RESEARCH ARTICLE

Role of Fast in Blunt Trauma Abdomen: A Promising Diagnostic Tool to Evaluate Management in Patients and Comparison of its Accuracy with CT and Laparotomy

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Received: 02nd February, 2024; Revised: 18th April, 2024; Accepted: 20th May, 2024; Available Online: 25th June, 2024

ABSTRACT

The article discusses about the role of FAST in patients with isolated blunt trauma abdomen (exclusive of Head Injury, Chest Injury, Limb Injury) and it's comparison with CT and laparotomy. We've included two groups of patients, one with stable vitals and other with unstable vitals, both undergoing FAST scans. CT was done only on stable patients. Deteriorating patients were managed by exploratory laparotomy/diagnostic laparotomy. In unstable patients CT was not done. Results were compared for the accuracy and reliability of FAST with CT & laparotomy.

Results were quick and reliable for FAST scans proving that it could be used safely within a short span of time to help confirm the diagnosis and management of patients undergoing blunt trauma abdomen.

Keywords: FAST, Laparotomy, CT, Blunt trauma abdomen.

Journal of Surgery Archives (2024);

How to cite this article: Yadav GD, Shukla P, Raj S, Tiwari A, Tiwari AK. Role of Fast in Blunt Trauma Abdomen: A Promising Diagnostic Tool to Evaluate Management in Patients and Comparison of its Accuracy with CT and Laparotomy. Journal of Surgery Archives. 2024;2(1):11-17.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

The abdomen can be injured in many types of trauma, injury may be confined to the abdomen or be accompanied by severe, multisystem trauma. The nature and severity of abdominal injuries vary widely depending on the mechanism and forces involved, thus generalizations about mortality and need for operative repair tend to be misleading.

Injuries are often categorized by type of structure that is damaged:

- Abdominal wall
- Solid organ (liver, spleen, pancreas, kidneys)
- Hollow viscus (stomach, small intestine, colon, ureters, bladder)
- Vasculature

Some specific injuries due to abdominal trauma are discussed elsewhere, including those to the liver, spleen, and genitourinary tract.

Blunt Trauma

The most common cause of blunt trauma is vehicular motor injuries. These are related to several key factors -

- Mass and speed of the vehicle at the moment of impact.
- Whether the occupants of the vehicle were restrained.
- Whether the occupant was ejected.
- The interaction of the occupants or pedestrians with vehicle.

Speed is a critical factor. A 10% increase in impact speed translates into a 40% rise in the case fatality risk for both restraints and unrestrained occupants. Ejection from the vehicle is associated with a significantly greater incidence of severe injury. The use of seatbelts and airbags is thought to reduce the risk of death or serious injury for front-seat occupants by approximately 45%. Unbelted rear seat occupants are also at increased risk of serious injuries.

Blunt abdominal trauma poses a major challenge in polytrauma patients due to the widespread injury and the delicate intra-abdominal structures. The presentation may vary from slight abdominal pain and vomiting to sudden collapse and death.

Blunt abdominal trauma may include solid or hollow viscera as well as vascular and excretory structures; accordingly, the presentation and management vary.

The early assessment of intra-abdominal injuries from blunt trauma is difficult and often inaccurate. Some patients with serious injuries initially appear unharmed, while patients with no visceral injuries may have marked abdominal signs and symptoms.

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Trauma to the abdomen is most often severe and generally associated with injuries to other parts of the body, such as the head, chest, and fractures of the limbs. It may be complicated by alcoholism, epilepsy, shock or unconsciousness, making the diagnosis more difficult.

The appropriate management of blunt trauma abdomen depends on careful initial evaluation, the timely use of diagnostic procedures and vigorous therapy directed at immediate life-threatening problems.

Routine lab workup and plain X-rays are not of much help. Two types of viscera involved in abdominal trauma are:

- Hollow viscus intestine, urinary bladder, gall bladder etc.
- Solid viscus Spleen, liver, kidney, etc.

The most common hollow viscus in abdominal trauma is the intestine because of its large length, complexity, and mobility. Most common solid viscus injury is splenic injury followed by liver injury.

Early investigation and rapid diagnosis results in decreased morbidity and mortality of the patients. Of the various modalities available at present, focused assessment with sonography in blunt abdominal trauma (FAST) is a rapid, non-invasive test for quick diagnosis of free intraabdominal fluid.

Focused Assessment with Sonography for Trauma

The focused abdominal sonogram in trauma is focused, goal directed, sonographic examination of the abdomen aimed at detecting the presence or absence of hemoperitoneum. It provides a viable alternative to other investigations in blunt abdominal trauma patients. It can be integrated into the primary survey in patients with signs of hemorrhagic shock or suspicion of intra-abdominal injury. It has the additional advantages of being non-invasive, reproducible and is capable of being rapidly performed. Indeed, the FAST scan is often regarded as being a simple extension of clinical examination rather than a definitive diagnostic investigation. A standard 4 view examination can be completed in approximately 2 minutes.

Focused Assessment with Sonography for Trauma (FAST) is a limited ultrasound examination directed solely to identify free intraperitoneal or pericardial fluid. In the context of traumatic injury, free fluid is usually due to hemorrhage and contributes to the assessment of the circulation.

Performed in the trauma room by properly trained and credentialed staff, it allows the timely diagnosis of potentially life-threatening hemorrhage and is a decision-making tool to help determine the need for transfer to the operating room, CT scanner, or angiography suite.

The FAST scan is a 4 view scan reliant on detecting the presence of fluid within the pericardium and most dependent zones of the peritoneum in the horizontal patient. It is capable of detecting more than 100–250 mL of free fluid. CT scanning, in comparison, can detect more than 100 ml of free fluid in the abdominal cavity. As a "rule of thumb", a rim of 0.5 cm of fluid in Morison's pouch represents approximately 500 mL of free fluid, and a 1-cm rim represents approximately 1000 mL.

FAST examines four areas for free fluid:

- Perihepatic and hepato renal space
- Perisplenic
- Pelvis
- Pericardium

FAST is indicated in the patient who has sustained blunt abdominal trauma who may or may not be hemodynamically unstable. The FAST examination is directed purely at detecting free intraperitoneal fluid or the presence of cardiac tamponade.

Hemodynamic instability and free intraperitoneal fluid mandate a laparotomy for intraabdominal hemorrhage. In the presence of hemorrhagic shock but a negative FAST examination, other sites of hemorrhage must be sought and controlled. Serial FAST examinations may be required. Thoracic hemorrhage may require a thoracotomy, pelvic hemorrhage angiographic embolization. Retroperitoneal hemorrhage from vascular injury remains a possibility with a negative FAST.

Non-hemorrhagic shock is also a possibility. FAST can detect a pericardial collection causing cardiac tamponade, but profound hypoxia, tension pneumothorax and blunt myocardial injury must also be excluded.

Computed Tomography

The contrast-enhanced CT scan is a non-invasive procedure. It has become the gold standard radiographic modality in evaluating blunt abdominal trauma patients. CT scanners are available now in most trauma centers. With the advent of helical CT scans, scan time has become significantly shorter. CT scan is indicated in blunt abdominal trauma in hemodynamically stable patients with equivocal findings on physical examination, neurological injury or impaired sensorium due to drugs or alcohol, multiple extra-abdominal injuries, and when the mechanism of injury is suggestive of duodenal or pancreatic injury . CT scan is contraindicated in a blunt abdominal trauma patient with clear indication of laparotomy and in a hemodynamically unstable patient.

CT scan has a high accuracy reaching about 95%. It has a very high negative predictive value reaching almost 100%. Despite that, patients with suspected abdominal injury should be admitted for at least 24 hours in the hospital for observation even with a negative CT scan result. CT provides a detailed image of injuries. Finding free intraperitoneal air or rupture diaphragm are definite indications for laparotomy.

Helical CT with contrast enhancement can detect arterial extravasations (contrast blush) in blunt abdominal trauma patients. This can be used to localize the anatomical sites of injury and to guide angiographic or surgical intervention. Follow up CT scan is useful to help make clinical decisions when adopting a conservative approach. It allows adequate assessment of retroperitoneal structures. This is a major advantage over the other modalities.

Furthermore, it allows the assessment of blood perfusion of different organs. Helical CT scan sagittal and coronal reconstruction images are useful for detecting ruptured diaphragm. Moreover, it seems to improve the diagnosis of gastrointestinal injuries.

Nevertheless, CT scanning has certain limitations. It needs a specialized technician to perform it and a radiologist to read it. Although very sensitive in detecting solid organ injuries, CT scan may miss mesenteric tears, bowel injury especially small tears, diaphragmatic rupture if coronal and sagittal reconstruction was not made, and pancreatic injury if done early after trauma. A large multi-institutional study has shown that 13% of patients with perforated small bowel injuries had a normal CT scan preoperatively. Intravenous and oral contrast has the hazards of aspiration, delay in diagnosis when oral contrast is used, and allergic reaction with the use of intravenous contrast. The presence of free intraperitoneal fluid in blunt abdominal trauma in the absence of a detectable solid organ injury creates a clinical dilemma. There is a probability of 25% of missing bowel lesions. DPL is advised in that situation if a conservative approach is advocated.

MATERIALS AND METHODS

This was a prospective observational study. Total of 60 patients who sustained blunt abdominal trauma and were admitted to L.L.R. Hospital underwent this study during a period between January 2021 to Aug. 2022.

Inclusion Criteria

- All the cases of blunt trauma abdomen exclusive of other causes related to any mode of trauma.
- Age: 7–80 years

Exclusion Criteria

- Cases of chest injury, head injury, limb injury with blunt trauma abdomen.

FAST is a goal-directed sonographic examination of the abdomen aimed at detecting the presence or absence of free intraperitoneal fluid. It provides a valuable alternative to other investigations in the blunt abdominal trauma patient and can be integrated into the primary survey in the patients with signs of hemorrhagic shock or suspicion of intra-abdominal injury. It has the additional advantage of being non-invasive, reproducible and is capable of being rapidly performed. A standard 4 view examination can be completed in approximately 2 minutes.

A four-view fast scan was performed at the end of the primary or secondary survey (depending on the clinical stability) in all patients alleged to have sustained blunt abdominal trauma and were admitted to the emergency department of L.L.R. & Associated hospitals, Kanpur.

VERBAL or written consent was taken from the patient, if possible.

The fast scan was performed by color doppler Siemens Sonoline G-50 machine using either 2-5 MHz convex transducers or 5–10 MHz linear transducer department of Radiology L.L.R. Hospital, Kanpur at

FAST examines four areas for free fluid:

- Perihepatic and hepato-renal space,
- Perisplenic,
- Pelvis
- Pericardium

Perihepatic Scanning

The hepatorenal space (pouch of Rutherford - Morison) is the most dependent part of the upper peritoneal cavity and small amounts of intra-peritoneal fluid may collect in this region first. Blood shows as a hypoechoic black stripe between the capsule liver and the fatty fascia of the kidney.

The probe is placed in the right mid to posterior axillary line at the level of the 11^{th} and 12^{th} ribs.

Perisplenic Scanning

The left upper quadrant examination visualizes the spleen and peri splenic areas. The transducer is placed on the left. Posterior axillary line region between the 10^{th} and 11^{th} ribs.

Pelvic Scanning

The pelvic examination visualizes the cul-de-sac: the Pouch of Douglas in females and the rectovesical pouch in male. It is

Figure 1: FAST Scanning Technique

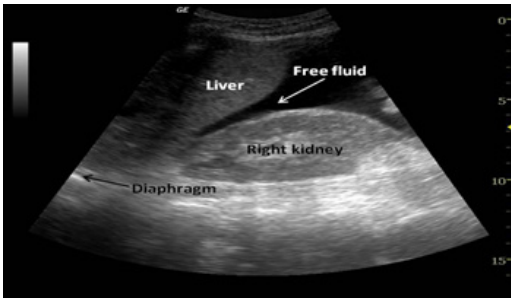


Figure 2: A positive FAST Scan demonstrating free fluid in Morrison's Pouch on FAST scanning

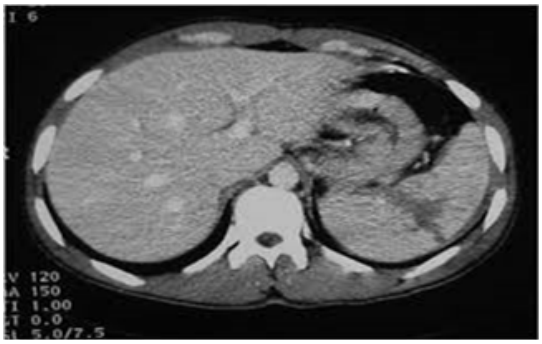


Figure 3: CECT Whole abdomen showing Spleen Tear

Table 1: Observations

Age	*No. of Cases*	*Male*	*Female*
<10 Yrs	5	5	0
11–20 Yrs	11	9	2
21–30 Yrs	13	11	2
31–40 Yrs	14	11	3
41–50 Yrs	10	10	0
51–60 Yrs	0	0	0
61–70 Yrs	4	3	1
71–80 Yrs	3	2	1
Total	60	51	9

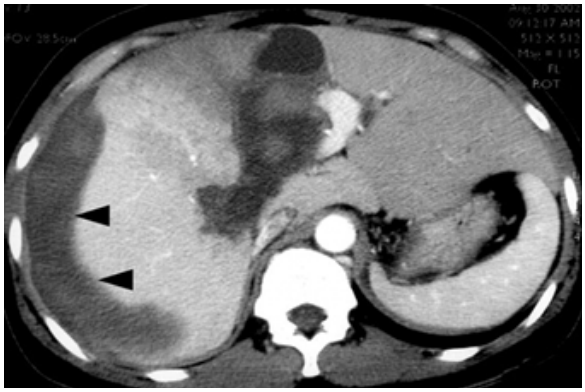


Figure 4: CECT whole abdomen showing Massive Liver Hematoma due to Blunt Trauma Abdomen

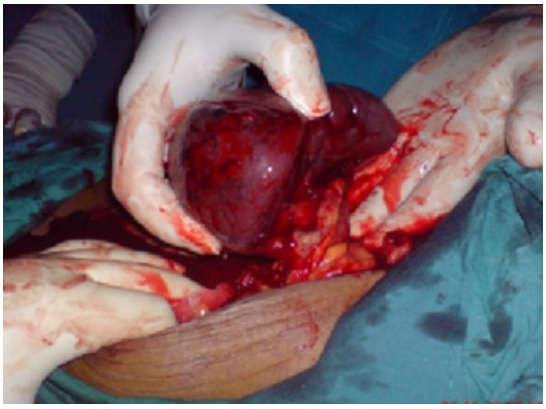
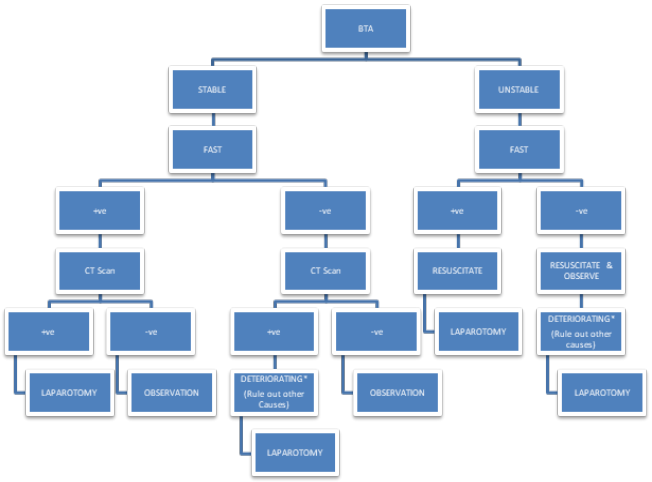


Figure 5: A spleen tear visible after Exploratory laparotomy

Figure 6: Exploratory laparotomy demonstrating a Liver Laceration due to Blunt Trauma Abdomen



Flowchart 1: Rule out other causes i.e., Head Injury, Chest Injury, Long Bone Injury etc

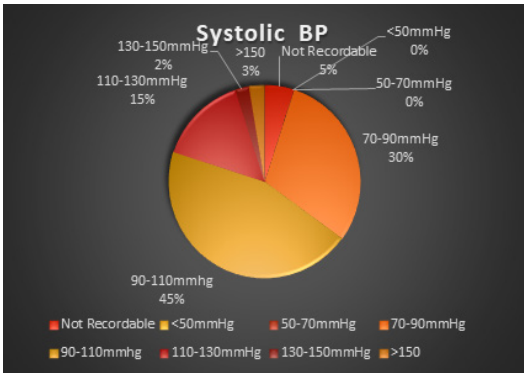


Figure 7: Systolic BP

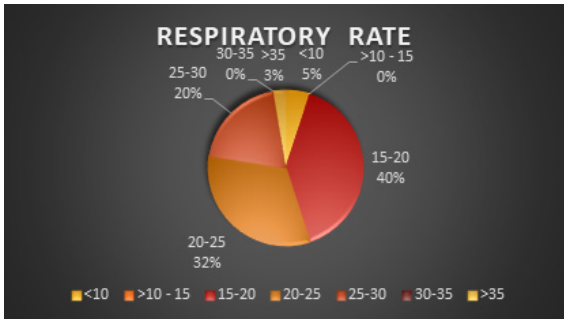


Figure 8: Respiratory rate

the most dependent portion of the lower abdomen and pelvis, hence where fluid will collect.

The transducer is placed midline just superior to the symphysis pubis.

Pericardial Scanning

The pericardial examination screens for fluid between the fibrous pericardium and the heart, and hence possible cardiac tamponade. The transducer is placed just to the left of the xiphisternum and angled upwards under the costal margin (Figure 1).

A positive FAST Scan demonstrating free fluid in Morrison's Pouch on FAST scanning.

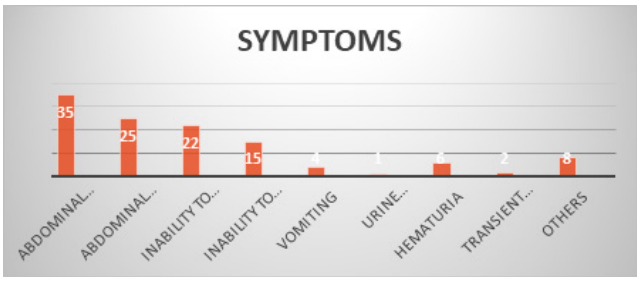


Figure 9: Symptoms

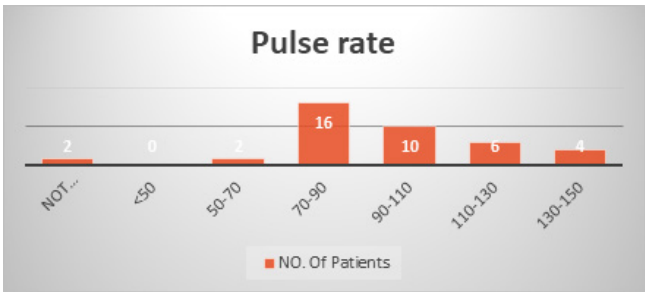


Figure 10: Pulse rate

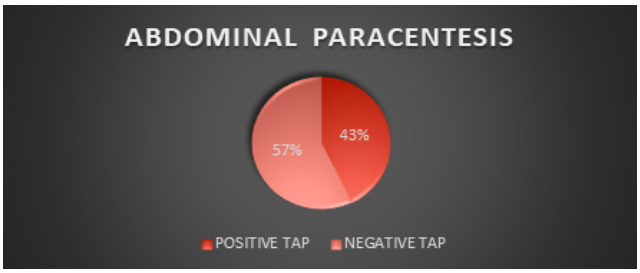


Figure 11: Abdominal paracentesis

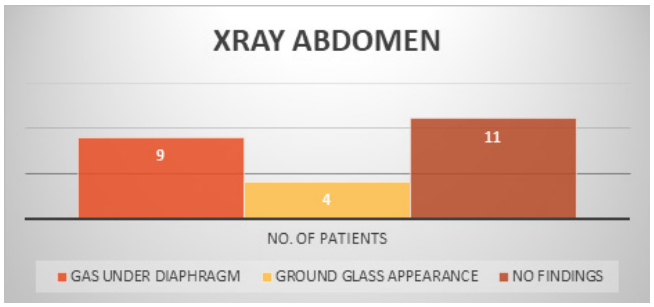


Figure 12: X-ray Abdome

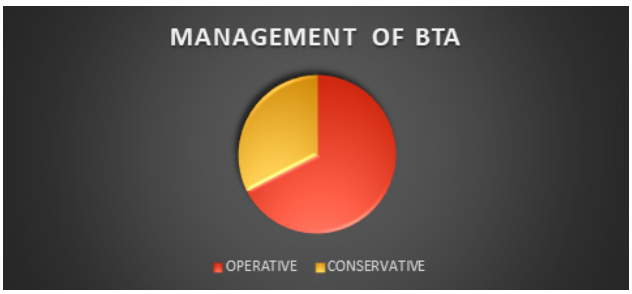


Figure 13: Management of bta

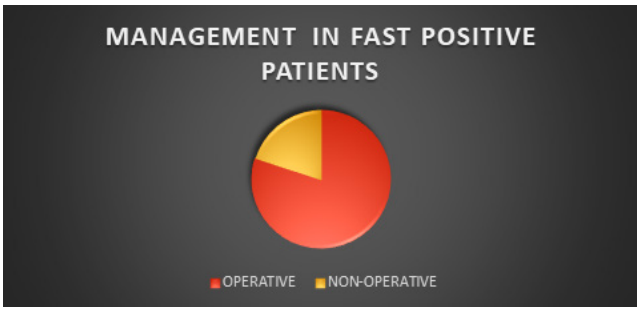


Figure 14: Management in fast positive patients

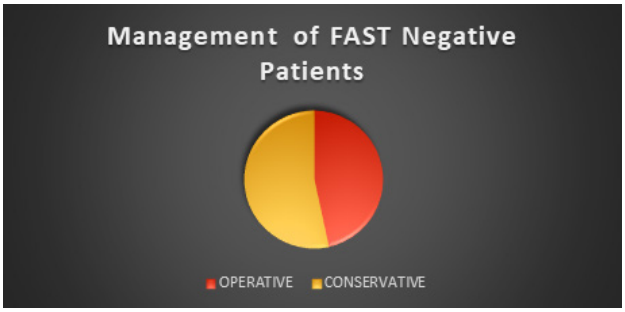


Figure 15: Management of FAST negative patients

Figure 16: Operative findings

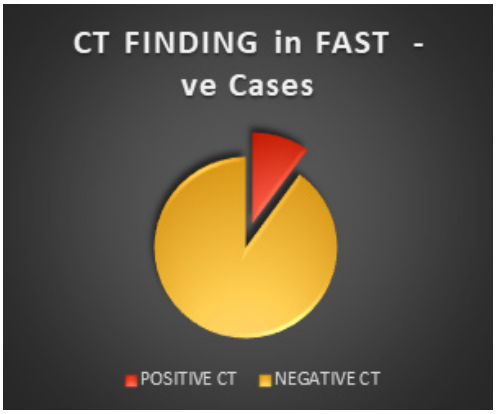


Figure 17: CT finding in fast - ve cases

CECT Whole abdomen showing spleen tear.

CECT whole abdomen showing Massive Liver Hematoma due to blunt trauma abdomen.

A spleen tear visible after exploratory laparotomy.

Exploratory laparotomy demonstrating a liver laceration due to blunt trauma abdomen (Figures 2-6).

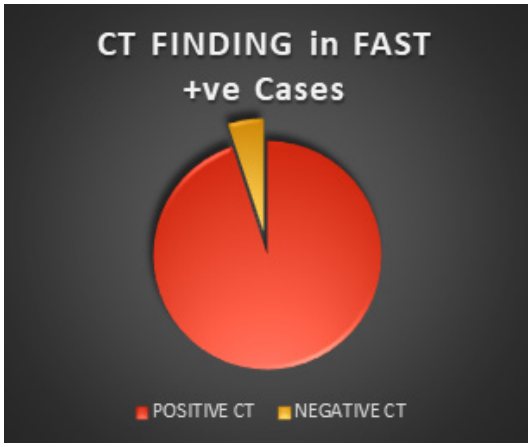


Figure 18: CT finding in fast + ve cases

Figure 19: Laparotomy findings in fast positive unstable patient

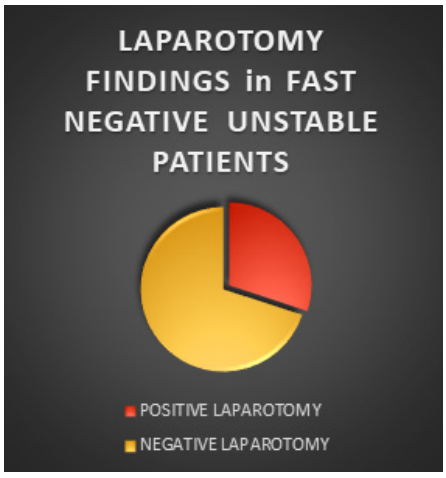


Figure 20: Laparotomy findings in fast negative unstable patients

Treatment Decisions With Fast In Blunt Trauma Abdomen

*Rule out other causes i.e., Head Injury, Chest Injury, Long Bone Injury etc (Flowchart 1).

In this study, we will also be comparing the accuracy of FAST vs CT/Laparotomy.

OBSERVATIONS

Age and Sex

The following observations were recorded

Maximum patients were between the age of 20–50 years. It maybe because they are more physically active (Table 1).

Others: injury to thorax, limbs, or head injury.

In all the 65% stable patients who underwent FAST and were found to be negative-:

- Only 10% had +ve CT scan findings.

90% negative CT scan findings. In all the 65% of stable patients who underwent FAST and were found to be positive-:

- 95% had +ve CT scan findings.
- 5% negative CT findings.

In 35% of unstable patients had 90% positive FAST scans-:

- Had 100% operative findings.
- There were 0% negative laparotomies !!
- In 35% of unstable, deteriorating patients, they had 10% negative FAST scans-:
- Only 30% had operative findings.
- 70% had negative laparotomies!

Where retroperitoneal injury/pelvic trauma/duodenal perforation and major vessel Injuries were found to be the cause if the deteriorating vitals of the patient (Figures 7-20).

RESULTS

The highest incidence of blunt trauma abdomen was found in age group 20-50 years (67.5%). Males were most commonly affected (92.5%). It is most commonly accidental type and road traffic accident is most common cause of injury. A total 45% of patients had systolic blood pressure 90–110 mmHg. 55% of patients had tachypnoea. Shock (SBP <90 mmHg) is present in 30% of patients. The most common presenting symptom was abdominal pain (87.5%), and the second most common symptom was abdominal distension (62.5%). Total 40% of patients had a pulse rate of 70–90/mi. The physical findings within the normal range at the time of the admission were not of much help in the diagnosis. These findings worked as baseline values for the monitoring of the patient-ray abdomen was positive in 54.17% either in the form of gas under the diaphragm or ground glass appearance. FAST was positive in 62.5% of cases of blunt trauma abdomen. A total 67.5% of blunt trauma abdomen cases had to undergo operative management. Most of the patients who had to undergo operative management were hemodynamically unstable and do not improve even after initial resuscitation.80% of the FAST positive had to undergo operative management. Patients who were in shock and had positive FAST are considered for operative intervention. 53.33% of FAST-negative patients were managed conservatively.74.07% of the patients who were operated on had positive FAST. The most common viscera involved in blunt trauma abdomen in gastrointestinal tract (30%) and spleen in the second most common viscera.

CONCLUSION

We have studied 60 cases of blunt trauma abdomen in this series admitted in LLR Hospital, Kanpur during the period from Jan. 2021 to Aug. 2022.

In the study, we found that FAST was a quite promising diagnostic tool for evaluating patients of blunt trauma abdomen. Because of the ease and reliability of the tool it can be a promising investigation to rule out abdominal injuries unless the results are ambiguous. FAST's sensitivity was 87.5%, with the specificity of FAST upto75%. The Negative predictive value of FAST was 80%. On the other hand CT scan had a sensitivity of 97% with a specificity of 95%. The positive Predictive Value OF CT Scan was 92% and the negative predictive Value of CT Scan was 100%.

Exploratory/diagnostic laparotomy was GOLD standard with specificity of 100% in blunt trauma abdomen.

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