAST in blunt abdominal trauma in children, 259 children admitted with BAT underwent FAST. The authors found that compared with CT, FAST is more versatile, easier to perform in children and more cost effective, even with addition of a functional imaging modality like Doppler study or intravenous urography. [27]

In a prospective comparison of diagnostic peritoneal lavage, CT and FAST for the diagnosis of blunt abdominal trauma, a prospective study comparing the accuracy of diagnostic peritoneal lavage, CT and ultrasonography screening was carried out. Patients with stable vital signs following their initial resuscitation received both CT and FAST. DPL was then done. The sensitivity, specificity and accuracy of these procedures were detected. The author suggested avoiding overestimation of the capability of US and finding that FAST, diagnostic peritoneal lavage and CT are complimentary and important in the diagnosis of blunt abdominal trauma. [28]

In a study carried out for ultrasonographic evaluation of haemoperitoneum during resuscitation, to assess the need for therapeutic laparotomy in patients with blunt abdominal trauma, FAST and its suitable scoring pattern were used to estimate the amount of haemoperitoneum during resuscitation.

The study suggested FAST as an initial rapid screening procedure in patients with BAT and is useful for trauma surgeons in decision making during resuscitation. [29]

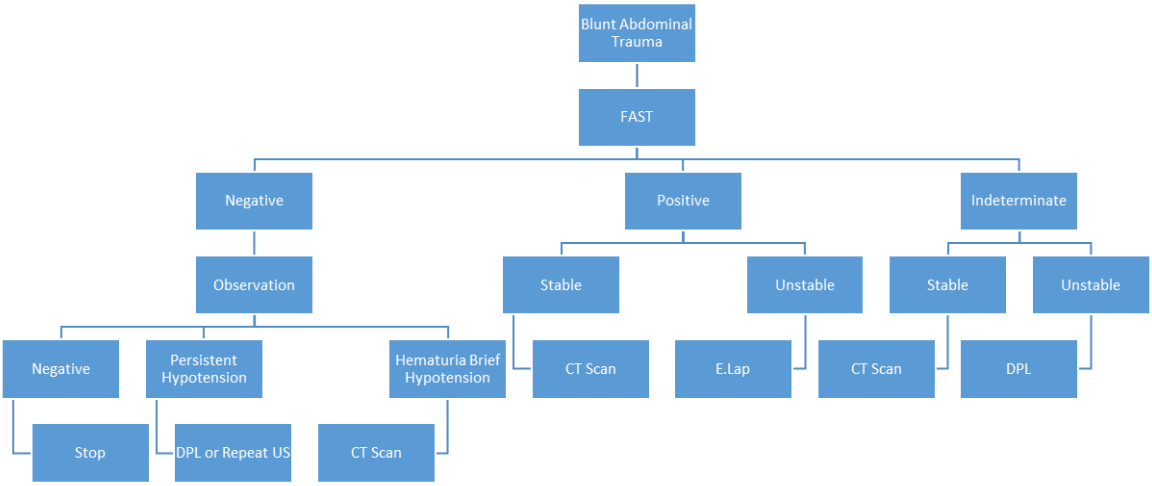
In a study evaluated for the role of FAST in the initial assessment of BAT in 1000 patients it was concluded that emergency US may be used as the initial diagnostic modality for suspected blunt abdominal trauma, as FAST combines the advantages of DPL (Fast and accurate) with those of CT (Non - invasive and accurate). [11]

In a study design to evaluate the overall diagnostic value of FAST, including identification of individual organ injuries in 1,239 patients seen during a 15yrs period it was concluded that FAST is reliable for the detection of injuries and the identification of solid organ injuries but it has poor sensitivity for intestinal injuries. [30]

In the assessment of the role of FAST for detection of bowel and mesenteric injury from blunt trauma in a prospective study for 3 years, it was concluded that, free fluid in the abdomen is not detected in the majority of patients with isolated bowel and mesenteric injury. For clinical suspicion of bowel and mesenteric injury, observation, serial physical abdominal examination, and CT may be helpful in diagnosing this condition. [10]

In a retrospective analysis of USG data base over a 30 months period involving

576 USG's, to determine the diagnostic capacity of US in the evaluation of BAT, they concluded that emergency USG is highly reliable and may replace CT scan and DPL as the initial diagnostic modality in the evaluation of most patients with BAT. They recommended the following algorithm for the evaluation of BAT [5]:



In a prospective study in 744 consecutive children to assess the accuracy of FAST in the detection of both haemoperitoneum and parenchymal organ

Injury in children, they concluded that FAST for blunt trauma in children is highly accurate and specific, but moderately sensitive, for detection of intra-abdominal injury.

In an evaluation of FAST for indirect (with free fluid analysis only) and direct (with free fluid and parenchymal analysis) detection of organ injury in patients with BAT with findings at CT and / or surgery as the standard of diagnosis in a prospective study conducted during a 22 month period at a level I emergency trauma centre, they concluded that FAST is highly sensitive for the detection of free intraperitoneal fluid but not sensitive for the identification of organ injuries. In haemodynamically stable patients, the value of FAST is mainly limited by the large percentage of organ injuries that are not associated with free fluid. [31]

In a retrospective study of 604 patients with BAT examined by US and CT for a period of 14 years by 2 groups on their experience with US, it was concluded that the sensitivity of US decreased, but however, FAST was found to enable experienced examiners to detect and classify parenchymal injuries efficiently, despite disadvantage in detecting superficial and vascular injury. FAST should be used to explore not only free fluid but also solid organ injury. [32]

Fig 4: FAST procedure in our Emergency Department

A

B

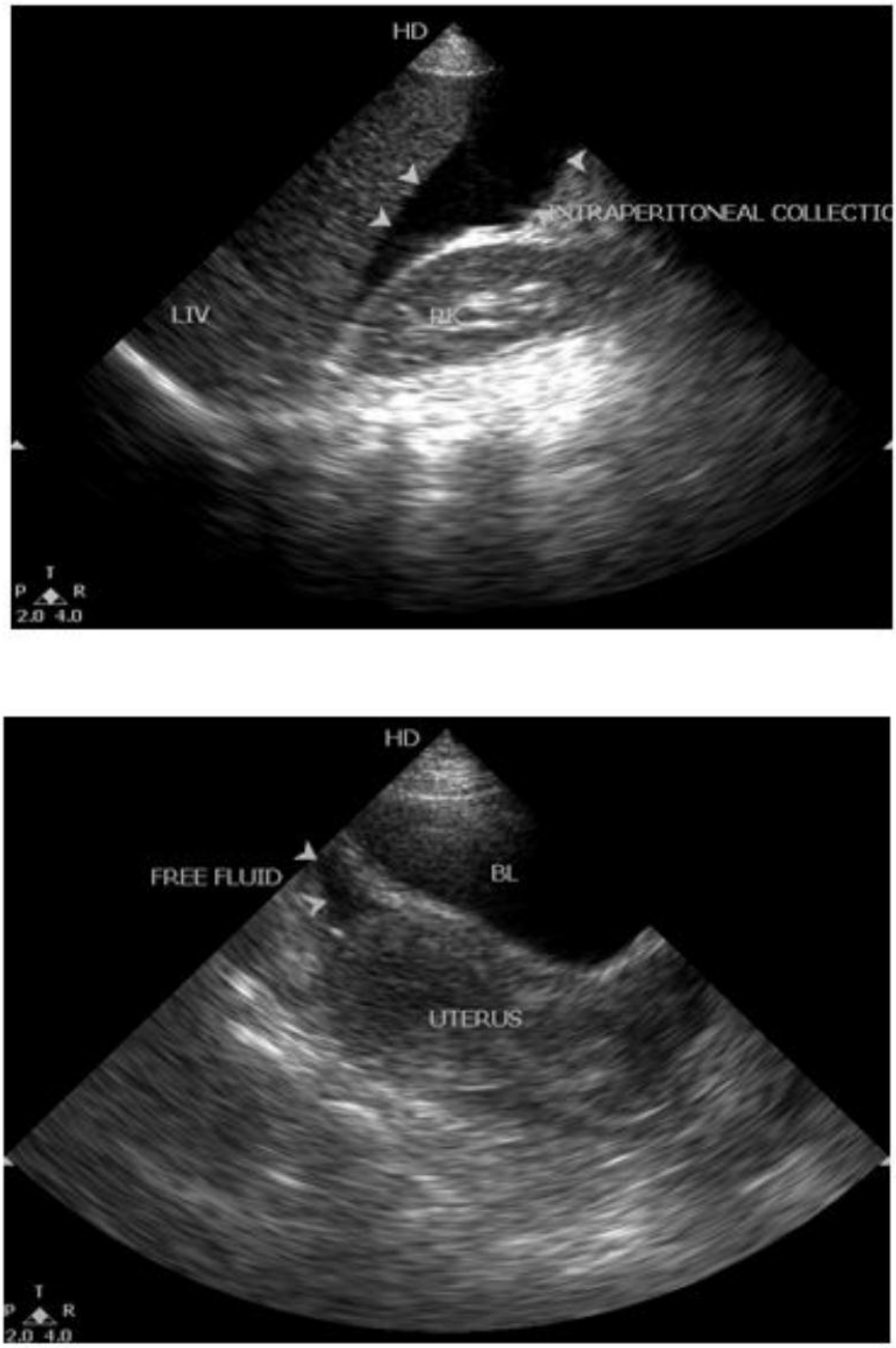


Fig1: a) free fluid in Morrison’s pouch

b) Free fluid in pelvis

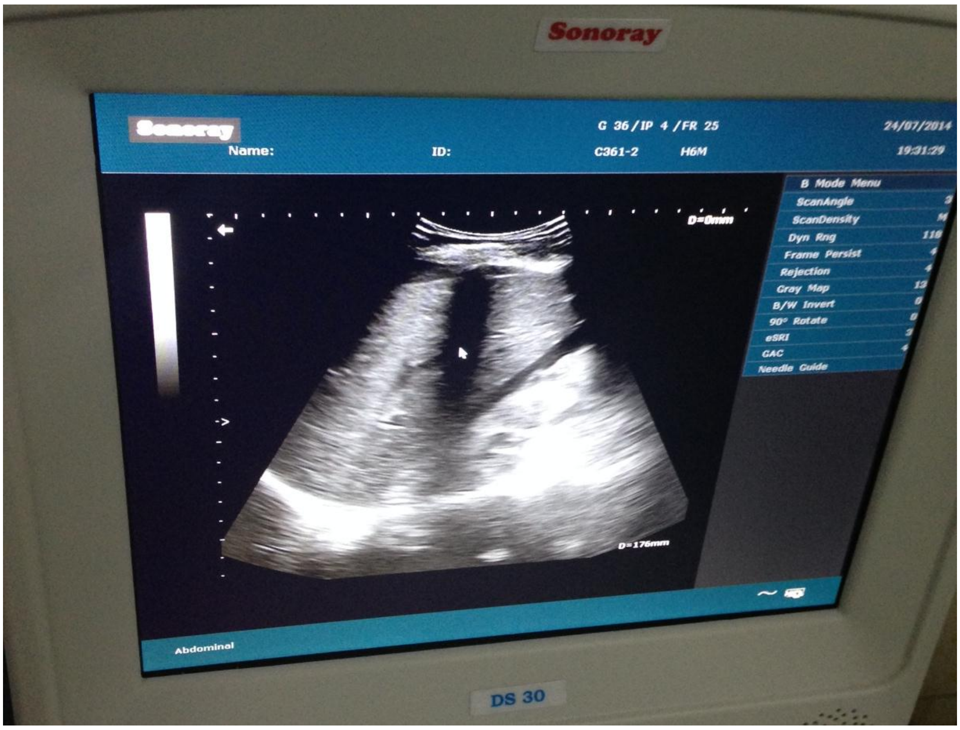


Fig 2: free fluid in Morrison's pouch

Fig 3: free fluid in Pelvis

ULTRASOUND FEATURES

The FAST findings in blunt abdominal trauma can broadly be divided into:

a. Free fluid in abdominal cavity.

b. Visceral injuries.

FREE FLUID IN ABDOMINAL CAVITY:

Free fluid typically appears as a hypo echoic region within the peritoneal cavity or pelvis and is usually linear or triangular in shape. The shape of the fluid depends on its compression by the surrounding structures, like it is linear when present between liver and kidney and the fluid that surrounds the bowel often appears triangular. Fluid often accumulates at the site of injury and then flows throughout the abdomen and into the pelvis. At the site of injury the blood may appear echogenic as it forms a clot adjacent to the injured organ. [33]

Free intraperitoneal fluid most often collects in the most dependent portions of the abdominal cavity. The common sites to detect intraperitoneal free fluid are as follows:

PELVIS:

This is one of the dependent parts of the peritoneal cavity and so free fluid usually accumulates in pouch of Douglas or in the perivesical space. Sonographic sensitivity for the detection of free fluid could be improved by having a full bladder, which acts as an acoustic window to detect even small amount of free fluid was first documented by Mc Gahan et al in 1997. [9, 33]

MORRISON'S POUCH OR HEPATORENAL RECESS:

This space is between liver and right kidney.

FLANKS:

Free fluid can be detected earlier in flanks in right and left paracolic gutters.

It is more common on right side than left. This can be located by changing position of the patient and transducer. Free fluid will accumulate at the site of visceral lesion.

The capability of FAST to detect minimum amount of free fluid significantly varies according to the authors.

Free fluid in the abdomen may represent blood, intestinal contents, extravasated unopacified urine, or fluid instilled during diagnostic peritoneal lavage. [34] Free intraperitoneal fluid of whatever origin appears similar on FAST. Thus sonologically, fresh unclotted blood cannot be distinguished from bile or urine.

The initial focus of sonographic examination was a single view of the hepatorenal fossa (Morison's pouch). It was soon realized that a more comprehensive examination of the abdomen improved detection of free fluid, however. This included examination of upper quadrants, the paracolic gutters, and pelvis. [33]

The standard FAST procedure consisted of views of four areas obtained with the patient in the supine position.

- Pelvic fluid (women of child bearing age).
- Loops of fluid filled bowel.
- Incomplete / empty bladder.
- Echogenic clot.
- Contained injury.

In a patient whose status was haemodynamically unstable, if haemoperitoneum is present on FAST, then laparotomy is mandatory. Due to the above pitfalls, when FAST becomes positive for haemoperitoneum, it indicates the presence of injuries that are significant, but the absence of detected haemoperitoneum does not exclude injury. In spite of all that, the use of a FAST protocol examination (Focused Assessment with Sonographic examination of the Trauma patient) for visualising abdominal quadrants for free fluid is an irreplaceable tool in the initial and rapid evaluation of the acutely injured patient. [36]

FREE FLUID SCORING SYSTEMS [33]:

Scoring systems have been developed to help stratify patients into groups who may or may not require laparotomy. Others have stratified patients based on either the amount of free fluid in one location or the number of locations in which free fluid was detected. For instance, Sirlin et al, described a scoring system based on the location of the fluid was described by Sirlin et al. For each anatomic region in which fluid was detected, one point was given.

Higher the score, higher the injury rate and the greater the need for laparotomy.

Others have advocated scoring systems based on the number of free fluid sites or the vertical height of free fluid.

A common theme would be, more the amount of free fluid, the greater the likelihood of injury or the need for surgical intervention.

In almost all recent studies of the use of FAST for detection of free fluid in patients with BAT, the specificity of FAST is high. In some cases FAST may detect small amounts of free fluid that are not visualized with CT.

SOLID ORGAN INJURY:

Initially FAST was used in detecting organ injuries in the 1970s, but more recent studies focused on the detection of free fluid. A few recent studies have demonstrated the ability of sonography to detect parenchymal organ abnormalities directly.

A sensitivity rate of 41.4% for the direct detection of solid organ injuries by sonography was reported by Rothlin et al. [33], [37] a sensitivity rate of 41% detection in solid organ Injuries was also reported by Mc Gahan et al. [9]

Polletti et al showed a sensitivity rate of 41% for direct demonstration of organ injury. [31]

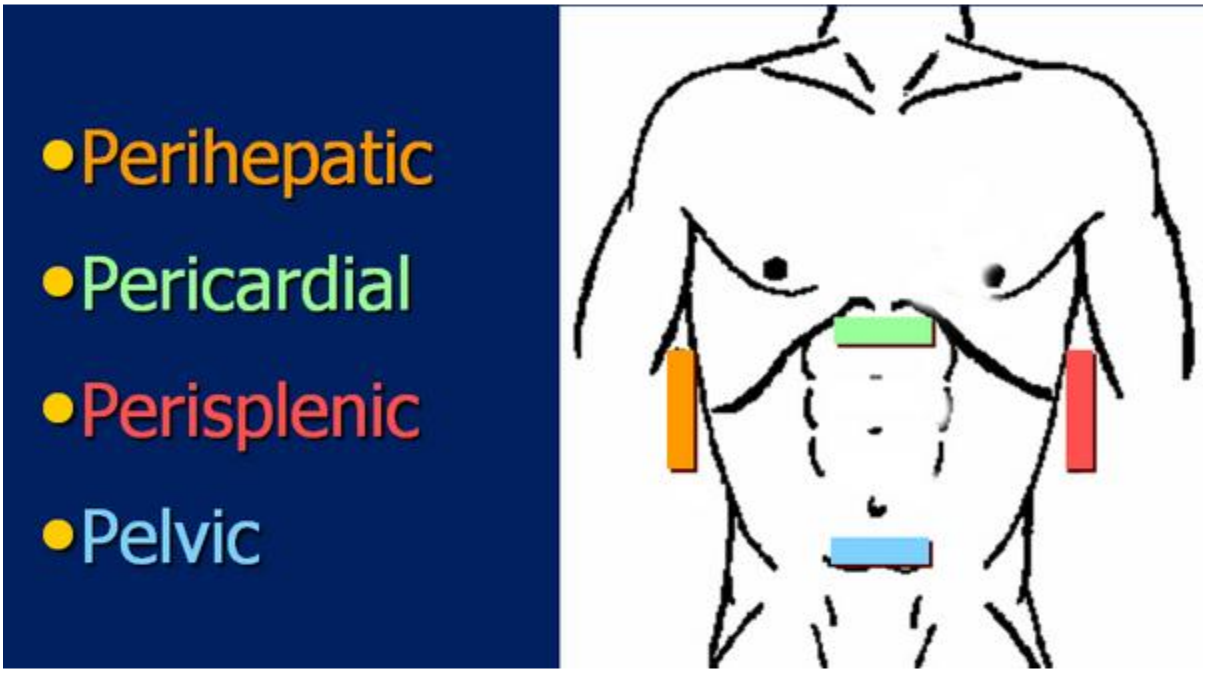


Fig 6: Probe positions in FAST

More recently in an article by Hahn et al, patients with proven intra Abdominal injuries after BAT were evaluated and it was demonstrated that the finding of free fluid with FAST was important. [33, 35] They showed that examination of Morrison's pouch had the highest detection rate of free fluid in their study (66%), whereas free fluid was detected 56% of the time in the upper quadrants, 48% of the time in the paracolic gutters, and 36% of the time in the pelvis, so examination of all the areas was important.

Pitfalls in the examination of abdomen for free fluid. [33]

- Pre-existing fluid (ascites)
- Iatrogenic free fluid as in dialysis or direct peritoneal lavage.

SONOGRAPHIC APPEARANCE OF SOLID ORGAN INJURIES [33]:

Much of the work on sonographic classification and appearance of solid organ injuries have been performed by McGahan et al and Richards et al. When identified, acute solid organ injuries are often echogenic on sonography. Splenic injuries are identified by a diffuse heterogeneous echogenic pattern. Hepatic injuries show a discrete hyper echoic or diffuse hyper echoic pattern. Renal injuries are echogenic, with a disorganized appearance that occurs with severe renal lacerations.

SPLENIC INJURIES:

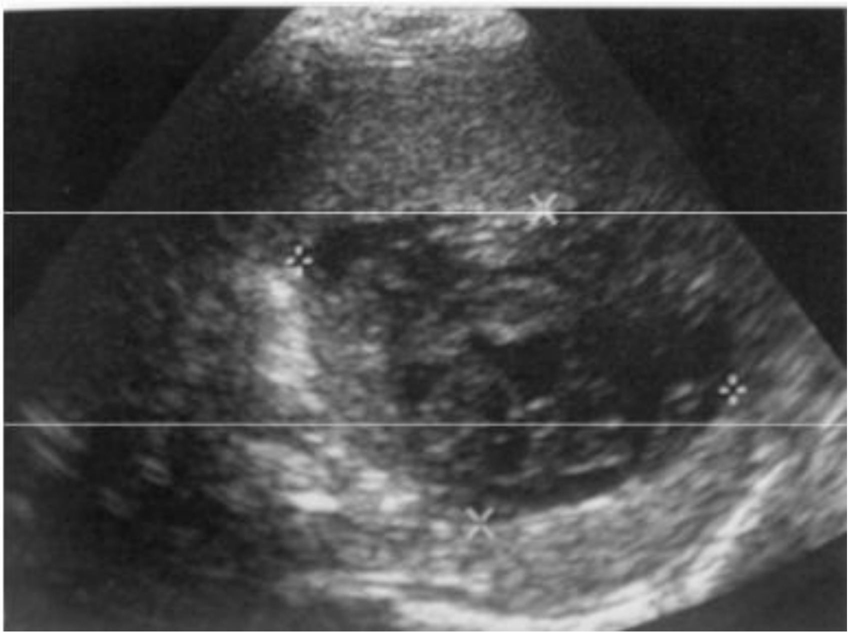


Fig 7: FAST showing hematoma in the spleen

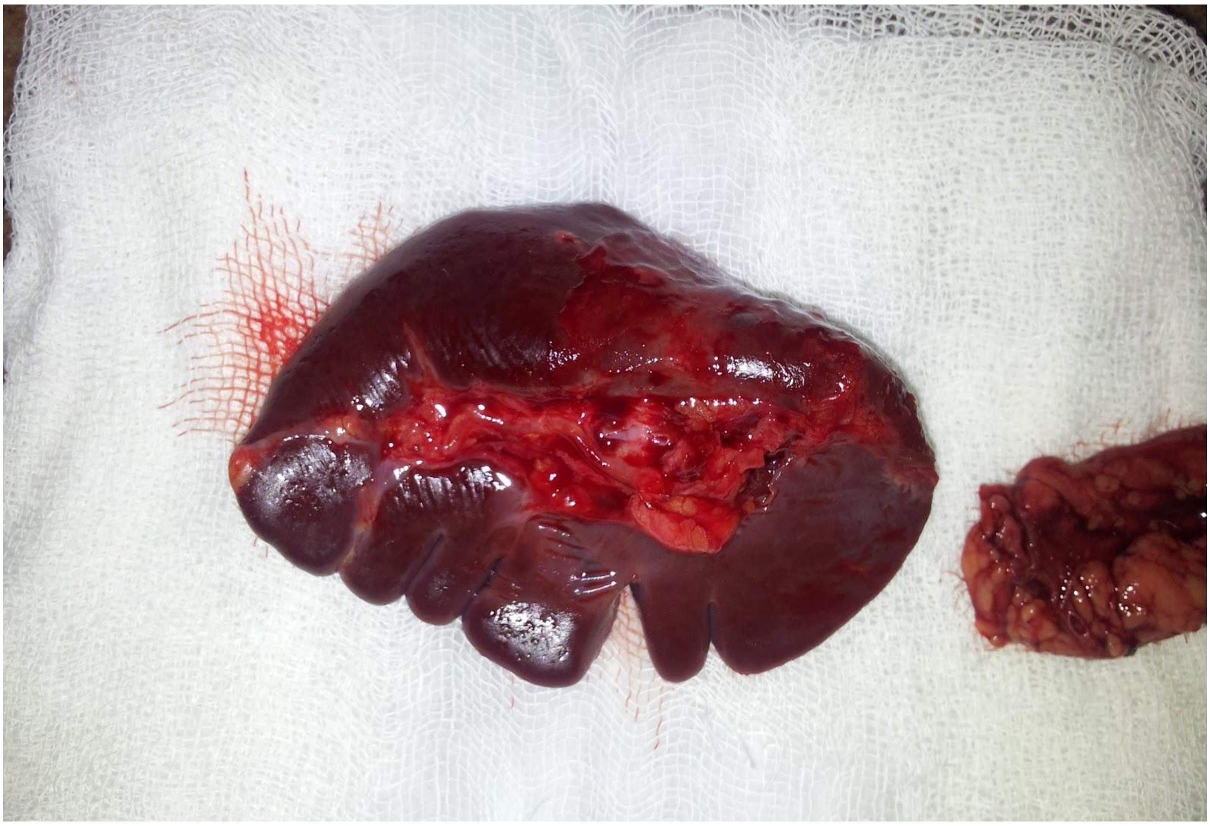


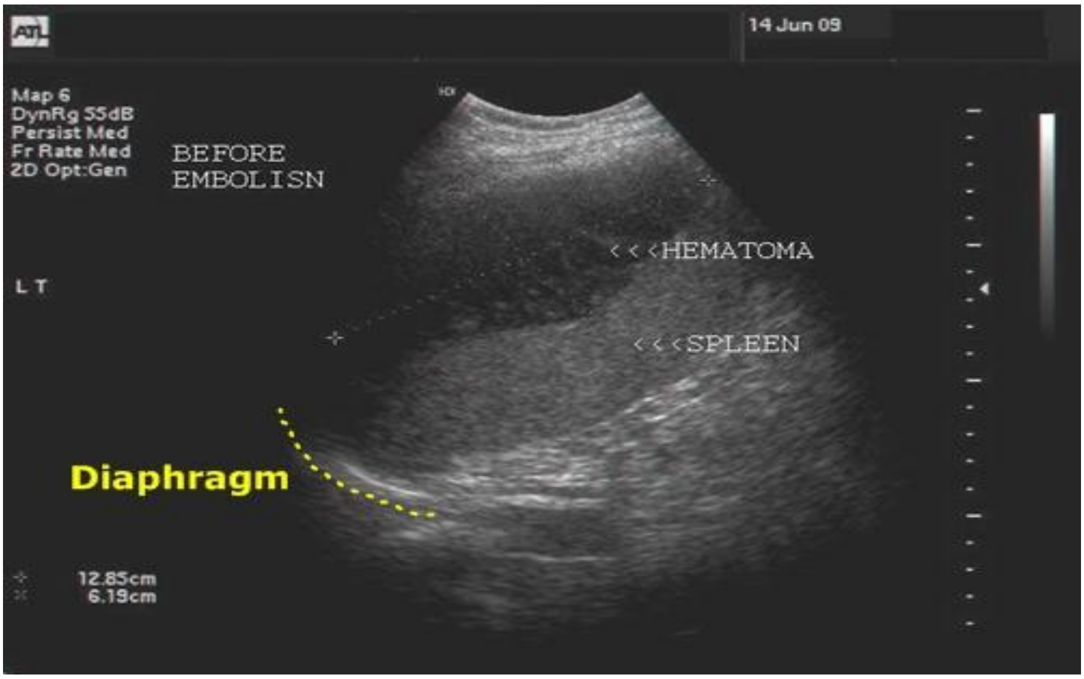
Fig 8: Splenic hilar tear

In blunt abdominal trauma, the most commonly injured organ is the spleen which accounts for nearly 40% of all solid organ injuries. Potential factors that can be responsible for splenic injuries are fractured ribs, intra-abdominal compression and its rich blood supply and a relatively unprotected area. Almost 20% of patients with left sided lower rib fractures are associated with splenic trauma, although fractures are not associated with 60 % of splenic injuries. There is increased susceptibility to trauma in the spleen in persons with splenomegaly or splenic infections such as infectious mononucleosis. [36]

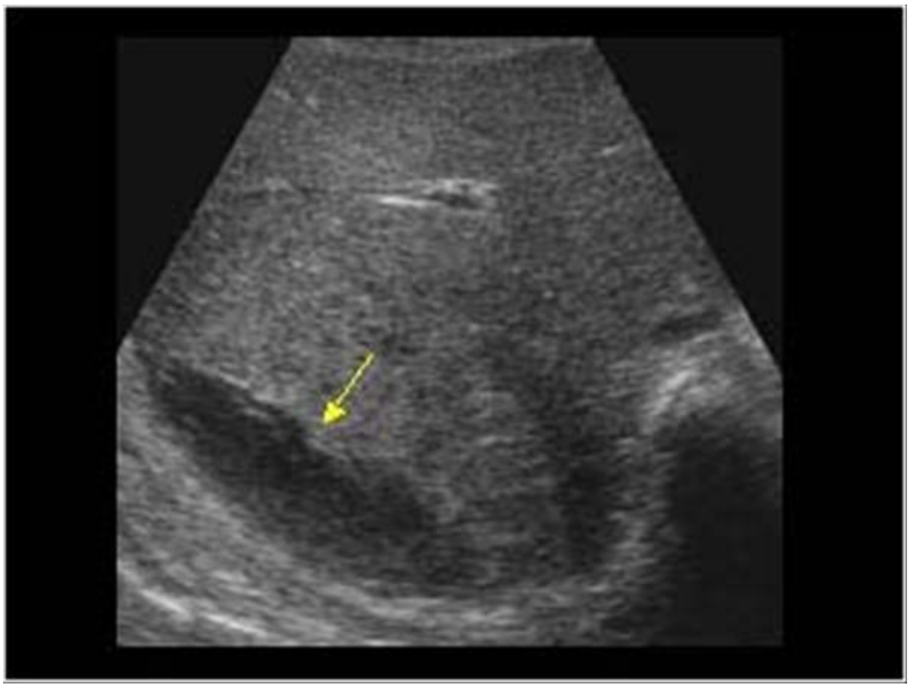
Various types of injuries seen are:

HAEMATOMA:

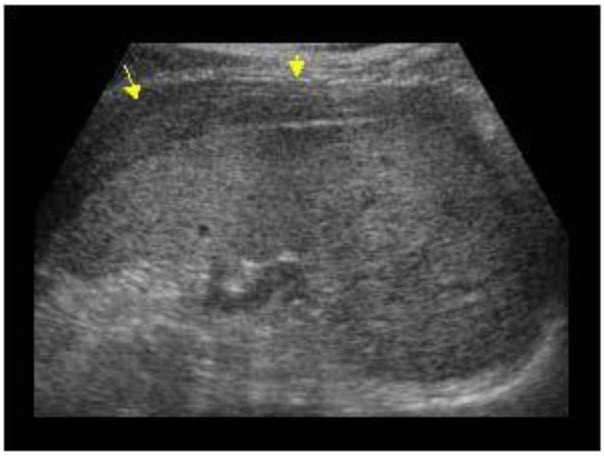
This can be:



a. Sub capsular haematoma.



b. Intraparenchymal haematoma.



c. Perisplenic haematoma.

It is important to consider the timing of FAST relative to the trauma. Immediately after the trauma, the hematoma is liquid and can easily be differentiated from splenic parenchyma. However, after the blood clots and for the next 24 to 48 hours, the echogenicity of the blood clot around the spleen may closely resemble the echogenicity of normal splenic parenchyma albeit slightly enlarged. Later, the blood reliquefies and the diagnosis becomes easy again. [38]

With time, one may clearly see the subcapsular hematoma differentiated from the pericapsular, walled-off hematoma by the capsule itself. The splenic capsule is very thin and is mostly not visualized separately from adjacent fluid. In such cases, an important clue to the location of the hematoma is provided by the shape of the fluid collection. If the collection is crescentic and conforms to the contour of the spleen, then a subcapsular hematoma should be suspected. But with perisplenic hematomas, more irregularly shaped collections are seen. [38]

Intraparenchymal or subcapsular hematoma initially appears only as an Inhomogeneous area in the otherwise uniform splenic parenchyma. Subsequently, the hematoma may resolve and repeat scans show the cyst at the site of the original injury.

LACERATION:

A small peripheral laceration appears as a linear echo poor defect. With transection, a more extensive plane of fluid may be seen traversing the entire thickness of splenic pulp. [16, 39]

A shattered Spleen usually results from complex lacerations that are interconnected.

RUPTURE:

A large laceration can be caused by severe injury, through and through the splenic parenchyma and cause acute rupture of the spleen.

Late splenic rupture is defined as bleeding occurring due to injury to the spleen that occurs 48 hours after the blunt abdominal trauma. Subcapsular splenic haematomas which eventually ruptures is responsible for most of these cases. Lysis of the clot and the resultant osmotic shift of fluid due to high oncotic pressure or the initial pressure of the haematoma by the organs surrounding the spleen is the most common mechanism of rupture. [36]

CONTUSION:

Focal areas of inhomogeneity or altered echo pattern represent contusion. With time it will become more fluid and well defined haematoma is formed.

Splenic cyst: They are generally organized haematoma. They appear as sonolucent cystic collection.

Free intraperitoneal fluid or left pleural effusions are usually seen with splenic injuries.

HEALING PATTERN:

The nature and size of initial lesion determines the pattern of splenic healing and the time it takes. Structural splenic recovery may or may not be associated with resolution of sonographic appearances. On FAST, the spleen usually does not change back to the previous normal appearance, a fibrous band is represented by a residual echogenic band. A haematoma that is resolving is sometimes results in small cysts. Sometimes a foci of calcification can also develop. [36]

STAGING, GRADING OR CLASSIFICATION CRITERIA [40]:

- Grading may be misleading; minor injuries can also go on to devastating delayed bleed.

O Grade 1: Subcapsular haematoma or laceration < 1 cm.

O Grade 2: Subcapsular haematoma or laceration 1-3 cm.

O Grade 3: Capsular disruption; haematoma > 3 cm; parenchymal haematoma > 3 cm.

O Grade 4A: Active parenchymal or subcapsular bleeding, pseudo aneurysm or Arteriovenous fistula; shattered spleen.

O Grade 4B: Active intraperitoneal bleed.

The need for surgery in general is usually associated with a higher grade or score of injury. This is demonstrated by most of the classification systems. But in certain cases, several patients with even low grades of injury may subsequently require emergency surgery.

In addition to all this, a look back of the patient records using such methods that demonstrate that many patients with high-grade injuries have also been successfully managed by conservative approach. [36]

LIVER INJURIES:

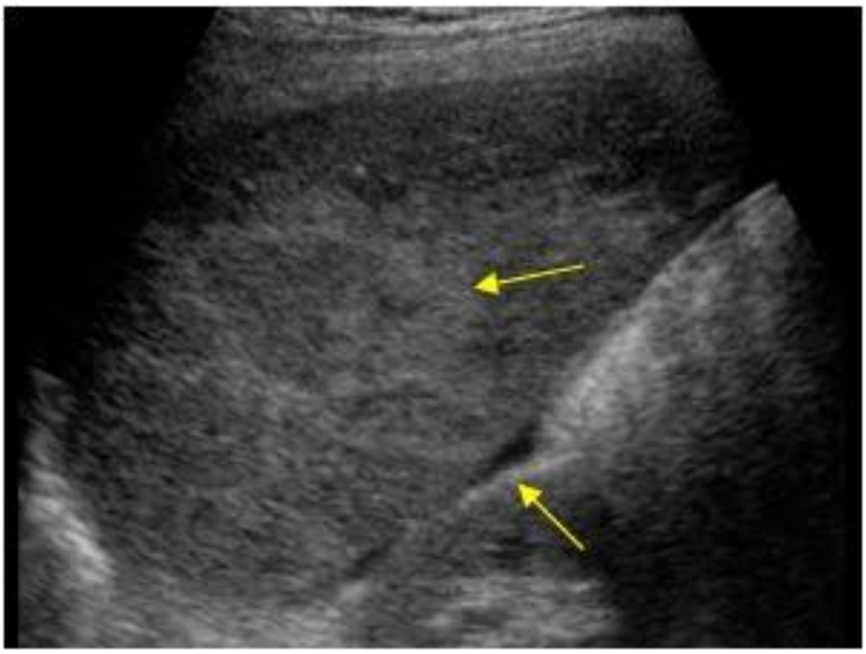


Fig 9: FAST showing liver injury

Fig 10: subscapular hematoma liver

Liver occupies the second position behind the spleen in organs injured most commonly in blunt abdominal trauma, this accounts for more than 20 -30 % of all abdominal trauma. The Right lobe injury is four times more common than the left lobe, the main reason for which is the larger size of the right lobe. Injuries to the liver are accompanied by other injuries in over 50% of cases. Splenic injuries are associated with usually left lobe injuries (45%) or pancreatic trauma may also be involved, whereas rib injuries (33%) or adrenal trauma most commonly associated with right lobe injuries. [36]

In children, BAT most commonly injured organ is the liver. [34]

Various lesions encountered in blunt liver trauma are:

LACERATIONS:

Lacerations are present as sonolucent bands traversing the capsule (capsular tear) or through and through the liver parenchyma (central laceration). This is the most common type of injury paralleling branches of the right and middle hepatic veins and the anterior and posterior branches of right portal vein.[41],[42]

HAEMATOMAS:

Subcapsular haematomas occur in potential space between liver parenchyma and liver capsule as lentiform or curvilinear fluid collections :

Initially - anechoic

After 24 hrs - echogenic

After 4 -5 days - hypoechoic

After 1- 4 wks - internal echoes and septations develop within haematoma. [43]

Intrahepatic haematomas are surrounded by liver parenchyma. With an acute bleed, the pattern tends to be echogenic. The sonographic findings of acute trauma to the liver (<24hrs) was evaluated by Van Sonnenberg et al and was determined that fresh hemorrhage was echogenic. On serial follow up scans, there may be a significant increase in the cystic component before there is a reduction in size and complete resolution.

CONTUSIONS:

Contusions appear as inhomogeneous or altered echo texture in the liver. Large contusions may lead to formation of haematomas.

The liver has a dual blood supply which is the main reason why the liver is protected from any localised infarctions in the absence of any gross parenchymal disruption. [36]

STAGING, GRADING OR CLASSIFICATION CRITERIA [43]:

•Clinical classification based on “American Association for Surgery of Trauma” (AAST).

O Grade I

- Subcapsular haematoma: Less than 10% surface area

- Laceration: Capsular tear, less than 1 cm depth of parenchyma.

O Grade II

- Subcapsular haematoma: 10-50% surface area
- Intraparenchymal haematoma: Less than 10cm diameter.
- Laceration: 1-3cm parenchymal depth, less than 10 cm in length.

O Grade III

- Subcapsular haematoma: More than 50% surface area; expanding/ruptured Subcapsular or parenchymal haematoma.
- Intraparenchymal haematoma: More than 10cm or expanding.
- Laceration: Parenchymal fracture more than 3 cm deep.

O Grade IV

- Laceration: Parenchymal disruption involving 25-75% of hepatic lobe or 1-3 Couinaud segments within single lobe.

O Grade V

- Laceration: Parenchymal disruption involving > 75% of hepatic lobe or > 3 Couinaud segments within a single lobe.
- Vascular: Juxta hepatic venous injuries (retro hepatic venacava, major hepatic veins).

O Grade VI

- vascular: Hepatic avulsion

While the classification of liver injuries may in certain conditions predict the results in the injured patients, 50-80% of patients with liver injuries are most commonly managed by a conservative approach in recent times. This has reduced the need for a highly specific staging.

RENAL LESIONS:

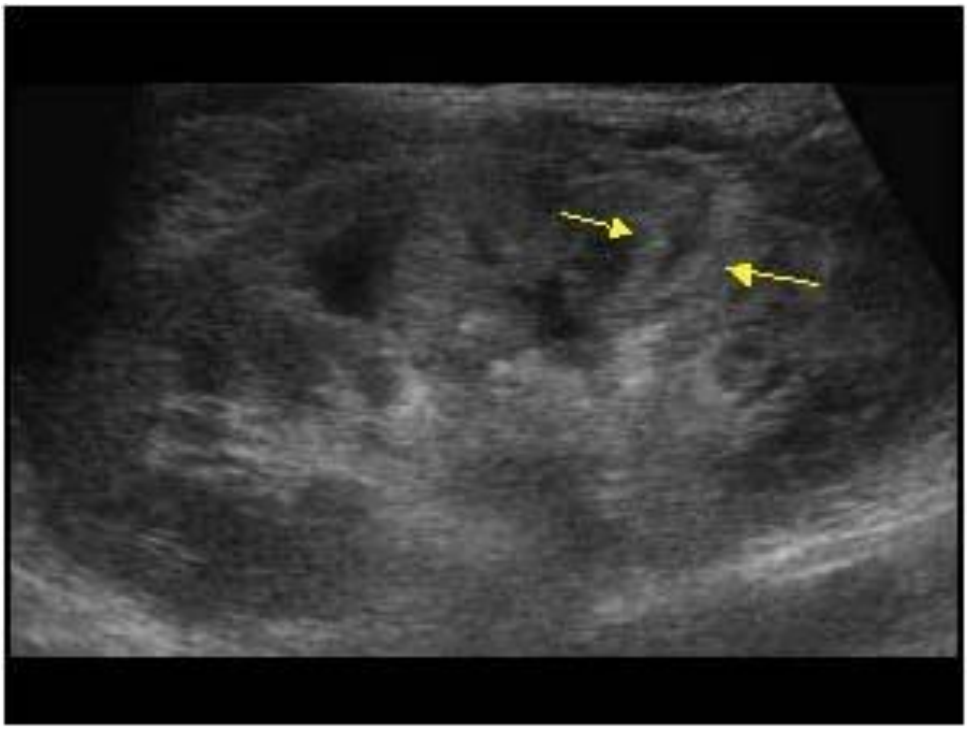


Fig 11: FAST showing Renal Laceration

Renal injuries are mostly caused by blunt abdominal trauma. Such injuries one usually mild and heal without specific therapy. [43] Serious renal injury is often associated with damage to other organs such as liver, spleen, bowel, pancreas or chest. Multiorgan involvement occurs in 20% of those with blunt trauma. The degree of renal injury varies considerably in blunt abdominal trauma.

RADIOLOGICAL CLASSIFICATION OF RENAL INJURIES: [43]

• GRADE I: 75-85% of all renal injuries.

O Minor injury (contusion; intrarenal or subcapsular haematoma)

O Minor laceration + limited perinephric haematoma.

- No extension to collecting system or medulla.

• GRADE II: 10% of all renal injuries.

O Major Injury (major cortical laceration and extension to medulla and collecting system).

O With or without urine extravasation or segmental renal infarct.

• GRADE III: 5% of cases

Catastrophic injury (multiple renal lacerations and vascular injury involving renal pedicle).

• GRADE IV: rare

Ureter - pelvic junction injury - complete transection or laceration.

Subcapsular or perinephric haematomas may be present in any of these categories. Any combination of these injuries may be seen in a single kidney. The presence of congenital or acquired cystic disease, hydronephrosis and solid vascular lesions (e.g., renal cell carcinomas, angiomyolipomas) also predisposes to injury.

Ultrasonography is useful in detecting internal lesions as well as perirenal pathology in blunt kidney trauma.

HAEMATOMAS [45], [46]:

Sonographic appearance of haematoma, changes with age or duration of process. When fresh, or in early stages, it appears as a sonolucent or anechoic fluid mass. In later stages, coarse clumps of strongly echogenic material are identified in previously echo free collection, which represent clot material. Internal haematoma, usually appear as a circumscribed disturbance of the echo structure within the kidney. Depending upon the age of haematoma the disturbance in the echotexture may be either more hypoechoic or hyperechoic than the surrounding kidney tissue.

Subcapsular haematomas appear as small sickle shaped sonolucent areas inside the renal capsule. Blood clots in collecting system appear as scattered hypoechoic or hyperechoic areas. The pelvi- calyceal system is usually dilated.

LACERATIONS [47]:

Appear as linear band shaped hypoechoic or echodense zone in the sonogram, or as a deformity of the contour of the kidney in this area. Parenchymal lacerations, which communicate with the calyceal system on sonography, appear as disruption of the central pelvic echoes, with a sonolucent band or area in a plane at right angles to it, in transverse scan (also called fractured kidney).

SHATTERED KIDNEY[46] :

A complete disruption of the renal parenchyma with displacement of fragments can easily be diagnosed by sonography and is always associated with accumulation of fluid in the renal bed. Shattering of kidney can be sonographically identified by the irregular density of the parenchymal structure in a large part of the kidney together with movement of fragments. Normal kidney structures cannot be identified.

In cases of injury to renal vascular pedicle the sonographic appearance of the kidney can be completely normal.

PERINEPHRIC LESIONS: This can be of the following types:

a. EXTRA-CAPSULAR HAEMATOMA [46]:

Perirenal, pararenal and retroperitoneal haematomas are also sickle shaped or crescent shaped, but lie outside the renal capsule or in the retroperitoneal space. The kidney may be displaced by the haematoma.

b. URINOMA:

Perirenal collection of urine after trauma is called urinoma. Perirenal haematoma and urinoma usually cannot be differentiated by FAST.

PANCREATIC INJURIES:

Pancreatic injuries in blunt abdominal injuries is rarer when compared to other solid organs, it is encountered in only 3 - 12% of blunt abdominal trauma. The main cause of injuries is the Compression of the body and the neck of the pancreas against the vertebral column by either steering wheels or seat belts in adults and bicycle handlebars in children. [36]

Acute traumatic injury to the pancreas includes contusion with oedema, laceration, haemorrhage and transection, which almost always occurs in the body of pancreas. [19]

The ultrasonography findings with pancreatic trauma depend on the extent of trauma. With contusion, a focal hypoechoic mass or diffuse hypoechoic enlargement of the gland may be seen. With laceration or rupture, fluid may be demonstrated in the retroperitoneum or intraperitoneal space. Traumatic pseudocyst formation is known to occur in 30-60% of patients. [48] On ultrasonography, pseudocysts appear as well defined anechoic masses with associated distal acoustic enhancement. The most common sites for pseudocysts are lesser sac, anterior or posterior pararenal space. A significant number of cysts will resolve spontaneously and as such should be followed on ultrasonography. Surgical intervention is required for a persistent cyst.

ADRENAL INJURIES:

Relatively uncommon. In BAT, usually unilateral in 80% of cases (Right - 85% and left - 15%) and bilateral in 20% of cases. [43]

Ultrasound initially shows an echogenic adrenal mass that may contain a bright central region. Later the mass will become hypoechoic or anechoic centrally and with time, may shrink. With progressive decrease in size the mass may again become more echogenic and calcifications often develop. Alternatively, a pseudocyst with all the ultrasound characteristics of a simple cyst may be left behind. [49]

HOLLOW VISCUS:

BOWEL AND MESENTERIC INJURIES:

Bowel and mesenteric injuries are involved in approximately up to 5% of all blunt abdominal trauma cases, as a result, they are relatively rare. [36]

The best treatment for mesenteric and bowel injuries is early surgical management. As a result the rapid detection of bowel injuries is of paramount importance. This is different from management of other organs where conservative management can be practised. Morbidity and mortality is increased by any delay in diagnosis and management. [36]

Injuries occurring due to deceleration can cause shearing forces at the points of fixation of the bowel, such as, the ligament of Treitz, the retroperitoneal duodenum, the ileocaecal valve and any hernias that may be incidentally present. These shearing stresses can cause tears of the mesentery or injuries of the bowel wall. Restraining forces usually causes an increase in the intraluminal bowel pressure that results in the direct rupture of the bowel. Blunt injury to the colon is relatively rare. [36]

The various types of traumatic bowel lesions include:

CONTUSION:

Appears sonologically as increase in thickness of wall of the injured loop with ileus localized to the area of injury.

PERFORATION:

Localized heterogeneous collection adjacent to the contused segment is an indirect pointer to the diagnosis. However, it is difficult to localise the exact site of perforation. Free intraperitoneal fluid may be the only finding present. If large in amount floating bowel loops are seen with hypoperistalsis or aperistalsis. [48]

INTRAMURAL HAEMATOMA:

Haematoma is usually localized to the submucosa if haematomas large, diffuse gut wall thickening may be seen on sonograms.

MESENTERIC HAEMATOMA:

Bleeding from small mesenteric vessels will lead to a haematoma formation that involves mesentery alone or extends to bowel wall. The ultrasonography appearance of haematoma depends on the time interval between the onset of bleeding and examination. In most cases appearances are those of anechoic mass due to unclotted blood. As the haematoma becomes organized internal echoes are found and a complex mass results. [50]

Due to extensive gas, bowel injuries are difficult to identify on FAST.[30] The absence of any solid organ injury, with presence of Intraperitoneal free fluid should alert the sonologist to associated bowel injury. [34, 36]

URINARY BLADDER INJURIES:

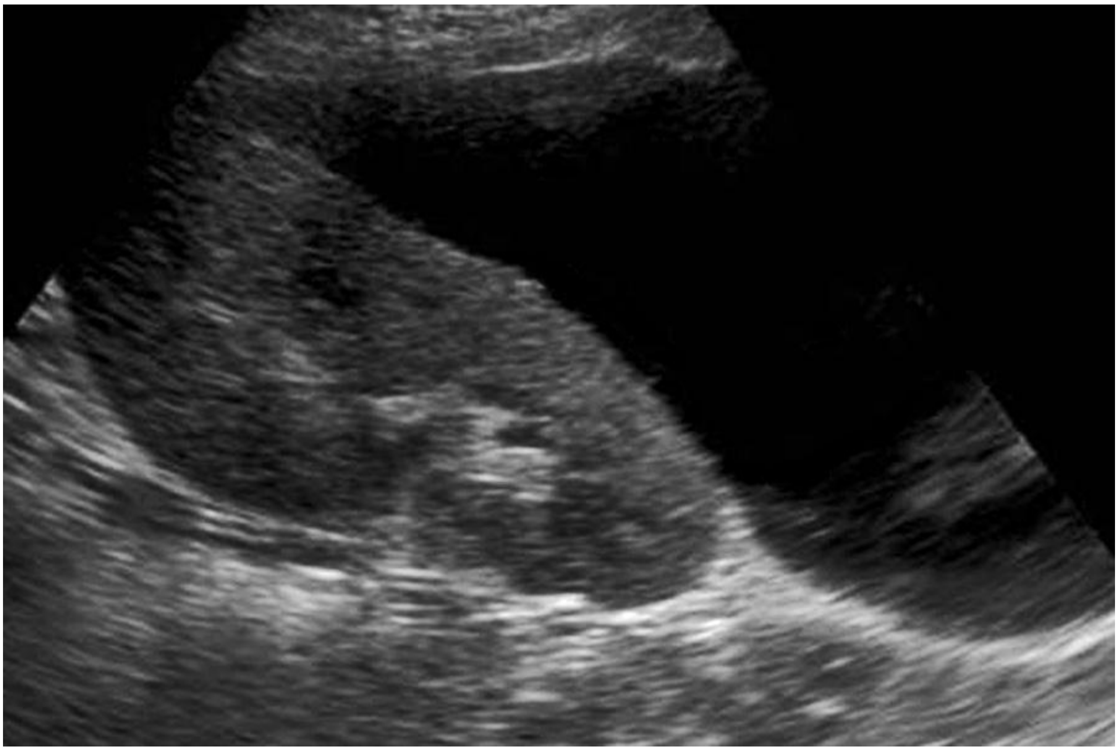
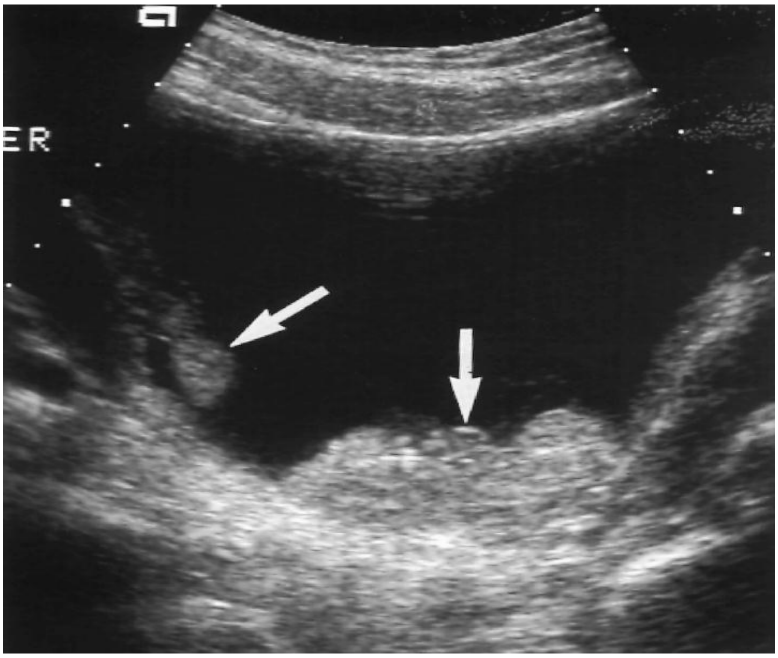


Fig 12: (a) perinephric collection



(b) Echogenic blood in urinary bladder

Bladder injuries are classified into extra peritoneal and intraperitoneal types, but these categories may be further subdivided as follows [51]:

Type I: Bladder contusion with incomplete or non-perforating tear of the bladder.

Type II: Intraperitoneal rupture.

Type III: Interstitial rupture defined as mural defect without extravasation.

Type IV:

a. Simple extra peritoneal rupture with extravasation limited to perivesical space.

b. Complex intraperitoneal rupture with extravasation outside the perivesical space.

Type V: Combined intra and extra peritoneal rupture of bladder.

On FAST, free intraperitoneal fluid or free fluid in extra peritoneal

Perivesical space is noted in intraperitoneal or extra peritoneal rupture of bladder respectively. Sometimes “bladder within a bladder” appearance is noted, since hypoechoic urine outlines inner bladder wall and hypoechoic blood and urine outlines outer bladder wall. On ultrasonography, echogenic masses representing blood clot in the bladder can be detected.

However, sonography is usually not helpful in the assessment of these injuries except to identify large fluid collection or free intraperitoneal fluid. [44] Cystography is highly useful in detecting bladder rupture.

Many examiners incorporate the subcostal view of the heart as a portion of FAST scan. This is useful for diagnosing a pericardial effusion. Finally cardiac tears or ruptures of the heart may be noted on sonography.

Thus in the future, sonography will probably prove to be a more useful tool in identifying abnormalities in the chest with blunt trauma. [39]

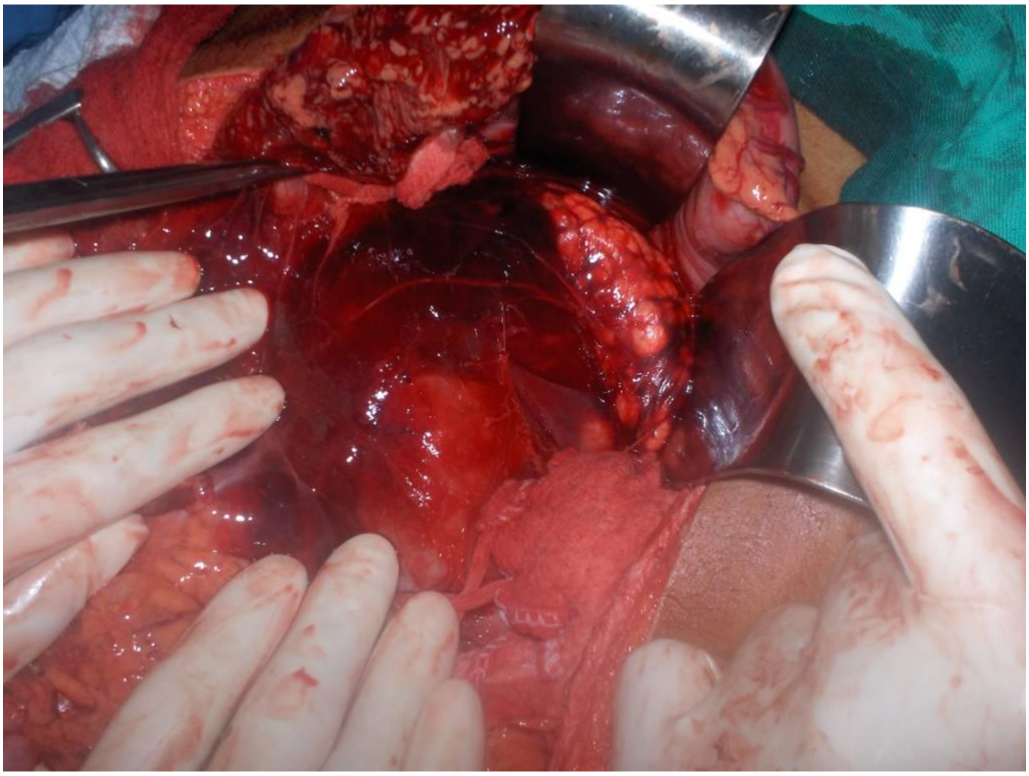


Fig 13: Zone I Retroperitoneal Hematoma

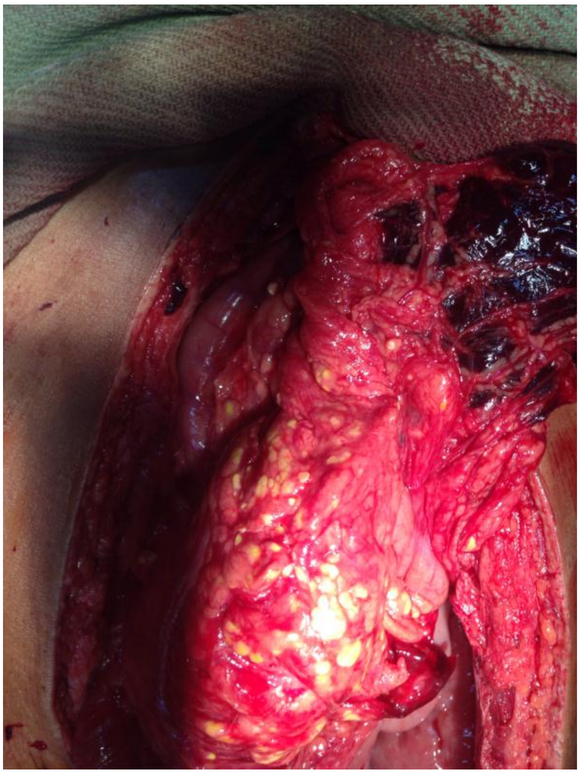


Fig 14: traumatic pancreatitis with saponifaction and hematoma of greater omentum

MECHANISM, PATTERNS AND PATHOPHYSIOLOGY OF VARIOUS BLUNT ABDOMINAL INJURIES

Obtaining history of mechanism of injury is of great importance in blunt trauma abdomen. [52]

.. Some 50-60% of closed injuries are due to road accidents and most victims are occupants of the vehicle, but 15% are on a motor cycle or pedal cycle and 15% are pedestrians. Other causes are falls, accidents at work or in the home, assaults and seat-belt injuries. [53]

.. Injuries to the left side, with involvement of spleen are more common as is rupture of the duodenum (closed loop due to seat belt) in occupants of left hand seat of a car, whereas liver injuries are more common in right sided occupants. [54]

PATHOPHYSIOLOGY OF BLUNT TRAUMA ABDOMEN [55]:

LIVER [55]

The liver is one of the most commonly injured organ in all patients with abdominal trauma. It can be injured in both blunt as well as penetrating injuries to the abdomen due to its weight, size and narrow attachment.

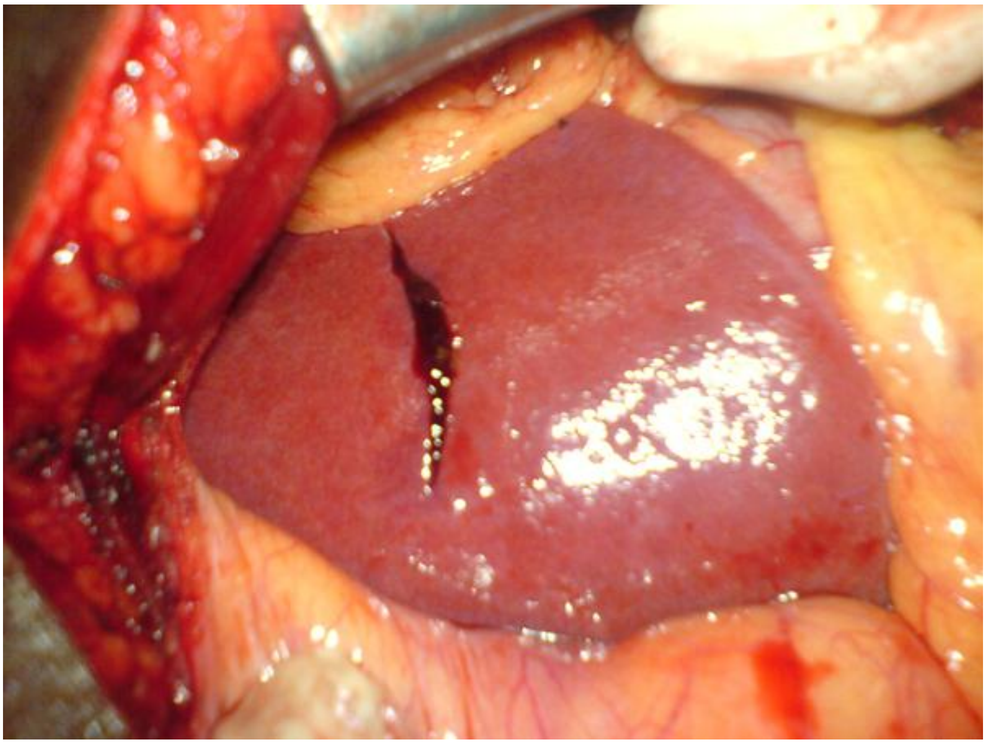


Fig 15: Liver laceration on laparotomy

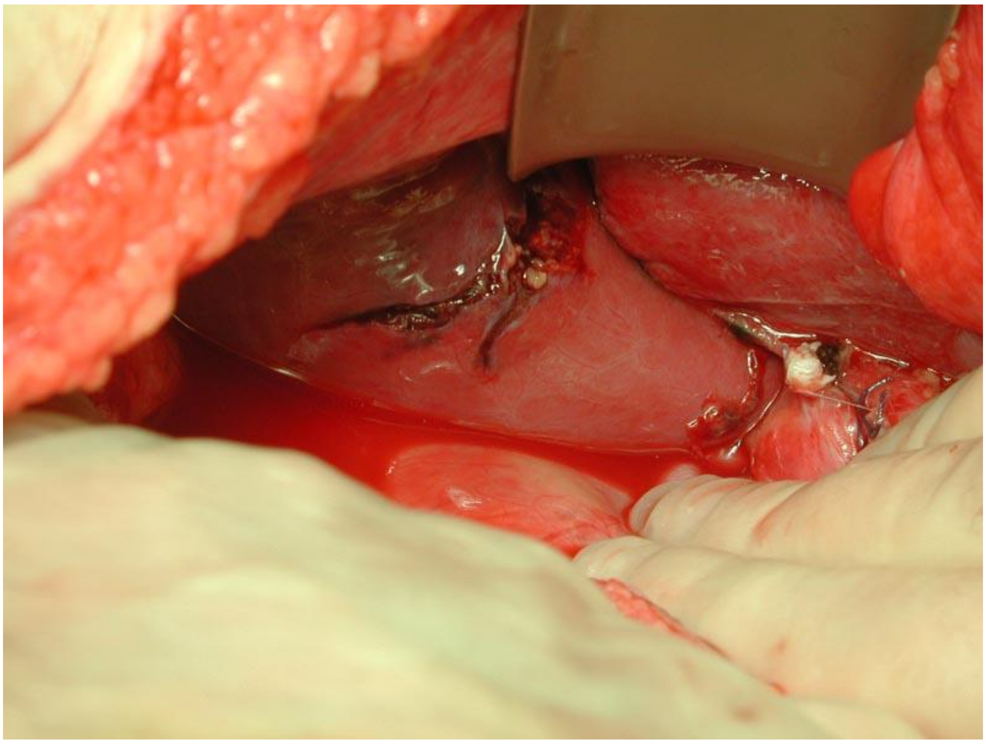


Fig 16: Liver laceration with contusion on laparotomy

Although its location in the right upper quadrant and costal margin afford some protection, the position assumed at the time of injury may make it possible for injurious forces applied to the other quadrants of the abdomen to reach and produce deleterious effects on this organ. Death is usually due to haemorrhage.

The mechanism of liver injuries are direct blows, which causes compression between lower ribs on the right and the spine, or shearing at fixed points, secondary to decelaration in blunt abdominal trauma.

Blunt trauma to the liver may cause a disruption of the hepatic substance beneath an intact Glisson's capsule. Bleeding beneath the capsule can result in subcapsular haematoma. The haematoma may be small and contained or continue to expand. The capsule may be stripped from a large surface area of the liver.

HEPATIC INJURIES: [56]

LIVER INJURY SCALE:

Grade Injury description

GRADE I

Haematoma

Laceration

Subcapsular, non expanding, < 10% surface area

Capsular tear, non bleeding, < 1cm parenchyma

GRADE II

Haematoma

Laceration

Subcapsular, non expanding, 10-50% surface area

Capsular tear, active bleeding, 1-3cm parenchymal depth, < 10cm in length

GRADE III

Haematoma

Laceration

Subcapsular, > 50% surface area or expanding, ruptured

subcapsular haematoma with active bleeding, intraparenchymal

haematoma > 10cm or expanding > 3cm parenchymal depth

GRADE IV

Laceration

Parenchymal disruption involving 25-75% of hepatic lobe

\GRADE V

Laceration

Parenchymal disruption involving > 75% of hepatic lobe

Juxtahepatic venous injuries, i.e. retrohepatic vena cava / major hepatic veins

\GRADE VI

Vascular Hepatic avulsion

SPLEEN:

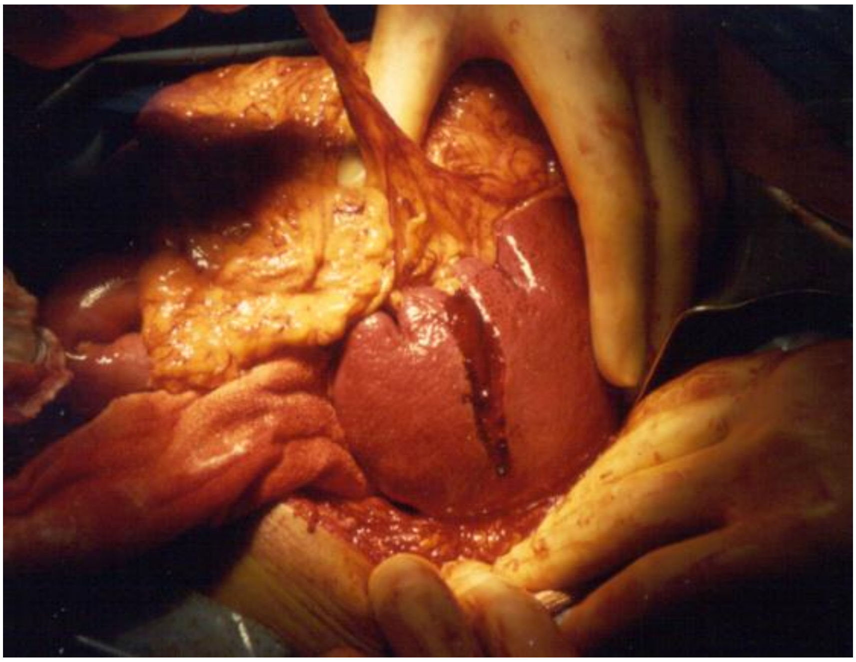


Fig 17: Splenic laceration

The spleen is the most commonly injured organ in patients who have suffered blunt abdominal trauma. Although the normal spleen is relatively well protected by the ribcage posteriorly and laterally and softly cushioned by surrounding organs medially and anteriorly, it is one of the most frequently injured organs in cases of blunt abdominal trauma.

The mechanism of injury is compression between the anterior abdominal wall or anterior chest wall and the posterior rib cage on the left or by compression between the perietes and vertebral column. The relative mobility of the spleen at its pedicle subjects it to sudden and forceful dislodgement from the peritoneal attachment by counter-coup, resulting in splenic capsular and parenchymal tears. In some patients, fractures occur along the major segmental arteries of the spleen.

Traumatic rupture of the spleen is relatively common and not infrequently is the sole critical injury produced by blunt trauma to the left anterior or lateral thoracoabdominal wall.[57]

GRADE INJURY DESCRIPTION[58]:

GRADE I

Haematoma Subcapsular, non-expanding, <10 % surface area,

Laceration Capsular tear, non bleeding, <1cm parenchymal depth.

GRADE II

Haematoma Sub capsular, non expanding, 10-50% surface area.

Laceration Capscular tear, active bleeding.

GRADE III

Haematoma Subcapscular, >50 % surface area or expanding Ruptured subcapscular haematoma, active bleeding

Intraparenchymal haematoma, >2 cm or expanding

GRADE IV.

Laceration > 3 cm parenchymal depth or involving trabecular vessels

GRADE V.

Laceration - completely shattered spleen

Vascular – hilar vascular injury

SPLENIC INJURY IN CHILDREN

Approximately half of the injuries occur during play or athletic activities Whereas the remainder result from vehicular trauma. Abuse or neglect is important to consider in children under 4 years of age when a reliable history is not available. [59]

GASTRIC INJURIES:

The stomach is located in the intrathoracic portion of the abdomen and so it is protected from injury by the overlying rib cage. It is loosely suspended in the abdomen by the gastrohepatic ligament superiorly, the gastrocolic ligament inferiorly, and by its attachment to the spleen laterally. It is relatively fixed at the gastroesophageal junction and the retroperitoneal duodenum'

Blunt injuries to the stomach are uncommon and have been reported in less than 2% of cases of blunt abdominal injury. Most blunt gastric injuries have been observed after rapid deceleration motor vehicle accidents and in these cases are often combined with significant associated injuries to the liver, spleen, duodenum, pancreas and diaphragm. Relatively minor but focused blows, such as those caused by bicycle handle bars, can also produce full-thickness gastric rupture. [60]

BILIARY INJURIES [61]:

Extra hepatic biliary injuries after blunt trauma are uncommon. Gall bladder avulsion can occur with high energy blunt trauma. Shearing forces can avulse the gallbladder from its fossa and may leave it attached only by the cystic duct and vascular structures. This has been termed traumatic cholecystectomy and these patients are at high risk of volvulous of the gall bladder if the organ is not removed.

Traumatic cholecystitis occurs when direct contusion to the gall bladder or hemobilia from liver injury fills the gall bladder with blood. This blood stagnates, clots and cannot be expelled from the gall bladder. The cystic duct becomes blocked, and acute distension results.

EXTRAHEPATIC BILIARY TRAUMA:

The most common site of duct disruption from blunt forces is along the superior border of the duodenum as the duct enters the pancreas. Shear forces across the duct seem to be the most likely explanation, and avulsion of the duct from the papilla is possible. [62]

SMALL BOWEL

Small bowel is the most commonly involved viscera in abdominal trauma.

The mechanism of injury to the small bowel are crushing injury, shearing injury and bursting injury. Crushing injury is the commonest of them all. When a violent force is directly applied to the abdomen it crushes the intestines between the force and lumbosacral spine causing crushing type of injury [63]. The second mechanism is tearing or shearing of the bowel and its mesentery at points of fixation. Tears are common near the ligament of Treitz and ileocaecal valve where the short mesentery serves as tethering point. Reports have demonstrated vertical decelerations, by falls or jumps from heights cause shearing intestinal injuries

.

Fig 18: traumatic bowel injury

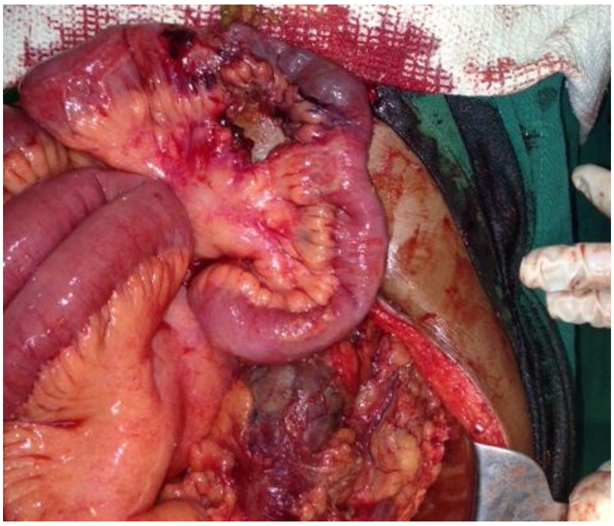


Fig 19: Mesenteric tear with bowel injury

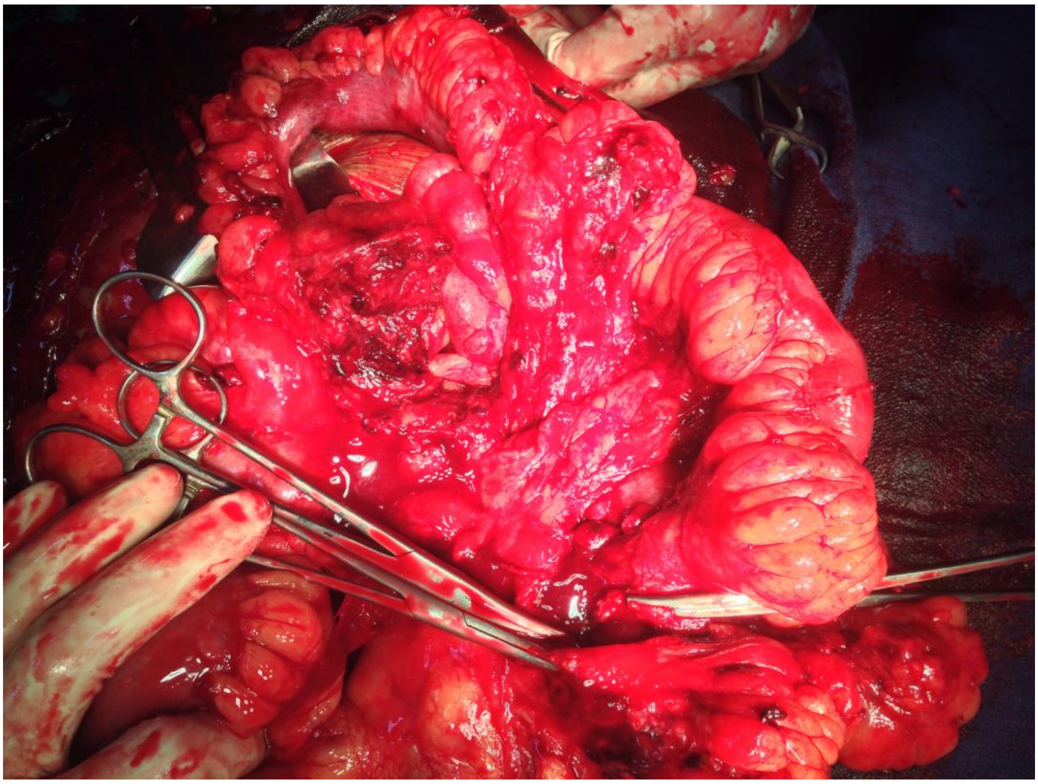


Fig 20: Traumatic mesenteric tear with contusion of bowel

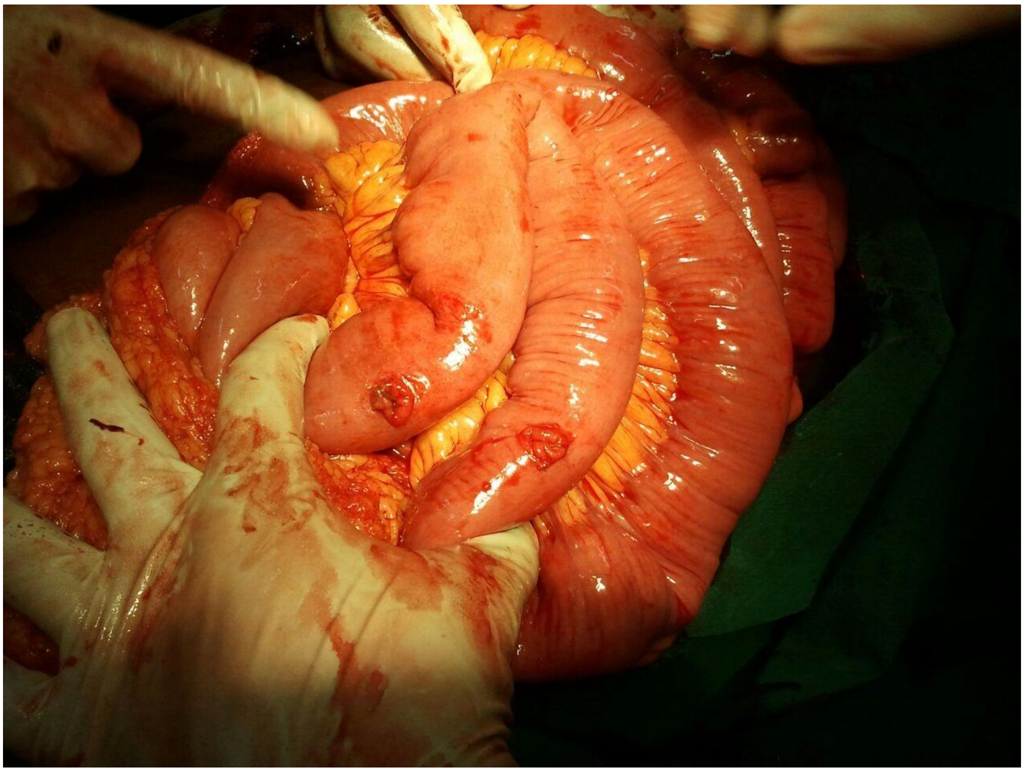


Fig 21: Traumatic bowel perforation

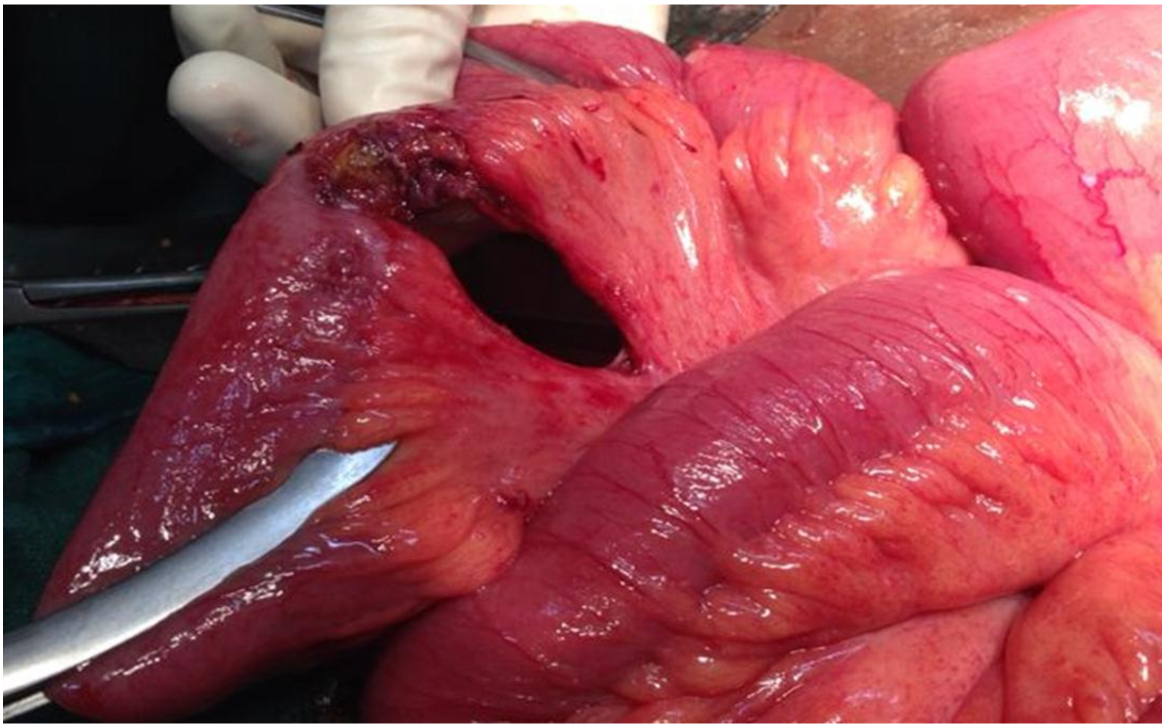


Fig 22: Vertical mesenteric tear and bowel injury

COLON AND RECTUM: [64]

Colorectal injuries are more common in penetrating abdominal trauma than in Blunt abdominal trauma. The mechanism of injury to the colon and rectum are crushing injury, bursting injury and shearing injury. When violent force is applied directly to the abdomen the intestines are crushed against the vertebral column.

Bursting injuries are caused by a sudden blow against a distended loop. Shearing injury occurs with sudden deceleration.

URINARY TRACT

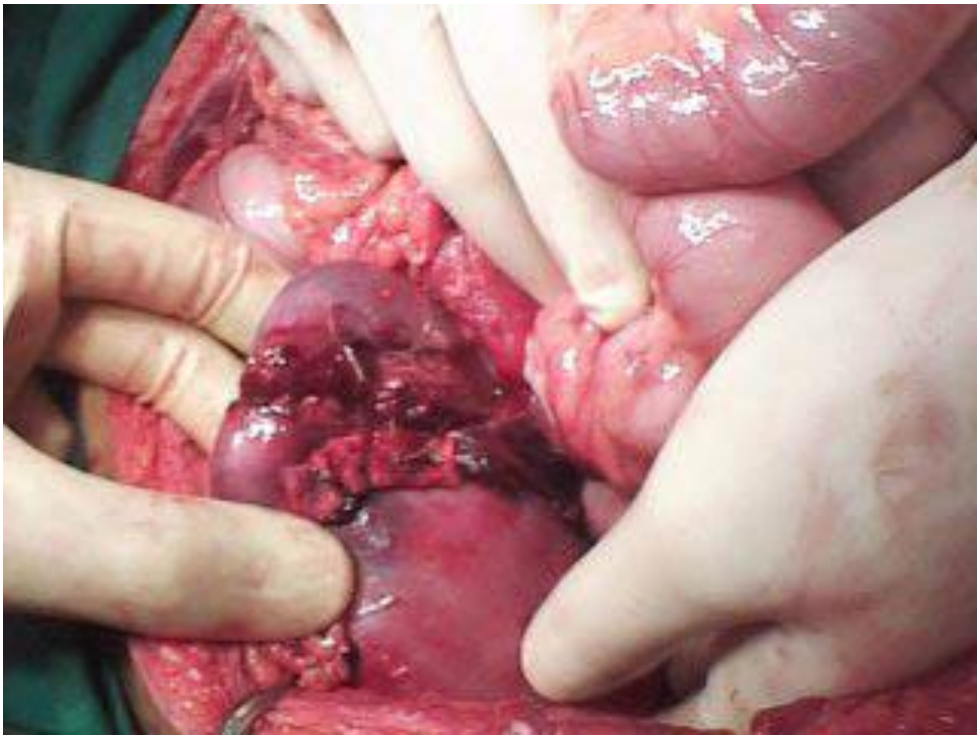


Fig 23: Renal laceration on laparotomy

Urologic injury is usually not suspected initially unless the patient has gross haematuria. Injury to the urinary tract can be caused by both blunt as well as penetrating abdominal trauma. Although the normal kidney is afforded some protection by its mobility and its partly intrathoracic position, the kidney is often found fractured because of its tension within a thin capsule. The kidneys that are ectopic, malrotated or fused are more vulnerable because of their intraabdominal locations. Owing to the greater mobility of kidney in females as well as to the somewhat more sheltered life of women and possibly to the protection afforded by the wearing of corsetts the relative incidence of injuries in adult males and females is 10:1.

• “Kidney is the most commonly injured organ in the urogenital” system. [65]

• “Renal injuries from blunt trauma occur consequent to upper abdominal injury and rapid deceleration”.

CLASSIFICATION OF RENAL INJURY

I. MAJOR RENAL INJURIES

a. Renal pedicle injury

b. Deep parenchymal injury with an intact capsule

c. Deep parenchymal injury with a disrupted capsule

d. Shattered kidney with an intact capsule

e. Shattered kidney with a disrupted capsules

f. Urethral or renal pelvis injury

II. MINOR RENAL INJURIES

a. Contusion

b. Shallow cortical laceration

c. Forniceal disruption

Renal trauma of severe magnitude is seldom seen as an isolated injury, therefore, unless a life threatening situation occurs, this type of trauma can usually be treated with excellent results by conservative measure.

BLADDER INJURIES

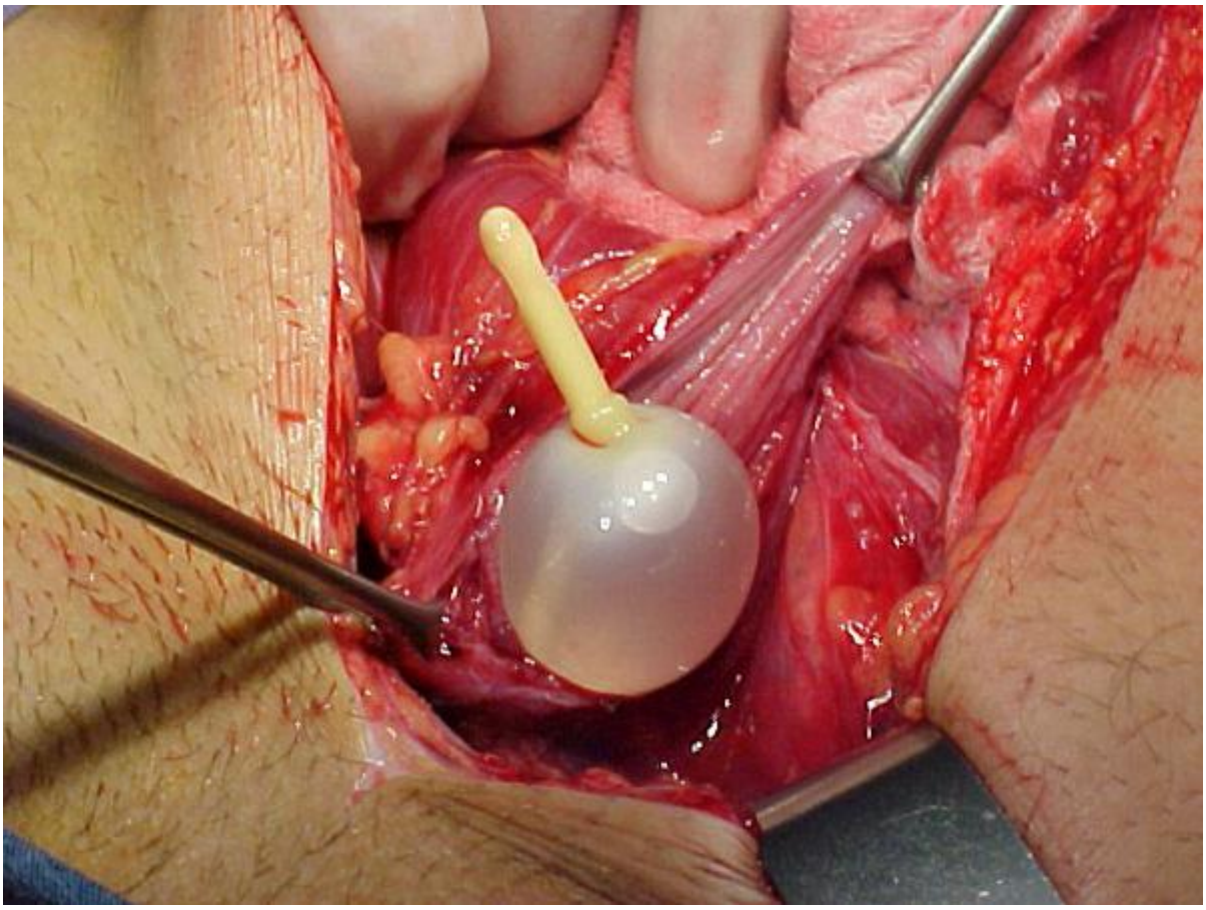


Fig 24: Bladder injury

Bladder injuries most commonly results from external violence is blunt trauma to the abdomen, mostly from crushing injuries to the bony pelvis, motor vehicle accidents but also from falls or blows to the abdomen. The full bladder is especially vulnerable to a deceleration injury.

In motor vehicle accidents, injuries are seen in passengers wearing seat belts when the force of the collision may focus on the abdomen and thus the full bladder, in the unrestrained child (or less commonly, the adults) who is thrown by the impact against an unyielding object, or secondary to a pelvic fracture. [66]

CLINICAL FEATURES OF DIFFERENT BLUNT ABDOMINAL INJURIES

SPLENIC TRAUMA [52]:

These are two classes

1) RAPID DEATH:

Spleen has been avulsed or severely damaged by either a run-over or a blast injury. The patient is admitted exsanguinated and dies before the resuscitation can be begun or a laparotomy performed.

2) SHOCK:

The largest group presents with shock, signs of rupture in about three quarters of all cases. The patient shows variable signs of hypovolemia and there is evidence that points to a serious intra-abdominal problem. There may be external evidence of damage to the left upper quadrant and if chest x-ray has been taken then one or more fractured ribs may be visible. The patient is pale.

The abdomen may be slightly distended. Abdominal rigidity is variable, ranging from generalized rigidity to that localized to left upper quadrant and extending towards the flank. Tenderness is likewise variable.

DELAYED RUPTURE:

In instances many months after the putative injury, it has been described but the peak of occurrence is within a few days.

LIVER INJURIES [52]:

Major hepatic injuries are easy to detect because of position of trauma, profound hypotension and marked abdominal distension. A presence of unexplained hypovolemia occurring with a bloody abdominal paracentesis, contusion of the right upper quadrant or lower anterior chest, referred pain to the right shoulder and signs of peritoneal irritation in the right upper quadrant clinches the diagnosis of liver injury.

In closed injury there is much similarity between the presentations of rupture of the liver and rupture of the spleen. The three types- early death in spite of attempts at resuscitation, gradual development of signs of intra-abdominal disaster and frank delayed rupture – are all seen but, by comparison with the spleen, the last is rare.

Shoulder pain is not as common as in ruptured spleen but is clearly a helpful indicator when it occurs. Apart from symptoms and signs of peritoneal irritation, which is very nonspecific, detection of fractures to overlying ribs may help to raise the suspicion of an underlying liver injury.

SMALL INTESTINE INJURY:

Any injury to the lower thorax, abdomen, or pelvis suggests the possibility of small bowel injury. The diagnosis of small bowel injury is based upon abdominal pain, signs of peritoneal irritation on physical examination, a positive abdominal tap, plain X-Ray abdomen in erect posture showing gas under diaphragm and ileus. But one must remember: ‘A negative peritoneal tap and normal X-Ray do not by any means rule out small bowel damage, particularly during the first 24 hours after the injury.[67]

Closed injury presents as peritoneal irritation, peritoneal lavage is helpful in making decisions but may not detect small perforations.

DUODENAL RUPTURE [52]:

a) INTRAPERITONEAL RUPTURES:

These produce the syndrome of rupture of the gut. The pain may be greater than usual, but this is not a reliable indicator.

b) RETROPERITONEAL RUPTURES:

There may be a significant latent period in which thepatient feels quite well. However within a matter of some hours or at the most a day, severe pain in the epigastrium and back begins and is associated with intractable vomiting, the abdomen is commonly a little distended and silent.

RUPTURE OF THE LARGE INTESTINE:

Nothing distinguishes colon rupture from that of rupture of other segments of the gut except for the delayed variety of closed caecal rupture where the blow is followed by a latent period, which in turn gives way to the right iliac fossa symptoms and signs, culminating all too often in catastrophic faecal peritonitis.

INJURIES TO THE PANCREAS:

They are rare and are found only in 1-2% cases of all the abdominal injuries. Pancreas is rarely injured because of its anatomical position which provides it with shelter from other abdominal viscera. The injuries are often diagnosed on exploration for traumatic abdomen with associated visceral injuries because the pancreas is surrounded by major abdominal organs and blood vessels. The opening of the lesser sac is very important to rule out the possibility of pancreatic injury. [68] Absolute criteria do not exist for the firm preoperative diagnosis of pancreatic injury. Gambil and Mason believed that the determination of the urine amylase is a more reliable index of pancreatic injury than the serum amylase. [69]

RENAL INJURIES: [65]

• Gross or microscopic haematuria is mostly seen.

•” These patients often have profuse abdominal tenderness, lower rib fractures, vertebral body fractures and flank contusions.”

• A abdominal mass that is palpable and with associated shock may indicate a rapidly developing retroperitoneal haematoma “from a major renal parenchymal or renal vascular injury”.

Haematuria may not be seen, and in that case diagnosis must be confirmed by imaging study prompted by a higher level of suspicion.

URINARY BLADDER INJURIES: [66]

Signs and symptoms of rupture of bladder rupture are mostly not specific. The patient may complain of suprapubic pain or relate that he attempted to urinate and could not.

Tenderness is present in the suprapubic area and bowel sounds are absent, especially if it is an intraperitoneal rupture.

Haematuria is a hallmark finding of bladder injuries.

METHODOLOGY

METHODOLOGY

As the world wide population is increasing there is an increasing incidence of road traffic accidents and violent trauma.

The present study is carried out on 100 patients with history of blunt abdominal trauma in a period of 1 year and 9 months from march 2013 to august 2014 in Tirunelveli Medical College hospital, Tirunelveli.

The patients were included in the study only if they met the following criterias.

INCLUSION CRITERIA:

- All patients with blunt abdominal trauma
- Cases are included irrespective of age and sex.

EXCLUSION CRITERIA:

- Penetrating abdominal injuries.
- Dead on arrival.

All patients included in the study were subjected to FAST using 3.5 - 12 MHz transducer.

All the cases were critically evaluated and correlated with fast finding and operative findings wherever possible.

EQUIPMENTS:

1) L&T

2) SONORAY

Fig 25 : Sonoray USG machine

Fig 26: Ultrasound Gel

PATIENT PREPARATION:

No specific preparation was given prior to examination as the study was done on emergency basis. Very uncooperative patients (mostly of paediatric age group) were studied after giving mild sedation to patient.

SCANNING TECHNIQUE:

Initially, the patient was asked to lie in supine position. This position is most comfortable for the patient.

Adequate amount of ultrasonography jelly was applied to reduce the air gap between transducer face and skin surface.

Initially, the transducer was placed beneath the xiphisternum in transverse plane, and moved slowly down the abdomen, angling to right and left to complete the survey. This plane shows the following organs.

Pancreas, left lobe of liver, retroperitoneal vessels and retroperitoneal collections.

Sagittal planes of scan were achieved by sweeping the transducer in the sagittal plane slowly from midline to right and to left starting at xiphisternum and ending in both flanks. The probe was alternately angled up and then down to visualize the dome of the diaphragm and more inferiorly placed structures such as the inferior margin of the liver, gall bladder, and pancreas. The transducer was also kept in both flanks to look for free fluid in paracolic gutters.

Subcostal plane of scan on right side was achieved by keeping the transducer subcostally, at a cranial angle of 45 degrees to the body surface. The patient was asked to suspend respiration in deep inspiration (if possible) so that liver was brought down to a more accessible location. The transducer was further angled cranially and caudally, to scan the entire liver. This plane also allowed proper visualization of gall bladder, pericholecystic areas, hepatic veins. This plane was useful for detecting pleural effusion, sub diaphragmatic or sub hepatic fluid collection.

Intercostal views for liver were obtained by keeping the transducer in right 8th, 9th and 10th intercostal spaces on right side and the scan plane being along the intercostal space to allow maximum visualization of liver parenchyma.

The transducer was placed longitudinally in 10th and 11th intercostal spaces in right midaxillary line to identify the hepatorenal recess or Morrison’s pouch which is the commonest dependent site for the fluid collection.

Decubitus (Rt. and Lt) raising alternately the right and left side causes descent of liver and spleen further into the abdomen and allows axial scanning of the kidneys and retroperitoneum. This and the oblique position encourages free fluid into the most dependent position and displaces gas from the mid abdomen.

Spleen was best visualized by keeping the transducer in the left 8th, 9th and 10th intercostal spaces, with scan plane along the intercostal spaces and patient in right decubitus position. This view helps to detect splenic lesion, perisplenic collection and left pleural effusion.

Coronal and axial scan planes were used for evaluation of kidneys which were achieved by placing the probe in patient's right and left flank with the patient in left and right lateral decubitus respectively. While scanning the kidneys in the coronal planes, it was taken into account the fact that the lower poles of the kidneys are more anteriorly placed than the upper pole. The scan planes for kidneys are also helpful for detecting retroperitoneal pathology.

Sagittal and transverse scans of the pelvis were obtained by placing the transducer longitudinally and transversely in the midline just above symphysis pubis. The transducer was angled both cranially, caudally and side ways to delineate the entire pelvic anatomy. The bladder was identified as anechoic structure and the pouch of Douglas was examined for blood collection.

OBSERVATION

AND

RESULTS

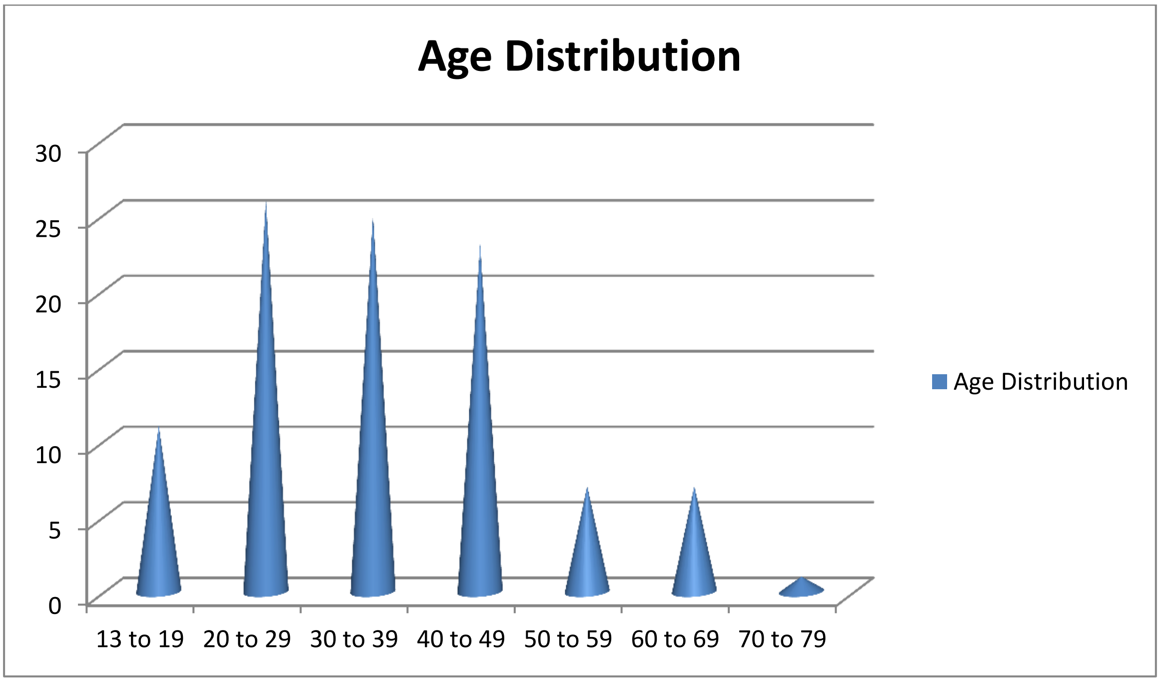
OBSERVATION AND RESULTS

AGE DISTRIBUTION

Table – 1

Age (in years)	Number of Patients	Percentage
13-19	11	11
20-29	26	26
30-39	25	25
40-49	23	23
50-59	7	7
60-69	7	7
70-79	1	1
Total	100	100

Chart – 1

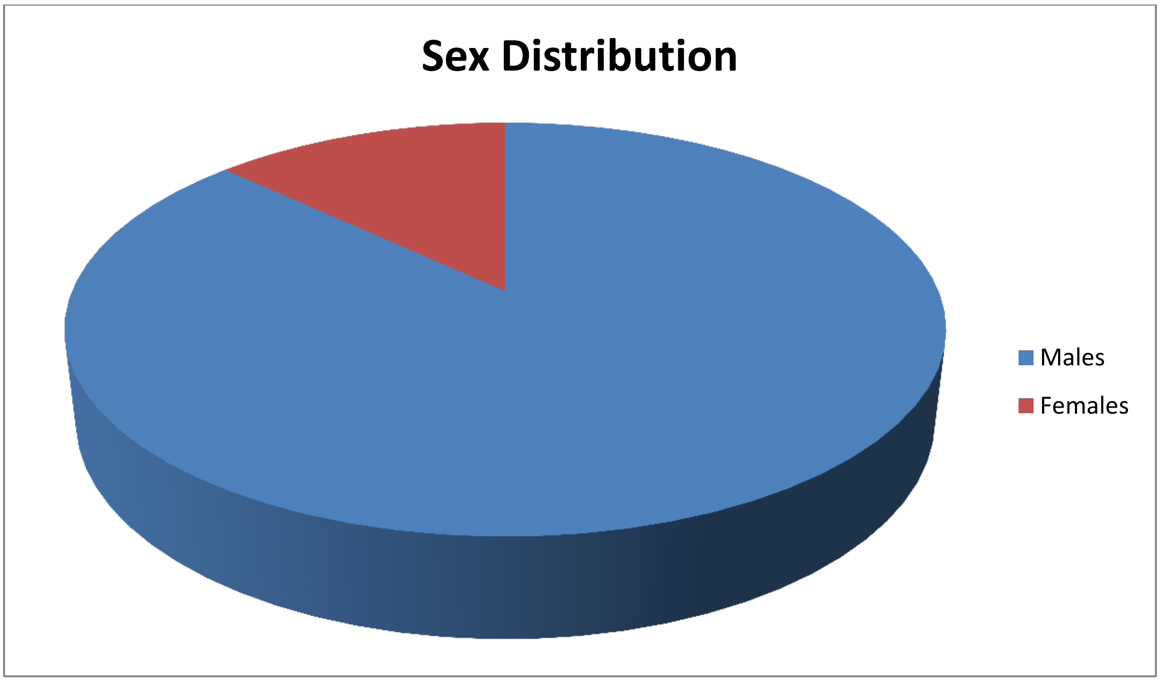


SEX DISTRIBUTION

Table – 2

Sex	Number of Patients	Percentage
Male	87	87
Female	13	13
Total	100	100

Chart – 2

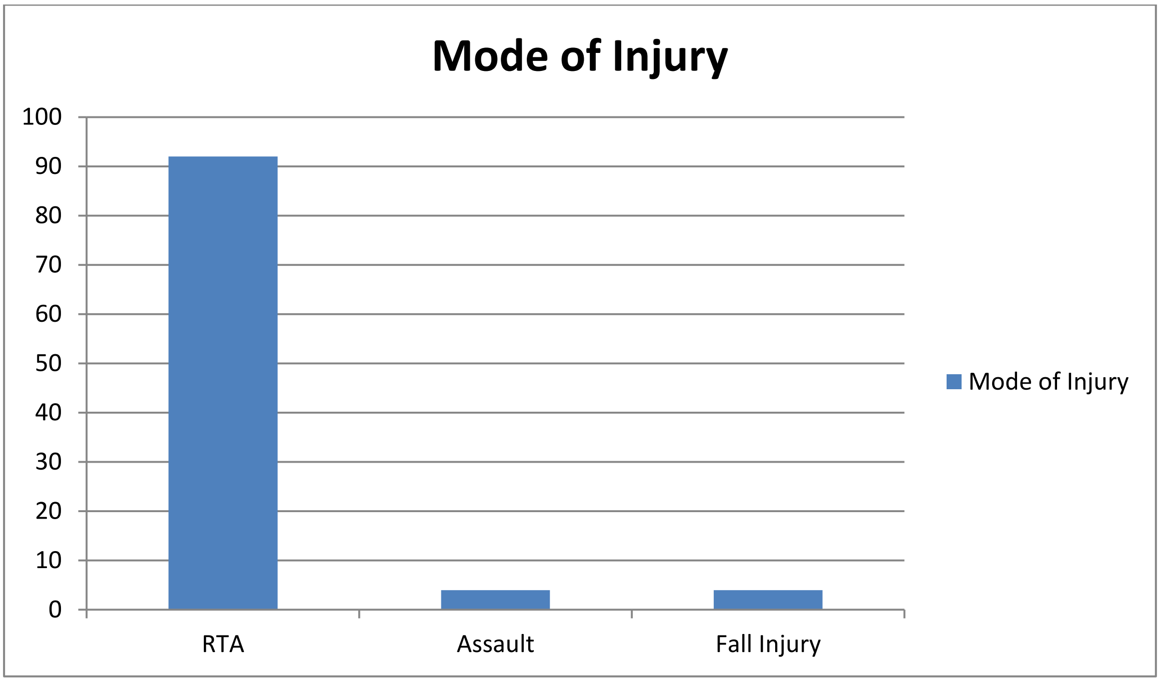


MODE OF INJURY

Table – 3

Mode	Number of patients	Percentage
RTA	92	92
Assault	4	4
Injury due to fall	4	4
Total	100	100

Chart – 3

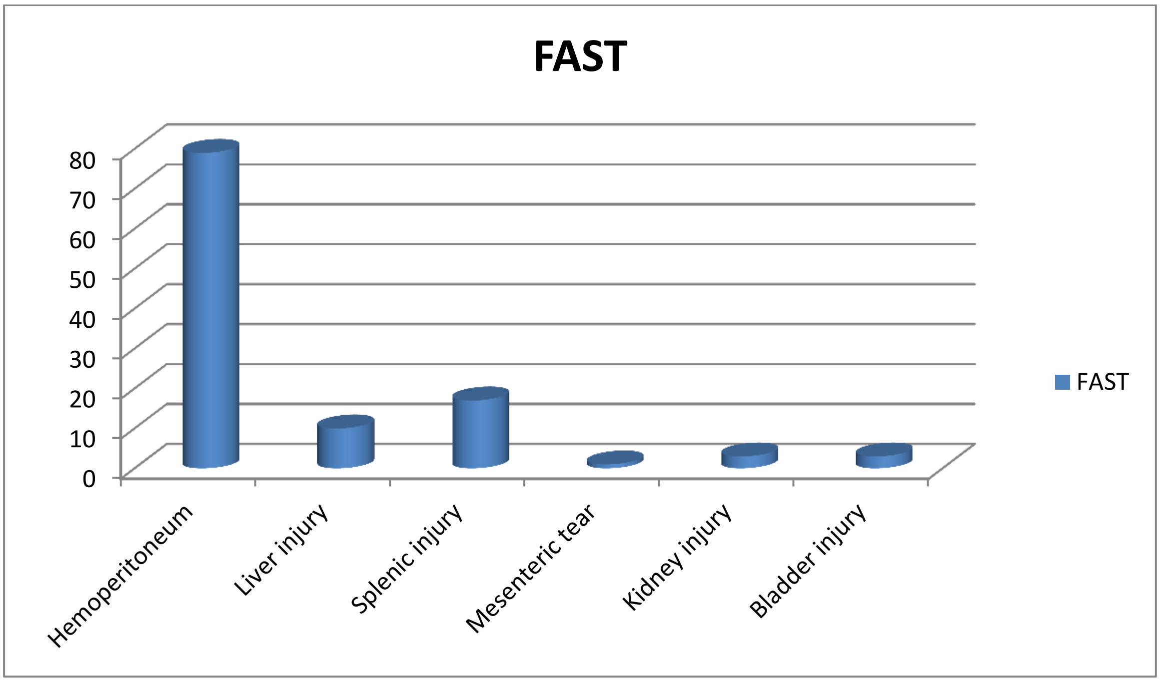


FAST DATA

Table – 4

Injury	Number of Patients	Percentage
Hemoperitoneum	83	83
Liver injury	10	10
Splenic injury	17	17
Mesenteric tear	1	1
Kidney	2	2
Bladder injury	3	3

Chart -4

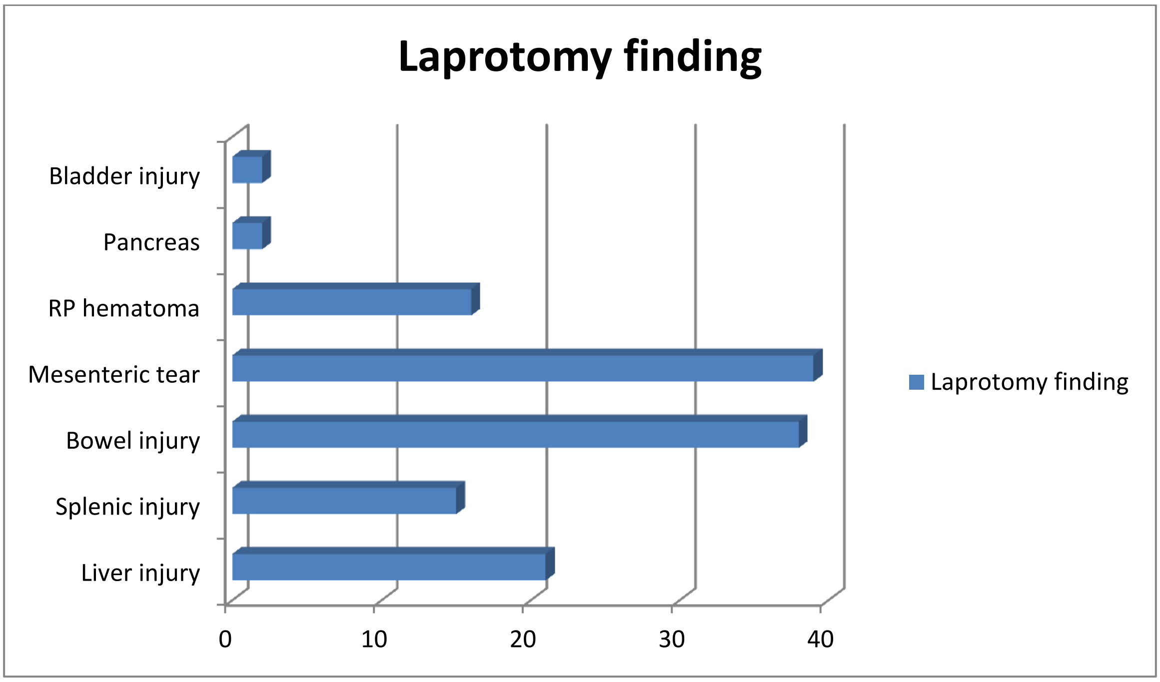


LAPAROTOMY DATA

Table – 5

Finding	Number of Patients	Percentage
Liver injury	15	15
Splenic injury	21	21
Bowel injury	38	38
Mesenteric tear	39	39
RP hematoma	16	16
Pancreas	2	2
Bladder injury	2	2

Chart – 6

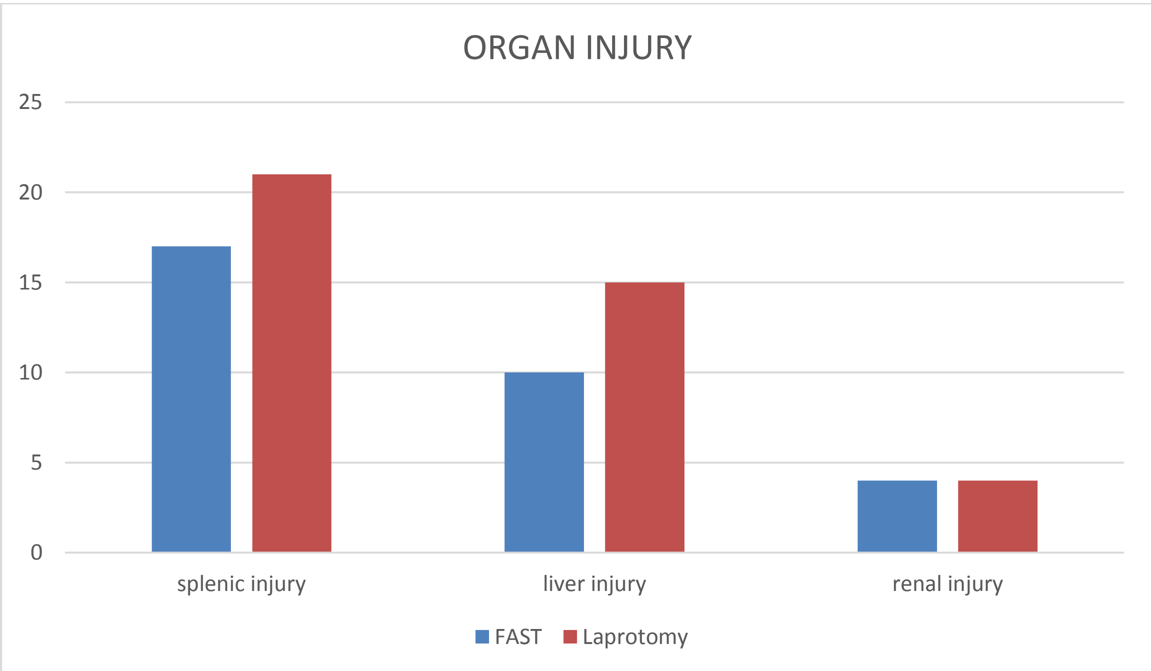


SOLID ORGAN INJURY

Table – 7

FAST Finding	FAST	Laparotomy
Splenic injury	17	21
Liver injury	10	15
Renal injury	4	4

CHART – 7

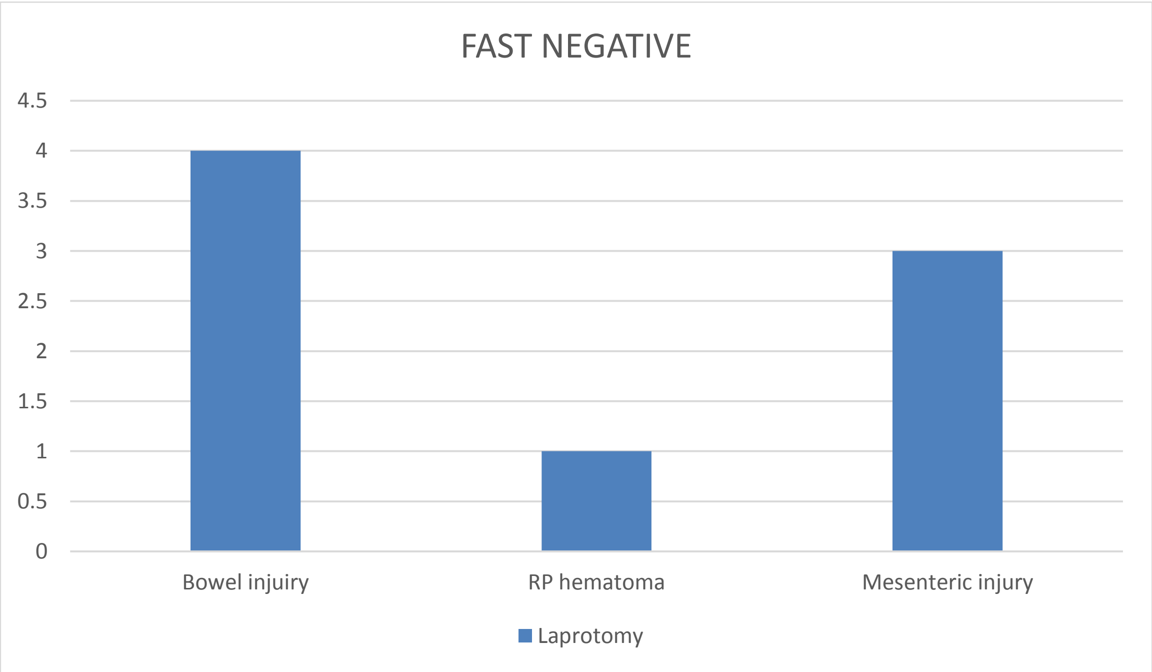


FALSE NEGATIVE

TABLE – 8

Finding	FAST negative	Laparotomy
Bowel injury	0	4
Retro peritoneal Hematoma	0	1
Mesenteric Injury	0	3

CHART – 8

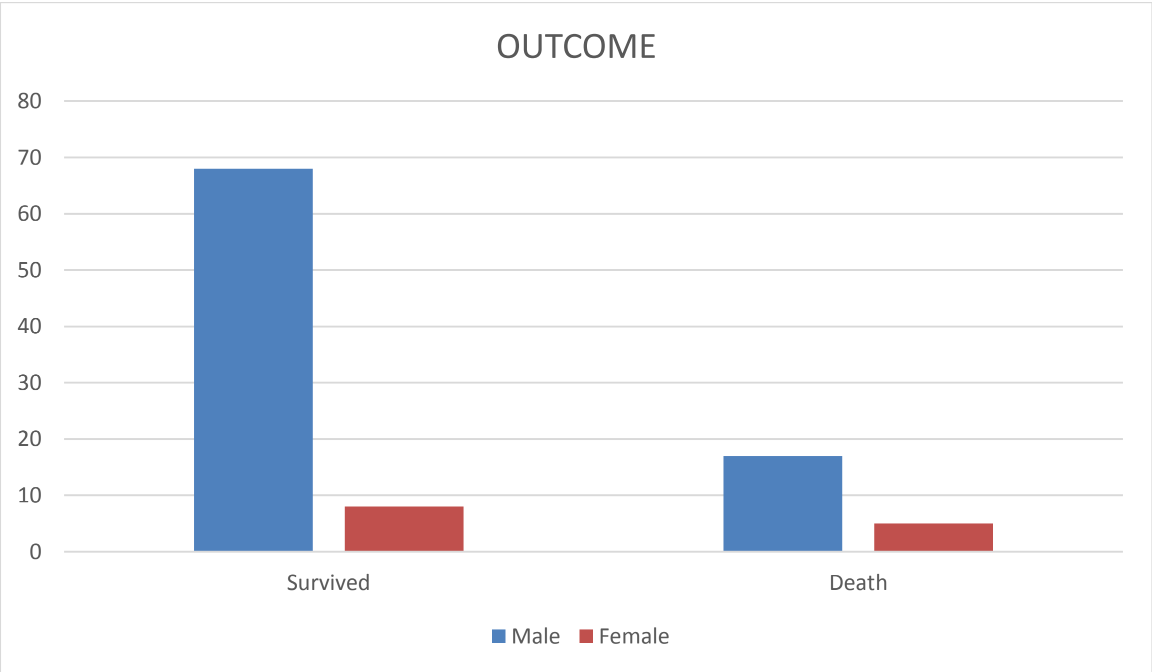


OUTCOME

TABLE – 9

Outcome	Male	Female
Survived	68	8
Death	17	5

CHART – 9



CALCULATIONS:

TEST		LAPAROTOMY (RESULT)		
		+ve	-ve	total
FAST	+ve	80 (a) TP	3(b) FP	83(a+b)
	-ve	8(c) FN	9 (d) TN	17(c+d)
	Total	88(a+c)	12 (b+d)	100

$$\text{Sensitivity} = \frac{\text{True Positive}}{\text{Total Positive}} \times 100$$

$$= \frac{TP}{TP+FN} \times 100$$

$$= \frac{a}{a+c} \times 100$$

= 80/80+8 x 100

=80/88 x100

=90.9 %

$$\text{Specificity} = \frac{\text{True Negative}}{\text{Total Negative}} \times 100$$

$$= \frac{TN}{TN + FP} \times 100$$

$$= \frac{d}{b+d} \times 100$$

= 9/12 x100

= 75 %

Positive Predictive Value = True Positive/ Test Positive x 100

= TP/ TP+FP x100

= a/a+b x100

=80/80 + 3 x100

= 80/83 x 100

= 96.38 %

Negative Predictive Value = True Negative/ Test Negative x 100

= TN/ TN + FN x100

= c/c+d x100

= 9/8+9 x 100

= 9/17 x 100

= 52.94 %

Thus total positive cases detected by FAST are 83 FOR WHICH POSITIVE LAPAROTOMY findings noted in 80 cases(true positive).nil laparotomy finding noted in 3 cases (false positive)

Total FAST negative cases are 17 in which positive laparotomy finding noted in 8 cases (false negative). Nil laparotomy finding in 9 cases (true negative)

Thus out of 100 patients evaluated by FAST, a true positive of 80 and a true negative value of 9 were obtained. Thus giving a sensitivity of 90.9% and a specificity of 75% on FAST

The positive predictive value is 96.38% and a negative predictive value is 53%.

DISCUSSION

DISCUSSION

Blunt abdominal trauma is still a major diagnostic challenge, even to the experienced surgeon. The low sensitivity of clinical examination in detecting intra- abdominal injuries calls for additional diagnostic methods especially in comatose patients with multiple injuries. Timely management is very important because blood loss is time dependent and diagnostic procedures must be quick and accurate and decision making must be prompt and correct. The most important objective in management of the patient with blunt abdominal trauma is to ascertain whether or not a laparotomy is needed and not the diagnosis of the specific organ injury FAST examination is non-invasive, rapid to perform, relatively inexpensive, portable for bed side evaluation in the emergency room, free from radiation and can be repeated at any time without contraindications.

In this series, a total number of 100 cases of blunt abdominal trauma were evaluated by real time sonography.

In our series, out of 100 patients there were 87 male and 13 female patients. Thus an overall male predominance (87%) over female was found. The higher incidence of males could be attributed to rash driving of vehicle, seat belt injury, more outdoor nature of occupation, alcohol addiction and driving, not obeying traffic rules, and involvement in violence in males than compared to females.

In our series, the youngest patient’s age was 14years and the eldest 73 years. A peak incidence of 26% was found in 2nd decade of life and a second peak of

25% was found in the 3rd decade of life. The problem of blunt trauma assumes its importance because it affects the young productive members of the society.

It indirectly affect national growth and development.

In this series, road traffic accident was the commonest cause of the injury. Out of 100 cases, in 92 cases (92 %) vehicular accident was responsible for trauma followed by injury caused due to assault (4%). The reasons for which could be an increase in the population leading to an increase in number of vehicles on the road with poor maintenance of roads and rash, drunken driving and not following traffic rules.

Findings on FAST included hemoperitoneum, solid organ injuries (lacerations, contusions, haematomas, and rupture) and perivisceral collections.

FREE FLUID:

Free fluid was detected in 83 cases. Out of 83 cases with free fluid, Only 80 had significant organ injuries along with fluid in the peritoneal cavity, on laparotomy.

The accuracy of ultrasound in detecting free fluid was 97% in our study. The true sensitivity of sonography revealed in our study because almost all cases were confirmed by laparotomy.

Kimura et al [24] in their study noted that ultrasound findings of hemoperitoneum Should be an integral part for evaluating laparotomy indication in blunt abdominal trauma.

Rothlin et al [38] in their study of 312 patients found the sensitivity of ultrasound for detection of free fluid close to 98%.

Most of splenic and hepatic injuries were associated with free fluid, however, out of 3 patients with renal injuries 1 was associated with free fluid (33%)

SOLID ORGAN INJURIES:

SPLEEN INJURIES:

Spleen was the single most common organ injured in blunt abdominal trauma in the present study.

Spleen was injured in 21 cases (21 %), out of these 17 were detected on FAST (80.9%)

The commonest type detected was splenic rupture (80%) followed by intraparenchymal haematoma (17%). The other injuries present were subcapsular haematoma and laceration.

This correlates well with the study of Reinhard Hoffman et al [25], where splenic rupture was the commonest type of injury (71%) in splenic trauma.

1 case of splenic laceration was missed on US probably due to initial is echogenicity of the splenic injury and also due to presence of excess bowel gas and inability to scan in different planes due to unco-operative patient.

US detected 1 case of splenic haematoma but on laparotomy it was normal.

LIVER INJURIES:

Hepatic injuries noted on laparotomy in 15 patients (15%). Out of these 10 cases were detected on FAST (66.7%).

5 case of hepatic injury was missed on FAST (33%).

4 out of 5 cases detected on US were associated with free fluid. 1 case each of liver laceration and contusion did not show free fluid.

RENAL INJURIES:

In our study 4 patients had renal injuries (4%). Out of these haematoma and perinephric collection was noted in 2 cases each (50%) and 1 case of renal laceration noted. (Renal laceration and perinephric collection was noted together in one case). US detected all cases of renal injuries.

Out of 4 cases one was associated with free fluid. 2 cases of haematomas and one case of renal laceration did not show free fluid.

PANCREATIC INJURIES:

2 cases noted in laparotomy as contusion which not detected by FAST.

HOLLOW VISCUS:

BOWEL AND MESENTERIC INJURIES:

Bowel injury occurred in 38 patient in our study. Free gas under diaphragm was noted on erect abdominal radiography.

It was not diagnosed directly by FAST, however, US revealed free fluid in abdomen.

Mesenteric injury was seen in 39 patient on laparotomy, missed on FAST. But FAST detected free fluid in abdomen which was confirmed by exploratory laparotomy.

2 cases of bladder injury noted in laparotomy which was not detected by FAST but it detected free fluid in abdomen.

16 cases of retroperitoneal haematoma noted on laparotomy not revealed by FAST. But it detected free fluid in abdomen and other solid organ injuries.

None of the patients in the present study had injury to diaphragm, adrenals great vessels.

Thus in our series, commonest visceral injury was spleen (21%), followed by liver (15%) and kidney (4%).

Comparison of our study with other authors

Authors	US detected cases	Spleen injury	Liver injury	Kidney injury
Francois I Luks et al	116	44	08	40
Ming Liu et al	55	16	04	01
Mu Shun Huang et al	49	22	12	00
Rothlin MA et al	52	22	07	10
Akio Kimura et al	21	05	07	06
R. Grussner et al	35	18	13	00
Our study	83	17	10	4

Thus from above, it is concluded that in most of the studies spleen is the most common organ to be injured in BAT and liver or the kidney are the commonest organs involved after spleen

Comparison of sensitivity and specificity, positive and negative predictive value of FAST in blunt abdominal trauma with studies conducted by other group of workers is as follows:

Authors	No. of cases	Sensitivity (%)	Specificity (%)	PPV* (%)	NPV* (%)
Grussner R et al	71	84	86	89	-
Akio Kimura et al	72	86.7	100	-	-
Hoffman R et al	291	89	97	94	95
Frankois Luk et al	259	89	96	-	-

Ming Liu et al	55	91.7	94.7	-	-
Our study	100	90.9	75	96.38	53

*Positive predictive value * NPV - Negative predictive value

Thus from above, it is obvious that our study is comparable with above other studies for sensitivity, specificity and predictive values of FAST in the evaluation of blunt abdominal trauma.

Technical difficulties during US examination also had a role in the evaluation of blunt abdominal trauma. Subcutaneous emphysema, excessive bowel gas or to some extent pneumothorax cause total reflection of sound waves and so underlying organic lesions can be missed. In very fat or obese patients, adequate resolution is not possible and this leads to false positive and false negative results.

Sometimes organic bleeding starts only after successful shock treatment and so can be missed in the initial sonography examination.

Artefacts secondary to improper positioning of transducer or bony structures like ribs are most commonly encountered in the examination of spleen and left kidney and hence alter the diagnosis.

Thus, by considering the above factors, which can lead to false positive and false negative results, our study may differ to some extent with most of the other studies performed, in its sensitivity, specificity and predictive values.

Thus the ability of FAST to accurately detect the presence of free fluid and to pin point the injured organ, helps the SURGEON in contemplating and planning the appropriate therapeutic approach to a patient with suspected blunt abdominal trauma.

SUMMARY

SUMMARY

The detection of an intra-abdominal injury is a frequent diagnostic problem in multiple injured patients. Delay in diagnosis and treatment of abdominal injuries substantially increases morbidity and mortality in trauma patients due to bleeding from solid organ or vascular injury, or infection from perforation of a hollow viscus. Physical examination is often unreliable especially when there is associated head injury, spinal cord injury, or drug ingestion and intra-abdominal injuries may be missed in 16 to 45% of patients.

In recent years FAST has taken quantum leaps in its utility, accuracy and acceptance by the clinical community as it is easy to perform, quick, cost-effective, non-invasive, no ionizing radiation or toxic contrast material is needed and can be repeated as often as required.

US combines the advantages of DPL (Fast and accurate) with those of CT (Non-invasive and accurate).

In our study, out of 100 patients evaluated by FAST, a true positive of 80 and a true negative value of 9 were obtained. Thus giving a sensitivity of 90.9% and a specificity of 75% on US.

The positive predictive value is 96.38% and a negative predictive value is 53%.

Thus the ability of FAST to accurately detect the presence of free fluid and to pin point the injured organ, FAST serve us best screening test in blunt

abdominal trauma and also help us to arrive and plan the appropriate therapeutic approach to a patient with suspected blunt abdominal trauma.

CONCLUSION

CONCLUSION

Thus, a total no of 100 patients with blunt abdominal trauma were evaluated by FAST and true positive findings (haemoperitoneum and organ injury) were detected on laparotomy in 80 patients with a sensitivity 0f 90.9%. True negative finding noted on laparotomy in 9 patients with a specificity of 75% that ultrasonography is very useful and highly reliable screening modality in such cases. It is not only cheap and non-invasive but also rapid to perform, portable for bed side evaluation in the emergency room, without any radiation to patient, requires no administration of contrast medium and can be repeated at any time without contraindication.

The overall sensitivity of ultrasonography in the evaluation of blunt abdominal trauma was 90.9% and specificity was 75%.

Intraperitoneal free fluid collection was the commonest abnormality detected. The sensitivity of real time ultrasonography was 90.9% in our study because not all cases were confirmed by CT or laparotomy.

Amongst the visceral injuries, spleen, liver, kidney were the most common abdominal organs injured with incidence of 17%, 10% and 4% respectively. The percentage of false positive in our study was 3% and the percentage of false negative was 8%. But as compared to the sensitivity (90.9%) and specificity (75%), this percentage is negligible.

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ANNEXURE

PROFORMA

NAME : IP NO :

AGE/SEX : WARD :

DOA: HOSPITAL:

DOD:

ADDRESS:

CHIEF COMPLAINTS:

MODE OF INJURY: RTA / ASSAULT / FALL / OTHERS -------------------

CONDITION OF PATIENT AT THE TIME OF INJURY:

HISTORY OF PRESENTING SYMPTOMS

PAST HISTORY

GENERAL EXAMINATION: PULSE - BP - RR -

CLINICAL EXAMINATION: ABDOMEN

INSPECTION:

SWELLING

SKIN

MOVEMENTS

PALPATION:

TENDERNESS/ RIGIDITY/GUARDING

MASS

ORGANOMEGALY

SURGICAL EMPHYSEMA

PERCUSSION:

SHIFTING DULLNESS

FLUID THRILL

SPLENIC DULLNESS

LIVER DULLNESS

RENAL ANGLE

AUSCULTATION:

BOWEL SOUNDS

OTHERS: GENITALIA, SPINE, PELVIS, RIBS, PER RECTAL

SYSTEMIC EXAMINATION:

RS / CVS / CNS

ROUTINE INVESTIGATION:

HB- TC- DC- S.AMYLASE- BL.GROUP

URINE – ALB / MICRO

RADIOLOGICAL INVESTIGATION:

CHEST X-RAY:

ABDOMEN:

ERECT ABDOMEN, SUPINE ABDOMEN, LAT DECUBITUS

CONTRAST STUDIES:

ULTRASOUND:

CT SCAN:

CLINICAL DIAGNOSIS:

ORGAN OF INJURY: SPLEEN / LIVER / KIDNEY / PANCREAS / DIAPHRAGM / SMALL BOWEL

TREATMENT GIVEN:

CONSERVATIVE:

OPERATIVE PROCEDURE:

OPERATIVE FINDINGS:

POST OPERATIVE RESPONSE OR RECOVERY:

FOLLOWUP:

CAUSE OF DEATH:

MASTER CHART

S.NO	NAME	AGE	SEX	IP NO.	DOA	MODE OF INJURY	FAST			LAPAROTOMY FINDINGS						OUTCOME
							Hemoperitoneum or free fluid	Solid Organ Injury	Others	Liver Injury	Splenic Injury	Bowel Injury	Bladder Injury	Mesenteric Injury	Others	
1	AMMATHAMMAL	65	F	48157	29/09/14	RTA	+	-	-	-	-	jejunum	-	-	-	DISCHARGED
2	SALAMAN RAJ	34	M	46286	20/08/14	RTA	+	-	-	-	-	ileum	-	-	-	DISCHARGED
3	RAJENDRAN	61	M	46142	19/08/14	RTA	+	-	-	-	-	ileum	-	-	-	DISCHARGED
4	SIVAM	43	M	46089	19/08/14	RTA	-	-	-	-	-	ileum, jejunum	-	-	-	DISCHARGED
5	SARAVANAKUMAR	32	M	45274	15/08/14	RTA	+	-	-	-	-	-	-	+	-	DISCHARGED
6	HAKKIM	25	M	44702	12-08-14	RTA	+	-	-	-	-	-	+	-	RP hematoma	DISCHARGED
7	MOOKAMMAL	43	F	43344	05-08-14	ASSAULT	+	+(SPLEEN)	-	-	+	-	-	-	-	DISCHARGED
8	KARUPPASAMY	26	M	42563	01-08-14	RTA	+	-	-	+	-	-	-	-	-	DISCHARGED
9	MURUGAN	43	M	41797	29/7/4	RTA	+	+(SPLEEN)	-	-	+	-	-	-	-	DISCHARGED
10	CHINNARAJ	30	M	41063	24/7/14	RTA	+	-	-	-	-	-	-	+	-	DISCHARGED
11	LAKSHMI	55	F	40072	20/07/14	RTA	-	-	-	-	-	-	-	-	-	DISCHARGED
12	NAMBIRAJAN	14	M	39589	17/07/14	RTA	+	-	-	-	-	-	-	-	-	DISCHARGED
13	ESAKKIRAGURAM	15	M	38145	11-07-14	RTA	+	-	mesentry	-	-	jejunum	-	-	-	DISCHARGED
14	VOORKATHAN	25	M	37181	06-07-14	RTA	+	-	-	-	-	-	-	+	-	DISCHARGED
15	KALIRAJ	31	M	37118	05-07-14	ASSAULT	+	-	-	-	-	-	-	+	-	DISCHARGED
16	SEKAR PANDI	19	M	36142	01-07-14	RTA	+	-	pleural effusion	-	-	colon	-	-	-	DISCHARGED
17	NARAYANAN	32	M	35778	29/06/14	RTA	-	-	-	-	-	-	-	-	-	DISCHARGED
18	MARIAMMAL	31	F	34201	22/06/14	RTA	+	-	-	-	-	transverse colon	-	+	-	DEATH
19	AVUDAIAPANDI	40	M	33859	20/06/14	RTA	+	-	-	-	-	jejunum	-	+	RP hematoma	DEATH
20	BACKIYARAJ	26	M	33395	18/06/14	RTA	+	-	-	-	-	jejunum	-	+	-	DISCHARGED
21	ESAKKIMUTHU	50	M	32584	15/6/2014	RTA	+	-	-	-	-	-	-	+	RP hematoma	DEATH
22	PETCHIMUTHU	17	M	30778	06-06-14	RTA	+	-	-	+	-	-	-	-	-	DISCHARGED
23	PITCHAMUTHU	21	M	25902	14/5/2014	FALL INJURY	+	-	-	-	-	-	-	-	-	DISCHARGED
24	DAVID RAJKUMAR	37	M	25154	11-05-14	RTA	+	+(SPLEEN)	-	-	+	-	-	-	-	DISCHARGED
25	SENTHIL	28	M	23072	30/04/14	RTA	+	-	-	-	-	ileum	-	-	-	DISCHARGED
26	MAHADEVAN	46	M	20582	17/04/14	RTA	+	+ (LIVER)	-	+	-	-	-	-	-	DEATH
27	MALIK MOHAMMED	25	M	20175	15/04/14	RTA	+	+(LIVER)	-	+	-	-	-	-	-	DISCHARGED
28	ALAGIYANAMBI	31	M	19938	15/4/2014	RTA	+	-	-	-	-	ileum, colon	-	-	-	DISCHARGED
29	PANDIYAMMAL	32	F	17857	03-04-14	RTA	+	-	pleutal effusion	-	-	-	-	+	stomach	DEATH
30	SURESH	30	M	17073	30/03/14	RTA	+	-	-	-	-	jejunum	-	-	-	DISCHARGED
31	SAKTHIVEL	27	M	16770	29/3/14	FALL INJURY	+	+(SPLEEN)	-	+	+	-	-	-	-	DISCHARGED
32	RAJA	26	M	12895	11-03-14	RTA	+	-	-	-	-	jejunum,ileum	-	-	-	DISCHARGED
33	VELPANDI	21	M	12480	08-03-14	RTA	+	+(LIVER)	-	+	-	-	-	-	-	DISCHARGED
34	RAJAN	40	M	12093	05-03-14	RTA	+	-	-	-	-	jejunum	-	+	-	DISCHARGED
35	AMARNATH	18	M	9962	25/2/14	RTA	-	-	-	-	-	-	-	-	-	DISCHARGED
36	PITCHIYA	45	M	8936	18/2/14	RTA	-	-	dilated bowel	-	-	sigmoid colon	-	+	-	DEATH
37	VEERAPANDI	47	M	8530	16/2/14	RTA	-	-	-	-	-	-	-	-	-	DISCHARGED
38	SONU	17	M	8002	13/02/14	RTA	+	+(spleen)	-	-	+	-	-	-	-	DISCHARGED
39	KARUPPASAMY	30	M	7863	13/2/14	RTA	+	-	-	-	-	duodenum	-	+	-	DISCHARGED
40	NAMBIAMMAL	50	F	7683	11-02-14	RTA	-	-	-	-	-	-	-	-	-	DISCHARGED
41	CHANTHRU	24	M	5566	31/1/14	RTA	+	+(SPLEEN)	-	-	+	-	-	-	-	DISCHARGED
42	CHELLAYANDI	30	M	5342	30/1/14	RTA	+	+(LIVER)	-	+	-	-	-	-	-	DISCHARGED
43	VASU	32	M	4302	24/1/14	RTA	+	+(SPLEEN)	-	-	-	-	-	+	omentum	DEATH
44	NAGARAJ	26	M	2503	16/01/14	RTA	+	+(SPLEEN)	-	-	+	-	-	-	-	DISCHARGED
45	MANIKANDAN	28	M	757	05-01-14	RTA	+	-	-	+	-	-	-	+	RP hematoma	DEATH
46	LATHA	42	F	295	02-01-14	RTA	+	-	-	-	-	-	-	+	-	DISCHARGED
47	RAMAMOORTHY	67	M	74922	25/12/13	RTA	-	-	-	-	-	-	-	-	-	DISCHARGED
48	PERATCHISELVI	32	F	74528	24/12/13	ASSAULT	-	-	-	-	-	-	-	-	-	DISCHARGED
49	RAJAMMAL	45	F	73081	16/12/13	RTA	-	+(SPLEEN)	-	-	-	-	-	-	-	DISCHARGED
50	ESAKKIMUTHU	29	M	73033	12-12-13	RTA	-	-	-	-	-	-	-	-	RP hematoma	DISCHARGED
51	SUDALAI	45	M	68452	24/11/13	RTA	-	-	-	-	-	gastric	-	-	-	DISCHARGED
52	MUTHUSMY	54	M	67035	17/11/13	RTA	+	-	-	-	-	jejunum,colon	-	-	-	DEATH
53	ANTONY GEORGE	29	M	64526	05/11/13	RTA	+	-	-	+	-	-	-	-	-	DISCHARGED
54	MUTHIAH	58	M	64381	05-11-13	RTA	+	-	-	-	-	ileum	-	-	-	DISCHARGED
55	KATTURAJA	20	M	64290	04-11-13	RTA	+	+(SPLEEN)	-	-	+	-	-	-	-	DISCHARGED
56	DHAMODARAN	35	M	63520	31/10/13	RTA	+	+(SPLEEN)	-	-	+	-	-	-	-	DISCHARGED
57	CHINNASAMY	42	M	63469	30/10/13	RTA	+	-	-	-	-	colon	-	+	-	DISCHARGED
58	VELRAJA	23	M	61383	22/10/13	RTA	+	+(SPLEEN)	-	+	+	caecum	-	-	-	DISCHARGED
59	CHANDRU	18	M	61950	22/10/13	RTA	-	-	-	-	-	-	-	+	-	DISCHARGED
60	ANTONY RAJ	45	M	61272	19/10/13	RTA	+	-	-	-	-	colon	-	+	RP hematoma	DEATH
61	VANARAJ	32	M	60190	13/10/13	RTA	+	-	-	-	-	ileum,caecum	-	-	-	DISCHARGED
62	MAHARAJAN	28	M	58678	05-10-13	RTA	-	-	-	-	-	-	-	-	-	DISCHARGED
63	BAHAVAN	18	M	55565	19/9/13	RTA	-	-	-	-	-	-	-	+	-	DISCHARGED
64	ARUMUGAM	42	M	54997	17/9/13	RTA	+	-	-	-	-	jejunum	-	-	-	DISCHARGED
65	RAMACHANDRAN	60	M	53647	10-09-13	RTA	+	-	-	-	-	-	-	+	-	DISCHARGED
66	MOSES	28	M	53678	10-09-13	RTA	+	-	-	+	-	-	-	+	-	DISCHARGED
67	JEYASHANKAR	40	M	53314	07-09-13	RTA	+	-	-	-	-	ileum ,sigmoid	-	+	RPhematoma	DEATH
68	SUNDARACHIAMMAL	65	F	51380	28/8/13	RTA	+	-	-	-	-	-	-	+	RPhematoma	DEATH
69	VELMUTHU	17	M	47039	05-08-13	RTA	+	-	-	-	-	jejunum	-	+	-	DISCHARGED
70	MAHENDRAN	18	M	45410	28/7/13	RTA	+	-	-	-	-	jejunum	-	+	-	DISCHARGED
71	KARTHIK	24	M	44844	25/7/13	RTA	-	+(LIVER)	-	+	-	-	-	-	-	DISCHARGED
72	PETCHIAMMAL	42	F	43365	18/7/13	FALL INJURY	+	+(SPLEEN)	-	-	+	-	-	-	-	DEATH
73	MARIAPPAN	41	M	42636	14/7/13	RTA	+	-	-	-	-	COLON	-	-	-	DISCHARGED
74	SANKAR	50	M	42310	12-07-13	RTA	+	-	-	+	-	-	-	+	-	DISCHARGED
75	KALIMUTHU	45	M	41198	07-07-13	RTA	+	-	-	-	-	-	-	+	RPhematoma	DEATH
76	KAMAL BATCHA	48	M	39622	29/6/13	RTA	+	-	-	-	-	-	-	+	RPhematoma	DEATH
77	PANDI	63	M	37842	20/6/13	ASSAULT	-	-	-	-	-	-	-	-	omentum	DISCHARGED
78	SANKAR	44	M	36786	15/6/13	RTA	+	+(LIVER)	-	-	-	ileum ,sigmoid	-	+	-	DEATH
79	MURUGAN	40	M	34641	05-06-13	RTA	+	+(LIVER)	-	+	-	-	-	-	-	DISCHARGED
80	IYYADURAI	23	M	33437	31/5/13	RTA	+	+(LIVER)	-	+	-	-	-	-	-	DISCHARGED
81	SURESH	32	M	33205	29/5/13	RTA	-	-	-	-	-	-	-	+	-	DISCHARGED
82	DAYANIDHI	32	M	33196	29/5/13	RTA	+	-	-	+	-	-	-	-	gastric	DISCHARGED
83	SHANMUGAIAH	38	M	32712	27/5/13	RTA	-	-	-	-	-	-	-	-	-	DISCHARGED
84	VELLASAMY	73	M	31622	23/5/13	RTA	+	-	-	-	-	ileum	-	+	-	DISCHARGED
85	ARIYANAYAGAM	25	M	28605	09-05-13	RTA	+	-	-	-	-	jejunum	-	+	-	DISCHARGED
86	MAHESHWARI	36	F	28957	09-05-13	RTA	+	-	-	-	-	ileum	-	+	RPhematoma	DEATH
87	SELVAM	23	M	26109	01-05-13	RTA	+	-	-	-	-	-	+	-	-	DEATH
88	ALAGESAN	67	M	25949	28/4/13	RTA	-	+(LIVER)	-	+	-	-	-	-	-	DISCHARGED
89	MANIKARAJ	32	M	24713	22/4/13	RTA	-	-	-	-	-	ileum	-	+	RPhematoma	DISCHARGED
90	ALAGULINGAM	38	M	24467	21/4/13	RTA	+	-	-	-	-	-	-	+	RPhematoma	DEATH
91	ARASUKUMAR	40	M	24415	21/4/13	RTA	+	-	-	+	-	-	-	-	gastric	DISCHARGED
92	VIJAYAKUMAR	24	M	22663	15/4/13	RTA	+	+(LIVER)	pluera Effusion	+	-	asc. Colon	-	-	-	DISCHARGED
93	RAVI	23	M	19860	31/3/13	RTA	+	-	-	+	-	-	-	+	-	DEATH
94	MADASAMY	40	M	15135	11-03-13	RTA	+	-	-	-	-	-	-	+	hematoma,pancr	DEATH
95	RAMALAKSHMI	21	F	13944	05-03-13	FALL INJURY	+	+(SPLEEN)	-	-	+	-	-	-	-	DISCHARGED
96	VISAR	22	M	13077	05-03-13	RTA	+	-	-	+	-	-	-	+	RPhematoma	DEATH
97	MUTHIAH	53	M	8783	12-02-13	RTA	-	+(SPLEEN)	-	-	+	-	-	-	kidney	DISCHARGED
98	BALAMURUGAN	36	M	8755	10-02-13	RTA	+	+(SPLEEN)	-	-	+	-	-	-	pancreas	DISCHARGED
99	MADASAMY	37	M	8255	07-02-13	RTA	+	+(SPLEEN)	-	-	+	-	-	-	-	DEATH
100	MARIMUTHU	34	M	8002	06-02-13	RTA	+	-	-	-	-	jejunum	-	+	RPhematoma	DEATH

KEY TO MASTER CHART

Sl. No. - Serial Number

IP No. - Inpatient number

DOA – Date of Admission

M - Male

F - Female

RTA - Road traffic accident

FAST – Focussed Abdominal Sonography for Trauma

RP Hematoma – Retroperitoneal Hematoma

(+) – Present

(-) – Absent