# "EFFECTIVENESS OF CLINICAL ABDOMINAL SCORING SYSTEM IN THE MANAGEMENT OF PATIENTS WITH BLUNT TRAUMA ABDOMEN"


**By**

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**In partial fulfillment of the requirements for the degree of**

**MASTER OF SURGERY**

**IN**

**GENERAL SURGERY**

**Under the Guidance of**
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# LIST OF ABBREVATIONS

| | | |
|---|---|---|
| i.e. | : | That is |
| CASS | : | Clinical Abdominal Scoring System |
| DPL | : | Diagnostic Peritoneal Lavage |
| FAST | : | Focused Abdominal Sonography for Trauma |
| eFAST | : | Extended Focused Abdominal Sonography for Trauma |
| CECT | : | Contrast Enhanced Computed Tomography |
| GCS | : | Glasgow Coma Scale |
| DJ | : | Duodeno-jejunal |
| IVC | : | Inferior Venecava |
| WBC | : | White Blood Cell |
| RBC | : | Red Blood Cell |
| ECG | : | Electrocardiogram |
| ABG | : | Arterial Blood Gas |
| IVF | : | Intravenous Fluid |
| ARDS | : | Acute Respiratory Distress Syndrome |
| CVP | : | Central Venous Pressure |
| AP | : | Anteroposterior |
| EMD | : | Emergency Department |
| Hrs | : | Hours |
| IU | : | International Unit |
| dL | : | Decilitre |
| AAST | : | American Association for the Surgery of Trauma |

| | | |
|---|---|---|
| DCS | : | Damage Control Surgery |
| CBD | : | Common Bile Duct |
| CPR | : | Cardiopulmonary Resuscitation |
| OT | : | Operation Theater |
| OG | : | Oesophagogastric |
| MPD | : | Main Pancreatic Duct |
| SMV | : | Superior Mesenteric Vein |
| PCN | : | Percutaneous Nephrostomy |

# ABSTRACT

**Background:** Trauma is one of the common cause of mortality and morbidity encountered in routine practice. Abdominal injury is common after extremities and head injury. Early diagnosis and treatment can reduce mortality in abdominal injury by upto 50%. The common causes for blunt trauma abdomen includes motor vehicle crashes, direct trauma and fall from heights

**Objectives** (a) To score all the patients with blunt trauma abdomen with Clinical Abdominal Scoring System (CASS). (b) To compare the score of clinical abdominal scoring system with USG/CT abdomen and pelvis findings in patients of blunt trauma abdomen.

**Methods:** All patients who are suspected to have blunt trauma abdomen are scored using Clinical Abdominal Scoring System (CASS) and radiological investigations would be done in the emergency department of R L Jalappa Hospital. The decision to proceed with the surgery would be done if the patient had Clinical Abdominal Scoring System score of more than 12 and/or if the radiological investigation shows features of blunt trauma abdomen like air under diaphragm or grade IV/V solid organ injury.

**Results:** Males were predominantly involved in the BTA constituting around 81% and the rest being females with 19%. Most common age group involved in is 21-30years followed by 31-40years together constituting more than half of the total cases i.e.59.5%. Most common mode of injury was found to be RTA. Most common injured organs are spleen>liver>small intestine (ileum). The CASS have specificity of

84.62%, sensitivity of 99.2%, PPV-33.3%, NPV-100%. Total mortality in the study was 7.1%

**Conclusion:** Most common gender to involved is male and most common mode is RTA. Most of the patient of blunt trauma abdomen can be managed conservatively if patients are hemodynamically stable. With score less than 8 as per CASS , patient can be managed conservatively with regular monitoring of the vitals even in the absence of imaging modality. Patient with score more than 12 or hemodynamically unstable can be taken up for emergency laparotomy without any radiological investigations. Patients with CASS score 9-11, with good clinical assessment aided with radiological investigations can be managed depending upon the severity of the injury.

**Keywords:** CASS, blunt trauma abdomen, USG abdomen and pelvis

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# INTRODUCTION

# INTRODUCTION

Trauma is one of the common cause of mortality and morbidity encountered in routine practice. Abdominal injury is common after extremities and head injury. Early diagnosis and treatment can reduce mortality in abdominal injury by upto 50%. The common causes for blunt trauma abdomen includes motor vehicle crashes, direct trauma and fall from heights.[1]

The incidence of abdominal trauma increases with industrialization and rapid development of the rural area thus early and timely evaluations plays significant role in its management. Moreover bull gore injuries which are common in the rural area, early diagnosis of abdominal trauma will improve the outcome. Reports show that more than 50% of mortalities due to blunt trauma abdomen are preventable and hence precise management and in time laparotomy plays a critical role in reducing mortality rate.

Imaging along with others means of investigation plays a vital role in arriving at a precise diagnosis in most of the cases. However, non-availability of sophisticated investigations with lack of experienced radiologist may be limiting factors in arriving at a timely precise diagnosis. This explains the utmost need for an accurate and handy method for evaluation of such patients who require further surgical interventions. In this study, effectiveness of clinical abdominal scoring system in relation to the radiological investigation will be assessed in the management of patients with blunt trauma abdomen.

In a referral centre like R.L JALAPPA hospital which is rural based and on a highway where abdominal trauma cases are encountered and patients belonging to low socioeconomic status, this clinical abdominal scoring system (CASS) will be useful in timely diagnosis and assessment of severity of blunt trauma abdomen.

# OBJECTIVES

# OBJECTVES OF THE STUDY

1. To score all the patients with blunt trauma abdomen with Clinical Abdominal Scoring System(CASS)
2. To compare the score of clinical abdominal scoring system with USG/CT abdomen and pelvis findings in patients of blunt trauma abdomen.

# REVIEW OF LITERATURE

# REVIEW OF LITERATURE

Blunt and stab abdominal injuries have been recognized since historical times. Aristotle was the first who recorded visceral injuries secondary to abdominal trauma. Hippocrates and Galen are said to have given correct description for the blunt abdominal injuries. [2]

Trauma is one among the other leading causes for death and disability in developing countries like India and considered as the most common cause for death under 45 years of age. All over world, trauma is the 7$^{th}$ most common cause of mortality and abdomen is the third most commonly injured after head and extremities injury. Blunt trauma abdomen is most common constituting 85% followed by stab injuries, and among them most of them managed are conservatively. The spleen followed by liver are the most commonly injured solid organs resulting from blunt trauma to abdomen.[3]

Automobile accidents most common mode of blunt trauma abdomen accounting for 53% of cases followed by fall from height which accounted for 43% of the cases.[3]

Commonest hollow viscus organ injured is small bowel. Among small bowel, ileum is the most commonly injured. Other injuries which are encountered includes colonic injuries, renal injuries, bladder injuries, transection of stomach, herniation of stomach through the diaphragm.[4]

Radiological investigation like chest X-ray and erect abdomen X-ray may demonstrate a diaphragmatic rupture along with the air under diaphragm suggesting of hollow viscous perforations. However, in unconscious patient or patient with spine injury lateral decubitus may be helpful in arriving the diagnosis. The erect abdomen X-ray exposes the patient 35 times the radiation dose of chest X-ray(0.7mSv).[5]

Diagnostic Peritoneal Lavage (DPL) which was first used by Root in 1960, is used in clinical situations which is difficult to interpret, in case of unconscious patient and in polytrauma with high suspicion of intraabdominal injury. The sensitivity is 95% and specificity is 99%. Being an invasive procedure, it carries a risk of visceral injury of about 0.6%.[5]

Other modality is ultrasonography of abdomen and pelvis. Ultrasonography is regarded as investigation of choice for early diagnosis in patients with suspected blunt trauma abdomen. In experienced hand both solid organ injuries and free intraabdominal fluid can be detected with high accuracy. It is highly dependent on the skill of the operator. The sensitivity of ultrasound is around 79-100% and specificity is around 95.6%-100%.[6]

Focused abdominal sonography for trauma (FAST) is an abbreviated protocolised form of ultrasound that seeks only to demonstrate intraperitoneal and pericardial fluid. FAST is considered as investigation of choice in hemodynamically unstable patients. FAST was initially started in Europe and Japan in the 80's which is adopted by N. America in early 90's. The sensitivity reaches upto 100%. The use of FAST has replaced the use of DPL for detecting intraperitoneal fluid. eFAST is the extended FAST which demonstrate pleural fluid too.[7]

CT abdomen and pelvis has now become the most useful investigation in the patients with blunt trauma abdomen. It is considered as the gold standard investigation in hemodynamically stable patient. It is sensitive (92-97.6%) and specific (98.7%). CT has high accuracy of about 95% and negative predictive value of 100%.[8]

Laparoscopy, although available since 1930s, has recently become popular among surgeons. It is more specific for the detection of bleeding than the peritoneal lavage.[2]

Although ultrasound is the first diagnostic approach in blunt trauma abdomen patients, its accuracy is highly operator dependent. CT scan is the gold standard investigation, but being expensive and not accessible in every setup, it exposes patient to radiation. And hence CASS will be beneficial in the diagnosis and severity of the BAT.[9]

Clinical abdominal scoring system (CASS) has shown an accuracy of 94% for the detection and exclusion of intra-abdominal injury with sensitivity of 100%, specificity of 88% and positive predictive value of 90%.

Other scoring system which is being used in trauma cases are Glasgow Coma Score (GCS), Revised Trauma Score (RTS), Injury Severity Score (ISS), Trauma Score Injury severity Score (TRISS) etc. Among these most commonly used is GCS.

## ANATOMY OF ABDOMINAL CAVITY[10,11]:

The extent of the abdominal cavity is from the nipple to deep into the pelvis. The organs present in the abdominal cavity vary from the solid organs to hollow viscus. The abdominal cavity is bounded by rectus abdominis anteriorly, external oblique muscle, internal oblique muscles and transverse abdominis laterally, iliac muscles forms the inferior border and the vertebral columns and psoas major, psoas minor and quadratus lumborum form posterior border.

For the descriptive purpose, two horizontal lines and two vertical arbitrary lines divides the abdominal cavity into nine regions. The horizontal line known as transpyloric passes through the tip of the ninth costal cartilage at the level of pylorus of stomach and the other horizontal passes through the intertubercles of the both ilium. The two vertical lines passes downward in the mid clavicular line as shown in Fig 1.

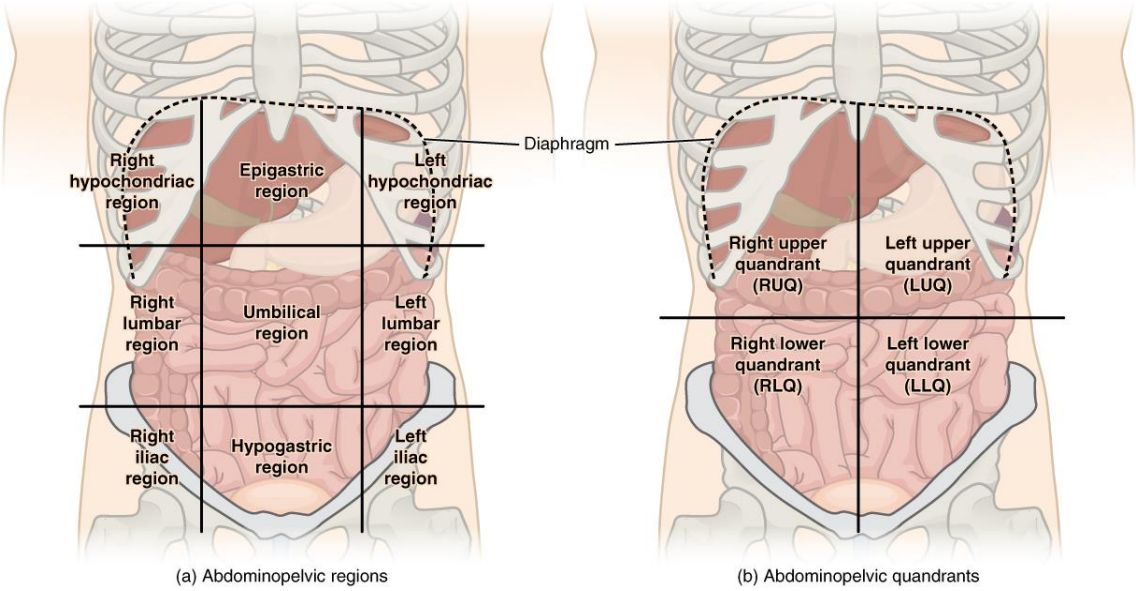



**Fig 1 showing nine regions with four quadrants of abdomen**

The nine regions includes:- i) Right hypochondrium ii) left hypochondrium iii) epigastric iv) Right lumbar v) left lumbar vi) umbilical vii) Right iliac fossa viii) left iliac fossa and ix) hypogastric. Further abdominal cavity is divided into following

mentioned four quadrants as shown in fig. 1:- i) right upper quadrant ii) left upper quadrant iii) right lower quadrant and iv) left lower quadrant.

**Peritoneal cavity**: The serous membrane which lines the abdominal cavity wall is known as peritoneum which is of two types:-1.Parietal peritoneum. 2. Visceral peritoneum. Parietal peritoneum lines the abdominal cavity whereas visceral peritoneum lines viscera. The opposing peritoneal layers either between the viscera and the abdominal cavity or between two viscera forms visceral ligaments. These peritoneal folds divide the peritoneal cavity into the greater sac and the lesser sac. The lesser sac lies behind the lesser omentum, stomach and gastro colic ligament and communicates to the greater sac through the foramen of Winslow. The structures which are not suspended by the mesentery or the visceral ligaments in the abdominal cavity are retroperitoneal structures. In males it is a closed cavity, whereas in females it communicates with exterior through the fallopian tube opening at the fimbrial end.

## Gastrointestinal Tract:

### Stomach[10,11]

The stomach is a hollow viscus which is located in the intra-thoracic part of the abdominal cavity. It is loosely suspended into the abdominal cavity by the following ligaments- i) superiorly by the gastro-hepatic ligament, ii) inferiorly by the gastro-colic ligament, and iii) laterally by gastrosplenic ligament. It communicates superiorly with the esophagus at the cardiac orifice marking its fixed point and inferiorly by the pyloric channel to the duodenum. The anterior relation includes:-i) diaphragm ii) left lobe of the liver and iii) left rectus sheath. The posteriorly related structures forms the stomach bed which includes the diaphragm, left splenic artery, left suprarenal gland, transverse mesocolon, pancreas, and the spleen.

The gastric wall is made of an outermost serosal layer followed by muscularis propria which includes- an outer longitudinal, middle circular, and an inner oblique layer. The strongest layer is submucosal followed by innermost mucosal layer which has a rich capillary network. Because of thick walled, stomach is less vulnerable for injury following blunt trauma to abdomen. Parts of stomach includes:- i) fundus ii) body iii) antrum and iv) pylorus as shown in Fig 2a.

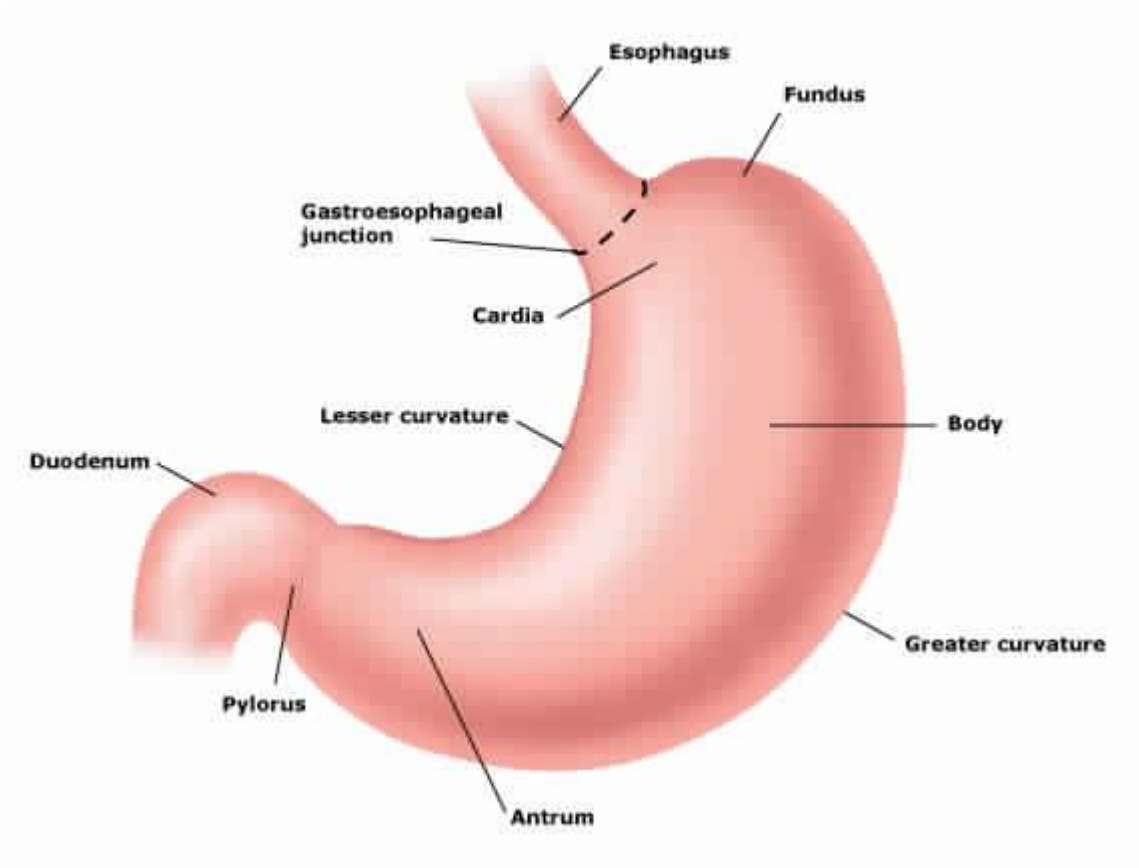



**Fig 2a. Parts of stomach**

Blood supply of the stomach: - i) left gastric artery, ii) right gastric artery iii) left gastro-epiploic artery and iv) right gastro-epiploic artery (Fig 2b). Because of the extensive collateralization between the gastric arteries, even if three out of four major arteries got disrupted there won't be necrosis of the gastric wall. Thus allows most of the gastric injuries repair without fear of devascularisation of a portion of the gastric

wall. Gastric injuries may bleed heavily, and hence appropriate care must be taken to achieve adequate hemostasis during its repair.

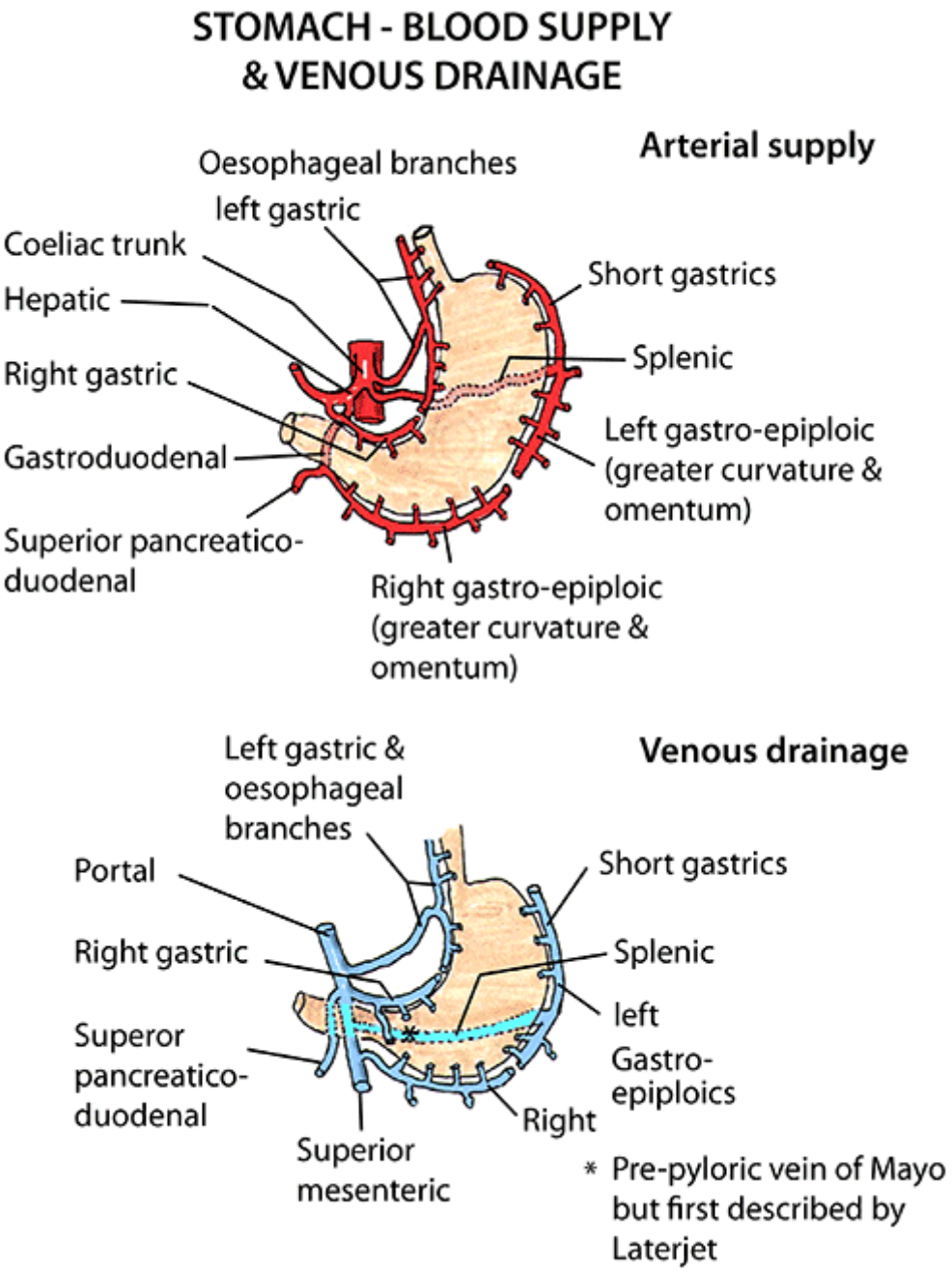



**Fig 2b:- Blood supply of stomach**

Nerve supply: 1. sympathetic (celiac plexus) 2. parasympathetic (vagus nerve)

Lymphatic drainage: It includes four main groups of lymph nodes: - 1. Superier gastric group of lymph nodes, 2. pancreaticolienal group of lymph nodes, 3.

Suprapyloric group of lymph nodes, 4. Inferier gastric subpyloric group of lymph nodes

**Duodenum[10,11]:-** Duodenum extends from the pylorus, which is at the level of the first lumbar vertebra, to the duodenal jejunal flexure. It is of 'C' shaped and is approx. 25cm in length. Because of its deep anatomic location, retroperitoneal fixation, and connection to the secretory ducts of liver and pancreas makes it unique part of small intestine.

Duodenum derives its blood from the celiac and the superior mesenteric vessels and also shared its blood supply with the head of the pancreas thus complicating the management of complex pancreatic and duodenal injuries. It has four parts. The first part is intraperitoneal and a bit mobile. The remainder of the duodenum is retroperitoneal. The second and part of the third portions can be easily mobilized through the bloodless plane by Kocher manueuver[8]. The duodenal-jejunal flexure is suspended by a fibromuscular band known as ligament of Trietz.

Blood supply (Fig 3.): 1. Superior pancreatico duodenal artery 2. Inferior pancreatico duodenal artery. First portion of duodenum receives additional supply from a. Right gastric artery b. Supraduodenal artery (of Wilkie) c. Retroduodenal branches of gastroduodenal artery d. Some branches from right gastroepiploic artery.

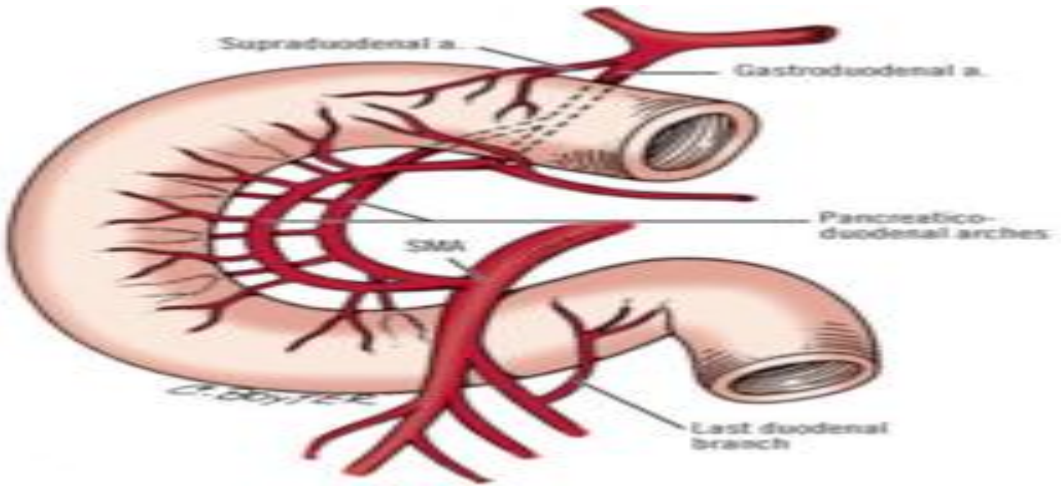



**Fig 3 blood supply of duodenum**

**Small Intestine[10,11]:-** The small intestine measures around 6 meters extending from the ligament of Trietz to the caecum and freely moveable on its mesentery. The upper $2/5^{th}$ is jejunum, and the lower $3/5^{th}$ is ileum. The adult small intestine measures approximately twice the height of the body. The small bowel is suspended by the fan shaped mesentery which extends from the left side of the $2^{nd}$ lumbar vertebrae downwards to the right sacroiliac joint, traversing through the aorta, transverse duodenum, inferior venacava, right gonadal vessels and right ureter, The jejunum and ileum derives its blood supply from the superior mesenteric artery which arises from the aorta.

**Large Intestine[10]:-** The large bowel measures around 1.5 meters in length and it extends from the IC (ileocaecal) junction to the anus. It is divided into i) appendix, ii) caecum, iii) ascending colon,iv) transverse colon, v) descending colon, vi) rectum and vii) anal canal. The ileum opens into the caecum by a longitudinal slit which is guarded by the IC (ileocaecal) valve. The longitudinal muscles of the large bowel forms ribbon like structures called taenia coli which is three in number and converge

at the base of the appendix and spread out on the sigmoid colon to become continuous with the longitudinal muscle of the rectum distally.

**Liver[10]:**

The liver is located in the right hypochondrium of the body. It is wedge shaped whose base is directed to the right side of the body. Liver is the largest gland of the body. The anterior surface of the liver is triangular in shape and is related to the xiphoid process and the diaphragm on either side. The superior surface is quadrilateral in shape and is marked by the cardiac impression in the middle. The diaphragm separates liver from the pericardium and the heart in the middle and from the pleura and lungs on each side. The inferior surface is also quadrilateral and has a sharp border. The liver has two lobes. Right lobe, which has two additional lobes, the caudate and quadrate lobes. Left lobe on the inferior surface presents the omental tuberosity. It is held in position by various ligaments such as falciform ligament, ligamentum teres, anterior and posterior layers of coronary ligament and right and left triangular ligaments. Liver receives 20% of its blood supply from the hepatic artery, and 80% from the portal vein. Before entering the liver, the hepatic artery and portal vein divide into right and left branches. Venous drainage is from the hepatic veins, which drain directly into the inferior vena cava. common bile duct and drains into the second part of duodenum.

**Spleen[10]**:

Spleen lies in the left hypochondriac region of the abdomen, its long axis being parallel to that of ninth rib, behind the stomach and inferior to the diaphragm. It is a lymphatic organ connected to the vascular system. It is surrounded by the peritoneum and is suspended by the following ligaments.

a) Gastro-splenic ligament from hilum to the greater curvature of stomach.

b) Lienorenal ligament from the hilum to the anterior surface of left kidney.

c) Phrenicocolic ligament supports the anterior end of the spleen. Splenic artery, a branch of coelic artery, supplies it.

**Pancreas[10,11]:**

Pancreas lies obliquely on the upper part of the posterior abdominal wall extending from the concavity of the duodenum to the spleen at the level of L1 and L2 vertebra. It is an elongated organ which has both exocrine and endocrine functions. Anteriorly, it is related to transverse colon and stomach. Posteriorly, to the aorta, inferior venacava, superior mesenteric artery and the left crus of diaphragm. The tail of the pancreas is related to the hilum of spleen.

**Kidneys and suprarenal[10,11]:**

Kidneys are a pair of excretory organs situated on the posterior abdominal wall one on each side of the vertebral column behind the peritoneum. The right kidney is slightly lower than the left, and the left kidney is a little nearer to the median plane than the right. Each kidney has got two poles, two borders and two surfaces. Upper pole is broad and is related to suprarenal gland, the lower pole is pointed. Lateral border is convex; the medial is concave, with hilum in the middle. Anterior surface is irregular and posterior surface is flat. Right kidney is related to right suprarenal gland, second part of duodenum, hepatic flexure of colon and small intestine. The left kidney is related to left suprarenal gland, spleen, stomach, pancreas, splenic vessels, splenic flexure, descending colon and the jejunum. Posterior surface of both the kidneys are related to diaphragm, medial and lateral arcuate ligaments, psoas major, quadratuslumborum, transverse abdominis, subcostal vessels and the subcostal, iliohypogastric, and ilioinguinalnerves. In addition, the right kidney is related to 12th rib, and the left kidney to 11th and 12thribs. Renal fascia (fascia of Gerota) is the

fibroareolar sheath surrounding the kidney and perirenal fat. Renal artery and vein supply kidneys. Renal artery is a direct branch of aorta; renal vein drains directly into the inferior venacava.

**Adrenal gland[10,11]:-**

The adrenal glands are infrequently injured by blunt trauma. They lie close to the middle of the upper abdomen and are protected by the spine, ribs, and major organs. Adrenal injury has been reported in 28% of patients with moderate abdominal injury studied at autopsy. Hematoma in adrenal is seen as a round or ovoid mass. High density Strands also represent hemorrhage may be seen in the perirenal fat. Initially the Hematoma in adrenal may demonstrate an increased density. As time progress the density decreases as the blood clot lyses. In large no of patients the hematoma will be reabsorbed, but occasionally it will persist to form a seroma. This will be the most common cause of adrenal pseudocysts. In most patients, adrenal injury has little significance clinically. The quantity of blood loss is large and more than 90% of functioning adrenal tissue must be lost before the patient becomes adrenal insufficient. However, if bilateral hematoma in adrenal occur, the potential for developing Addison's disease must be considered.

**Retroperitoneum[10,11]:-**

It is often difficult to diagnose the injuries to the retroperitoneum, especially in the presence of other injury, as the physical signs may be masked. Intraperitoneal diagnostic tests such as ultrasound and diagnostic peritoneal lavage may be negative. The computerized tomographic scan is the investigation of choice in such patients. The only limitation is that the patient should be physiologically stable. The retroperitoneum can be divided into three zones (Figure 4)

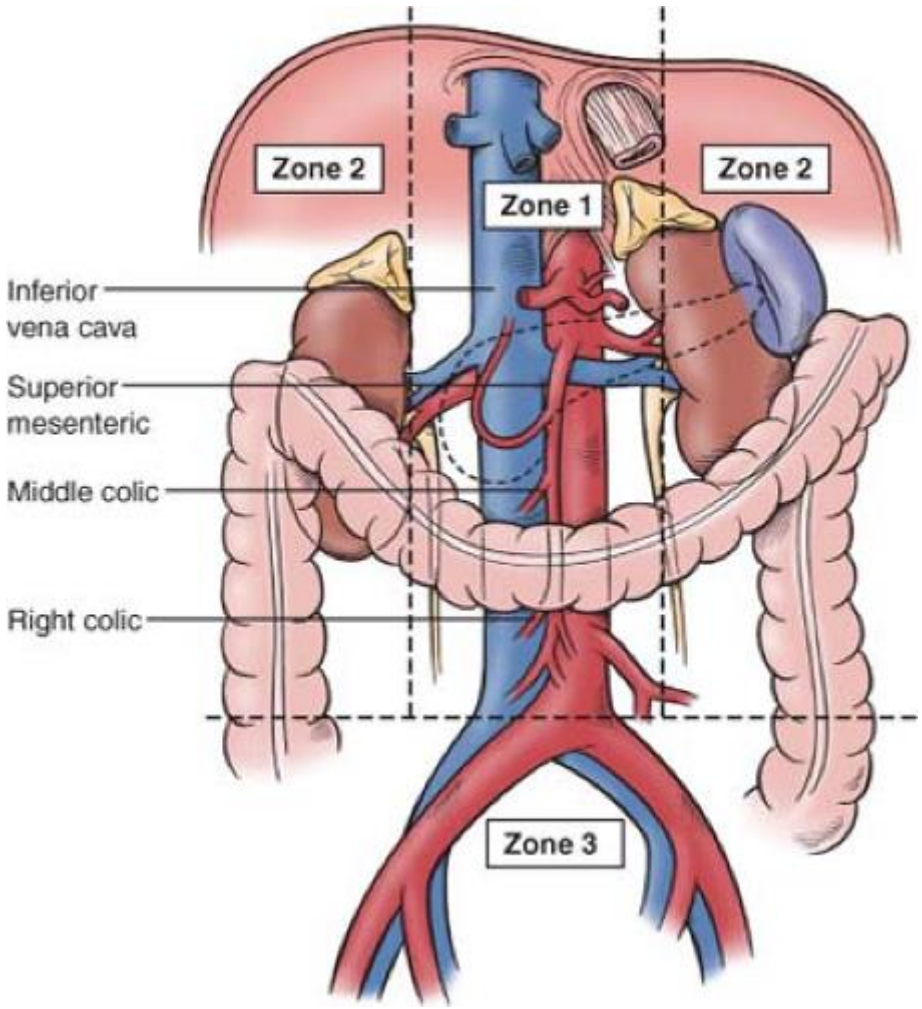



**Fig 4 zone of abdominal injury**

Zone 1 (central): Central hematomas in this zone should always be explored, with proximal and distal vascular control.

Zone 2 (lateral): Lateral hematomas in this zone usually represent a renal injury and this can be managed non-operatively and sometimes with angioembolization

Zone 3 (pelvic): It is very difficult to control a pelvic hematoma and it should not be opened unless required. They can be controlled with intra or extra pelvic packing or angioembolization. Experience along with investigation have been the most important in determining the use of diagnostic methods.

**Pathophysiology[13]:**

There are many pathophysiological processes that occur in a case of blunt trauma abdomen (BTA). The mode of injury and impact of injury plays a crucial role in the management of the patients with BTA. Basically mode of injuries is further classified into two types:-

i) high energy injuries and

ii) low energy injuries.

Vikram Yogesh et al explained the mechanisms of injuries causing BTA which includes below mentioned mechanisms[14]:-

1. Deceleration. Rapid deceleration causes differential movement among adjacent structures. As a result, shear forces are created and cause hollow, solid, visceral organs and vascular pedicles to tear, especially at relatively fixed points of attachment. Classic deceleration injuries include hepatic tear along the ligamentum teres and intimal injuries to the renal arteries. As bowel loops travel from their mesenteric attachments, thrombosis and mesenteric tears, with resultant splanchnic vessel injuries, can result.
2. The second mechanism involves crushing. Intraabdominal contents are crushed between the anterior abdominal wall and the vertebral column or posterior thoracic cage. This produces a crushing effect, to which solid viscera (e.g. spleen, liver, and kidneys) are especially vulnerable.
3. The third mechanism is external compression, whether from direct blows or from external compression against a fixed object (e.g. lap belt, spinal column). External compressive forces result in a sudden and dramatic rise in intra-abdominal pressure and culminate in rupture of a hollow viscous organ (i.e. in accordance with the principles of Boyle's law).

4. Indirect evidence for BTA includes:-

(i) $7^{th} – 9^{th}$ ribs fracture on the right side may lead to liver injury

(ii) $8^{th}$ -$10^{th}$ ribs fracture on the left side may lead to spleen injury

(iii) $11^{th}$ / $12^{th}$ ribs fracture or haematuria may lead to kidney injury

## Clinical Examination[13]:

**History and physical examination:-**

As soon as the patient comes to the casualty brief history should be taken from the ambulance personnel or policeman or bystander who accompany the patient. After receiving the patient to the resuscitation area immediately we do triage. Then we do primary survey with simultaneous resuscitation which includes:-

1) Airway maintenance with restriction of cervical spine motion
2) Breathing ventilation
3) Circulation with haemorrhage control
4) Disability
5) Exposure/ Environmental control

Adjuncts to the primary survey includes

1) ECG monitoring to look for any dysrhythmia
2) Pulse Oximetry
3) Capnography and ABG
4) Urinary and Gastric Catheters
5) X-Ray Examination and Diagnostic Studies
6) Hemogram with blood grouping and typing
7) Coagulation profile
8) FAST and eFAST
9) Venous lactate level

Secondary Survey

The secondary survey is a head to toe evaluation of the trauma patient that is complete history and physical examination, including reassessment of all vital signs.

History:

- Mode of injury
- Impact of injury
- Allergies
- Medications currently used
- Past illness/ Pregnancy
- Last meal
- Events/ Environmental related to the injury

Physical examination will be followed after secondary survey which has to be followed in the following order to look for other injuries.

1. Physical examination follows the sequence of
2. Head
3. Maxillofacial structures
4. Cervical spine and neck
5. Chest
6. Abdomen and Pelvis
7. Perineum, rectum, vagina, musculoskeletal system
8. Neurological system

**Prehospital Phase of resuscitation[13]:-**

At trauma site, the under mentioned measures should be taken to stabilize the patient and present further damage.

1) Patent airway should be ensured by suctioning and jaw thrust and chins lift.

2) External bleeding should be arrested either by applying tourniquet proximal to the injury or by applying pressure over the wound
3) IV line should be secured and IVF fluid should be initiated
4) Philadelphia collar should be applied in order to prevent cervical spine injury.
5) All suspected fractures should be stabilized by using splint.

**Hospital phase of resuscitation:**

The goal for resuscitation includes:

1) To save the life of the patient
2) To save the limb
3) To minimize the disability
4) To maintain cosmesis

**Adequate Airways:-**

For all patients with trauma patency of the airway should be checked. If airway is threatened suctioning of the airway should be done followed by jaw thrust and chin lift. If still airway is threatened then we should plan for endotracheal intubation or surgical intervention like needle cricothyroidotomy and tracheostomy.

**Breathing:-**

This implies normal ventilation, perfusion and pulmonary circulation. It will be disturbed in ribs fracture, hemothorax, pneumothorax, tracheobronchial injuries or in case of lung contusions, and ARDS. High flow oxygen should be supplemented at the rate of 8 litres/min through the face mask. Chest defects should be stabilized. Ventilatory effort should be assisted to maintain normal rate, rhythm and ABG and $pCO_2$. Pleural space collection either pneumothorax or hemothorax should be evacuated by intercostal drains which in turn to be connected to underwater sealed containers.

**Circulation:-**

Patient with blunt trauma abdomen mostly present with hypovolemic shock which is characterized by cold calm peripherals, feeble thready pulse low systolic pressure and low pulse pressure. Most often such patients have polytrauma leading to loss of blood. So in such cases further blood loss should be prevented by applying pressure over the wound. Patient should be kept in Trendelenburg position and preferably with two wide bore IV cannula, IV access should be secured and warm crystalloids should be initiated response to the fluid challenge should assessed output charting, assessing the mental status of the patient, skin perfusion, CVP readings.

**Disability:**

After achieving adequate airways patency and control of haemorrhage, patient's level of consciousness should be assessed. This is done by assessing GCS of the patient followed by pupillary response in terms of reaction to light and disparity in the size of the pupil. A thorough examination of the spine should be done by performing log roll. Digital rectal examination should be done during log roll to rule out rectal injuries.

**Exposure:-**

After performing the first four step of the primary survey, patient should be exposed from head to toe and patient should be re-examined again. Any injuries should be noted and attended. Following complete exposure and examination patient should be immediately covered by blanket in order to prevent hypothermia.

After doing primary survey and initial resuscitation patient should undergo secondary survey where again head to toe examination should be performed and injures should be addressed followed by different radiological investigations should be performed in order to arrive at the diagnosis.

**Diagnostic Methods[15,16,17:-]**

The following diagnostic methods are useful in assessing severity of the blunt trauma abdomen.

1) Plain radiography and contrast studies[15]:-

X-rays should be done in the resuscitation area during resuscitation of the patient. If portable X-rays are not available in the trauma centre then patient should be resuscitated first and then shifted for x-rays only when patient responded well to the resuscitation. These x-rays includes AP view chest x-ray, abdominal x-ray in supine or lateral decubitus position and AP and lateral view cervical spine and AP view pelvic x-ray should be performed.

Chest x-ray will help in diagnosing rib fracture, pneumothorax, hemothorax and diaphragmatic injuries. In patients with hollow viscus injury, patient will have air under diaphragm as shown in fig 5.

Minimum of 800ml of intraperitoneal blood is required to become evident on plain abdominal radiograph. The following supporting signs may be observed.

*The flank stripe sign:-* is a fluid dense zone separating the ascending or descending colon from distinctly outlined lateral peritoneal wall and the colon is displaced medially.

*The dog ear sign:-* results from the accumulation of blood that gravitate between the pelvic viscera and the sidewalls of each side of the bladder.

*The hepatic angle sign:-* is loss of definition of the usually clearly defined inferior and right lateral borders of the liver as blood accumulates between the hepatic angle and the right peritoneal wall.

Hemoperitoneum leads to the shift of the small bowel in the centre of the abdomen leading to the ground glass appearance.

**Diaphragmatic trauma:-** following findings will be noted in abdominal radiograph:

- Malpositioned Ryle's tube is often the first sign of ruptured left diaphragm
- Shift of the mediastinum to the opposite of the injury.
- Bowel loop shadows will be seen above the diaphragm.

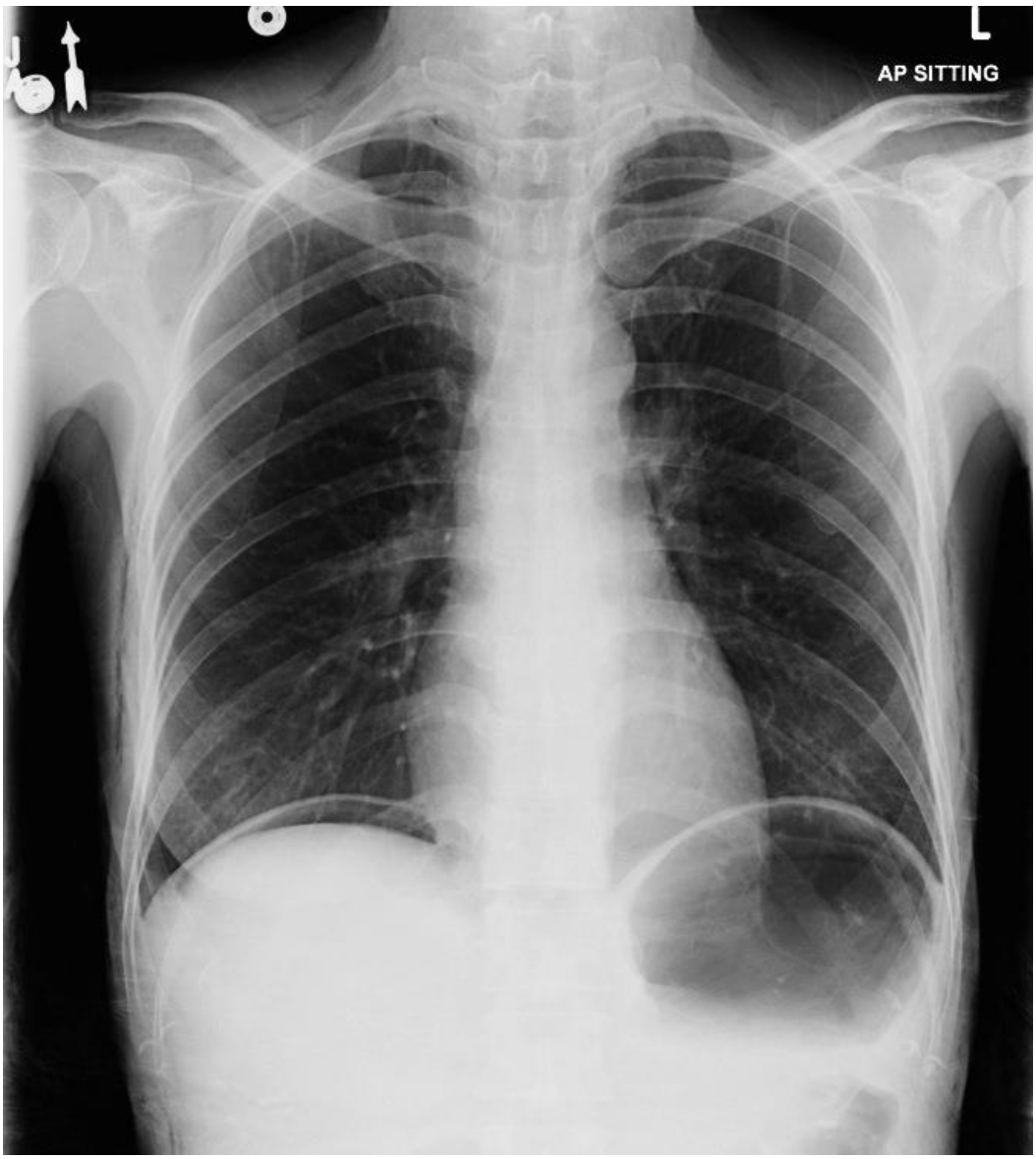



**Fig 5: Abdomen radiograph showing Air under diaphragm.**

**2. Focused Abdominal Sonography For Trauma (FAST)[18,19]:**

Focused abdominal sonography in trauma (FAST) was used in the United States by Rozycki in early 1990s. Starting and follow-up experience indicated that FAST was accurate, non-invasive, and expeditious in assessing the critically traumatised patient in emergency room. Due to availability of the portable ultrasound machine, it is used commonly in the initial assessment of patient with BTA. The FAST scan be done by the surgeons or radiologist or EMD consultant with almost equal reliability to look for hemoperitoneum. FAST can be completed within 3 to 4 minutes thus can be performed in the resuscitation area without affecting the resuscitation process[20]. Minimum of 200ml of intraperitoneal fluid should be present for detection in FAST scan. Four areas imaged are: 1. xiphisternum 2. Right hypochondrium (Morrison's pouch) 3. Left hypochondrium 4. Pelvis. eFAST includes cardiac to rule out cardiac tamponade.

Looks only for free fluid

Sensitivity 28 – 92 %

Specificity 90 – 100 %

Negative predictive value 84 – 99 %

Solid organ injury – 44 – 91 % sensitive

Absence of free fluid in the peritoneum wont't rule out an injury

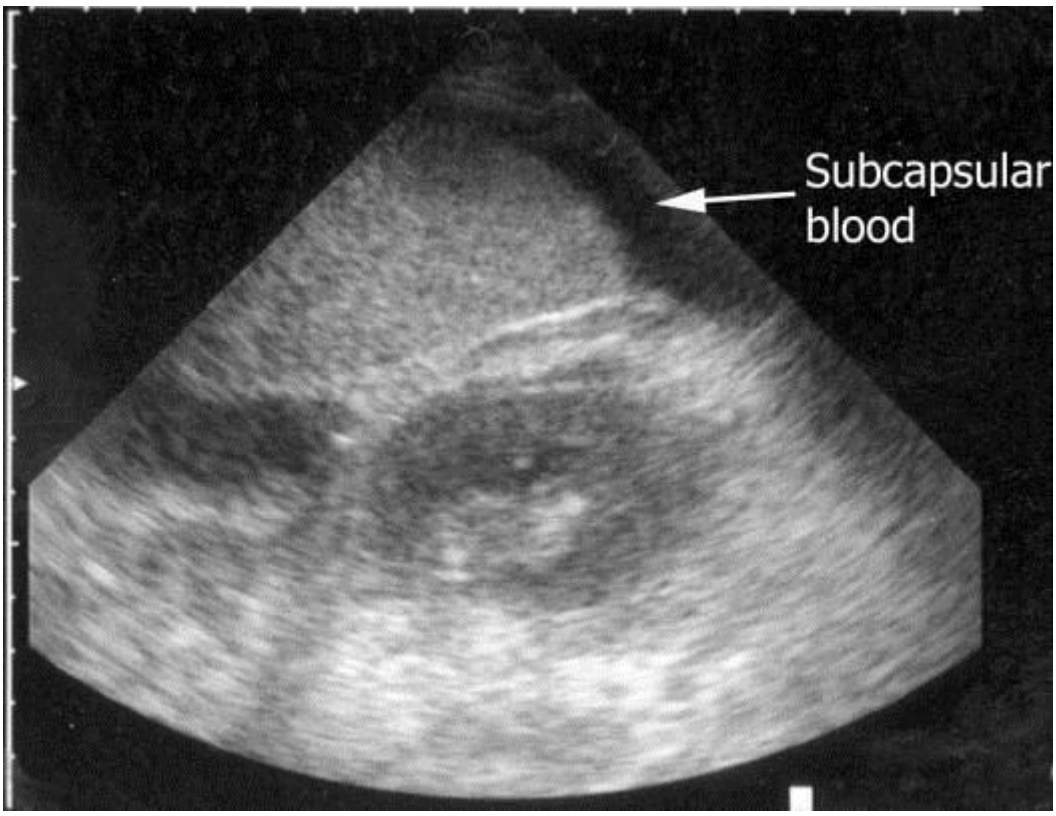



**Fig 6: FAST scan of splenic injury.**


**Fig 7: FAST scan of liver injury**

ADVANTAGES:

(i) Widely available.

(ii) No use of radiation or contrast media,

(iii) can be performed in concurrence to the resuscitation process,

(iv) it can be repeated.

DISADVANTAGE:

(i) Experienced radiologist needed and observer variation.

(ii) Difficult to scan in presence of lower rib fracture, extensive skin lesions, soft tissue injuries and dressings.

(iii) It doesn't grade the solid organ injury

(iv) Injuries without hemoperitoneum will not be detected.

3. **Contrast Enhanced Computerized Tomography of abdomen (CECT scan)[21,22]:**

Features of CECT: With oral, intravenous and rectal contrast help in evaluating and grading injuries thus helping in taking decision on management. It also helps in evaluating retroperitoneum and retroperitoneal structures.

Indications for CT:-

1) Positive FAST – haemodynamically normal
2) Negative FAST with:

a) Pain in lower chest or upper abdomen

b) Fractures above and below diaphragm

c) Altered mental status

d) Pelvic fracture

e) Haematuria

CECT abdomen and pelvis is the gold standard BTA patients. The scan is performed using intravenous contrast and often oral contrast as well. CT is sensitive for blood

and has the added advantage of sensitivity in diagnosing retroperitoneal injury. A normal abdominal CT excludes intraabdominal injury. The disadvantage of CECT is need to shift the patient to the scan room. Added, it is more costly than other investigation. CECT also grades solid organ injury, thus used in stable patient with positive FAST findings to grade organ injuries. If contrast is seen extravasating, even with low grade hepatic or splenic injuries, exploratory laparotomy or, more recently, interventional angiography and intravascular embolization are done. Fig 8,9,10 showing CECT findings in splenic, liver and renal injury respectively.

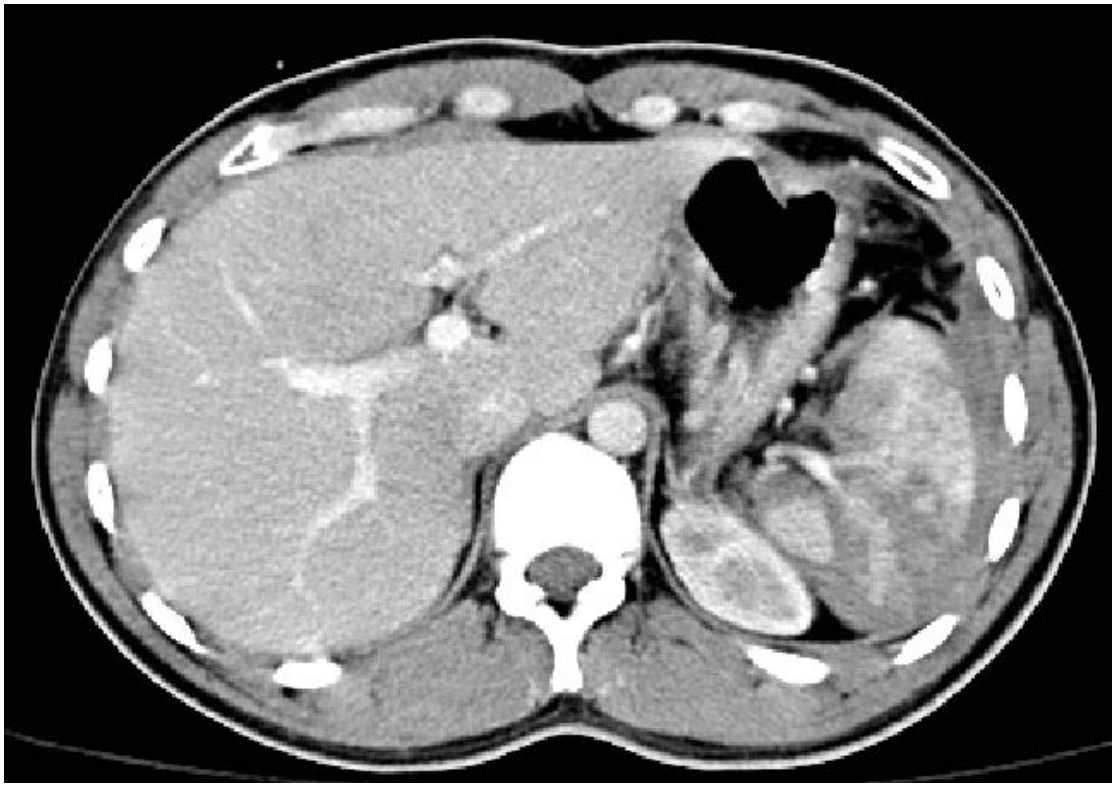


**Fig 8: CECT showing splenic laceration**


**Fig 9: CECT showing liver laceration**

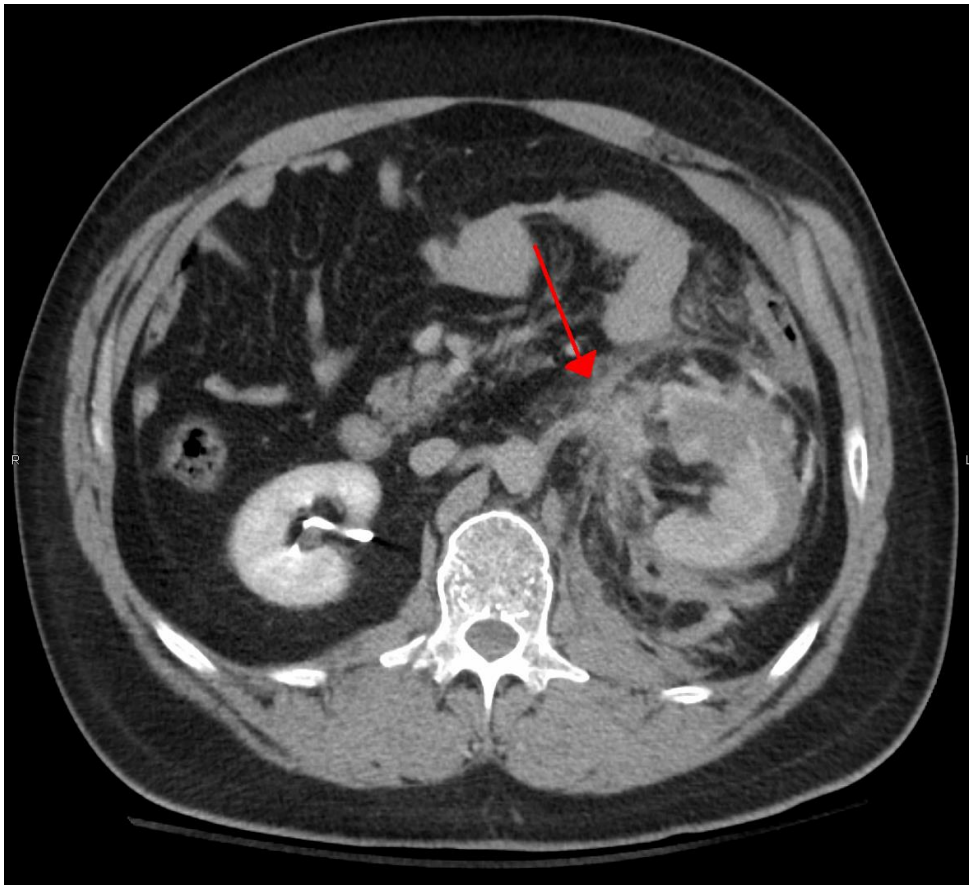


**Fig 10: CECT showing left renal injury**

Indication for CECT abdomen and pelvis include patients with solid organ injuries with dropping hemoglobin. The important drawback of CECT is its inability to diagnose hollow viscus injury. Usually, the presence of free fluid in the peritoneum on CECT without solid organ injury should rise doubt for mesenteric, intestinal, or urinary bladder injury and exploratory laparotomy is indicated. The most common problem encountered is what to do next when CECT shows free fluid in the peritoneum without any evidence of the solid organ injury or mesentery injury. Coupled with the low sensitivity of CECT to diagnose hollow viscus trauma, it creates a oscillation for most trauma surgeons. The choice are either to go for exploratory laparotomy for all such patients and accept a significant number of negative laparotomy or to watch and "act" when peritoneal signs develop while remembering in mind that a delay in the diagnosis of hollow viscus injury may be dangerous. A recent study in which trauma surgeons asked about what would be the appropriate plan of management of patients in this circumstance they showed mixed responses: 42% would do DPL, 28 % will observe the patient, 16% would surgically do exploration, and 12 % will repeat an abdominal CECT scan. The accuracy of CECT ranges from 92% to 98 %, with low false positive and false negativity rates.

Advantages

1) Adequate evaluation of the retro-peritoneum
2) conservative management of solid organ injuries
3) evaluation of renal perfusion
4) Non-invasive
5) Highly specific.

Disadvantages

1) Trained staffs

2) Hard-ware machinery

Future Prospects

As technology advances, evaluation of mesenteric and bowel injury by CECT will be smoother. 2D and 3Dreconstructions may help in the identification of intestinal thickening, free air near the area of injury, and free fluid between loops of intestine.

**4. Diagnostic Tapping (Four Quadrant Tap) [15]:-**

This is a supplemental rapid test but sometimes this test may be omitted by surgeons and proceed immediately with peritoneal lavage. Under local anaesthesia, and by an aseptic technique, all the four- quadrants of the abdomen are tapped by a wide bore 18 G needle. If aspiration is negative the test is repeated after taking the needle out and after rolling the patient towards the impact of the suspected injury. If aspiration is still negative, the test can be repeated in an hour or two, or Diagnostic Peritoneal Lavage (DPL) can be tried as described below. Blood in a hemoperitoneum is usually defibrinated and does not clot. But this may not so in some cases. Hence a negative result does not rule out an abdominal injury. Sometimes urine (from a ruptured bladder), cloudy or bile stained fluid or pus (in primary peritonitis) may be aspirated. The aspirate thus obtained can also be examined after Gram staining (for bacteria, leucocytes, or food).

**5. Diagnostic Peritoneal Lavage (DPL) [15,17]:-**

DPL was introduced by Root et al in 1965. In hypotensive or unresponsive blunt trauma patients, without any obvious indication for abdominal exploration, DPL can be used to identify intra-abdominal injuries[23]. A peritoneal dialysis catheter or an 8 – 10 Fr polyvinyl urethral catheter is used. The bladder is emptied by an indwelling catheter and 1% lignocaine and adrenaline are used to infiltrate the midline for approximately 3 cm below the umbilicus. A small midline sub umbilical incision is

made through skin and subcutaneous tissue over a length of about 3 cm. Hemostasis is secured and the Linea alba incised to expose the extra peritoneal fat. The peritoneum is then grasped with two forceps and a purse string suture inserted circumferentially around these. A 2-3 mm incision is made in the peritoneum and the peritoneal dialysis catheter inserted down into the pelvis, drawing the purse string suture tight as this is done. If blood enters the catheter immediately no more investigation is necessary and except to proceed to exploratory laparotomy or other diagnostic modality depending on the physiological state of the patient. Otherwise, 1 litre of isotonic saline or Hartman's solution is run in through the catheter from a routine infusion set over a period of a few minutes. The empty bottle or pack is placed on the floor and the lavage fluid allowed to reflux by gravity[24]( as shown in fig 11).

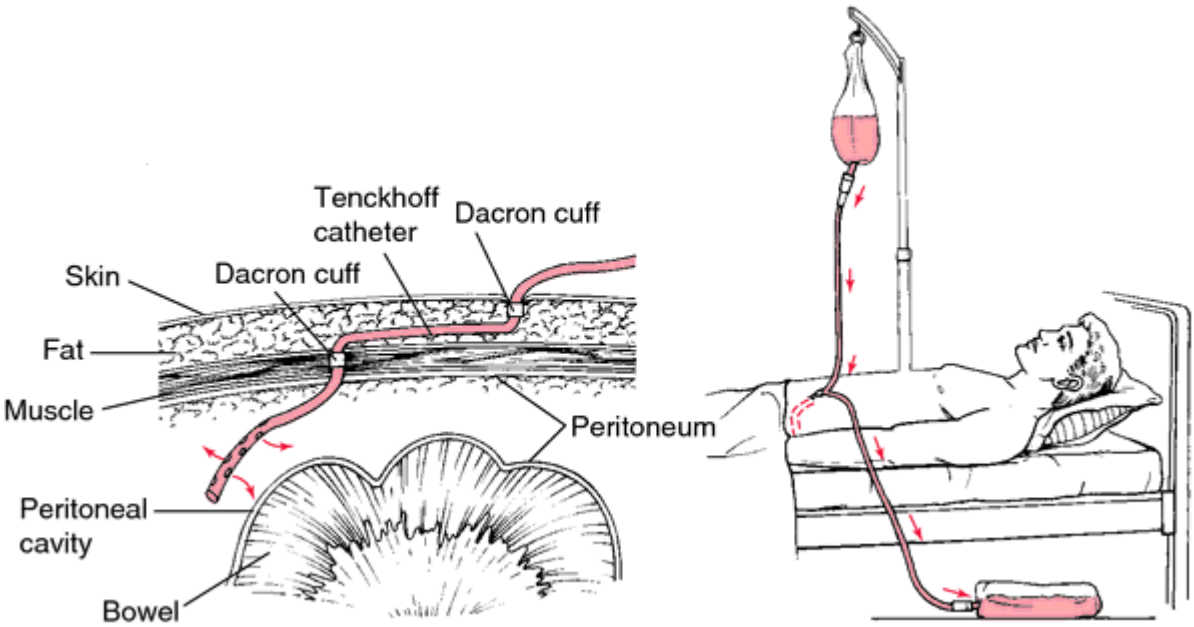



**Fig 11: Diagnostic Peritoneal Lavage**

Lavage strongly positive: If the refluxed fluid is red and opaque or if print cannot be read through the tubing of the bag or flask then an exploratory laparotomy is mandatory

Lavage weakly positive: If the refluxed fluid is pink or merely a tinge of color and print can be read through it then clinical observation, and, if available, more complex investigations should be carried out. Retroperitoneal hematoma is the most common cause of "weak positive".

Lavage negative: If the refluxed fluid is crystal clear then the patient is observed clinically for 24 hours.

Other indications of a positive lavage are bile or bowel content and lavage fluid appearing in the chest drain or urinary catheter. In doubtful cases the catheter should be left in situ and the procedure can be repeated 4-6 hrs later. Standard criteria for positive DPL result in blunt injury include aspiration of at least 10 mL of gross blood, a bloody lavage tapping, a RBC count greater than 100,000/mm3, a WBC greater than 500/mm3 (this is equivalent to 20ml of free blood in the abdominal cavity), Amylase level excess of 175 IU/dL, or detection of bile salts pigments, bacteria, or food particles. Drainage of lavage fluid via a chest drain indicates penetration of the diaphragm. Although DPL has largely been replaced by focused abdominal sonar for trauma (FAST), it remains the standard in many institutions where FAST is not available or is unreliable.

Outcomes of Peritoneal Lavage

Laparotomy required

1. RBC > 100 000/mm3

2. WBC > 500/mm3

Indeterminate

1. RBC 50 000 – 100 000/mm3

2. WBC 100 – 500/mm3

Non-operative management depending on circumstances

1. RBC < 50 000/mm3

2. WBC < 100/mm3

Indications

1) Equivocal physical examination
2) Unexplained shock or hypotension
3) Altered mental status (closed skull injury, drugs, etc.)
4) General anaesthesia for other operative procedures
5) Spinal Cord injury

Contra-indications

1) Clear- indication for exploratory surgical management

Relative Contra-indications

1) Previous exploratory surgical laparotomy
2) Pregnant ladies
3) Obese individuals

**Radionuclide imaging[25]:-**

This non-invasive, screening procedure uses radioactive isotope. Here patient are exposed to minimal radiation exposure thus procedure can be repeated safely. Disadvantages includes:- expensive, limited availability, need of expert radiologist for interpretation.

**Arteriography[17]:-**

Arteriography is an invasive procedure which was an important investigation before the advent of CT scan and ultrasound. Therapeutic embolization can be performed whenever required. Contraindications:- patient who is planned for laparotomy, hemodynamically unstable patient or allergic to the contrast agent. The main advantage is to prevent negative laparotomy and selective therapeutic embolization.

**Laparoscopy or diagnostic laparotomy[25]:-**

This is the best mode for the diagnosis of blunt trauma abdomen. It has distinct advantage over a other modes because it provides visualization of the site and extent of bleeding.

## MANAGEMENT OF INDIVIDUAL ORGAN INJURIES

### LIVER INJURIES [26, 27]:

The liver is the second most commonly injured organ after spleen in all patients with blunt trauma abdomen patients.

Table No.- 1 AAST Grading of liver injuries [28]

| *Grade* | *Injury description* |
|---|---|
| I. | Subcapsular haematoma of less than 10% of surface area<br>Laceration of less than 1cm in depth |
| II. | Subcapular haematoma of 10-50% of surface area<br>Intraparenchymal haematoma of less than 10cm in diameter.<br>Laceration of 1 to 3cm in depth and more than 10cm long |
| III. | Subcapular haematoma more than 50% or expanding haematoma<br>Intraparenchymal hematoma more than 10cm or expanding haematoma.<br>Laceration of more than 3cm in depth. |
| IV. | Parenchymal disruption of around 25 to75% of hepatic lobe or 1 to 3 couinaud's segments within a single lobe. |
| V. | Parenchymal disruption of more than 75% of hepatic lobe or more than 3 couinaud's segments within a single lobe. |

| | |
|---|---|
| | Juxtahepatic venous injuries i.e., retrohepatic venacava/central major hepatic veins injury |
| VI | Hepatic vessel avulsion. |

**Clinical presentation:**

Patient with hepatic injuries present with history of trauma and impact of injury over the right hypochondrium, abdominal pain, bruise over the right hypochondrium or right lower chest wall and with features of hypovolemic shock. The one with severe hypotension will have marked abdominal distension and non responsive to initial resuscitation by the IV fluids or blood and blood products. The one with minor injuries, bleeding might have stopped by the time they reached to the trauma centre. Hence wide variety of diagnostic modalities available to grade the injury and to plan the management which includes:-.

**Investigations**[29]:

1. Diagnostic peritoneal lavage (DPL): A positive peritoneal lavage will be considered when 10ml of blood aspirated or RBC of > 1,00,000/cumm or WBC >500/cumm in the aspirated irrigant. These days DPL is replaced by FAST scan in the most of the centre.
2. CECT abdomen and pelvis: CECT abdomen is the gold standard imaging for patients with BTA. It helps in grading the injury and thus helps in further plan of management. When most of the hemodynamically stable patients are opted for non-operative management, thus it is important to know about the degree of liver injury.
3. FAST: FAST scan is used to look for perihepatic collection which in the setting of trauma highly suggestive of the hemoperitoneum. It is one of the adjuncts to primary survey these days in most of the advanced trauma centre.

4. Radio isotope scanning will show filing defects in the hepatic substance due to intra-hepatic hematoma.
5. Arteriography: It is an invasive procedure. It helps outlining the intra-hepatic hematoma, and extravasation of dye or expanding hematoma is indicative of emergency laparotomy. Same information can be obtained by non-invasive procedure like CECT abdomen thus it is reserved only for evaluation of post-operative haemorrhage and haemobilia or thromboembolisation is planned.

**Management[30,31]:**

**Resuscitation:**

Most of the mortality that happened in patients with liver injuries is during preoperative phase due to hypovolemic shock secondary to inadequate resuscitation. Thus resuscitation of such patients after primary survey is the key for better outcome.

Thus resuscitation starts with securing two large bore IV lines preferably in the upper extremities, followed by transfusion of 1 litre of warm crystalloid and type specific blood if required and early operation for non-responder for control of ongoing haemorrhage.

Indications for exploratory laparotomy includes:

1. Hemodynamically unstable patient irrespective of grade of liver injury.
2. Patients who are planned for conservative management but develop following mentioned:

a) Deterioration of vitals or continuing need for blood transfusion

b) Increased abdominal pain, abdominal girth or new onset of peritonitis signs.

c) Progressive expansion of the hematoma as documented by CECT abdomen and

d) When intrahepatic or subcapsular hematoma got secondarily infected and considered as septic focus.

**Principles of operation:**

*Incision*: Midline incision.

*Initial evaluation*: The presence of blood and clots in the right upper quadrant indicative of hepatic injury. B/L flank and pelvic should be packed with mop to remove the blood and clots and then liver should be inspected for the laceration of the hepatic substance or any active bleed from the liver and tried to control the bleed by following undermentioned technique..

**Management of actively bleeding liver [32]:-**

Following mentioned techniques are used for the control of haemorrhage:

**Manual compression:** It is the first lifesaving manoeuvre attempted by the surgeons which includes compressing of the right and the left margins of the liver towards the centre alongwith posteriorly directed force may help in controlling bleeding in the retro hepatic surface and posterior perihepatic space.

**Portal triad occlusion:** The Pringles manoeuvre should be attempted to stop hepatic bleeding by means of artery occlusion. In this manoeuvre the left thumb is placed on the anterior surface of the hepato-duodenal ligament and the middle and index finger inserted into the foramen of Winslow and the structures in the porta hepatis are compressed. This can be performed using a vascular clamp or a Rumel torniquet. The upper limit of normothermic occlusion of the liver is not known accurately but can be extended up to one hour.

**Selective hepatic artery ligation:** It is indicated when injured vessels cannot be identified inside the liver and selective clamping causes cessation of arterial bleeding in the hepatotomy site or parenchymal laceration. Either of the right or the left hepatic

artery is ligated. Prophylactic cholecystectomy should be done to prevent gangrenous cholecystitis following right hepatic artery ligation.

**Perihepatic packing:** The involves packing pads or rolls of gauze around the injured liver i.e. between the diaphragm and the liver, below the liver and laterally until sufficient pressure is generated to achieve haemostasis.

Excessive packing should be avoided because it may compromise cardiac inflow from the IVC. When packing is on a raw surface, a small steri-drape is placed between the packs and the liver. This prevents disruption of haemostasis when the pack pads are removed during re-exploration. Closed suction drains are placed and the patient is transferred to the intensive care unit.

When patient is hemodynamically stable, acidosis, patients should be taken up for definitive surgery which is performed usually after 24 hours but within 72 hours of DCS.

**Surgical clamps:** the various surgical clamps are used which are broadly classified into two categories:

1. Occluding, non-crushing clamps and
2. Crushing clamps.

These clamps are used to occlude the bleeding vessels from the hepatic substance or other ligaments thus providing bloodless field to proceed for the surgery.

**Liver suture:** It is an adjunctive procedure. While performing liver suture one must take care of obliterating the dead space in order to avoid abscess formation or hemobilia. Ideally liver sutures should be placed parallel to the lacerated wound in order to control the bleeding by compression of the hepatic substance and leaving the wound open thus permitting adequate drainage of the wound. It is done by an

absorbable suture on a large, curved blunt tipped needle. Either figer of 8 or simple suture should be put. This mode is effective in controlling bleed from a grade III onward laceration.

**Resection:** Resection should be done to remove devitalized hepatic substance**.** This results in defect which usually does not require any closure. This is usually performed for case of avulsion injury (Grade IV) most often involving the right lobe of the liver. This can also be performed for the injuries involving lateral segment of the left lobe of the liver (segment II and III). It is associated with high mortality rate in case of major resection. Several methods are employed for resection which includes:

1. Finger fracture technique.
2. Cavitron ultrasonic surgical aspirator(CUSA)
3. Water jet knife.
4. Laser knife
5. Suction knife
6. Micro wave tissue coagulation

**Omental packs:** Stone and Lamb (1975) was first who used omentum for packing of the lacerated wound in case of liver injuries The omentum can be mobilized from left to right of the transverse colon to achieve large segment of omentum for packing. Then omentum is fixed by placing suture around the wound thus helping in eliminating the dead space as well as achieves haemostasis by compressing small vessels.

**Mesh hepatorraphy:** The goal of this procedure is to achieve hemostasis by wrapping the liver all round using a absorbable in a fashion to compress the liver and to achieve haemostasis. This is employed for grade III and grade IV and lobar tears.

**Post-operative course:** Following major hepatic resection, there may be deficiency of (i) coagulation factors, (ii) hypoglycaemia and (iii) hypoalbuminemia due to decreased volume of liver. Hence this should be corrected by infusion of 10% glucose or 25% dextrose, coagulation factors and salt free albumin.

**Post-operative complications:**

1. *Post-operative haemorrhage/ hemobilia:* It is an immediate post-operative complication which can be either due *to* inadequate haemostasis or coagulopathy. Bleeding secondary to coagulopathy should be corrected by transfusing fresh frozen plasma and platelets.

   For hemodynamically stable patient with haemorrhage, patient should be taken up for the surgery and wound should be explored to look for bleeding vessels and should be occluded. If the patient is hemodynamically unstable to tolerate a laparotomy, such patient should be considered should for angiography and selective embolization of the bleeding vessel. Haemobilia should be considered for patient who had bleeding after a period of post-operative stability and it usually reflects of a pseudo aneurysm. The classical triad of hemobilia includes (i) gastrointestinal bleeding, (ii) right upper quadrant pain and (iii) jaundice.

2. *Intra-abdominal abscess:*

   Persistent fever with tachycardia and rising total leukocyte count with evidence of sepsis indicative of abscess formation in and around liver. CECT is the imaging modality of choice to diagnose such condition. Treatment option includes percutaneous drainage usually USG guided or surgical drainage when safe window for percutaneous drainage is not available.

3. *Hyperpyrexia:*

The exact cause for the hyperpyrexia is still unclear considered to be secondary to reabsorption of the devitalized tissue. Usually it resolves in first 3-5 days of surgery. Persistent fever highly suggestive of either pulmonary or intra-abdominal sepsis.

4. *Biliary fistula:*

A persistent biliary leak following surgery is an indicative of a missed intra hepatic disruption of a biliary duct. Normally all biliary fistulas closes by its own within 6 weeks if there is no distal obstruction. The site of the fistula can be established by (i) HIDA scan, (ii) fistulogram or (iii) cholangiography. If case of major disruption of intra hepatic duct, reoperation with resection of the involved lobe or an intra hepatic Roux en Y hepatico-jejunostomy should be performed.

**Non operative approach [33,34]:**

Non operative management for hemodynamically stable patients is standard of care in many trauma centre these days. Following are the criterias for the non-operative management:

1. Grade I to III injury (As per AAST grading system)
2. No evidence of expanding hematoma.
3. Blood requirement of less than 40ml/kg in children and 20ml/kg in adults.
4. No other indications for surgery.
5. Easy access to CT scan and operation theatre.
6. Availability of surgeon/radiologist/anaesthetist.

Non operative management includes strict bed rest and repeated physical examination by the same surgeon. Complete haemogram should be done $12^{th}$ hourly. USG should be done daily to look for expanding hematoma. The patient should be continued for the bed rest for a period of 5-7 days and then discharge to home for further bed rest for 4 weeks. After 4 weeks CT scan has to be repeated as by this time 95% of lesion would have healed. Individual is then permitted to return to his previous profession. Sports should be forbidden for minimum of 3 months.

An indication for laparotomy during the period of observation includes[35]:

1. Continuing need for blood or blood products transfusion or deterioration of vital signs.
2. Increasing abdominal girth and signs of peritonitis.
3. Progressive expansion of the hematoma in CT or USG.
4. Hematoma considered as a septic focus.

**Biliary tract trauma [36]:**

Biliary tract injuries often associated with trauma to pancreas and duodenum thus complicating its treatment. The most frequently injured is CBD. The most common site is the point of transition between the flexible portion of the CBD within the hepato-duodenal ligament and the fixed portion of the duct within the pancreas. If major intra hepatic bile duct injury is suspected, an intra operative cholangiogram can be diagnostic.

*Treatment*:

1. If associated with gall bladder injury- cholecystectomy
2. Extra hepatic bile duct transection is treated by insertion of a T tube through a separate choledochotomy followed by repair of the duct.
3. For complete transection, direct anastomosis over a T tube can be done.

4. Long segment of a duct injured- choledocho-enteric anastamosis.
5. In hemodynamically unstable patient who cannot tolerate definitive reconstructive surgery a external fistula can be created by inserting a catheter in the proximal segment.

**Injury of the hepatic artery and portal vein [37]:**

Injuries to the hepatic artery and portal vein should be repaired if possible. Survival after hepatic artery ligation is well documented. If ligation is proximal to the cystic artery, the gall bladder should be removed to prevent gangrenous cholecystitis. The ability of the liver to the tolerate ligation of the portal vein is less well recognized. If irreparably damaged, ligation is preferable to a porto-caval shunt or an attempt at repair that seriously compromises the lumen of the vessel. If both the portal vein and the hepatic artery are damaged beyond the possibility of primary repair, flow must be established through one of the vessels. This may necessitate a vein graft as an interposition or a conduit from another source.

**SPLENIC INJURIES [38,39]:**

Spleen is the most common solid organ to get injured in BTA.

Spleen is more susceptible for injury in BTA because of soft in consistency, its location just below the $9^{th}$ to $11^{th}$ ribs and tendency for splenomegaly for various diseases.

Table No:- 2 AAST grade of Splenic injury [40]:

| *GRADE* | *INJURY DESCRIPTION* |
|---|---|
| I. | Subcapsular and non-expanding haematoma of less than 10% of surface area. |
| | Laceration of less than 1cm in depth. |
| II. | Subcapsular and non-expanding haematoma of 10-50% of surface area, Intraparenchymal and non-expanding haematoma of less than 2 cm in diameter |
| | Capsular tear with active bleeding. |
| III. | Subcapsular and expanding or reptured haematoma of more than 50% surface area, or Intraparenchymal hematoma of more than 2cm or Expanding haematoma. |
| | Laceration of more than 3cm in depth or involving trabecular vessels. |
| IV | Ruptured intraparenchymal hematoma with active bleeding. |
| | Laceration of segmental or hilar vessels producing major devascularisation (>25% of spleen) |
| V | Completely shattered spleen. |
| | Hilar vessel injury leading to devascularisation of spleen. |

**Clinical manifestation:**

Patient with splenic injury either succumb to death by the time they are brought to the trauma centre because of massive haemorrhage or patient will be presented with signs of hypovolemic shock or respond to the initial resuscitation for hypovolemic

shock and again deteriorate or patient will be having normal vitals for few days and then sudden deterioration of the general condition secondary to delayed bleeding.

The following investigations are used to evaluate the patient with splenic injury:-

**Ultrasound:** Being non invasive and rapid investigations it is used for the evaluations of the hemoperitoneum in the trauma centre. in expert hand grade of injuries can be assessed to high degree of accuracy. It is used to for follow up for the patients who are planned for the conservative management.

**Radioisotope scanning:** It is used for when patient is hemodynamically stable with high accuracy in diagnosing the spleen injury. CT has replaced it but it has its own advantage over CT which includes its feasibility for uncooperative and restless patient with minimal risk of contrast reaction.

**Angiography:-** It is an invasive procedure and takes more time for the final diagnosis thus its not suitable for hemodynamically unstable patient. Moreover its is observer dependent like USG thus expert radiologist is required for the same. This can be performed when therapeutic embolization is planned.

**Contrast enhanced CT** has high accuracy in diagnosing solid organ injury. Moreover it also helps in the grading of the injury thus in turn helps in the further management. But the disadvantage of the procedure is that it takes long time for the study and experienced radiologist is required to interpret the result and not widely available in the entire centre.

**Diagnostic Peritoneal Lavage:-** It is and invasive procedure which can be performed bedside even in hemodynamically unstable patients. But the disadvantage is it cannot predict the grade of injury. It has been largely replaced by the FAST scan in most of the trauma centre.

**Management[41]:**

**Preoperative management**:

Patient should be resuscitated adequately with warm crystalloids or blood if available or else blood should be arranged before surgery.

**Grade I injuries**: If diagnosed preoperatively then patient can be managed conservatively. If patient diagnosed to have grade 1 injury, either by tamponade effect with a dry sponge or topical application of haemostatic agents are sufficient for the control of bleeding.

**Grade II injuries**: Again such patients can be managed by use of topical haemostatic agent like gel foam or microfibillar collagen or by tamponade effect bleeding can be stopped. If persistent bleed then splenorrhaphy has to be performed by using monofilaments like chromic catgut and polypropylene

**Grade III injuries**: All the clots and devitalized tissue should be removed and the wound should be explored for any active bleed and if any active arterial bleed is found that should be stopped by using suture followed by approximation of the edges in such a way that dead space should be obliterated.

In case of expanding hemotoma in the CT, such hematoma should be explored and bleeder should be identified and ligated using the suture and the dead space should be closed by suturing of the wound or by wraping with polyglycolic acid mesh.

**Grade IV injuries:** These include segmental or partial splenectomy in case of segmental devascularisation. The raw area left behind should be wrapped with omental pedicle or mesh to achieve the haemostasis. Care should be taken for ligating segmental artery only. If its failed or surgeons are not expert then we should go for splenectomy.

**Grade V injuries:** Splenectomy is the treatment of choice for grade V splenic injuries.

**Post-operative complications[42]:**

These includes:-

***Left sub phrenic abscess or effusion:*** incidence varies from 3 to 13%. It resolves slowly by regular chest physiotherapy or it has to be drained if symptoms persist.

***Thrombocytosis:*** It is one of the common complications which occurs within 2 to 10 days and usually patient will have platelet count >4 lacs/cumm and it resolves by its own within 2 to 12 weeks.

***OPSI (overwhelming post splenectomy infections):*** it is defined as a fulminant bacterial illness that progress to death within 24 hours of recognition and does not always exhibit the usual prodromal infection. Symptoms include nausea, vomiting and malaise which rapidly progress to coma, hypotension and death within hours of onset.

Young age group are more susceptible for this with mortality rate almost around 50-8-%. The most common organisms which are cultured from such patients includes encapsulated bacteria such as streptococcus pneumonia, Haemophilus influenza and Neisseria meningitides. Other bacteria responsible for this are E. coli and other coliforms. Hence, it is advisable that all such patient should get polyvalent pneumococcal vaccine with haemophilus influenza type B vaccine within 1 week of splenectomy.

**Conservative management of splenic injuries [40]:**

In children splenic injuries are generally managed by conservative management with success rate of approximately 90% and the reason being haemostatic properties of the splenic capsule. It is generally attempted for the Grade I-III injuries.

These days conservative management are employed for the adults with splenic injuries if the following criteria are fulfilled:-

- Patient is hemodynamically stable.
- Low grade isolated splenic injury.
- Hemodynamically stable high grade splenic injuries.

The splenic injuries should be graded based on the CT findings. Then patient should be admitted in ICU and patient should be monitored closely for the vitals and the abdominal signs like diffuse tenderness, increased abdominal girth and diffuse guarding or rigidity. Every $6^{th}$ hourly haemogram should be repeated to look for drop in haemoglobin or PCV level. Follow up scan should be done in order to look for any expansion of the haematoma. Patient should be discharged after 7 days and should be called for regular follow up at 4 weeks and 12 weeks. Restricted activity should be asked to perform for 12 weeks.

**Stomach** [43]

Stomach injuries is most commonly seen in penetrating injuires. Blunt trauma abdomen causing stomach injury can be seen in case of motor vehicle accidents, after CPR, assault, and in case of child abuse.

The common mechanism for injury includes sudden increase in the intraluminal pressure following trauma in full stomach leading to rupture either along the greater curvature or on the anterior surface. In CPR, the injury happened due to direct compression of the stomach against the vertebral column. In case of rapid deceleration shearing force developed in the wall of the stomach at the GE junction leading to the stomach injury.

**Diagnosis:** Patient may have signs of peritonitis which give a clue for the hollow viscus injury. After passing nasogastric tube if the blood comes through the blood that

will confirm the diagnosis of upper GI bleed. NG tube further aid in decompressing the stomach. On chest x-ray, patient may or may not have air under diaphragm. DPL will show gastric contents. Further higher radiological investigations like CT may not be required**.**

**Management[44]:**

Prophylactic antibiotic should be started. After initial resuscitation of the patient should be shifted to OT without any delay. Laparotomy should be performed by midline incision by keeping in consideration to minimize wound contamination by the gastric content. Wound should be closed in two layer. Peritoneal lavage should be given. Entire of the stomach should be inspected especially OG junction and other associated injuries.

**Complications:** includes intraperitoneal abscesses, disruption of gastric repair, enterocutaneous fistula formation, missed injuries, bleeding and obstruction of gastro esophageal junction or pylorus surgical site infection, incisional hernia.

**Duodenum [45,46]:**

Duodenal injury following BTA is rare and the reason being its retroperitoneal location in the abdomen. Morbidity and mortality associated with it is high because of delayed diagnosis. Following direct blow to the abdomen by steering wheel in case of RTA, a force will be generated between duodenum and vertebral column known as crushing injury leads to duodenal injury.

In case of seat belt injury a closed loop obstruction developed between seat belt and the vertebral column leading to increase in the intraluminal pressure known as bursting injury that leads to the duodenal injury.

Another mode of injury is where shearing force generated within the muscular layer of the duodenum leading to disruption of the blood vessels and submucosal

bleeding which is more commonly seen in case of children, patients with coagulopathies and alcoholics.

Duodenal injuries accounts for 4.3% of BTA with mortality ranging between 13 and 28%. Morbidity associated with high chance of developing fistula with incidence of 2-14%.

Duodenal injuries often associated with other injuries and thus pose a great challenge for the management. Most commonly seen in case of 2nd part of duodenal injury which shares blood supply to the pancreas and hence not amenable to sound repair.

As it is fixed between two fixed point i.e. ligament of Trietz and portal triad thus more amenable for the deceleration injury.

Organs more susceptible for the injury alongwith duodenum are:- (a) Liver, (b) pancreas, (c) small bowel and (d) colon.

**Diagnosis:** Duodenal injury should be suspected for the patient who had impact of injury to upper abdomen either by the steering wheel or seat belt with abdominal symptoms out of proportion to the signs. Patient may develop signs of peritonitis later on.

Following mentioned investigations helps in arriving to diagnosis [11] :

1. Estimation of the serum amylase which is sensitive in this injury, is raised in approx. 50% of duodenal injuries.
2. DPL or four quadrant aspirate will often show bile or bowel contents in aspirate. A negative aspirate will not rule out duodenal injuries.
3. Erect abdomen x-ray or chest x-ray may show air under diaphragm, retroperitoneal or biliary tree will show air.

4. Upper GI study with water soluble contrast like gastrograffin is another way to rule out duodenal injury.
5. CECT abdomen will show retroperitoneal gas and extravasation of the contrast from the duodenum.

Severity of the duodenal injury is graded based on the following parameters[47] :-

Table 3:- Severity of Duodenal injury

| Parameters | Mild | Severe |
|---|---|---|
| Agent | Stab | Blunt or missile |
| Size | Less than 75 % of wall | More than 75% of wall |
| Site | Third and fourth part of duodenum | First and second part of duodenum |
| Injury-surgery interval | Less than 24 hrs | More than 24 hrs |
| Associated injury | No common bile duct injury | Common bile duct injury |

**Treatment:**

Retroperitoneum hematoma in right upper quadrant should be explored to rule out duodenal injury.There are different signs which indicate for the exploration to rule out duodenal injuries which are as follows:-(a) staining of the lateral margin of the duodenum by the bile or presence of crepitus along the lateral margin of the duodenum, (b) petechiae or fat necrosis in the right upper quadrant which includes right mesocolon or retroperitoneum, (c) phlegmon formation or discoloration in retroperitoneum. Under such condition duodenum should be mobilised by doing Kocher manoeuvre and duodenum should be explored up to its fourth part.

Duodenorrhapy is sufficient in 70-85% of the cases. Either single or double layer transverse

closure should be performed. A single layer closure technique known as Weinberg will be helpful in preventing narrowing of the lumen particularly near the pylorus. The drain should be kept in order to drain periduodenal area.

Patient with more than 50% of injuries generally pose a great challenge for its repair as primary closure will lead to narrow lumen. Thus in such condition its preferable to do resect the devitalized portion and anastomosis of the two end with better result provided the transacted end should not be near ampulla of vater.

Another method of treating large duodenal injury is jejunal patch repair.

Other methods include duodeno-jejunostomy if pancreas is not involved or pancreaticoduodenectomy if pancreas involved in the injury with pyloric exlusion if there is concern that pancreatic enzymes won't let the repair to heal.

For patient with intramural hematoma of duodenum, treatment modality is conservative with NG suctioning, IV crystalloids support and parenteral nutrition id required. Most of the cases improved by 5 days. Indication of surgery in such case includes signs of perforation.

**Pancreas** [48,49] :

Pancreatic injury have low incidence in abdominal trauma ranging from 3-12% and BTA constitute about 1/3$^{rd}$ of the total incidence. Isolated pancreatic injury is uncommon because of its proximity to other vital organs. For example trauma to the head of pancreas often associated with the duodenal or liver or other vascular injury. Similarly trauma to the body associated with transverse colon injury and tail of the pancreas trauma associated with splenic injury.

**Mechanism of injury:** Similar to the duodenum, crushing force between steering wheel and the vertebral column leads to pancreatic injury as seen RTA. It is diagnosed with high suspicion when patient will have epigastric pain which is more than abdominal signs.

**Classification of pancreatic injuries** [49]**:** This is shown in Table 4

Table No.- 4 Classification of pancreatic injuries

| Type | Definition |
|---|---|
| 1 | laceration and contusion of pancreas without ductal injury |
| 2 | Transection of the distal pancreatic parenchyma with involvement of the duct |
| 3 | Transection of the proximal pancreatic parenchyma with probable duct involvement |
| 4 | Pancreatic injury associated with duodenum with intact ampulla and blood supply |
| 5 | Massive injury including ampulla injury with devascularization. |

**Diagnosis [50] :**

Such patients generally present late mostly after 12 hours of injury and reason being its retroperitoneum location thus masking the signs of peritonitis and it has tamponading effect which prevent from more blood loss. Again such patients will have more symptoms than abdominal signs.

**Serum amylase**: It is non-specific test and generally its value will be raised at the time of admission. Further increase in the amylase level after 24 hours with high suspicion of the pancreatic injury proves to be diagnostic.

**Computed tomography:** helps in diagnosing this condition with high level of sccuracy and it also help in predicting the level of injury and helps in grading the injury thus plays a vital role in the management. DPL will be negative because pancreas is a retroperitoneal structure.

**Laparotomy:** is the best and reliable method of making accurate diagnosis.

**Management [50] :**

Basic principles involved in pancreatic injury management includes:

1) Haemorrhage and contamination should be controlled.

2) Debridement of dead pancreatic tissue.

3) Preservance of around 20-50 percent of functional pancreatic tissue.

4) Adequate internal or external drainage.

Management is based on the following findings :

1) Involvement of surrounding structure especially duodenum.

2) Type of pancreatic injury.

3) Integrity of the MPD and ampulla.

**Type I:** .

It accounts for 60% of all pancreatic injuries. Treatment for type I is achievement of hemostasis with external drainage Any attempt for suturing of the capsular laceration leads to pseudocyst thus draining it as controlled fistula is considered better option as such fistula is self limiting low output fistula which closes by 2 weeks.

**Type II and III injuries:** treatment for type II and III includes distal pancreatectomy with or without splenectomy. The distal end of the remaining duct should be closed either by figure of 8 or U stitch by using non-absorbable suture. The parenchymal raw area is closed by either mattress suture placed between anterior and posterior capsule or by using omental patch to buttress the raw area.Drain should be kept behind the transacted area

Arround 80% of the pancreatic tissue can be resected before keeping patient at risk of endocrine insufficiency and diabetes.

**Grade IV and V injuries:** Such patient has ductal injury to the right of the SMV.

Trauma to the head and neck, without pancreatic duct injury, are managed by external drainage. As pancreatectomy involving around 80-90% of the tissue will lead to endocrine insufficiency

thus for such case internal drainage should be established b Roux-en-Y distal pancreato jejunostomy either end to end or end to side method.

An Onlay Roux-en-Y method used for the head injury with duct disruption.

When pancreatic head injury associated with duodenal injury, treatment of choice will be duodenal diversion which can be achieved by 1) pyloric exclusion and 2) duodenal diverticulization.

Pancreaticoduodenectomy: associated with high incidence of mortality ranging from 30 -40% thus used for very severe injury. The incidence of performance of this procedure in the setting of trauma is approximately 2%.

**Complications:** Morbidity associated with pancreatic injury is very high and complications rate varies from 30 to 64%.

**Fistula:** Fistula is the most common complication with incidence ranging from 7 to 20% . Most of the pancreatic fistula closes spontaneously by conservative management which includes good drainage, replacement of lost fluid and supplementing KHCO3, Zn and Mg. Even somatostatin analogue like octreotide prove to be beneficial for controlling the fistula output which is given either SC or IV infusion along with TPN. If surgery is required, a Roux-en-Y loop to the offending areas is the option available.

**Abscess:** incidence varies from 10 to 25%.it can be diagnosed by USG abdomen and CT abdomen. Treatment option available is either percutaneous drainage or re operation. It carries high mortality if not diagnosed and drained early.

**Pancreatitis:** one of the common and serious complication which is associated with high incidence of mortality. The treatment is similar to other cause of pancreatitis i.e. IV fluid and analgesic with or without antibiotic coverage and somatostatin analogue.

**Death:** It is associated with high mortality rate and varies from 3-32%..

**Small bowel injuries [51,52] :**

Small intestine is the third most common injured organ after spleen and liver in BTA and the most common in penetrating injury. The incidence of small bowel injury varies from 5-15% and it depends on geographic location and socioeconomic status. Its injury occur following different mechanism as mentioned below[53]:

**Crushing injury:** In seat belt injury a force will be generated between the seat belt and vertebral column leading injury of the small bowel. It is associated with mesenteric tear or disruption or may be associated with other organ injury**.**

**Shearing injury**: this is seen in case of sudden deceleration when small bowel get avulsed from the fixed point causing small bowel injury with or without mesentery.

**Bursting injuries:** This is seen in case of blind loop bowel when intraluminal pressure abruptly increases leading to small intestine injuries.

Small bowel injury scale is as follows :

Table No.5- Grading of small bowel injury

| Grades | Injury description |
|---|---|
| 1 | Hematoma:- Contusion or intramural hematoma without devascularisation<br>Laceration :- Partial thickness of small bowel without perforation |
| 2 | Laceration:- less than 50% circumference involved |
| 3 | Laceration:- more than 50% circumference but no complete transection |
| 4 | Laceration:- Complete transection of small intestine |
| 5 | Laceration:- Complete transection with tissue loss<br>Vascular:- Devascularisation of segments. |

**Diagnosis :** Its diagnosis often got delayed in case of polytrauma and the reason being altered sensorium where clinical signs are masked and small leak of the intestinal content taking time to develop peritoneal signs.

Generally patient will present with pain abdomen and signs of peritonitis i.e. diffuse tenderness, guarding and rigidity following BTA that gives a clue for hollow viscus injury. Erect chest x-ray if patient if is conscious or lateral decubitus will show presence of air under diaphragm in 20 to 50% of patients.

**Diagnostic peritoneal lavage** DPL will be positive for intestinal content or estimation of alkaline phosphatase in the aspirate also shows small bowel injury. Negative DPL doesn't rule out small intestine injury.

USG will show free fluid in the peritoneum which on aspiration will show intestinal content. CECT is the most sensitive for the small bowel injury. Whenever in doubt best mode of diagnosing is exploratory laparotomy.

**Management :**

The only treatment for small bowel injury is exploraty laparotomy where abdomen is opened by midline incision and whole of the small bowel should be inspected from the ligament of Trietz to IC valve along with its mesenteric attachments.

**Perforations:** Treatment for small perforation is primary closure in two layer using absorbable suture for the inner layer and silk for the outer layer. In case of multiple perforations its pereferable to do resection and anastomosis but if its involving terminal ileum i.e. 15cm from the IC valve then we should go for ileocolic end to side anastomosis. Whole peritoneal cavity should be irrigated with warm saline and drain should be kept.

**Mural damage without perforation:** In this case decision should be taken on table. If viability of the intestine is not in doubt by assessing the peristaltic movement and colour and area of

hematoma is less than 1 cm then that segment should be turned in by multiple interrupted suture. If viability is in doubt then better to go for the resection and anastomosis.

**Mesenteric hematoma:** Management will depend upon the size and stability of the hematoma i.e expanding or non-expanding hematoma.

During exploration, mesentery should be examined for the site, size of hematoma and the corresponding bowel. Hematoma should be explored and the bleeding vessels should be identified and ligated using silk. Bowel should be inspected to look for viability and dealt accordingly. In case of large hematoma at the base of mesentery where viability of the bowel is in doubt, either we should go for vascular reconstruction or re laparotomy.

**Complications:** These includes:- (i) missed injury, (ii) haemorrhage, (iii) anastomotic leak, (iv) entero-cutaneous fistula, (v) obstruction and (vi) abscess formation etc.

We can avoid missed injury by inspecting the small bowel to its whole length along with the inspection of the mesentery.

**Anastomotic leak and fistula formation :** If the patient condition deteriorate despite of aggressive management then anastomotic leak should be suspected which will be confirmed by increased drain output. In such condition it's better to go for re laparotomy and excising the devitalised tissue and performing anastomosis between healthy ends. Sometimes due to inflammation tissues will be very friable so temporary ileostomy or jejunostomy is the treatment of choice. Rarely entero-cutaneous fistula formed post operatively which will heal spontaneously if there is no distal obstruction.

**Colon and rectal injuries [54]:**

Colorectal injury is very rare in BTA constituting around 4% to 6%

**Mechanism of injury:** The mechanism of injury remain same as of the small bowel injury which involves crushing injury between vertebral column and the seat belt or bursting injury or bowel injury secondary to deceleration injury. Other mechanism include pelvic fracture where

bony spicules leads to perforation. Mortality rate varies from 3% to10%.

The extra peritoneal rectum injury is often associated with pelvic fracture because of its fixity to the pelvis. The site for intraperitoneal injury is usually between the junction of the mobile and fixed portion such as junction of the sigmoid and descending colon. Mesentery injury leads to bleed. Injury to the bowel may lead to either intramural haematoma or laceration which may be partial or complete.

Table no.- 6: Colon injury scale [56] :

| *Grade* | *Injury description* |
|---|---|
| 1 | Hematoma:- Contusion or intramural hematoma without devascularisation<br>Laceration :- Partial thickness of colon without perforation |
| 2 | Laceration:- less than 50% circumference involved |
| 3 | Laceration:- more than 50% circumference but no complete transection |
| 4 | Laceration:- Complete transection of colon |
| 5 | Laceration:- Complete transection with tissue loss<br>Vascular:- Devascularisation of segments. |

Advance one grade for multiple injuries upto grade III

Table no-7: Rectum injury scale [56] :

| *Grade* | *Injury description* |
|---|---|
| 1 | Hematoma:- Contusion or intramural hematoma without devascularisation<br>Laceration :- Partial thickness of rectum without perforation |
| 2 | Laceration:- less than 50% circumference involved |
| 3 | Laceration:- more than 50% circumference but no complete transection |
| 4 | Laceration:- Complete transection of rectum |
| 5 | Laceration:- Complete transection with tissue loss<br>Vascular:- Devascularisation of segments. |

**Diagnosis of the injuries[55]:**

Clinical features of colonic injury includes pain abdomen, with or without signs od peritonitis. Patient may present with feature of shock which may be due to associated injuries. On digital rectal examination there may be possibility of soiling of gloves with blood which will present injury to lower GI tract. In such condition patient should be subjected to the proctoscopy or sigmoidoscopy if patient is hemodynamically stable to arrive at diagnosis. On chest x-ray air under diaphragm will be seen. USG abdomen will reveal intraperitoneal collection which on tapping depict faecal matter. Whenever there is doubt better to subject the patient for CECT with rectal enema to locate for the site of injury. Majority of the time this colonic injury are identified intraoperatively.

Thus treatment for colonic injury is surgery which includes:-

(i) Primary closure without colostomy.

(ii) Primary closure with de functioning colostomy

(iii) Resection and anastamosis.

(iv) Colostomy.

**Methods of repair[56]:**

**Primary repair (simple suture):** Simple closure should be performed in two layer when <25% of circumference of the colon is involved with minimal faecal contamination and within 8 hrs of trauma.

Primary repair should not be performed under following conditions:-

(i) persistent low blood pressure

(ii) > 6 hours of delay between trauma and surgery

(iii) Gross contamination with faeces

(iv) damage to the retroperitoneal or abdominal wall.

(v) Massive haemoperitoneum

(vi) Associated visceral injuries

(vii) >25% of circumference involvement

(viii) devascularisation of segment of colon

(ix) grade 3 or more colonic injury

**Primary resection and anastamosis:** Resection and anastomosis should be performed in extensive ascending colon injury where right hemicolectomy with ileocolic anastomosis should be performed. is ideal when there are extensive wounds of the right colon. In case of hemodynamically unstable patients, ileostomy should be performed and once the general condition of the patient improves patient should be taken up for the definitive surgery. Similarly patient with extensive descending colon injury left hemicolectomy with primary anastomosis with or without colostomy should be performed.

**Colostomy:** Colostomy should be performed under following conditions:- (i)hemodynamically

unstable patient as a DCS, (ii) when primary distal anastamosis is in doubt, (iii) when low rectal anastomosis is performed.

**Exteriorization of the colon**: It is a DCS which has to be performed in hemodynamically unstable patient with small lateral incision where colon is mobilized and brought out as double barrel colostomy.

**Defunctioning colostomy:** It is performed by bringing out colon as a single end stoma.

**Closure of colostomy:** Closure of the colostomy should be performed after 6 to 8 weeks of surgery and patient should be subjected to barium enema or colonoscopy prior to surgery to confirm the patency of the lumen.

**Rectal injuries[57]:**

Blunt trauma to the rectum is one of the rare presentations and generally associated with pelvic fracture following RTA where impact of injury is over the pelvis or run over by the vehicle. The mechanism for the injury remains the same i.e. crushing injury of fractured end causing perforation of the rectum.

On DRE, gloves will be soiled with the blood. Erect abdomen x-ray will show retroperitoneal air, proctoscopy or sigmoidoscopy should be performed for visualization of the rectal injury.

Any patient with pelvic fracture and bleeding per rectum or gross blood noted on DRE or perforation of the rectum noted on proctoscopy or sigmoidoscopy should undergo surgery.

**Management:**

Patient with rectal injury should undergo surgical repair under following condition:

(i) Anorectal injury noted on proctosigmoidoscopy regardless of any associated injuries.

(ii) A suspected anorectal injuries

(iii) open pelvic fracture may or may not associated with the anorectal injury.

Its management is based on 3 D's which includes:

(a) Diversion

(b) Debridement

(c) Drainage

**Diversion:** Diversion should be performed for the patient with rectal injury above the dentate line. Diversion in the form of loop colostomy should be performed and it is considered one of the key step in the rectal injury management.

**Debridement and suturing:** Through the transanal approach, anorectal injury should be primarily repaired by continuous suture using absorbable 3-0 suture material. If sphincter muscles are injured then that should be repaired by interrupted horizontal mattress suture using 3-0 suture material.

**Drainage:** Drainage should be performed by the Penrose drain or negative pressure suction drain which has to be brought out anterior to the coccyx.

**Distal wash out:** is done by irrigating the distal colostomy stoma with diluted povidone iodine solution through the dilated anus until effluent is clear.

**Kidney, ureter and bladder injuries[59,60] :**

The mode of renal injury in BTA includes RTA, fall from height, direct blow to the loin regions by cattle in rural area and assault where kidney is compressed between $12^{th}$ rib and vertebral column leading to renal injury. Diseased kidneys are more prone for injury even with minimal trauma as seen in case of polycystic kidney. Renal injury accounts for 8-10%.

**Ischemic necrosis:** This type of injury seen in case of vascular injury where depending upon the segment of vascular involvement either segment of the kidney or whole kidney will have ischemic changes. This is seen even with expanding haematoma where due to pressure effect of the haemotma over the vascular pedicle patient will sustain ischaemic necrosis of the kidney.

**Diagnosis[60]:**

Patient with BTA will have impact of trauma over the loin with complaint of loin pain. Most common presentation will be haematuria which can be manifested after Foley's catheterization. This haematuria can be grossly evident or in some case only microscopic haematuria will be present.

So any patient who presented to the EMD with onset of pain over the loin, with increase in the abdominal girth, associated with fracture of 10-12$^{th}$ ribs with gross haematuria or microscopic haematuria following BTA, such patient should be investigated for the renal injury.

The purpose of doing investigation is to stage the renal injury and to assess the functional status of the other kidney. Following investigations are used for diagnosis:-

**Investigations:**

**Urinalysis:** will show gross blood in the urine or RBC microscopically.

**Intravenous urography:** IVU is one of the important investigation which all patient with BTA should undergo. IVU includes Plain KUB X-Ray followed by contrast study.

Following mentioned findings will be seen in the plain KUB x-ray:-

- Soft tissue shadow of hematoma or urinoma.
- Psoas outline will be lost.
- Scoliosis of the lumbar vertebrae with concavity facing traumatised kidney.
- Fracture of the 12$^{th}$ rib.

IVU will show**:**

- Functional status of the opposite kidney.
- It helps in assessing the severity of trauma.
- Functional status of the injured kidney.

**Ultrasonogram:** it is the first investigation which has to be performed to rule out free fluid. Along with it also helps in quantifying the hematoma/urinoma and hydronephrosis if present.

**Selective renal angiography:** It is helpful in the vascular injury where need for vascular graft for vascular reconstruction is required or not. The disadvantage of the procedure is non availability in every centre and expert radiologist required for the interpretation of the result.

**Radionuclide imaging:** this another method of diagnosing infarcted segment or whole kidney.

**Retrograde pylography:** this is used when patient is allergic for iodine based contrast.

**Computed tomography scan [14] :** CECT abdomen is the investigation of choice for renal trauma following BTA. It also helps in assessing grading and severity of the renal injury thus in turn helps in adequate management of the patient.

**Management [61] :**

Management option varies from the conservative or surgical management. In general patient with minor injury can be managed conservatively and with major injury surgery is the preferred mode of management.

**Rectal contusion and lacerations (type I and II)** :- Grade I and II constitute around 85% of the total cases and are generally managed conservatively. Another 10-13%% constituted by grade III and IV where surgical intervention may be required. Vascular pedicle injury constitute around 2-5% of the total cases for whom immediate surgical intervention is required.

Conservative management includes strict bed rest with or without sedation, IV crystalloid, Ryle's tube in case of suspected ileus, serial CBC, Urine analysis and USG to look for expansion of haematoma/ urinoma and minimally invasive surgery if required. The main aim for the conservative management is absorption of the haematoma. Antibiotics to be given for 1-2 week.

Surgical management includes:

Immediate surgery: It should be performed for the patient with vascular pedicle injury to control haemorrhage..

Indication for surgical intervention during the course of the conservative management:-

- Uncontrolled haematuria
- Clinical signs deteriorated
- Expanding hematoma/urinoma
- Extravasation of contrast
- Associated solid organ or hollow visceral injury

**Surgical technique:**

Incision:- Paramedian or transverse incision

Approach: Transperitoneal.

Before opening Gerota's fascia renal artery followed by renal vein should be clamped as hematoma between Gerota's fascia and the rena parenchyma will prevent further bleeding.

The main objective of the surgery is to salvage the kidney.

Principles behind bladder repair includes:

- Debridement of dead renal tissue
- Adequate haemostasis
- Water tight closure of the collecting system
- Approximation of the margins in order to obliterate the dead space

For lacerated wound: debridement of the devitalised tissue followed by achieving adequate haemostasis and obliterating the dead space by the packing with omentum or paranephric fat.

For kidney rupture: if involving one segment with doubtful blood supply treatment will be partial nephrectomy.

Shattered kidney: Nephrectomy is the treatment of choice for such condition where renal artery

and veins are ligated separately and ureter should be ligated as low as possible

Pedicle injury: If diagnosed early best treatment is reconstruction with implant. Nephretctomy is the treatment of choice if reconstruction is not possible.

Peritoneal lavage should be performed and drain should be kept.

**Complications:**

(i) Secondary haemorrhage:- it usually resolved by 1-2 weeks by conservative management.

(ii) Hypertension:- this is delayed complication secondary to renal artery stenosis. Treatment for such condition is resection of the stenosed segment of the renal artery followed by reconstruction with the renal graft.

(iii) Hyperchloremic acidosis:-

(iv) A-V fistula:- it should be confirmed by angiography.

**Ureteral injuries[62]:**

Ureters are rarely involved in the BTA accounting for <1%.Usually it is associated with the other solid organ or hollow viscus injury.

Classification: Depending upon the site of the injury it is classified into:

a) Upper- From pelvic-ureteric junction to the iliac crest.
b) Middle-involves ureter overlying the pelvic bone.
c) Lower-involves ureter below the pelvic rim.

**Diagnosis:** Diagnosis can be made on high suspicion which includes shock mostly associated with the other organ injury, hematuria may or may not be present. Delayed clinical features secondary to urine leak includes fever, pain etc.

**Ultrasonography** is used for detecting hydronephrosis with dilated proximal segment of ureter.it can also diagnose urinoma.

**Intravenous urography** helps in detecting the site of injury which will be manifested as cut off sign and may or may not show extravasation of contrast.

**Management[63]:**

As ureteric injury most often associated with other visceral injury and hence exploratory laparotomy has to be performed for the associated visceral injury. The ureter should be inspected for its whole length to look for any discolouration or contusion and anastomosis should be performed if required.

**Percutaneous nephrostomy (PCN):**

PCN is indicated for the hemodynamically unstable patient. It's a type of DCS.

**Intubation:** either by antegrade or retrograde, a guide wire is passed across the injury site followed by double J stent passed over the guide wire and left for 4-6 weeks till healing occurs with no stricture formation.

**Surgical procedures[63]:**

Injury to the lower ureter or intramural defect:- Reimplantation of ureter

Boari-okerland bladder flap is reliable and is used for gaps more than 10 cms.

Bladder, ureter and kidney can be mobilized to gain about 7cms of length. Bladder is hitched to the psoas muscle to prevent mobility of extramural ureter.

Uretero-uretrostomy-spatulated, water tight tension free anastamosis is done. However, risk of damage to the good ureter is present. The procedure is suitable for upper and middle ureteric injuries.

Ileal substitute is used in case when there is total destruction of the ureteric length.

Auto transplantation- is also carried out in situation where total loss of ureter is present.

**Bladder injuries [64]:**

Injury to urinary bladder in BTA is very rare presentation as it is well protected in the pelvis. Most common associated injury associated with urinary bladder injury is pelvis fracture. Broadly it is divided based on the site of injury into:- (i) extraperitoneal and (ii) intraperitoneal. Extraperitoneal bladder injury is most common constituting 75% and associated with the pelvic

fracture. It has been observed that 8-10% of the pelvic fracture causes laceration of the bladder. Intraperitoneal bladder injury constitute 25% and commonly seen when bladder is full. This is commonly seen in case of RTA, fall from heights etc.

**Clinical features:** There will be history of RTA or fall from height with impact of injury over the lower abdomen, bruising may or may not be present, pain with tenderness in the lower abdomen, inability to pass urine and sometime haematuria will be the presentation.

**Diagnosis:** X-ray pelvis AP view confirms the fracture of the pelvis. Cystogram should be done using sterile contrast of around 250-300ml. intraperitoneal leak of the contrast confirms the diagnosis. Drainage film shows extravasation of the contrast in the pelvis suggestive of the extraperitoneal bladder injury.

**Management:**

Extraperitoneal rupture: No repair is required for the extreperitoneal injury. by drainingthe urine with indwelling Foley's catheter is sufficient for healing of the rent in 10-14 days.

Intraperitoneal rupture: it has to be repaired either in single or double layer using absorbable suture followed by keeping suprapubic catheter in situ for draining the urine and drain for draining the perivesical space. Cystogram should be performed to look for any leak.

# METHODOLOGY

# MATERIALS AND METHODS

**SOURCE OF DATA:**

All patients with blunt trauma abdomen treated in the Department of General Surgery of R.L. JALAPPA Hospital between the study period of December 2017 and June 2019.

SAMPLE SIZE - 42

DURATION OF STUDY-1year 6 months

**INCLUSION CRITERIA**

1. All patient of age group 18-70 years.
2. Undisplaced Pelvic fractures, rib fractures with pneumothorax.
3. Peritonitis secondary to Hollow Viscous organ injury following trauma.
4. Solid organ injury.

**EXCLUSION CRITERIA:**

Blunt trauma abdomen associated with

1. Severe Thoracic Injury.
2. Pregnant women.

**METHOD OF COLLECTION OF DATA:**

**Source of Data:** All patients with blunt trauma abdomen treated in the Department of General Surgery of R.L. JALAPPA Hospital between the study periods of December 2017 and June 2019.

**Methods of collection of data:** All patients who are suspected to have blunt trauma abdomen are scored using Clinical Abdominal Scoring System (CASS) (Annexure II) and radiological investigations would be done in the emergency department of R L Jalappa Hospital by the junior resident under the guidance of consultant. The decision to proceed with the surgery would be done if the patient had Clinical Abdominal Scoring System score of more than 12 and/or if the radiological investigation shows features of blunt trauma abdomen.

## PHOTO GALLERY

**Fig. 12 Case 1- Grade IV splenic injury**

**Fig 13 Case 2- Grade V splenic injury**

**Fig 14- Case 3 Grade V splenic injury**

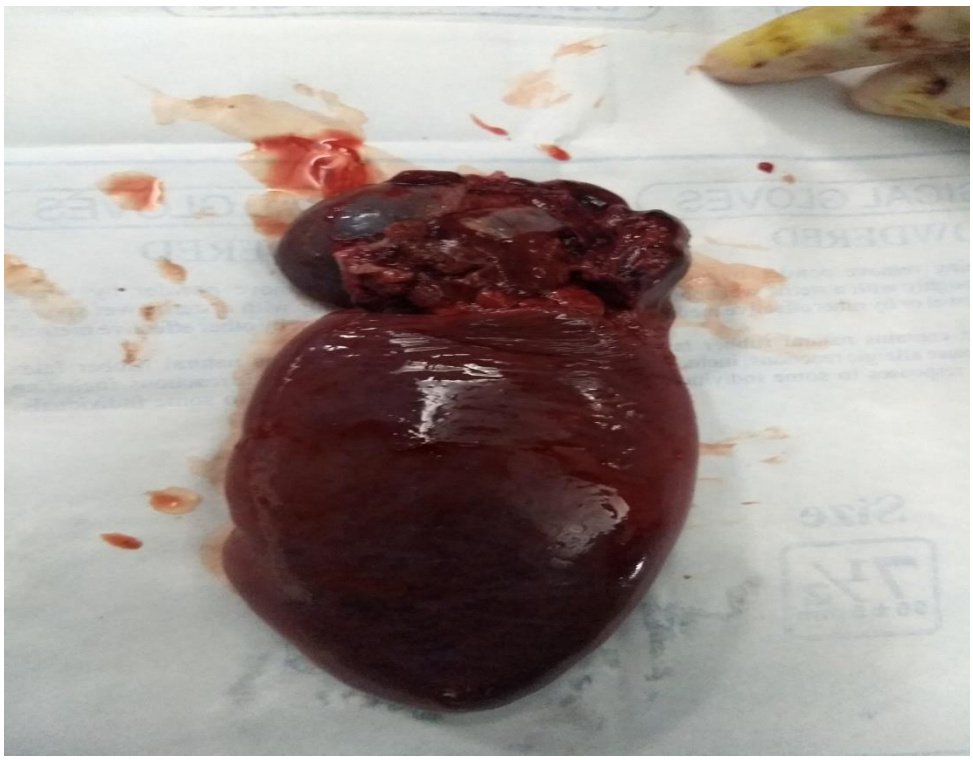


**Fig 15. Case 4 Grade IV splenic injury**

**Fig 16- Case 5 Grade IV splenic injury**

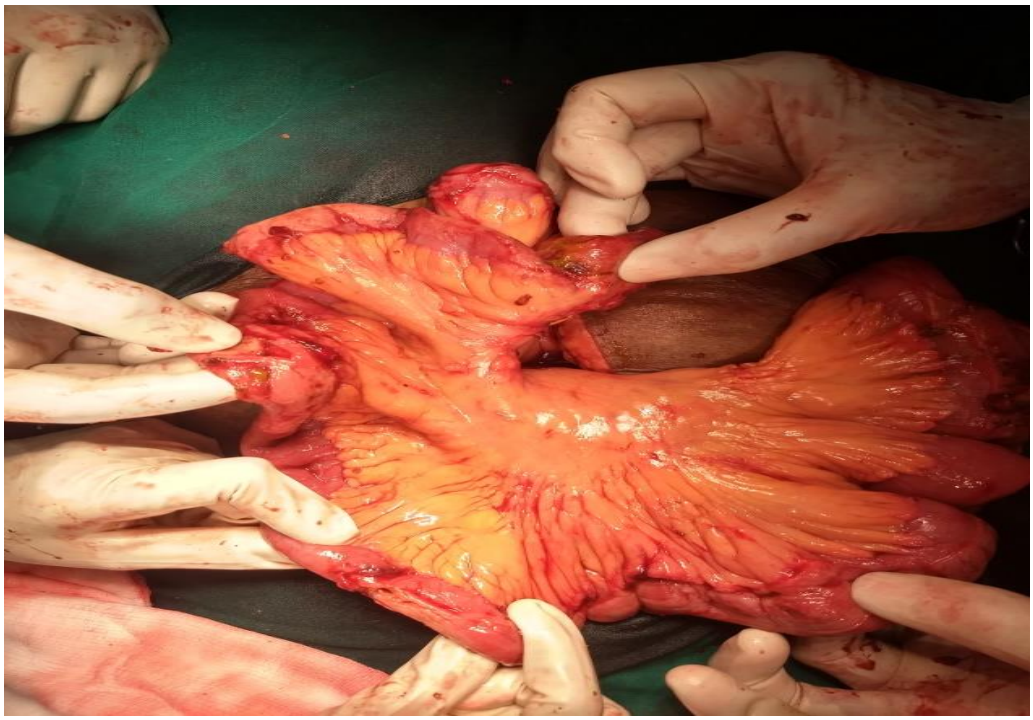


**Fig 17- Case 6 Multiple ileal perforations**

# RESULTS

# RESULTS

**Statistical analysis:**

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Continuous data was represented as mean and SD. **ANOVA (Analysis of Variance) or Kruskal Wallis test** was the test of significance to identify the mean difference between more than two groups for quantitative and qualitative data respectively.

**Pearson correlation** was done to find the correlation between two quantitative variables and qualitative variables respectively.

| Correlation coefficient (r) | Interpretation |
|---|---|
| **0 - 0.3** | Positive Weak correlation |
| **0.3-0.6** | Positive Moderate correlation |
| **0.6-1.0** | Positive Strong correlation |
| **0 to (-0.3)** | Negative Weak correlation |
| **(-0.3) to (-0.6)** | Negative Moderate Correlation |
| **(-0.6) to – (1)** | Negative Strong Correlation |

**Graphical representation of data:** MS Excel and MS word was used to obtain various types of graphs such as bar diagram, Pie diagram and Scatter plots.

**p value** (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

**Statistical software:** MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

**Results:**

**Table 8: Age distribution of subjects in the study**

| | | Count | % |
|---|---|---|---|
| Age | <20 years | 4 | 9.5% |
| | 21 to 30 years | 16 | 38.1% |
| | 31 to 40 years | 9 | 21.4% |
| | 41 to 50 years | 3 | 7.1% |
| | 51 to 60 years | 0 | 0.0% |
| | 61 to 70 years | 5 | 11.9% |
| | >70 years | 5 | 11.9% |
| | Total | 42 | 100.0% |

Majority of the patient belongs to the age group of 21-30 years, around 16 of 42 constituting about 38.1% followed by 31-40 years constituting (9 of 42) 21.4% , together constituting around 59.5%, thus forming the major bulk of the cases..

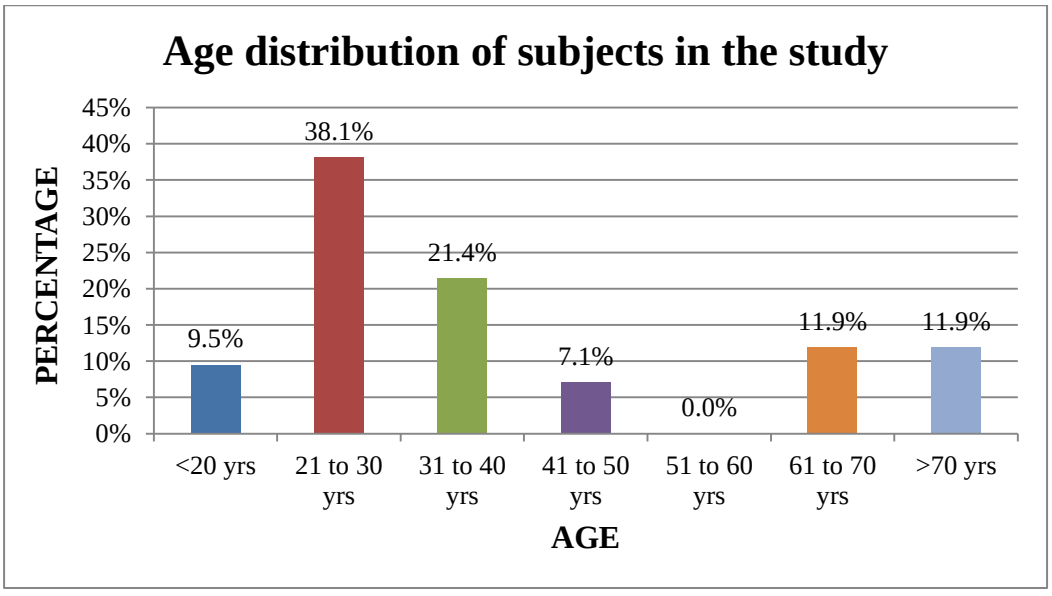



**Figure 1: Bar diagram showing Age distribution of subjects in the study**

**Table 9: Sex distribution of subjects**

| | | Count | % |
|---|---|---|---|
| Sex | Female | 8 | 19.0% |
| | Male | 34 | 81.0% |
| | Total | 42 | 100.0% |

Most common gender who sustained blunt trauma abdomen was found to be male (34 of 42 cases) with 81% and rest being female with (8 of 42 cases) 19% showing male preponderance in BTA.

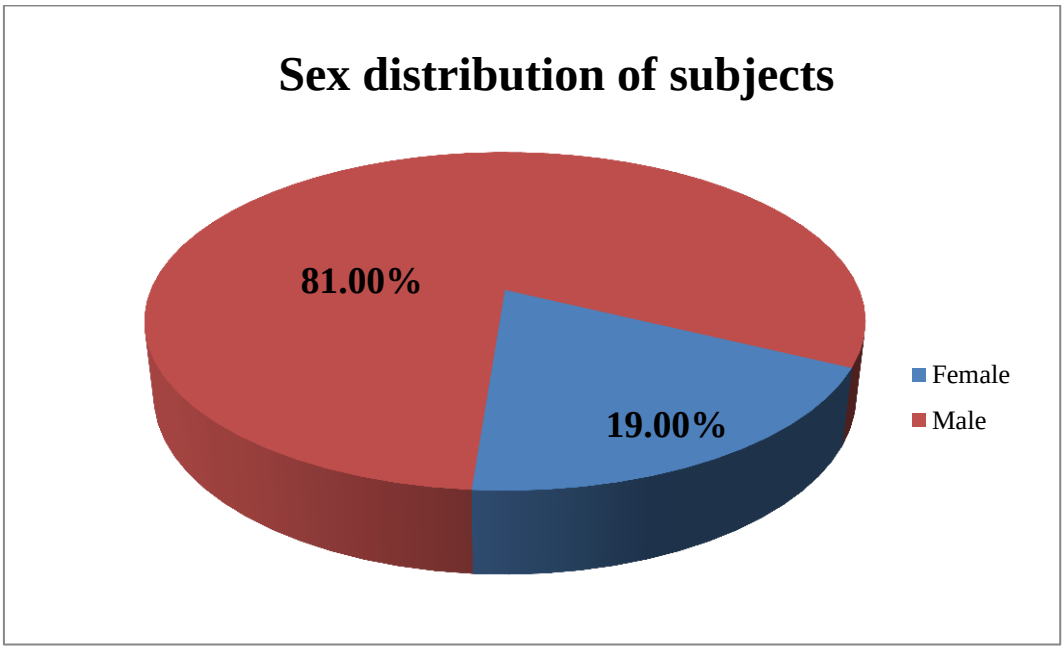



**Figure 2: Pie chart showing Sex distribution in study subjects**

**Table 10: Mode of Injury distribution of subjects**

| | | Count | % |
|---|---|---|---|
| Mode of Injury | RTA | 33 | 78.6% |
| | Fall from heights | 6 | 14.3% |
| | Other | 3 | 7.1% |
| | Total | 42 | 100.0% |

RTA is the most common mode of injury with 78.6% of subjects sustaining injury followed by fall from height with 14.3% and the remainder being other mode which includes assault, bull butt injury.

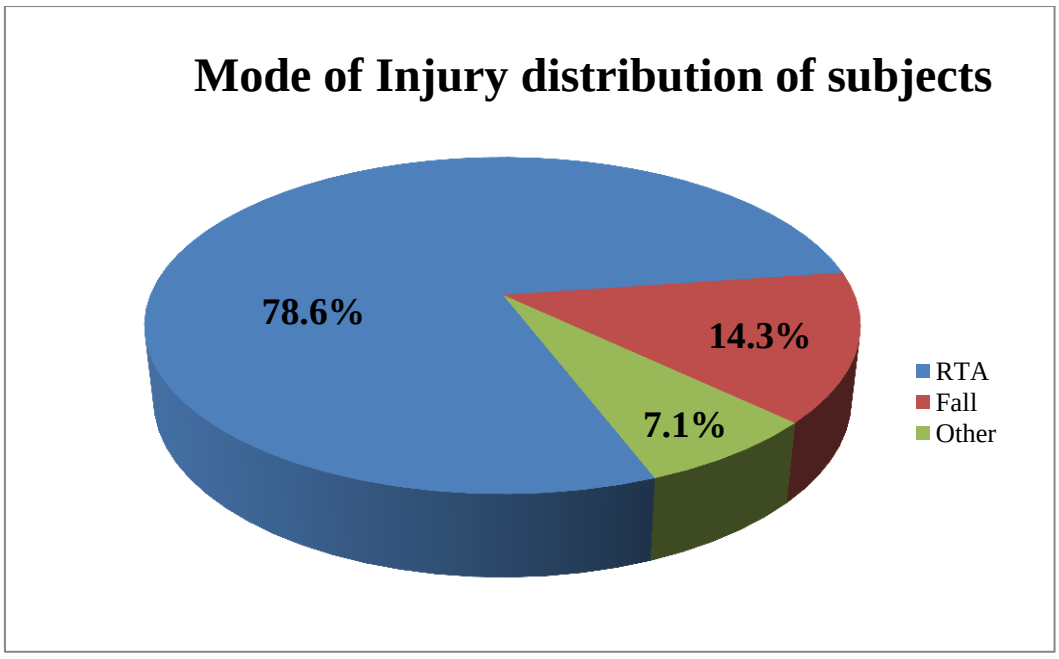



**Figure 3: Pie chart showing Mode of Injury distribution in study subjects**

**Table 11: Time of Presentation distribution**

| | | Count | % |
|---|---|---|---|
| TOP (hrs) | <2 hours | 7 | 16.7% |
| | 2 to 6 hours | 11 | 26.2% |
| | >6 hours | 24 | 57.1% |
| | Total | 42 | 100.0% |

Out of 42 cases 24 were brought to the casualty after 6 hours of trauma constituting 57.1% of the total cases. 11 of 42 cases constituting 26.2% were brought between 2 and 6 hours. Only 16.7% were brought within 2 hours.

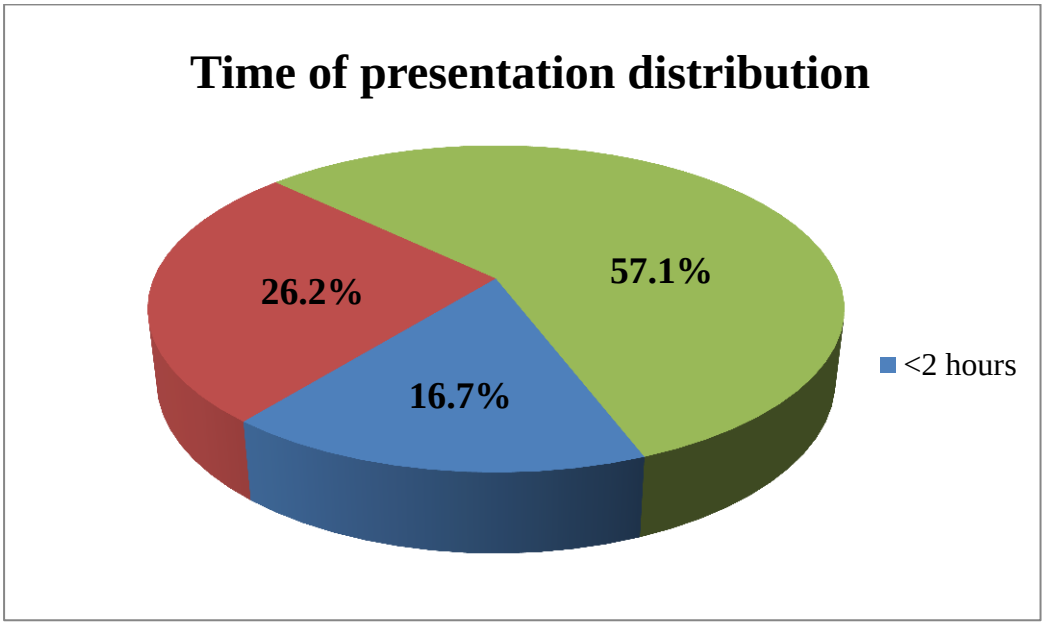



**Figure 4: Pie chart showing Time of presentation distribution in study subjects**

**Correlation between CASS and PR**

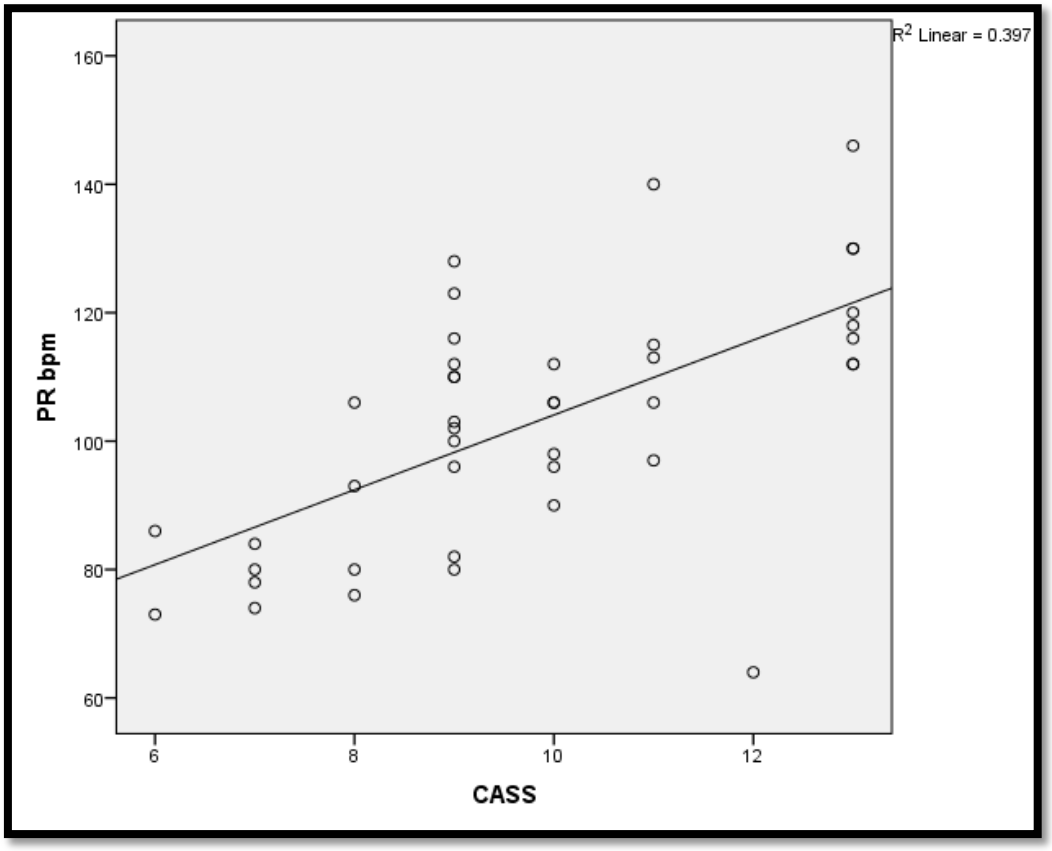



**Figure 5: Scatter plot showing positive correlation between CASS and Pulse rate**

**Fig No.- Correlation between CASS and SBP**

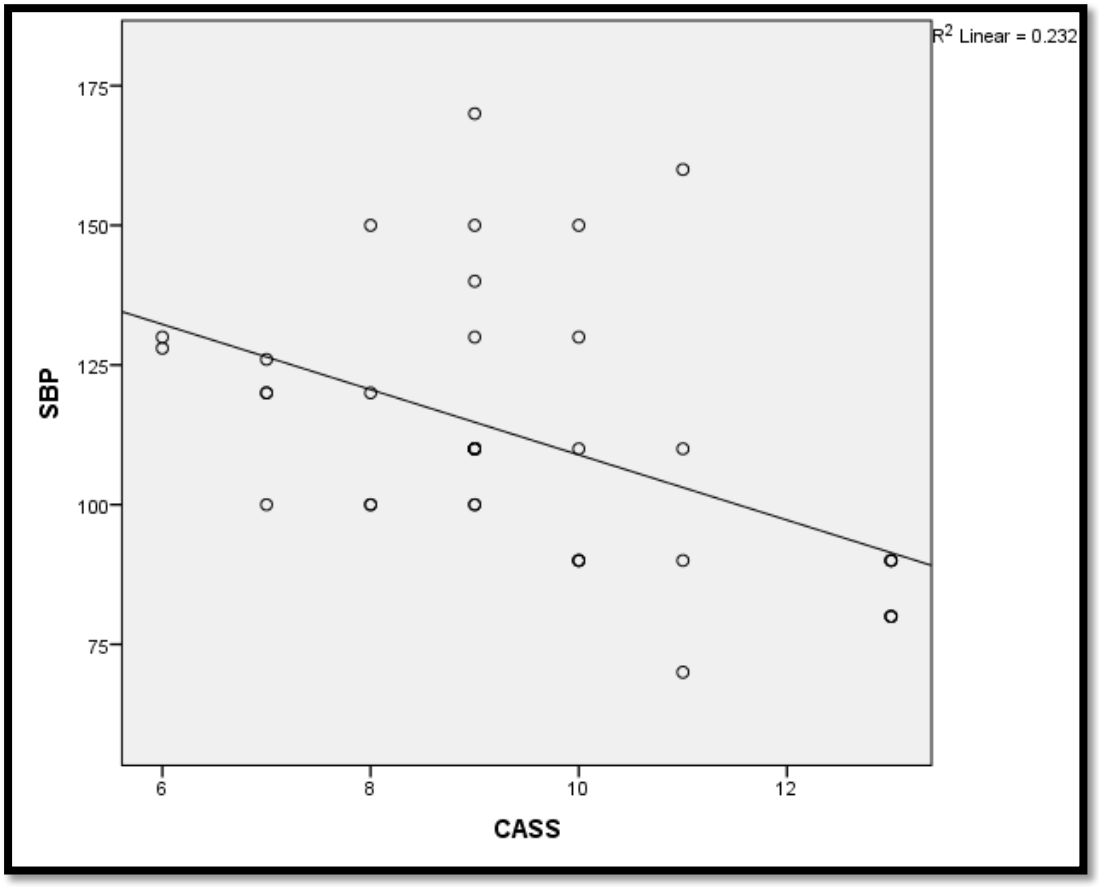



**Figure 6: Scatter plot showing negative correlation between CASS and SBP**

**Correlation between CASS and GCS**

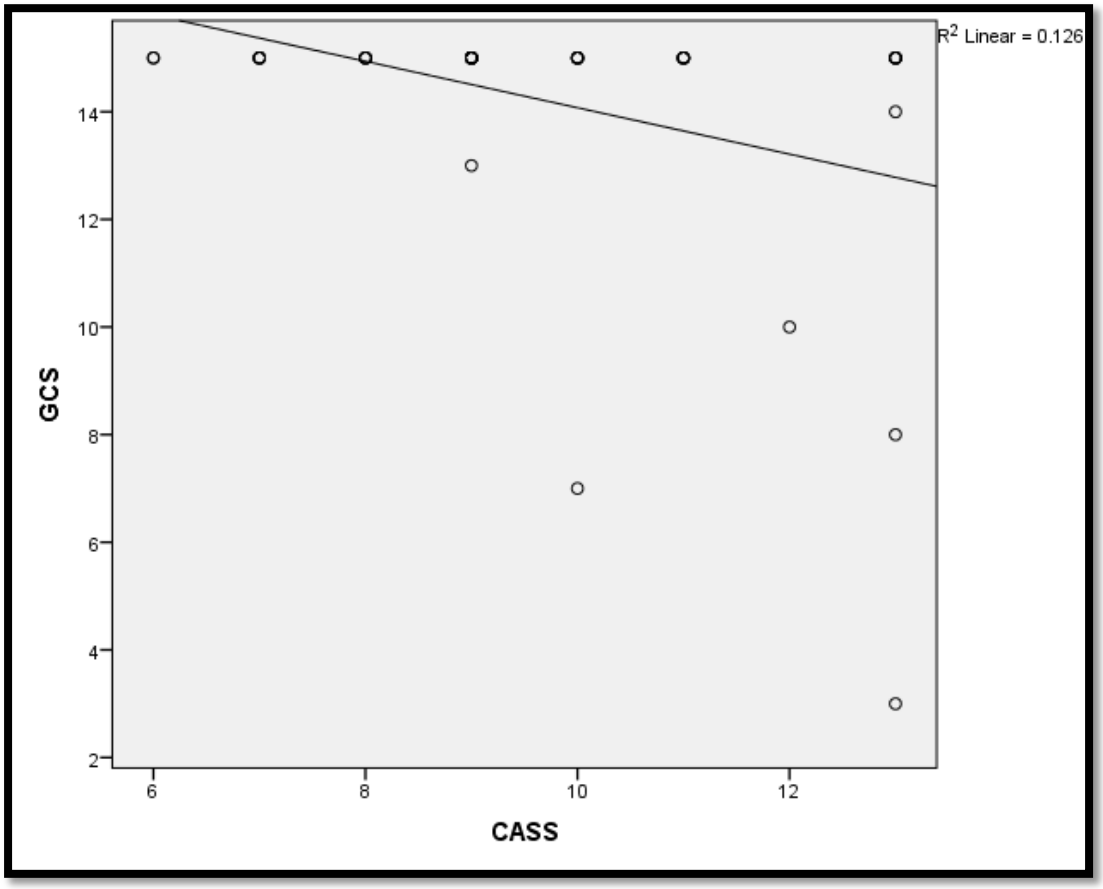



**Figure 7: Scatter plot showing negative correlation between CASS and GCS**

**Table 12: Correlation between CASS and PR, SBP, GCS**

| | | CASS | PR bpm | SBP | GCS |
|---|---|---|---|---|---|
| CASS | Pearson Correlation | 1 | 0.630** | -0.482** | -0.355* |
| | P value | | <0.001* | 0.002 | 0.021 |
| | N | 42 | 42 | 38 | 42 |

There was significant positive correlation between CASS and Pulse rate i.e. with increase in CASS there was increase in Pulse rate and vice versa.

Similarly there was significant negative correlation between CASS and SBP and GCS i.e. with increase in SBP and GCS there was decrease in CASS and vice versa.

**Table 13: Organ injured distribution among subjects**

| | | No. of patients | % |
|---|---|---|---|
| Organ injured | Spleen | 13 | 31.0% |
| | Liver | 6 | 14.3% |
| | Ileum | 3 | 7.1% |
| | Bowel | 3 | 7.1% |
| | Liver + Spleen | 3 | 7.1% |
| | Kidney | 2 | 4.8% |
| | Omentum | 1 | 2.4% |
| | Colon | 1 | 2.4% |
| | Hemoperitoneum | 1 | 2.4% |
| | Nil | 9 | 21.4% |

Out of 42 patients who were included in the study 33 patients had solid organ or viscus injury. Most commonly injured organ was found to be spleen (13/42) with 31% followed by liver (6/42 cases) constituting 14.3% followed by ileum with 7.1%. Other structures injured include kidney, colon, omentum. 21.4% of cases with blunt trauma abdomen doesn't had haemoperitoneum.

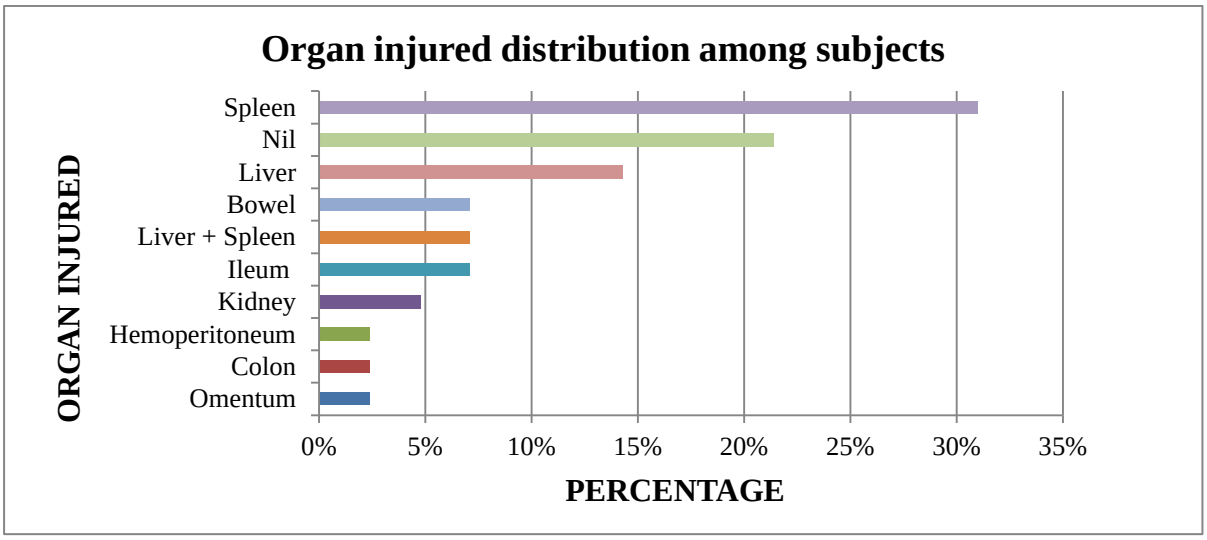



**Figure 8: Bar diagram showing Organ injured distribution in study subjects**

**Table no.- 14. CASS score and organs injured**

| | | CASS SCORE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | | 13 | |
| | Organs injured | Count | % | Count | % | Count | % | Count | % | Count | % | Count | % | Count | % | Count | % |
| Organ | Bowel | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 16.7% | 1 | 20.0% | 1 | 100.0% | 2 | 25.0% |
| | Spleen | 0 | 0.0% | 1 | 25.0% | 0 | 0.0% | 5 | 41.7% | 2 | 33.3% | 1 | 20.0% | 0 | 0.0% | 4 | 50.0% |
| | Liver | 1 | 50.0% | 1 | 25.0% | 1 | 25.0% | 0 | 0.0% | 3 | 50.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| | Liv+Splee n | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 20.0% | 0 | 0.0% | 2 | 25.0% |
| | Kidney | 0 | 0.0% | 1 | 25.0% | 0 | 0.0% | 1 | 8.3% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| | Ileum | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 8.3% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| | Hemoperit oneum | 0 | 0.0% | 0 | 0.0% | 1 | 25.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| | Colon | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 20.0% | 0 | 0.0% | 0 | 0.0% |
| | Omentum | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 8.3% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nil | 1 | 50.0% | 1 | 25.0% | 2 | 50.0% | 4 | 33.3% | 0 | 0.0% | 1 | 20.0% | 0 | 0.0% | 0 | 0.0% |

**Pearson Chi-Square Tests**

| | | CASS |
|---|---|---|
| Organ injured | Chi-square | 66.002 |
| | df | 63 |
| | Sig. | .374[a,b] |

Results are based on nonempty rows and columns in each innermost subtable.

a. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.

b. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

**Table 15: CASS score comparison with Organ injured**

| | | CASS | | | P value |
|---|---|---|---|---|---|
| | | Mean | SD | Median | |
| Organ | Bowel | 12 | 1 | 12 | 0.007* |
| | Spleen | 10 | 2 | 10 | |
| | Liver | 9 | 2 | 9 | |
| | Liver + Spleen | 12 | 1 | 13 | |
| | Kidney | 8 | 1 | 8 | |
| | Ileum | 9 | . | 9 | |
| | Hemoperitoneum | 8 | . | 8 | |
| | Colon | 11 | . | 11 | |

| | | | | | |
|---|---|---|---|---|---|
| | Omentum | 9 | . | 9 | |
| | Nil | 8 | 1 | 9 | |

**ANOVA test**

| **ANOVA** | | | | | |
|---|---|---|---|---|---|
| CASS | | | | | |
| | Sum of Squares | df | Mean Square | F | P value |
| Between Groups | 82.806 | 9 | 9.201 | 3.191 | 0.007* |
| Within Groups | 92.266 | 32 | 2.883 | | |
| Total | 175.071 | 41 | | | |

There was significant difference in mean CASS score with respect to organ injured. CASS score was highest in Bowel injury and Liver + Spleen (complex) injury and lowest among those with Kidney, hemoperitoneum secondary to omental injury.

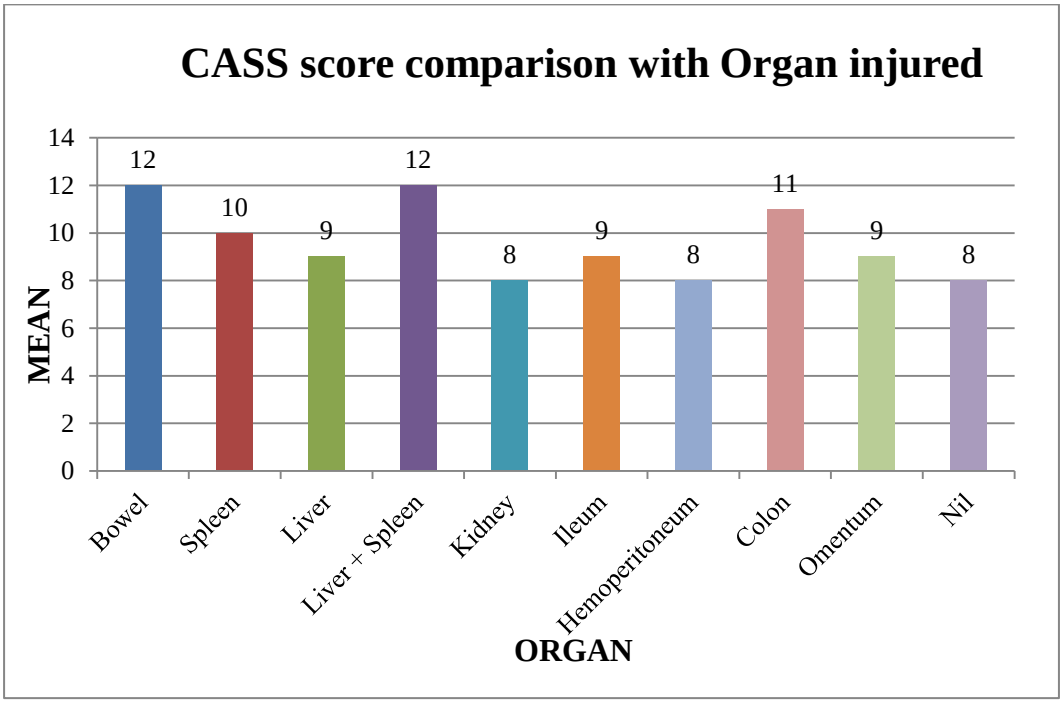



**Figure 9: Bar diagram showing Mean distribution of CASS score comparison with Organ injured in study subjects**

Table no 16.- CASS score and management

| | | CASS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | | 13 | |
| | | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % |
| Management | Conservative | 2 | 7.7% | 4 | 15.4% | 4 | 15.4% | 10 | 38.5% | 4 | 15.4% | 2 | 7.7% | 0 | 0.0% | 0 | 0.0% |
| | Exp lap | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 50.0% | 0 | 0.0% | 1 | 50.0% | 0 | 0.0% | 0 | 0.0% |
| | Splenectomy | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 16.7% | 1 | 16.7% | 0 | 0.0% | 4 | 66.7% |
| | Primary Closure | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 33.3% | 1 | 33.3% | 1 | 33.3% | 0 | 0.0% | 0 | 0.0% |
| | Expired | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 33.3% | 2 | 66.7% |
| | Referred | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 2 | 100.0% |

**Pearson Chi-Square Tests**

| | | CASS |
|---|---|---|
| Management | Chi-square | 53.532 |
| | Df | 35 |
| | Sig. | .023[*,b,c] |

Results are based on nonempty rows and columns in each innermost subtable.

*. The Chi-square statistic is significant at the .05 level.

b. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.

c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

**Table 17: Management distribution among subjects**

| | | Count | % |
|---|---|---|---|
| Management | Conservative | 26 | 61.9% |
| | Splenectomy | 6 | 14.3% |
| | Primary Closure | 4 | 9.5% |
| | Expired | 3 | 7.1% |
| | Left against medical advice | 2 | 4.8% |
| | Exp lap and omental repair | 1 | 2.3% |

Out of 33 cases who had sustained solid organ injury, 26 cases (61.9%) were managed conservatively, 6 cases had undergone splenectomy who had either grade V or IV injury. 9.5% (4/33 cases) had hollow viscus injury for which primary repair was done. 1 patient had hemoperitoneum without solid organ injury and intraoperatively found to had omental injury for which omental repair was done. Three cases succumbed to death to his injury forming 7.1 % and 2 cases left against medical advice.

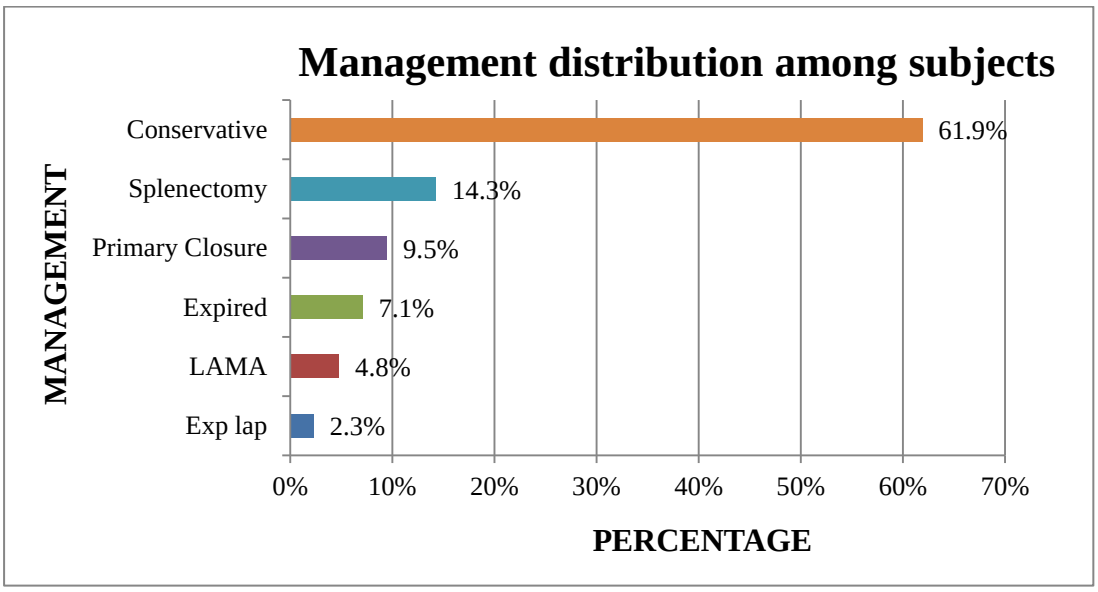



**Figure 10: Bar diagram showing Management distribution in study subjects**

**Table 18: CASS score comparison with Management**

| | | CASS | | |
|---|---|---|---|---|
| | | Mean | SD | Median |
| Management | Conservative | 9 | 1 | 9 |
| | Exp lap and omental repair | 10 | 1 | 10 |
| | Expired | 13 | 1 | 13 |
| | Primary Closure | 10 | 1 | 10 |
| | Referred | 13 | 0 | 13 |
| | Splenectomy | 12 | 1 | 13 |

| ANOVA | | | | | |
|---|---|---|---|---|---|
| CASS | | | | | |
| | Sum of Squares | df | Mean Square | F | P value |
| Between Groups | 115.418 | 5 | 23.084 | 13.930 | <0.001* |
| Within Groups | 59.654 | 36 | 1.657 | | |
| Total | 175.071 | 41 | | | |

Here a significant difference is noted in mean CASS score with respect to management. Mean CASS was highest among those who were referred and expired and lowest among those who had undergone conservative management.

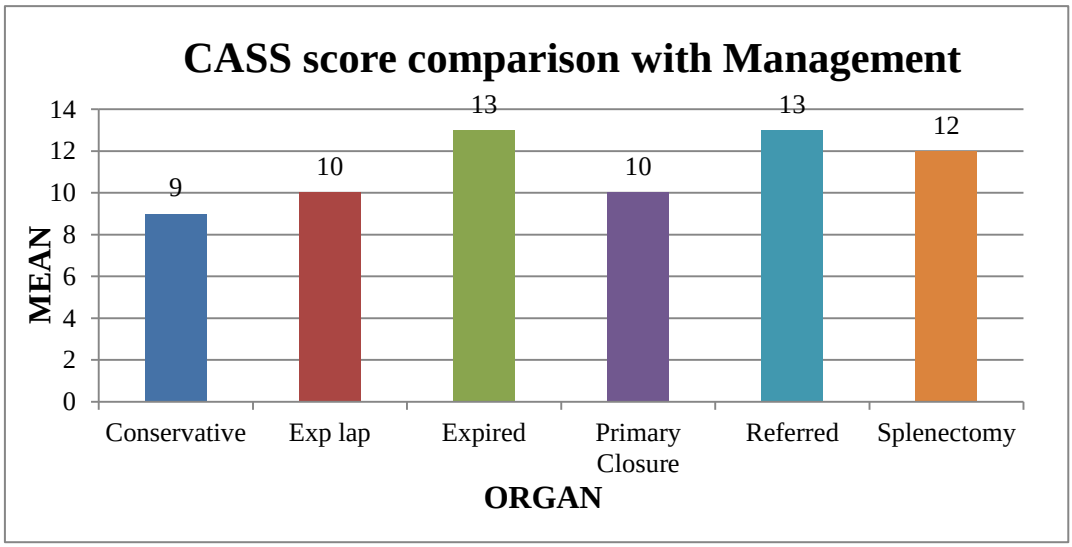



**Figure 11: Bar diagram showing Mean distribution of CASS score comparison with Management in study subjects**

**Table 19: CASS score comparison with Mode of Injury**

| | | CASS | | |
|---|---|---|---|---|
| | | Mean | SD | Median |
| Mode of Injury | RTA | 10 | 2 | 10 |
| | Fall | 8 | 2 | 8 |
| | Others | 10 | 3 | 9 |

| **ANOVA** | | | | | |
|---|---|---|---|---|---|
| CASS | | | | | |
| | Sum of Squares | df | Mean Square | F | P value |
| Between Groups | 18.359 | 2 | 9.180 | 2.284 | 0.115 |
| Within Groups | 156.712 | 39 | 4.018 | | |
| Total | 175.071 | 41 | | | |

There was no significant difference in CASS score with respect to mode of injury showing nil significance of the mode of injury in this clinical abdominal scoring system.

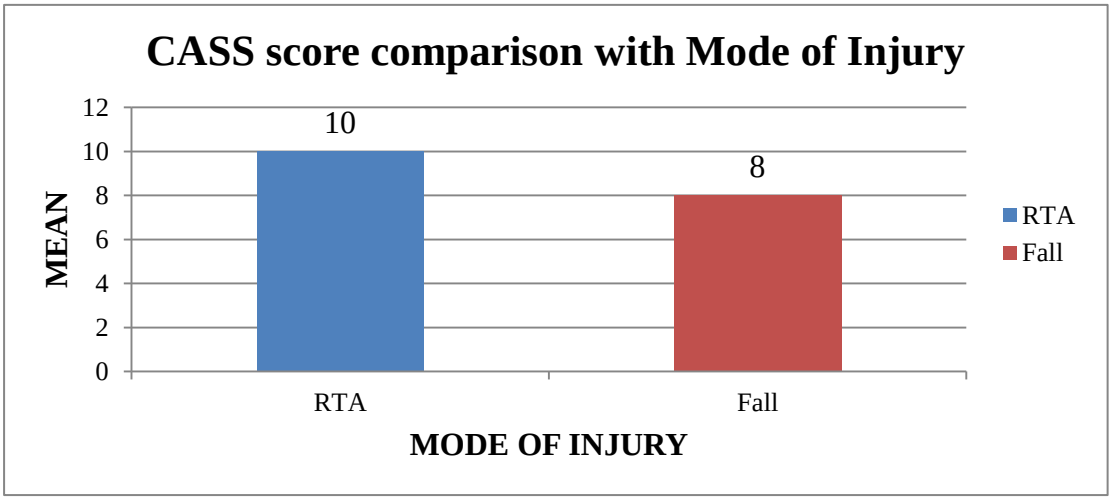



**Figure 12: Bar diagram showing MEAN distribution of CASS score comparison with Mode of Injury in study subjects**

**Table 20: CASS score comparison with Clinical Findings**

| | | CASS | | |
|---|---|---|---|---|
| | | Mean | SD | Median |
| Clinical Findings | Tenderness | 9 | 2 | 9 |
| | Diffuse tenderness | 11 | 2 | 11 |
| | Bruise | 8 | 3 | 8 |

| **ANOVA** | | | | | |
|---|---|---|---|---|---|
| CASS | | | | | |
| | Sum of Squares | df | Mean Square | F | P value |
| Between Groups | 66.238 | 2 | 33.119 | 11.868 | <0.001* |
| Within Groups | 108.834 | 39 | 2.791 | | |
| Total | 175.071 | 41 | | | |

In the study there was significant difference in mean CASS score between clinical findings. CASS score was high in those with diffuse tenderness and guarding showing serious abdominal injury and low in among those with bruise which may be just superficial injury.

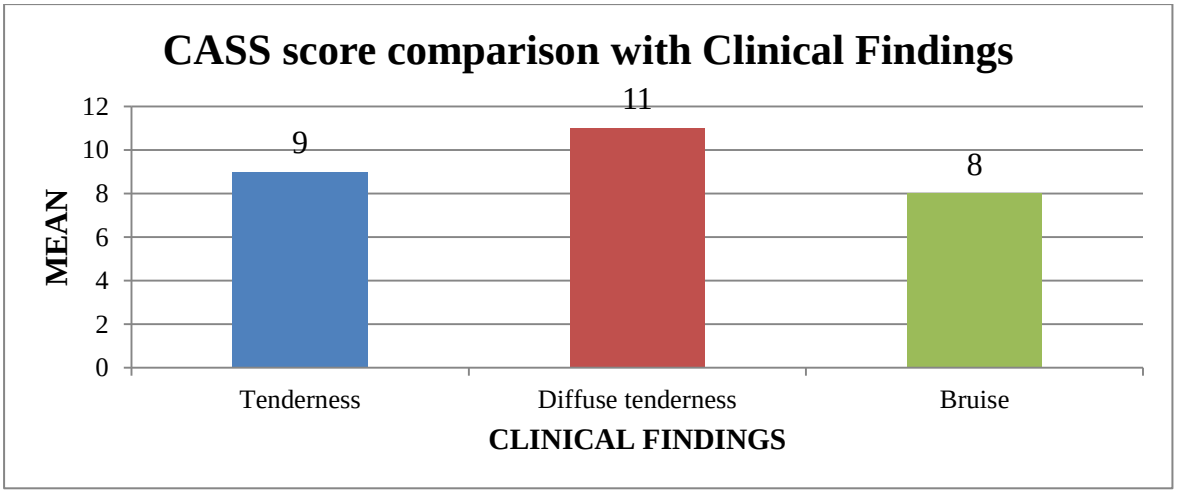



**Figure 13: Bar diagram showing Mean distribution of CASS score comparison with Clinical Findings in study subjects**

**Table No.- 21 USG abdomen and Organ Injuiry distribution**

| USG Abdomen and Pelvis | No of patients |
|---|---|
| Positive | 33 |
| Negative | 09 |

USG abdomen and pelvis shows free fluid in the peritoneum in 33 out of 42 cases. And No free fluid in rest of the 09 cases. Thus USG is good in detecting free fluid but doesn't decide about the need for surgery.

**Table No- 22 USG Findings and Management distribution:**

| USG abdomen and pelvis | Management |
|---|---|
| USG positive | Conservative- 17<br>Operative-11<br>Others- 5 |
| USG negative | Conservative- 09 |

Out of 33 patients in which USG shows free fluid, 11 patients had undergone surgery and were found to be either grade IV or grade V splenic injury which was confirmed with CECT abdomen and pelvis or they were found to have gross intraperitoneal collection and CXR showed air under diaphragm whereas 17 patients were managed conservatively and generally they had less severe injury in the form of splenic/renal/hepatic injury either grade I/II/III injury. 3 cases were succumbed to his injuries and 2 were left against medical advice. Patients with no free fluid in USG were managed conservatively.

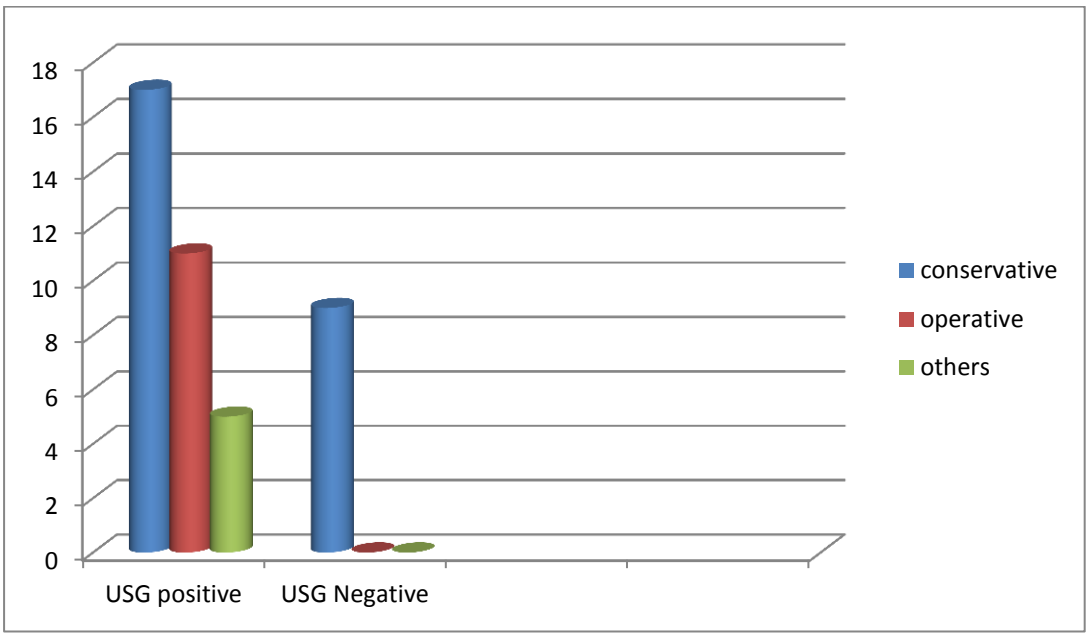



**Fig 14. Bar showing comparison of USG findings and management**

| | | CASS | | | | | |
|---|---|---|---|---|---|---|---|
| | | <8 | | 9 to 11 | | >12 | |
| | | Count | % | Count | % | Count | % |
| Management | Operative | 0 | 0.0% | 7 | 30.4% | 4 | 100.0% |
| | Conservative | 10 | 100.0% | 16 | 69.6% | 0 | 0.0% |

All patients with CASS<8 were managed conservatively. Between CASS 9-11, 69.6% of patients were managed conservatively and the rest underwent surgery. All patients with CASS >12 underwent surgery. 3 patients expired and 2 patients went LAMA.

**Pearson Chi-Square Tests**

| | | CASS |
|---|---|---|
| Management | Chi-square | 13.691 |
| | df | 2 |
| | Sig. | .001*,b |

Results are based on nonempty rows and columns in each innermost subtable.

*. The Chi-square statistic is significant at the .05 level.

b. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.

There is statistically significant difference between CASS and management.

**Area under the ROC curve (AUC)**

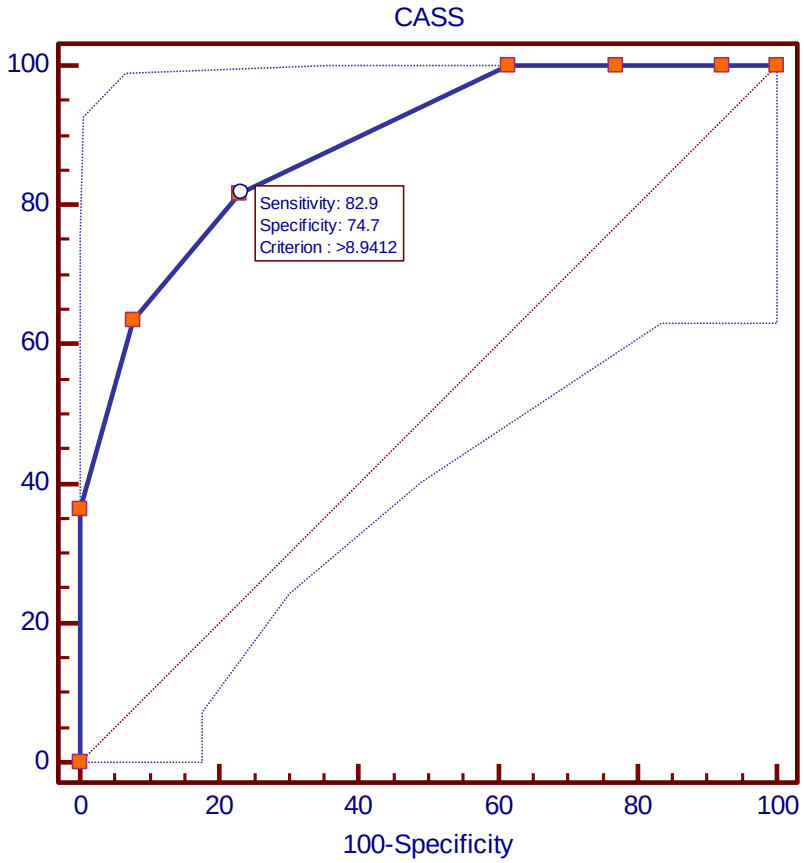
| | |
|---|---|
| Area under the ROC curve (AUC) | 0.885 |
| Standard Error[a] | 0.0567 |
| 95% Confidence interval[b] | 0.737 to 0.966 |
| z statistic | 6.783 |
| Significance level P (Area=0.5) | <0.0001 |

[a] DeLong et al., 1988

[b] Binomial exact

**Youden index**

| | |
|---|---|
| Youden index J | 0.5874 |
| 95% Confidence interval[a] | 0.3077 to 0.7797 |
| Associated criterion | >9 |
| 95% Confidence interval[a] | 8 to 9 |


CASS
100
80
60
40
20
0
Sensitivity: 82.9
Specificity: 74.7
Criterion : >8.9412
0
20
40
60
80
100
100-Specificity

**Criterion values and coordinates of the ROC curve**

| Criterion | Sensitivity | 95% CI | Specificity | 95% CI | +PV | 95% CI | -PV | 95% CI |
|---|---|---|---|---|---|---|---|---|
| ≥6 | 100.00 | 71.5 - 100.0 | 0.00 | 0.0 - 13.2 | 29.7 | 15.9 - 47.0 | | |
| >6 | 100.00 | 71.5 - 100.0 | 7.69 | 0.9 - 25.1 | 31.4 | 16.9 - 49.3 | 100.0 | 2.5 - 100.0 |
| >7 | 100.00 | 71.5 - 100.0 | 23.08 | 9.0 - 43.6 | 35.5 | 19.0 - 55.0 | 100.0 | 47.8 - 100.0 |
| >8 | 100.00 | 71.5 - 100.0 | 38.46 | 20.2 - 59.4 | 40.7 | 22.4 - 61.2 | 100.0 | 69.2 - 100.0 |
| **>9** | **81.82** | **48.2 - 97.7** | **76.92** | **56.4 - 91.0** | **60.0** | **32.3 - 83.7** | **90.9** | **70.8 - 98.9** |
| >10 | 63.64 | 30.8 - 89.1 | 92.31 | 74.9 - 99.1 | 77.8 | 37.5 - 97.7 | 85.7 | 66.9 - 96.1 |
| >11 | 36.36 | 10.9 - 69.2 | 100.00 | 86.8 - 100.0 | 100.0 | 39.8 - 100.0 | 78.8 | 61.1 - 91.0 |
| >13 | 0.00 | 0.0 - 28.5 | 100.00 | 86.8 - 100.0 | | | 70.3 | 53.0 - 84.1 |

**Group Statistics**

| | Management | N | Mean | Std. Deviation | P value |
|---|---|---|---|---|---|
| CASS | Conservative | 26 | 8.62 | 1.359 | <0.001* |
| | Operative | 11 | 11.18 | 1.601 | |

Number of patients who had mean CASS of 8.62 were managed conservatively. Number of patients who had mean CASS score of > 11.18 require surgical intervention. Thus surgical intervention can be planned for the patients who have CASS score of >11. There was statistically significant difference between CASS and the management. Thus with increase in CASS need for surgical intervention increases.

| | | CASS | | | | | |
|---|---|---|---|---|---|---|---|
| | | <8 | | 9 to 11 | | >12 | |
| | | Count | % | Count | % | Count | % |
| Mortality | No | 10 | 100.0% | 23 | 100.0% | 6 | 66.7% |
| | Yes | 0 | 0.0% | 0 | 0.0% | 3 | 33.3% |

Mortality is high with increase in CASS score. 3 patient expired who had CASS score>12 and those in whom CASS was 10 and above usually requires surgical intervention..

**Pearson Chi-Square Tests**

| | | CASS |
|---|---|---|
| Mortality | Chi-square | 11.846 |
| | df | 2 |
| | Sig. | .003[*,b,c] |

Results are based on nonempty rows and columns in each innermost subtable.

*. The Chi-square statistic is significant at the .05 level.

b. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.

c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

**Area under the ROC curve (AUC)**

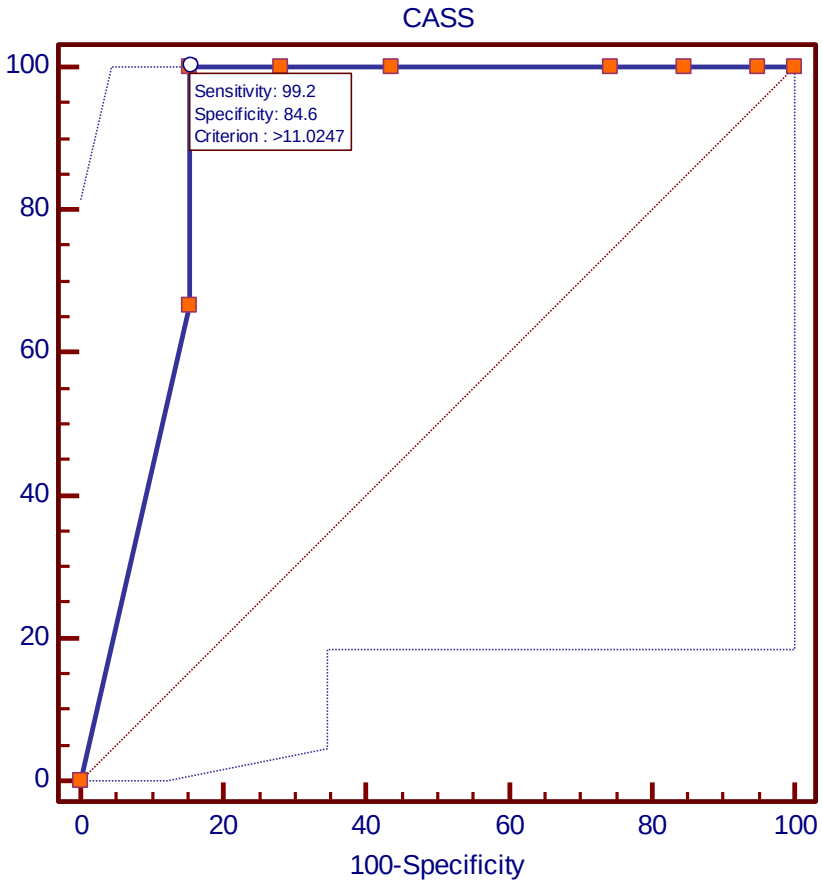
| | |
|---|---|
| Area under the ROC curve (AUC) | 0.897 |
| Standard Error[a] | 0.0467 |
| 95% Confidence interval[b] | 0.764 to 0.970 |
| z statistic | 8.512 |
| Significance level P (Area=0.5) | <0.0001 |

[a] DeLong et al., 1988

[b] Binomial exact

**Youden index**

| | |
|---|---|
| Youden index J | 0.8462 |
| 95% Confidence interval[a] | 0.6923 to 0.9231 |
| Associated criterion | >11 |
| 95% Confidence interval[a] | 10 to 10 |


CASS
Sensitivity: 99.2
Specificity: 84.6
Criterion : >11.0247
100
80
60
40
20
0
0
20
40
60
80
100
100-Specificity

**Criterion values and coordinates of the ROC curve** [Hide]

| Criterion | Sensitivity | 95% CI | Specificity | 95% CI | +PV | 95% CI | -PV | 95% CI |
|---|---|---|---|---|---|---|---|---|
| ≥6 | 100.00 | 29.2 - 100.0 | 0.00 | 0.0 - 9.0 | 7.1 | 1.5 - 19.5 | | |
| >6 | 100.00 | 29.2 - 100.0 | 5.13 | 0.6 - 17.3 | 7.5 | 1.6 - 20.4 | 100.0 | 15.8 - 100.0 |
| >7 | 100.00 | 29.2 - 100.0 | 15.38 | 5.9 - 30.5 | 8.3 | 1.8 - 22.5 | 100.0 | 54.1 - 100.0 |
| >8 | 100.00 | 29.2 - 100.0 | 25.64 | 13.0 - 42.1 | 9.4 | 2.0 - 25.0 | 100.0 | 69.2 - 100.0 |
| >9 | 100.00 | 29.2 - 100.0 | 56.41 | 39.6 - 72.2 | 15.0 | 3.2 - 37.9 | 100.0 | 84.6 - 100.0 |
| >10 | 100.00 | 29.2 - 100.0 | 71.79 | 55.1 - 85.0 | 21.4 | 4.7 - 50.8 | 100.0 | 87.7 - 100.0 |
| >11 | 100.00 | 29.2 - 100.0 | 84.62 | 69.5 - 94.1 | 33.3 | 7.5 - 70.1 | 100.0 | 89.4 - 100.0 |
| >12 | 66.67 | 9.4 - 99.2 | 84.62 | 69.5 - 94.1 | 25.0 | 3.2 - 65.1 | 97.1 | 84.7 - 99.9 |
| >13 | 0.00 | 0.0 - 70.8 | 100.00 | 91.0 - 100.0 | | | 92.9 | 80.5 - 98.5 |

| | | Mortality | | | |
|---|---|---|---|---|---|
| | | No | | Yes | |
| | | Count | % | Count | % |
| CASS | 6 | 2 | 5.1% | 0 | 0.0% |
| | 7 | 4 | 10.3% | 0 | 0.0% |
| | 8 | 4 | 10.3% | 0 | 0.0% |
| | 9 | 12 | 30.8% | 0 | 0.0% |
| | 10 | 6 | 15.4% | 0 | 0.0% |
| | 11 | 5 | 12.8% | 0 | 0.0% |
| | 12 | 0 | 0.0% | 1 | 33.3% |
| | 13 | 6 | 15.4% | 2 | 66.7% |

There were 3 mortalities in the present study. Those cases had a CASS of 12 (one case) and 13 ( two cases). All the patients with CASS of <11 recovered well. Hence mortality is high in the patients with CASS >12.

**Pearson Chi-Square Tests**

| | | Mortality |
|---|---|---|
| CASS | Chi-square | 19.385 |
| | df | 7 |
| | Sig. | .007*,b,c |

Results are based on nonempty rows and columns in each innermost subtable.

*. The Chi-square statistic is significant at the .05 level.

b. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.

c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

# DISCUSSION

# DISCUSSION

Trauma is one of the commonest causes for increased morbidity and mortality in the younger age group, across the world. The evaluation of patients with blunt trauma abdomen poses a significant diagnostic challenge to most of the trauma surgeons. Timely diagnosis and intervention improves the outcome of the patient. Thus the need for clinical scoring system which helps in assessing the need for surgical or conservative management without any undue delay in investigations which improves the outcome. Thus CASS is one among the other promising scoring system which is going to help in early diagnosis and timely intervention. The advantage of CASS is, it is purely based on the clinical features and hence can be applied bedside during initial assessment and resuscitation phase even in the centres where there is lack of FAST or other radiological investigations.

Mode of injury:-

**Table No. 23 Road traffic accident:**

| Study | Percentage (%) |
|---|---|
| Present study | 78.6 |
| Rahman S et al[65] | 67 |
| Mehta et al[66] | 53 |
| Peyman et al[1] | 80.6 |

**Table No.- 24 Fall from height:-**

| Study | Percentage (%) |
|---|---|
| Present study | 14.3 |
| Rahman S et al[65] | 17 |
| Mehta et al[66] | 43 |

The most common mode of injury, following road traffic accident was found to be 78.6% which is consistent with other study as shown in the table no. . Mohan et al says increase in the incidence of RTA is because of easily procurable of vehicles, daily migration to urban area for livelihood, unaccustomed to traffic, traffic sense and ignorance of safety measures[66]. The other mode of injury includes fall from heights which is 14.3% which is comparable to the Rahman S et al[65]. As our hospital is rural based referral centre hence bull butt injuries are other mode of injury leading to the blunt trauma abdomen.

**Table No.- 25 Gender Distribution:**

| Study | Percentage (%) |
|---|---|
| Present study | Male- 81%<br>Female- 19% |
| Vikram Yogesh et al[14] | Male- 75%<br>Female-25% |
| Mehta et al[66] | Male- 79%<br>Female-21% |
| Peyman et al[1] | Male- 37.5%<br>Female- 62.5% |

It has been observed that male are more predisposed for the blunt trauma abdomen constituting 81% and remaining being females which is supported by other studies except for the Peyman et al where female were predominantly involved in blunt trauma abdomen. The reason for above is more dependency on male gender for earning livelihood and thus migration to urban area and more substance abuse in male gender than female.

**Table No- 26 Age distribution:-**

| Study | Percentage (%) |
|---|---|
| Present study | 21-30 years- 38.1% |
| Mehta et al[66] | 21-30 years- 40% |
| Vikram Yogesh et al[14] | 21-30 years- 45% |
| Rahman S et al[65] | 21-30 years- 39% |

The age group in this study is 18-70 years. Youngest age involved is 18 years and oldest one being 70 years. The most common age group affected belongs to 21-30 years forming 38.1% of the total incidence followed by 31-40years constituting 21.4% which is similar to other studies too. This shows that young population which is more vulnerable to RTA, thus leading to loss of young productive group of the people.

**Table No- 27 Time of presentation**:-

| Study | Percentage (%) |
|---|---|
| Present study | >6 hours- 57.1% |
| Mehta et al[66] | <4 hours- 53.5% |
| Peymann et al[1] | <1 hour-57.5% |

Time of presentation in the EMD after trauma is a major deciding factor for the better outcome. In the present study around 57.1% of the patients presented to the casualty after 6 hours of trauma and the reason being lack of awareness of the significance of time, delay in response by the ambulance person, multiple hospital visits before coming to our hospital. As a result of delayed presentation three cases who had severe injury and presented late succumbed to their injury thus showing need for early

reference to the referral hospital for the appropriate assessment, resuscitation and management.

**Table No- 28 Most Common Organs injured distribution:-**

| Study | Organs injured in decreasing order |
|---|---|
| Present study | Spleen (31%)>liver (14.3%)>bowel (11.9%) |
| Amuthan et al[67] | Spleen (32%)> Liver(16%) >Bowel(14%) |
| Srivastava SK et al[68] | Jejunum(18.75%)> ileum(16.6%)> spleen and liver (14.5% each) |
| Singh SP et al[69] | Spleen (28%)> Liver (18%)> Bowel (16%) |

In BTA, the most common injured was spleen with 31% of cases followed by liver with 14.3% and then bowel 11.9% which is similar to Amuthan et al and Singh SP et al. But as per Srivastava SK et al most commonly injured organ is bowel followed by spleen and liver. The reason for more solid organ injury compared to hollow viscus was explained by Vikram Yogish et al who said it is because of crushing injury. Intraabdominal contents are crushed between the anterior abdominal wall and the vertebral column or posterior thoracic cage. This produces a crushing effect, to which solid viscera (e.g. spleen, liver, and kidneys) are especially vulnerable.

**Table No.29 Management distribution:**

| Study | Management |
|---|---|
| Present study | Conservative- 61.9%<br>Surgical management- 38.1% |
| Vikram Yogish et al[14] | Conservative- 28.4%%<br>Surgical management- 71.6% |
| Rahman S et al[65] | Conservative- 40%<br>Surgical management- 60% |

Here in our referral centre we managed 61.9% of cases conservatively because most of them responded well to initial resuscitation and continuously observed for signs of deterioration like hypotension, feeble thready pulse, increased abdominal girth, signs of peritonitis in well-established ICU care. Only 38.1% had undergone surgery and the most commonly performed surgery was splenectomy followed by primary closure of bowel perforations. This shows that most of the cases with BTA can be managed conservatively with keen observation on their vitals and abdominal symptoms and signs.

**Table No.- 30 CASS score and management:**

| Study | Management in terms of CASS with SD |
|---|---|
| Present study | Conservative- 8.62 with SD of 1.359<br>Operative- 11.18 with SD of 1.601 |
| Vanitha T et al[70] | Conservative- 6.35 with SD of 1.56<br>Operative- 11.56 with SD of 2.02 |

In present study we observed that patient with mean CASS score of 8.62 with SD of 1.359 can be managed conservatively and mean CASS score of 11.18 with SD of 1.601 can be managed by surgical intervention. This results are similar to the study done by Vanitha T et al.

**Table No- 31 Patient distribution based on CASS with USG findings:-**

| CASS Score | No of Patients | Percentage | USG Abdomen and Pelvis |
|---|---|---|---|
| <8 | 10 | 23.8% | Soft tissue injury ± grade I/II splenic/liver/renal injury |
| 9-11 | 23 | 54.7% | Bowel injury predominantly ileal perforation± grade II/III splenic/renal/liver injury |
| >12 | 9 | 21.4% | Severe injury in the form of Grade IV/V splenic/complex injury |

The number of patients who had a CASS of less than 8 were 10 out of 42 forming 23.8%. the number of patients who had CASS of 9-11 were 23. Thus more than half of the patients (54.7%) had CASS between 9 and 11. Patients with CASS>12 includes 9 of 42 forming around 21.4%.

**Table No.- 32 CASS Score and Management:**

| CASS Score | Surgical Management |
|---|---|
| <8 | 0 |
| 9-11 | 7 |
| >12 | 4 |

All the patients who had CASS <8 were managed conservatively. These patients had minor injuries either in form of the soft tissue injury or grade I/II splenic/renal/liver injury. Among the patients who had CASS>12, 4 patients required surgical intervention, 3 succumbed to their injury and 2 were went LAMA for whom surgery was the plan. These patients had grade IV and grade V splenic injury and the findings were consistent with the USG and CECT findings. Further, CASS between 9 and 11 includes 23 patients, out of which 7 required surgical interventions. Out of 7, 5 patients had bowel perforation predominantly ileal perforation for whom primary repair was done without waiting for any other higher radiological investigations. In 1 case USG abdomen and pelvis showed gross intraperitoneal collection without solid organ injury. USG guided tapping showed hemoperitoneum. As the patient was non responder to the resuscitation, patient was taken up for the exploratory laparotomy without going for CECT abdomen and pelvis. On table it was found to be active bleed from the omentum which shows that with high degree of suspicious and good clinical examination supported with FAST scan patient can be taken up for the surgery. Other one patient had grade III splenic injury but patient was transient responder hence patient was planned for the exploratory laparotomy and it was found to be grade IV splenic injury. This shows that radiological investigations had its own fallacy. Rest of the patients however were managed conservatively with close monitoring of the vitals

of the patients. Hence those who fall in the CASS 9-11 group may require careful close observation. Though most of them can be managed conservatively, a close observation or monitoring is essential in determining the need for the surgical intervention.

**Table No.- 33 USG abdomen and pelvis and organs injured and management:**

| USG abdomen | No of patients | Management |
|---|---|---|
| USG positive | 33 | Conservative-17<br>Operative- 11 |
| USG negative | 09 | Conservative- 09 |

It has been observed that USG abdomen and pelvis was positive for 33 cases and had sustained either hollow viscus injury, liver injury, splenic injury and kidney injury and most of them had CASS> 8. Out of 33 cases, 17 were managed conservatively and 11 had undergone surgery which includes splenectomy, omental repair and primary repair of the viscus, 3 succumbed to their injuries and 2 left against medical advice. The drawback of USG which was observed that we cannot assess which case to take for surgery or conservative management as it was evident by above observation and reporting is subjective. So in this respect CASS had upper hand in deciding the line of management and it is very economical and can be used in rural based hospital where there is unavailability of USG and radiologist.

**Table No. 34 Efficacy of CASS:**

| Study | CASS |
|---|---|
| Present study | Specificity- 84.62%<br>Sensitivity- 99.2%<br>PPV-33.3%<br>NPV-100% |
| Peyman et al[1] | Specificity-88%<br>Sensitivity-100%<br>PPV-90%<br>NPV-100% |

All parameters of CASS i.e. specificity, sensitivity and NPV were comparable to other studies except for the PPV which is low in our study. This shows its efficacy in predicting which case to take for conservative management with better outcome.

**Table No.35 Mortality distribution:**

| Study | Mortality |
|---|---|
| Present study | 7.1% |
| Vanitha T et al[70] | 8% |
| Mehta et al[66] | 4% |

The number of mortality observed in the study was 3 out of 42 cases constituting 7.1%. All these patients had a CASS of >12. There is no death for CASS score of less than 11. Thus the mortality is directly proportional to the CASS.

# SUMMARY

# SUMMARY

- Males were predominantly involved in the BTA constituting around 81% and the rest being females with 19%
- Most common age group involved in is 21-30years followed by 31-40years together constituting more than half of the total cases i.e.59.5%.
- Most common mode of injury was found to be RTA
- Most common injured organs are spleen>liver>small intestine (ileum).
- Majority of the patient fall in the group CASS <8 and 9-11. These are the patients in whom most of them can be managed conservatively..
- Early resuscitation and timely intervention is the key for better outcome.
- Patient with CASS> 12 either require surgery or succumbed to their injury thus showing severity of the injury with CASS>12 and hence such patients can be taken up for the laparotomy without waiting for any further investigations.
- Among patient with CASS 9-11 group, 91.3% (21 of 23 patients) of them had solid organ injury/hollow viscus injury. Among them 69.5% (16 of 23 patients) were managed conservatively and 30.5% (7 of 23 patients) had undergone exploratory laparotomy. Thus it is the group where after proper clinical assessment and with the help of radiological investigations we can plan for the further line of management.
- Patient with CASS <8 can be managed conservatively with continuous monitoring of the vitals even in the absence of imaging modality to confirm and grade the injury.
- Patient with CASS score >13 had high chances of mortality. Hence such patients should be taken for surgery after initial resuscitation.

# CONCLUSION

# CONCLUSION

- Most common gender to involved is male and most common mode is RTA.
- Most of the patient of blunt trauma abdomen can be managed conservatively if patients are hemodynamically stable.
- With score less than 8 as per CASS , patient can be managed conservatively with regular monitoring of the vitals even in the absence of imaging modality.
- Patient with score more than 12 or hemodynamically unstable can be taken up for emergency laparotomy without any radiological investigations.
- Patients with CASS score 9-11, with good clinical assessment aided with radiological investigations can be managed depending upon the severity of the injury.

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# BIBLIOGRAPHY


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# ANNEXURES

# ANNEXURE I

# PROFORMA

**EFFECTIVENESS OF CLINICAL ABDOMINAL SCORING SYSTEM IN THE MANAGEMENT OF PATIENTS WITH BLUNT TRAUMA ABDOMEN**

## Particulars of the patients

**Name: -**

**Age: -**

**Gender: -**

**UHID No.: -**

**Date of admission: -**

**Date of discharge: -**

**Chief Complaints:**

**History of presenting illness:**

**PREVIOUS HISTORY: -**

**FAMILY HISTORY: -**

**MENSTRUAL HISTORY IN FEMALE: -**

**PERSONAL HISTORY**

**Diet: -**

**Appetite: -**

**Sleep: -**

**Smoking: -**

**Alcohol: -**

**Bowel habits: -**

## GENERAL PHYSICAL EXAMINATION

**Appearance**

**Build and Nourishment**

**Level of consciousness**

**Dehydration**

**Temperature**

**Pulse**

**Blood pressure**

**$SpO_2$**

**B/L Pupil-**

**GCS**

**Chest compression test**

**Pelvic compression test**

**Spinal tenderness**

**B/L Clavicle**

**Pallor/Icterus/Clubbing/Cyanosis/Lymphadenopathy/Edema**

## LOCAL EXAMINATION[ABDOMEN]

**Inspection**

**Palpation**

**Percussion**

**Auscultation**

**OTHER RELAVENT EXAMINATIONS**

**Per rectal**

**SYSTEMIC EXAMINATION**

**CVS**

**RS**

**CNS**

**CASS SCORE (CLINICAL ABDOMINAL SCORING SYSTEM): -**

**INVESTIGATIONS:**

- **Routine blood investigations: -**

Hb: - RBC: - TLC: -
PLT: - BT: - CT:

BLOOD GROUP: - RBS: - B. UREA: - S. CREATININE: -

S. SODIUM: - S. POTASSIUM: - HIV: -
HBsAG: -

- **Chest X-ray**

- **X-ray erect abdomen: -**

- **USG abdomen and pelvis: -**

- **CT abdomen and pelvis: -**

**TREATMENT: -**

## ANNEXURE II

### Clinical abdominal scoring system (CASS)

| Item | Score |
|---|---|
| **1)Time of presentation after the trauma** | |
| Less than 2 h | 1 |
| 2-6 h | 2 |
| More than 6 h | 3 |
| **2)Pulse rate** | |
| Less than 90 beats/min | 1 |
| 90-110 beats/min | 2 |
| More than 110 beats/min | 3 |
| **3)Systolic blood pressure** | |
| Above 120 mm Hg | 1 |
| 90-120 mm Hg | 2 |
| Less than 90 mmHg | 3 |
| **4)Glasgow coma scale (GCS)** | |
| 13-15 | 1 |
| 9-12 | 2 |
| Less than 9 | 3 |
| **5)Abdominal clinical findings** | |
| Abdominal pain | 1 |
| Guarding | 2 |
| Abdominal rigidity and tenderness | 3 |

**Total score range: 5-15.**

**Patients with score of 12 or above are subjected to immediate laparotomy.**

**Patients with score of 9-11 are subjected to auxiliary investigations such as CT scanning and USG.**

**Patients with score of 8 and below are subjected to clinical observation with no auxiliary investigations up every 2 months for 6 months**

## ANNEXURE III

## INFORMED CONSENT FORM

I Mr./Mrs. have been explained in my own understandable language, that I will be included in a study which EFFECTIVENESS OF CLINICAL ABDOMINAL SCORING SYSTEM IN THE MANAGEMENT OF PATIENTS WITH BLUNT TRAUMA ABDOMEN being conducted in RL JALAPPA HOSPITAL.

I have been explained that my clinical findings, investigations, will be assessed and documented for study purpose.

I have been explained my participation in this study is entirely voluntary, and I can withdraw from the study any time and this will not affect my relation with my doctor or the treatment for my ailment.

I have been explained about the follow up details and possible benefits and adversities due to interventions, in my own understandable language.

I have understood that all my details found during the study are kept confidential and while publishing or sharing of the findings, my details will be masked.

I have principal investigator mobile no for enquiries.

I in my sound mind give full consent to be added in the part of this study.

Signature of the patient:

Name:

Signature of the witness:

Name:

Relation to patient:

Date: Place:

## ಮಾಹಿತಿದಾರರ ಒಪ್ಪಿಗೆ ಪತ್ರ

**ಅಧ್ಯಯನದ ಶೀರ್ಷಿಕೆ:** ಬ್ಲಂಟ್‌ಟ್ರಾಮು ಅಬ್ಡಾಮಿನಲ್ ಒಡೆತದ ಚಿಕಿತ್ಸೆಯಲ್ಲಿ "ಕ್ಲಿನಿಕಲ್ ಅಬ್ಡಾಮಿನಲ್ ಸ್ಕೋರಿಂಗ್ ಸಿಸ್ಟಮನ ಉಪಯೋಗತೆ"

ನಾನು ಶ್ರೀ/ಶ್ರೀಮತಿ_____ ಈ ಒಪ್ಪಿಗೆ ಪತ್ರದಲ್ಲಿ ತಿಳಿಸಿರುವ ಎಲ್ಲಾ ಕ್ರಮಗಳನ್ನು ಅರಿತುಕೊಂಡು ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ಒಪ್ಪಿರುತ್ತೇನೆ.

ನನಗೆ ತಿಳಿದಿರುವ ಸ್ಥಳೀಯ ಭಾಷೆಯಲ್ಲಿ ಎಲ್ಲವನ್ನು ಓದಿ ವಿವರಿಸಿರುತ್ತಾರೆ. ಮತ್ತು ಈ ಅಧ್ಯಯನದ ಉದ್ದೇಶವನ್ನು ಅರಿತುಕೊಂಡಿರುತ್ತೇನೆ. ಈ ಅಧ್ಯಯನದ ಸಂದರ್ಭದಲ್ಲಿ ಸಂಗ್ರಹಿಸಲ್ಪಡುವ ಎಲ್ಲಾ ವಿಷಯಗಳು ಗೋಪ್ಯ ರೀತಿಯಾಗಿರುತ್ತೆ. ಮತ್ತು ಅಧ್ಯಯನಕ್ಕಾಗಿ ಮಾತ್ರ ಬಳಸಲ್ಪಡುತ್ತೆಂದು ಗೊತ್ತಿರುತ್ತೆ. ಈ ಸಂದರ್ಭದಲ್ಲಿ ನನ್ನಲ್ಲಿ ಉದ್ಭವಿಸಿದ ಎಲ್ಲಾ ಪ್ರಶ್ನೆಗಳನ್ನು ಸಮರ್ಪಕವಾಗಿ ಉತ್ತರಿಸಿರುತ್ತಾರೆ ಮತ್ತು ಸಂಗ್ರಹಿಸಿದ ಮಾಹಿತಿಗಳನ್ನು ಸಂಶೋಧನೆಗಾಗಿ ಬಳಸುವರೆಂದು ತಿಳಿದಿರುತ್ತೇನೆ.

**ಡಾ.ಧರ್ಮೇಂದ್ರ ಕುಮಾರ್ ಮೊ. ಸಂ: 7042285155**

ಭಾಗವಹಿಸುವ ಡಾಕ್ಟರ್ ಸಹಿ:

ರೋಗಿಯ ಸಹಿ/ಎಡ ಹೆಬ್ಬೆರಳಿನ ಗುರುತು:

ಸಾಕ್ಷಿಗಳು:

1. ಸಹಿ/ಹೆಸರು ದಿನಾಂಕ:

2. ಸಹಿ/ಹೆಸರು ದಿನಾಂಕ:

## ANNEXURE IV

## PATIENT INFORMATION SHEET

**Study title**: "EFFECTIVENESS OF CLINICAL ABDOMINAL SCORING SYSTEM IN THE MANAGEMENT OF PATIENTS WITH BLUNT TRAUMA ABDOMEN"

**Study location:** R L Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Tamaka, Kolar.

**Details**-

Patients aged between 18 and 70 years diagnosed as blunt trauma abdomen and admitted to general surgery department of R.L.Jalappa Hospital will be included in this study.

Patients in this study will be assessed based on the clinical abdominal scoring system and will undergo ultrasound of abdomen and pelvis and CT abdomen and pelvis as required. Then the effectiveness of clinical abdominal score will assessed in relation to the radiological investigation and then further plan of management will be decided. Patient has to undergo routine investigations. Standard of care of the patient will be maintained throughout the study.

Please read the following information and discuss with your family members. You can ask any question regarding the study. If you agree to participate in the study, we will collect information (as per proforma) from you or a person responsible for you or both. Relevant history will be taken. This information collected will be used only for dissertation and publication. All information collected from you will be kept confidential and will not be disclosed to any outsider. Your identity will not be revealed. This study has been reviewed by the Institutional Ethics Committee and you are free to contact the member of the Institutional Ethics Committee. There is no compulsion to agree to this study. The care you will get will not change if you don't wish to participate. You are required to sign/ provide thumb impression only if you voluntarily agree to participate in this study.

For further information, contact

Dr. Dharmendra kumar (Post graduate)

Department of General Surgery

SDUMC, Kolar

Patient's signature/thumb impression

Witness signature/thumb impression

**ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆ**

**ಶೀರ್ಷಿಕೆ:** ಬ್ಲಂಟ್‌ಟ್ರಾಮು ಅಬ್ಡಾಮಿನಲ್ ಒಡೆತದ ಚಿಕಿತ್ಸೆಯಲ್ಲಿ "ಕ್ಲಿನಿಕಲ್ ಅಬ್ಡಾಮಿನಲ್ ಸ್ಕೋರಿಂಗ್ ಸಿಸ್ಟಮನ ಉಪಯೋಗತೆ"

**ಅಧ್ಯಯನದ ಸ್ಥಳ:** ಕೋಲಾರದ ಶ್ರೀ ಆರ್.ಎಲ್.ಜಾಲಪ್ಪ ಆಸ್ಪತ್ರೆ ಮತ್ತು ಸಂಶೋಧನಾ ಕೇಂದ್ರ ಶ್ರೀ ದೇವರಾಜ್ ಅರಸ್ ವೈದ್ಯಕೀಯ ಮಹಾವಿದ್ಯಾಲಯ ತಮಕ.

**ಮಾರ್ಗದರ್ಶಕರು :** ಡಾ.ಮೋಹನ್ ಕುಮಾರ್.ಕೆ

ಡಾ.ಧರ್ಮೇಂದ್ರ ಕುಮಾರ್ ಮೂಲಕ ನಡೆಸಲ್ಪಟ್ಟ ಅಧ್ಯಯನದ

ಆರ್.ಎಲ್.ಜಾಲಪ್ಪ ಆಸ್ಪತ್ರೆಯ ಸಾಮಾನ್ಯ ಶಸ್ತ್ರ ಚಿಕಿತ್ಸೆ ಇಲಾಖೆಯಲ್ಲಿ ದಾಖಲಾಗುವ 18 ರಿಂದ 70 ವರ್ಷ ವಯಸ್ಸಿನ ರೋಗಿಗಳು , ಅವರಿಗೆ ಹೊಟ್ಟೆ ಭಾಗದ ಮೋಗೇಟು ಆಗಿರುವವರು ಈ ಅಧ್ಯನದಲ್ಲಿ ನೇರಿಸಲಾಗುತ್ತದೆ.

ಈ ಅಧ್ಯಯನ ರೋಗಿಗಳು ಕ್ಲಿನಿಕಲ್ ಅಬ್ಡಾಮಿನಲ್ ಸ್ಕೋರಿಂಗ್ ವ್ಯವಸ್ಥೆಯನ್ನು ಆಧರಿಸಿ ಮೌಲ್ಯಮಾಪನ ಮಡುತ್ತಾರೆ ಮತ್ತು ಹೊಟ್ಟೆ ಮತ್ತು ಪೆಲ್ವಿಸ್ ಸಿ.ಟಿ, ಹೊಟ್ಟೆ ಮತ್ತು ಪೆಲ್ವಿಸ್ ಅಲ್ಟ್ರಾಸೌಂಡ್ಗೆ ಒಳಗಾಗುತ್ತಾರೆ. ನಂತರ ಕ್ಲಿನಿಕಲ್ ಅಬ್ಡಾಮಿನಲ್ ಸ್ಕೋರಿಂಗ್ ಪರಿಣಾಮಕಾರತ್ವವನ್ನು ವಿಕಿರಣಶಾಸ್ತ್ರದ ತನಿಖೆಗೆ ಸಂಬಂಧಿಸಿದಂತೆ ಹೋಲಿಸಿ ಮತ್ತು ನಂತರ ನಿರ್ವಹಣೆಯ ಹೆಚ್ಚಿನ ಯೋಜನೆ ನಿರ್ಧರಿಸಲ್ಪಡುತ್ತದೆ. ರೋಗಿಯ ಆರೈಕೆಯ ಪ್ರಮಾಣವನ್ನು ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಕಾಯ್ದಿರಿಸಲಾಗುತ್ತದೆ.

ಕೆಳಗಿನ ಮಾಹಿತಿಯನ್ನು ಓದಿ ಮತ್ತು ನಿಮ್ಮ ಕುಟುಂಬ ಸದಸ್ಯರೊಂದಿಗೆ ಚರ್ಚಿಸಿ, ಅಧ್ಯಯನದ ಬಗ್ಗೆ ನೀವು ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನು ಕೇಳಬಹುದು. ನೀವು ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಒಪ್ಪಿಕೊಂಡರೆ, ನಿಮ್ಮಿಂದ ಅಥವಾ ಇಬ್ಬರಿಗೂ ಜವಾಬ್ದಾರರಾಗಿರುವ ಮಾಹಿತಿಯನ್ನು ನಾವು (ಮಹಿತಿ ಪ್ರಕಾರ) ಸಂಗ್ರಹಿಸುತ್ತೇವೆ. ಸಂಬಂಧಿತ ರೋಗಲಕ್ಷಣಗಳನ್ನು ತೆಗೆದುಕೊಳ್ಳಲಾಗುವುದು. ಸಂಗ್ರಹಿಸಿದ ಈ ಮಾಹಿತಿಯನ್ನು ಪ್ರೌಢಪ್ರಬಂಧ ಮತ್ತು ಪ್ರಕಟಣೆಗಾಗಿ ಮಾತ್ರ ಬಳಸಲಾಗುತ್ತದೆ. ನಿಮ್ಮಿಂದ ಸಂಗ್ರಹಿಸಿದ ಎಲ್ಲಾ ಮಾಹಿತಿಯನ್ನು ಗೌಪ್ಯವಾಗಿರಿಸಲಾಗುವುದು. ಮತ್ತು ಯಾವುದೇ ಹೊರಗಿನವರಿಗೆ ಬಹಿರಂಗಗೊಳ್ಳುವುದಿಲ್ಲ. ನಿಮ್ಮ ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನವು ಸಾಂಸ್ಥಿಕ ನೀತಿಶಾಸ್ತ್ರ ಸಮಿತಿಯಿಂದ ಪರಿಶೀಲಿಸಲ್ಪಟ್ಟಿದೆ ಮತ್ತು ನೀವು ಸಂಸ್ಥೆಯ ಎಥಿಕ್ಸ್ ಸಮಿತಿಯ ಸದಸ್ಯರನ್ನು ಸಂಪರ್ಕಿಸಲು ಮುಕ್ತವಾಗಿರುತ್ತೀರಿ. ಈ ಅಧ್ಯಯನಕ್ಕೆ ಒಪ್ಪಿಗೆ ನೀಡಲು ಯಾವುದೇ ಕಡ್ಡಾಯವಿಲ್ಲ. ನೀವು ಭಾಗವಹಿಸಲು ಬಯಸದಿದ್ದರೆ ನೀವು ಪಡೆಯುವ ಆರೈಕೆ ಬದಲಾಗುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನೀವು ಸ್ವಯಂ ಪ್ರೇರಣೆಯಿಂದ ಒಪ್ಪಿಕೊಳ್ಳುವುದಾದರೆ ಮಾತ್ರ ಹೆಬ್ಬೆರಳು ಅನಿಸಿಕೆಗೆ ನೀವು ಸಹಿ ನೀಡಬೇಕಾಗಿದೆ.

**ಹೆಚ್ಚಿನ ವಿವರಗಳಿಗೆ ಸಂಪರ್ಕಿಸಿ:**

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**ಮೊ: 7042285155**

**ಶ್ರೀ ದೇವರಾಜ್ ಅರಸು ವೈದ್ಯಕೀಯ ಮಹಾವಿದ್ಯಾಲಯ, ತಮಕ, ಕೋಲಾರ**

**ರೋಗಿಯ ಸಹಿ/ಹೆಬ್ಬೆರಳು ಗುರುತು** **ವಿಟ್ನೆಸ್/ಹೆಬ್ಬೆರಳು ಗುರುತು**

# KEY TO MASTER CHART

SI No.- Serial Number

UHID- unique hospital identification number

MOI- mechanism of injury

TOP- time of presentation

PR- pulse rate

SBP- systolic blood pressure

GCS- Glassgow coma scale

CF- clinical features

CASS- Clinical Abdominal Scoring System

| Sl No | UHID | AGE | SEX | MOI | TOP | PR | SBP | GCS | CF | CASS | Organ inj | manag |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 551219 | 28 | F | RTA | <2hrs | 123/min | 110mmhg | 13/15 | Tenderness | 9 of 15 | Nil | Conservative |
| 2 | 559015 | 22 | M | RTA | <2hrs | 106/min | 100mmhg | 15/15 | Tenderness | 8 of 15 | Nil | Conservative |
| 3 | 543014 | 52 | M | FALL | >6 hrs | 80/min | 140mmhg | 15/15 | Tenderness | 9 of 15 | Nil | Conservative |
| 4 | 547013 | 24 | M | RTA | >6hrs | 128/min | 150mmhg | 15/15 | Tenderness | 9 of 15 | Kidney | Conservative |
| 5 | 524636 | 36 | M | RTA | >6hrs | 106/min | 110mmhg | 15/15 | Diffuse ten | 11 of 15 | Colon | Exp lap |
| 6 | 517499 | 50 | M | FALL | 2-6hrs | 86/min | 130mmhg | 15/15 | bruise+ | 6 of 15 | Nil | Conservative |
| 7 | 546318 | 27 | M | RTA | >6hrs | 74/min | 120mmhg | 15/15 | Tenderness | 7 of 15 | Nil | Conservative |
| 8 | 486027 | 30 | M | RTA | >6hrs | 98/min | 130mmhg | 15/15 | bruise+ | 10 of 15 | Spleen | Splenectomy |
| 9 | 471317 | 60 | M | OTHER | >6hrs | 82/min | 130mmhg | 15/15 | Diffuse ten | 9 of 15 | Ileum | Primary Closure |
| 10 | 555752 | 45 | M | RTA | >6 hrs | 64/min | NR | 10 0f 15 | Tenderness | 12 of 15 | Bowel | Expired |
| 11 | 554574 | 57 | F | RTA | <2 hrs | 146/min | NR | 3 of 15 | Diffuse ten | 13 of 15 | Liv+Spleen | Expired |
| 12 | 558991 | 35 | M | RTA | <2hrs | 93/min | 150mmhg | 15/15 | Tenderness | 8 of 15 | Liver | Conservative |
| 13 | 567076 | 18 | M | RTA | 2-6 hrs | 112/min | 11ommhg | 15/15 | Diffuse ten | 9 of 15 | Nil | Conservative |
| 14 | 561971 | 22 | M | FALL | >6hrs | 78/min | 126mmhg | 15/15 | Tenderness | 7 of 15 | Spleen | Conservative |
| 15 | 561972 | 27 | M | FALL | >6 hrs | 80/min | 120mmhg | 15/15 | Tenderness | 7 of 15 | Kidney | Conservative |
| 16 | 569857 | 24 | F | RTA | >6hrs | 80/min | 120mmhg | 15/15 | Tenderness | 8 of 15 | hemoperit | Conservative |
| 17 | 561521 | 31 | M | RTA | >6 hrs | 110/min | 110mmhg | 15/15 | Diffuse ten | 9 of 15 | Spleen | Conservative |
| 18 | 563215 | 30 | M | RTA | >6 | 106 | 90mmhg | 15/15 | Tenderness | 10 of 15 | Liver | Conservative |
| 19 | 596176 | 18 | M | RTA | 2-6hrs | 96/min | 110mmhg | 15/15 | Tenderness | 10 of 15 | Spleen | Conservative |
| 20 | 564473 | 31 | M | RTA | 2-6hrs | 110/min | 110mmhg | 15/15 | Tenderness | 9 of 15 | Nil | Conservative |
| 21 | 556683 | 70 | M | RTA | >6hrs | 106/min | 150mmh | 15/15 | Diffuse ten | 10 of 15 | Bowel | Primary Closure |
| 22 | 568040 | 57 | M | RTA | 2-6 hrs | 73/min | 128mmhg | 15/15 | Tenderness | 6 of 15 | Liver | Conservative |
| 23 | 566094 | 40 | F | OTHER | >6hrs | 76/min | 100mmhg | 15/15 | Tenderness | 8 of 15 | Nil | Conservative |
| 24 | 594076 | 40 | M | RTA | <2 hrs | 140/min | 70mmhg |  | Diffuse ten | 11 of 15 | Liv+Spleen | Conservative |
| 25 | 598590 | 65 | M | RTA | 2-6hrs | 103/min | 170mmhg | 15/15 | Diffuse ten | 9 of 15 | Omentum | Exp lap |
| 26 | 567538 | 46 | F | FALL | 2-6 hrs | 100/min | 100mmhg | 15/15 | Tenderness | 9 of 15 | Spleen | Conservative |
| 27 | 567049 | 40 | M | RTA | >6 hrs | 116/min | 90mmhg | 14/15 | Diffuse ten | 13 of 15 | Bowel | Expired |
| 28 | 560254 | 40 | M | RTA | 2-6hrs | 116/min | 110mmhg | 15/15 | Tenderness | 9 of 15 | Spleen | Conservative |
| 29 | 654886 | 20 | M | RTA | <2 hrs | 120/min | NR | 8 of 15 | Diffuse ten | 13 of 15 | Liv+Spleen | Referred |
| 30 | 653676 | 63 | F | OTHER | >6 hrs | 130/min | 80mmhg | 15/15 | Diffuse ten | 13 of 15 | Bowel | Referred |
| 31 | 657035 | 65 | M | RTA | >6 hrs | 112/min | 90mmhg | 15/15 | Diffuse ten | 13 of 15 | Spleen | Splenectomy |
| 32 | 698115 | 18 | M | RTA | >6 hrs | 130/min | 90mmhg | 15/15 | Diffuse ten | 13 of 15 | Spleen | Splenectomy |
| 33 | 671435 | 28 | F | RTA | >6 hrs | 112/min | 80mmhg | 15/15 | Diffuse ten | 13 of 15 | Spleen | Splenectomy |
| 34 | 639714 | 70 | F | FALL | >6hrs | 113/min | 160mmhg | 15/15 | Diffuse ten | 11 of 15 | Spleen | Splenectomy |
| 35 | 697169 | 30 | M | RTA | 2-6hrs | 84/min | 100mmhg | 15/15 | Tenderness | 7 of 15 | Liver | Conservative |
| 36 | 575731 | 30 | M | RTA | >6 hrs | 112/min | 90mmhg | 15/15 | Tenderness | 10 of 15 | Liver | Conservative |
| 37 | 645602 | 36 | M | RTA | <2hrs | 90/min | 90mmhg | Jul-15 | Tenderness | 10 of 15 | Liver | Conservative |
| 38 | 747855 | 24 | M | RTA | >6 hrs | 118/min | 80mmhg | 15/15 | Tenderness | 13 of 15 | Spleen | Splenectomy |
| 39 | 640983 | 22 | M | RTA | >6 hrs | 115/min | NR | 15/15 | Diffuse ten | 11 of 15 | Bowel | Primary Closure |
| 40 | 673214 | 25 | M | RTA | 2-6 hrs | 102/min | 100mmhg | 15/15 | Tenderness | 9 of 15 | Spleen | Conservative |
| 41 | 668321 | 30 | M | RTA | 2-6 hrs | 96/min | 110mmhg | 15/15 | Tenderness | 9 of 15 | Spleen | Conservative |
| 42 | 616012 | 55 | M | RTA | >6 hrs | 97/min | 90mmhg | 15/15 | Diffuse ten | 11 of 15 | Nil | Conservative |