A Thesis in General Surgery

A CLINICAL STUDY OF BLUNT TRAUMA ABDOMEN

Submitted in partial fulfillment of the
Requirements for the Degree of
M.S General Surgery
(Branch I)

Kilpauk Medical College
The Tamilnadu Dr. M.G.R Medical University Chennai

APRIL – 2015

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled "**A CLINICAL STUDY OF BLUNT TRAUMA ABDOMEN"** is a bonafide and genuine research work carried out by me under the guidance of Dr.V.Chitra, M.S., Professor, Department of General Surgery, Kilpauk Medical College, Chennai.

This dissertation is submitted to THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY, CHENNAI in partial fulfillment of the requirements for the degree of M.S. General Surgery examination to be held in April 2015.

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The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "AClinical Study of blunt trauma abdomen" – For Project Work submitted by Dr.Sruthi.S, MS (GS), PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

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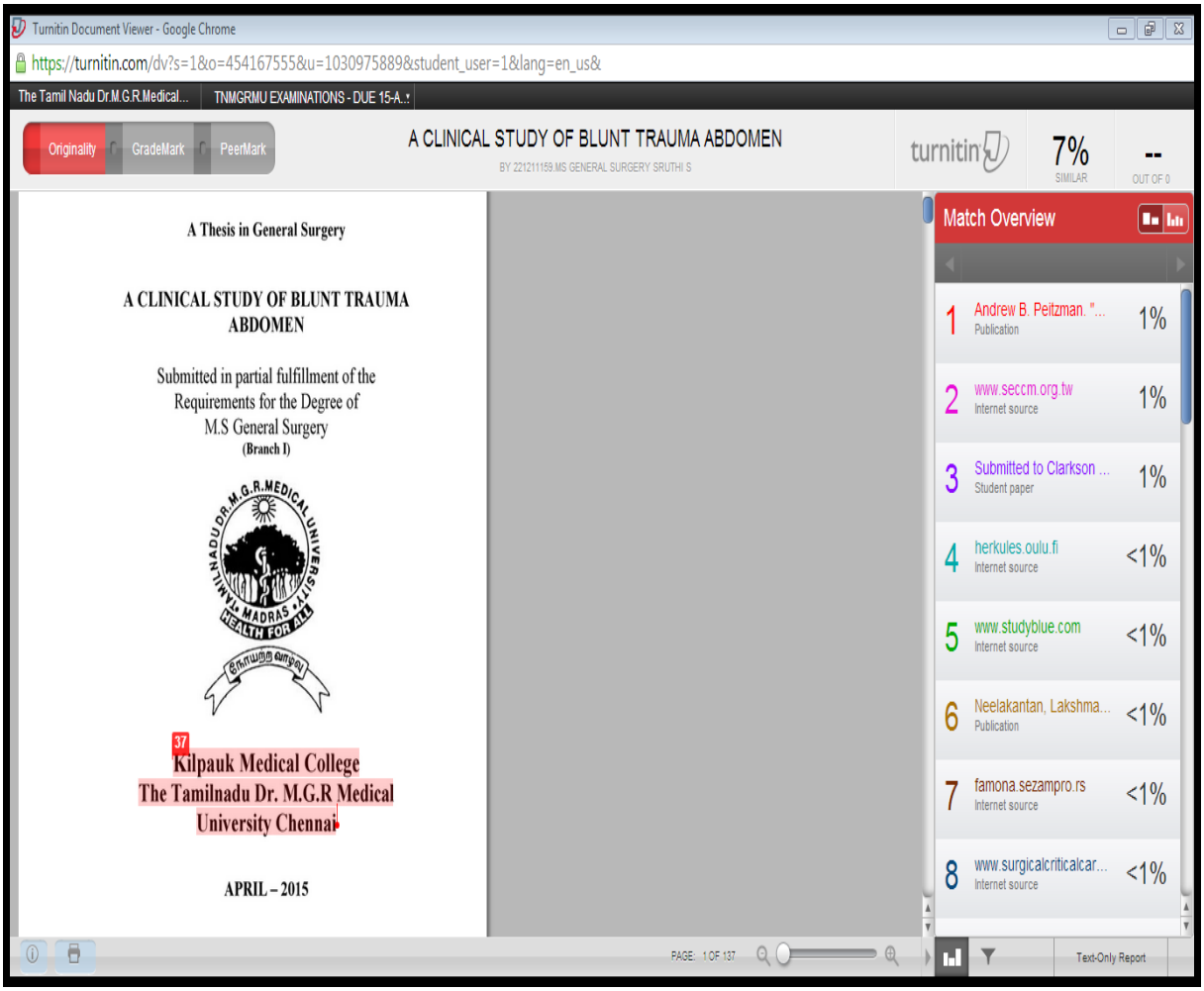
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ABSTRACT

OBJECTIVES

- To find out age and sex distribution of blunt trauma abdomen
- To study the etiology of blunt trauma abdomen
- To study the modes of presentation, investigations and management for different organ injuries.
- To study the morbidity and mortality of blunt trauma abdomen.

BACKGROUND DATA

Abdominal trauma is a preventable cause of trauma- related deaths. Blunt abdominal trauma is a hard encounter because clinical signs may not be obvious. In view of its increasing incidence, diagnostic and treatment issues, this dissertation has been chosen.

METHODOLOGY

50 consecutive cases of blunt trauma abdomen presenting to Government Royapettah Hospital from April 2014 to September 2014 were prospectively studied. Patients with head, chest and orthopaedic injuries that require immediate surgical intervention were excluded from the study.

Various parameters were analysed, ie, age, sex, etiology, latent period, symptoms, signs, different organ injuries, investigations, treatment, operative procedures, complications, duration of stay in hospital, outcome and inferences made.

RESULTS

Blunt trauma abdomen was common in 3rd decade(26%), predominantly affecting males(80%). Road traffic accident was the commonest etiology(50%). 50% presented within 4 hours of injury. Pain(100%) and tenderness(98%) were the commonest presentation. 60% had intra-abdominal injuries. Spleen was commonly involved in 28%. USG and CECT were 73.3% and 100% sensitive, respectively. X-Ray was 85.7% sensitive in detecting bowel injuries. 56% were managed conservatively. 8% underwent splenectomy, the commonest procedure. Surgical site infections were seen in 18%. 72% were discharged without any complications. 6% died due to complications.

CONCLUSION

Preventing road traffic accidents can considerably reduce blunt trauma abdomen. Clinical suspicion is more important which could be complemented with investigations. In haemodynamically stable patients with low-grade injuries, conservative management can be tried with careful monitoring.

KEY WORDS

Blunt abdominal trauma; Road traffic accidents; Computed tomography abdomen; Early diagnosis; Conservative management.

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INTRODUCTION

Abdominal trauma is one of the most common causes of preventable trauma- related deaths. Its incidence is on the rise because of urbanization and industrialization. Increased use of machinery and road traffic accidents have resulted in considerable morbidity and mortality, more so for the working population.

As a surgeon, blunt abdominal trauma is a hard encounter because clinical signs may not be always obvious, and diagnosis may be missed or delayed which can cost even the life of the patient. Strong clinical suspicion is crucial and this coupled with appropriate investigations will alleviate the diagnostic issue and guide us to institute proper treatment.

In the current era of evidence based medicine, negative laparotomies should be avoided and at the same time, subtle findings should not be missed. Time should not be wasted on unnecessary investigations, and resuscitation should be the priority in unstable patients. Surgery should not be deferred in deserving cases as time plays a vital role in deciding the outcome.

In view of increasing incidence of blunt trauma abdomen, its varied presentation, diagnostic issues and mixed outcome, this dissertation has been chosen to study the cases of blunt trauma abdomen presenting to Government Royapettah Hospital, Kilpauk Medical College, Chennai.

OBJECTIVES

- To find out age and sex distribution of blunt trauma abdomen.
- To study the etiology of blunt trauma abdomen.
- To study the modes of presentation, investigations and management for different organ injuries.
- To study the morbidity and mortality of blunt trauma abdomen.

REVIEW OF LITERATURE

SELECTIVE HISTORY [1]

Injury has been a consistent companion since evolution of mankind and surgeon's role in an injured has been documented in history. Smith Papyrus, the first recorded medical text in history written over 5000 years ago describes 48 different injuries with distinct triage and surgical protocol.

Intra-abdominal injuries due to blunt trauma have been recognized for a long time.

Visceral injuries due to blunt trauma were first recorded by Aristotle who said " a slight blow will cause rupture of intestines without injury to the skin", which was also later described by Hippocrates and Gale. Hippocrates quoted "a severe wound to the liver is deadly".

Ancient Chinese assassins used blunt trauma as a method of killing by giving a blow in the region of spleen.

In 1253, De Saliat described the repair of an intestinal wound.

In 1827, Trausse presented the fracture of body of pancreas due to blunt trauma and Von Recklinhausen described artery thrombosis following blunt trauma.

In 1899, Walker repaired a ruptured diaphragm secondary to blunt trauma.

In 1902, Baudel first described delayed rupture of spleen.

In 1906, Solomon described and performed the technique of abdominal paracentesis.

In 1922, Picasteth described non-penetrating gastric injuries. Transection of stomach was described by Plancaslillin.

Bailey reported 32 cases of splenic rupture from 1894-1924.

In 1934, Aenhium described the use of abdominal wall puncture as a diagnostic method in intra-abdominal injuries.

In 1938, Branch described 2 cases of liver laceration treated by left lobe resection.

Regarding laparotomy for closed injuries, Gray turner (1940) said "The patient will not die from a very big incision, but may very likely succumb if some important injury is overlooked".

The world war was an eye-opener in terms of management of blunt trauma abdomen. The significance of time interval between injury and treatment was well recognized and was a pioneer for development of regional trauma systems.

Diagnostic peritoneal lavage using sterile solution was first described by Root in 1965. Until then needle paracentesis was used as only investigation.

CT was introduced as an investigation modality in 1981 and since then missed injuries have come down. Now, MRI is also being used.

ANATOMY O F ABDOMINAL CAVITY [2]

Abdominal cavity is the largest cavity. It extends from just below the xiphisternum deep into the pelvis. It is bound anteriorly by the rectus abdominis, laterally by oblique muscles and tranversus abdominis, posteriorly by vertebral column, psoas muscles and quadratus lumborum, superiorly by diaphragm and inferiorly by pelvic diaphragm. It encloses the peritoneal cavity between its parietal and visceral layers.

Abdominal cavity is divided into nine regions by four imaginary planes, two horizontal and two vertical planes. Transpyloric plane of Addison passes anteriorly through the tips of ninth costal cartilage and posteriorly through the body of L1 vertebra. Transtubercular plane passes through the tubercles of iliac crest and body of L5 vertebra. Right and left lateral planes correspond to the midclavicular lines and passes through the midinguinal point and tip of ninth costal cartilage. Sometimes subcotal plane is used instead of transpyloric plane, which passes through the 10^{th} costal cartilage and body of L3. The different zones are right and left hypochondrium, epigastrium, right and left lumbar, umbilical, right and left

iliac, hypogastrium. Additionally, external genitalia is considered as 10th quadrant and left supraclavicular region as 11th quadrant.

Peritoneal Cavity [2]

The peritoneum is a large serous membrane lining the abdominal cavity and is in the form of a closed sac which is invaginated by a number of viscera. It is broadly divided into two parts- greater and lesser sacs, which communicate through the epiploic foramen or foramen of Winslow.

Individual Organs

Liver [3]

Large solid gland situated in right upper quadrant of abdomen. It is divided into right and left lobes by falciform ligament anteriorly, fissure for ligamentum teres inferiorly and fissure for ligamentum venosum posteriorly.

Anterior surface is related to xiphoid process, anterior abdominal wall and diaphragm.

Posterior surface is related to the diaphragm, right suprarenal gland, inferior vena cava, coeliac trunk, portal vein, oesophagus.

Superior surface is related to heart and diaphragm.

Inferior surface is related to the gall bladder, lesser omentum, stomach, 1st and 2nd part of duodenum, transverse colon, hepatic flexure and right kidney.

Gall bladder [3]

Pyriform shaped organ situated on the inferior surface of right lobe of liver between porta hepatis and inferior border. It is in contact with the anterior abdominal wall at the level of ninth costal cartilage.

Spleen [2]

Spleen is a wedge-shaped organ lying mainly in left hypochondrium and partly in epigastrium.

It is wedged between the fundus of stomach and diaphragm and is in close relation to the tail of pancreas. It lies between 9th and 11th ribs and its long axis is along the 10th rib. It is suspended by the gastrocolic, leinorenal and phrenicocolic ligaments.

Pancreas [2]

Soft, lobulated and elongated organ which lies across the posterior abdominal wall at the level of L1 and L2, extending between C-loop of duodenum to spleen.

Anteriorly, it is related to the stomach and transverse colon.

Posteriorly, it is related to the aorta, inferior vena cava, superior mesenteric vessels and left crus of diaphragm.

Tail of pancreas is related to the hilum of spleen.

Gastrointestinal Tract [2]

Stomach

It is a seromuscular organ located in the intra-thoracic part of the abdominal cavity and thus well-protected by rib cage. It is relatively fixed at the gastro-oesophageal junction and duodenum, and is loosely suspended by the gastrosplenic and gastrocolic ligaments.

Anteriorly it is related to the rectus sheath, diaphragm, left lobe of liver.

Stomach bed structures including diaphragm, left kidney and suprarenal gland, pancreas, transverse mesocolon, splenic flexure, splenic artery, spleen form the posterior relation.

It has rich vascular supply from right and left gastric arteries, right and left gastroepiploic arteries with extensive collateral circulation.

Small Intestine

It is 6 metres long and extends from pylorus to ileocaecal junction. It includes duodenum, jejunum and ileum.

Duodenum

It extends from the pylorus to duodenojejunal flexure and lies opposite L1 to L3 vertebrae. It is 25 cm long, C-shaped and curved around the head of pancreas. It is divided into 4 parts.

Duodenum is mostly retroperitoneal and fixed except at its two ends. Ligament Trietz is a fibromuscular band that suspends and supports the duodenojejunal flexure.

Jejunum and ileum

They are suspended from posterior abdominal wall by mesentery which extends from duodenojejunal flexure on the left side of L2 to the upper part of the right sacroiliac joint and it crosses the 3rd part of duodenum, aorta, inferior vena cava, right ureter, right psoas major.

Jejunum constitutes upper two-fifths and ileum constitutes lower three-fifths. Jejunum occupies upper and left parts of intestinal area and ileum occupies lower and right parts.

Large intestine

It extends from the ileocaecal junction to the anus, is about 1.5 m long and consists of caecum, appendix, ascending colon, hepatic flexure, transverse colon, splenic flexure, descending colon, sigmoid colon, rectum, anal canal.

Greater part of the large intestine is fixed except for appendix, transverse colon, sigmoid colon.

Kidney [2]

Bean-shaped retroperitoneal organ situated on the posterior abdominal wall, on each side of the vertebral column.

Right kidney is slightly lower than the left and left kidney is closer to the median plane. Right kidney is related to the 12^{th} rib and left kidney is related to 11^{th} and 12^{th} ribs.

Upper pole is broad and related to the suprarenal gland.

Anteriorly, right kidney is related to the right suprarenal gland, 2^{nd} part of duodenum, hepatic flexure of colon, small intestine and left kidney is related to left suprarenal gland, spleen, stomach, pancreas, splenic vessels, splenic flexure, descending colon, jejunum.

Posterior surface is related to diaphragm, medial and lateral arcuate ligaments, psoas major, quadratus lumborum, transversus abdominis, subcostal vessels, subcostal, iliohypogastric, ilioinguinal nerves.

Bladder [2]

It is a muscular structure which lies in the anterior part of pelvic cavity. As the bladder fills, it extends upto the umbilicus or even higher.

PATHOPHYSIOLOGY [4]

Injuries can be divided into high energy and low energy injuries. There are different mechanisms of injuries, listed as follows:

1. Sudden increase in intra-abdominal pressure causing a combination of shearing, bursting, compression forces.
2. Crush injury by compression against bony structure like vertebrae.
3. Shearing forces causing avulsion of vascular pedicles and organs.
4. Oblique and deceleration forces causing tearing of viscera at fixed parts.
5. Inertia of motion in high velocity accidents.

Patterns in blunt abdominal injury [25]

Direct Impact Injuries	Associated Regional Injuries
Lower right rib fracture	Liver disruption
Lower left rib fracture	Splenic disruption
Mid-epigastric contusion	Duodenal perforation, pancreatic fracture
Lumbar transverse process fracture	Renal injury
Pelvic fracture	Bladder rupture, urethral injury

Pathophysiology of blunt trauma to individual organs

According to international series [4], the frequency of different organ injury is:

Organ	Relative Incidence
Spleen	46
Liver	33
Mesentery	10
Renal	9
Pancreas	9
Small bowel	8

Organ	Relative Incidence
Large bowel	7
Duodenum	5
Stomach	2

Spleen [4]

Commonest organ to be injured in blunt trauma to abdomen is spleen. Mechanism of injury is compression between anterior chest wall or abdominal wall and posterior rib cage and vertebra. Countercoup injury and dislodgement owing to its relative mobility on its pedicle result in capsular and parenchymal tear.

Splenic injury scale [1, 56]:

Grade	Injury Description
I	Haematoma – subcapsular, non-expanding, <10% surface area Laceration – capsular tear, <1 cm parenchymal depth
II	Haematoma – subcapsular, non-expanding, 10-50 % surface area/ intra-parenchymal non-expanding <5cm diameter Laceration – capsular tear, 1-3 cm parenchymal depth, <10 cm length, not involving the trabecular vessels

Grade	Injury Description
III	Haematoma – subcapsular >50% surface area or expanding/ ruptured with active bleeding/ intra-parenchymal > 5cm or expanding Laceration - > 3 cm parenchymal depth / involving trabecular vessels
IV	Laceration: involving segmental or hilar vessels producing major devascularization (>25% of spleen)
V	Completely shattered spleen. Hilar vascular injury that devascularises the spleen

*Advance one grade for multiple injuries upto grade III.

Liver [3]

Mechanism of liver injuries include direct blows which cause compression of liver between right lower ribs and spine and shearing forces secondary to decelaration. Death in liver injury is due to haemorrhage.

Liver injury scale [1, 56]:

Grade	Description of injury
I	Haematoma - Subcapsular, <10% surface area

Grade	Description of injury
	Laceration - Capsular tear, <1cm parenchymal depth
II	Haematoma - Subcapsular, 10% to 50% surface area/ intraparenchymal <10 cm in diameter Laceration - Capsular tear 1-3 parenchymal depth, <10 cm in length
III	Haematoma - Subcapsular, >50% surface area of ruptured subcapsular/ parenchymal hematoma; intraparenchymal hematoma > 10 cm/ expanding Laceration - >3 cm parenchymal depth
IV	Laceration - Parenchymal disruption involving 25% to 75% hepatic lobe or 1-3 Couinaud's segments
V	Laceration - Parenchymal disruption involving >75% of hepatic lobe or >3Couinaud's segments within a single lobe Vascular - Juxtahepatic venous injuries; ie, retrohepatic vena cava/central major hepatic veins
VI	Vascular - Hepatic avulsion

*Advance one grade for multiple injuries up to grade III

Biliary injuries [3]

High energy shearing forces can avulse the gall bladder from cystic plate, leaving it attached only by cystic duct and vascular structures. This is termed as traumatic cholecystectomy and these patients are at high risk of volvulus of gall bladder.

Traumatic cholecystitis results when direct contusion or bleeding from liver injury fills the gall bladder with blood which clots, thus blocking the cystic duct causing distension of gall bladder. Common bile duct is commonly injured at the superior part of duodenum as it enters the pancreas.

Pancreas [1]

Blow to the epigastrium can compress the pancreas against the vertebral column causing fracture of pancreas. Neck of the pancreas is the most commonly injured part.

It usually occurs associated with other injuries to spleen, liver, stomach, duodenum, kidney. Isolated pancreatic trauma is rare and occur in 1-4% cases.

Pancreas injury scale: [1, 56]

Grade	Injury and Description
I	Haematoma - Minor contusion without duct injury Laceration - Superficial laceration without duct injury
II	Haematoma – Major contusion without duct injury or tissue loss Laceration - Major laceration without duct injury or tissue loss
III	Laceration - Distal transection or parenchymal injury with duct injury
IV	Laceration - Proximal transection or parenchymal injury involving ampulla
V	Laceration - Massive disruption of pancreatic head

*Advance one grade for multiple injuries upto grade III.

Gastric injuries [1]

Rapid deceleration motor vehicle accidents cause gastric injury with other associated injuries to liver, spleen, pancreas, duodenum and diaphragm.

Focussed blows to epigastrium like those caused by seat-belt or bicycle handle bars cause gastric rupture.

Duodenum [4]

Blunt duodenal injuries are rare due to its retroperitoneal location. A crushing injury caused by blow to the abdomen from steering wheel or seat belt is the commonest cause. Shearing forces may also cause avulsion of blood vessels.

Duodenal injuries occur in 4.3% patients with abdominal trauma and are usually associated with other injuries to pancreas, liver, portal triad, colon and stomach. These injuries are associated with 13-28% mortality. Duodenal fistula occurs in 2-14% cases following repair.

Small and Large bowel [1]

Small bowel is the third commonest injured organ in blunt trauma accounting for 5-15% and large bowel accounts for 4-6%.

Mechanisms of injury include crushing, shearing and bursting forces, of which injury due to crushing force is commonest. Bowel may be crushed against the lumbosacral spine. Shearing forces cause tearing of bowel and mesentery at points of fixation like ligament of Treitz and ileocaecal junction. In colon, blunt injury most commonly occurs at the junction of mobile and fixed portions.

Bowel injury grading is as follows: [38, 56]

Grade	Description of injury
I	Hematoma - Contusion or hematoma without devascularisation Laceration - Partial thickness, no perforation
II	Laceration <50% of circumference
III	Laceration >50% of circumference without transection
IV	Transection of bowel
V	Transection of the bowel with segmental tissue loss Vascular - Devascularized segment

*Advance one grade for multiple injuries upto grade III.

Urinary tract [1, 4]

Though kidney is offered some protection by its mobility and partly intra-thoracic location, it is the most commonly injured organ of the urogenital system. Major renal injuries are usually associated with other injuries to liver, small bowel.

Renal injuries include:

MAJOR RENAL INJURIES

- Renal pedicle injury
- Deep parenchymal injury with an intact/ disrupted capsule
- Shattered kidney with an intact/ disrupted capsule
- Urethral/ renal pelvis injury

MINOR RENAL INJURIES

- Contusion
- Shallow cortical laceration
- Forniceal disruption

Kidney injury scoring scale: [56]

Grade	Description of injury
I	Contusion - Microscopic or gross hematuria, urologic studies normal Haematoma - Subcapsular, nonexpanding without parenchymal laceration
II	Haematoma – Non-expanding peri-renal haematoma confirmed to

Grade	Description of injury
	renal retroperitoneum Laceration - <1.0 cm parenchymal depth of renal cortex without urinary extravasation
III	Laceration - <1.0 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation
IV	Laceration - Parenchymal laceration extending through renal cortex, medulla, and collecting system Vascular - Main renal artery or vein injury with contained hemorrhage
V	Laceration - Completely shattered kidney Vascular - Avulsion of renal hilum which devascularizes kidney

*Advance one grade for bilateral injuries up to grade III

Bladder injuries occur due to pelvic fracture or seat belt injuries. The full bladder is especially vulnerable to a deceleration injury. Extra-peritoneal bladder rupture accounts for 75% cases and is associated with pelvic fracture. Intraperitoneal rupture occurs in blunt trauma to a fully distended bladder and accounts for 25%.

Retroperitoneum [1, 4]

Retroperitoneal haematomas can involve the central, flank or pelvic zones. Central retroperitoneal haematomas are associated with pancreatico-duodenal and major vascular injuries. Urinary tract injuries cause flank haematoma. Pelvic fractures cause pelvic haematoma.

Vascular injuries [1, 4]

Vascular injuries occur in combination with other injuries. They lead to exsanguination, shock and death unless repaired.

CLINICAL FEATURES OF DIFFERENT ORGAN INJURIES DUE TO BLUNT TRAUMA

Splenic trauma [4]

There are three classes of presentation

1. Rapid death due to exsanguination, patient dies before resuscitation or laparotomy.
2. Shock – Nearly 75 % cases present with shock and rupture of spleen. Patient may show variable features of shock such as hypotension, tachycardia, pallor, cold peripheries, reduced urine output. There may be external evidence of injury such as contusion or fractured ribs. Patient presents with tenderness in left hypochondrium, with or without associated guarding or rigidity.
3. Delayed rupture usually presenting few days to months after the injury.

Clinically splenic injury can be elicited by following signs:

1. Ballance sign: Dullness in left flank (coagulated blood) and shifting dullness in right flank (fluid blood).
2. Saegesser sign: Contraction of left hemidiaphragm and pain along the rectus muscle lateral border on compressing the phrenic point.

3. Snowball sign: Bulging of pouch of Douglas caused by haemoperitoneum
4. Kehr's sign: Shoulder tip pain seen in haemoperitoneum or peritonitis. Left sided pain in indicative of splenic injury.

Liver injuries [3]

Patient may present with profound hypotension and abdominal distension or unexplained hypovolemia with bloody abdominal paracentesis or with signs of peritoneal irritation. Contusion may be present in the right upper quadrant or lower anterior chest with referred pain to the right shoulder. There are three classes of presentation ranging from sudden death due to haemorrhage to gradual development of and shock to delayed rupture.

Pancreatic injury [4]

Injuries are often diagnosed during laparotomy on exploration for other injuries. Opening of lesser sac is crucial for diagnosis of pancreatic injury. Preoperative clinical diagnosis is difficult and investigations are the mainstay.

Gastric injury [1]

Patients present with symptoms and signs of peritonitis which include epigastric pain and tenderness, guarding and rigidity. Haemetemesis and blood in ryle's tube aspirate may point out to gastric injury.

Small intestinal injury [1,4]

Clinical diagnosis of bowel injury is based on abdominal pain and signs of peritonitis which include tenderness, guarding, rigidity and absence of bowel sounds. Further investigations are required to confirm the suspicion.

Duodenal injury – Intraperitoneal rupture of duodenum present similar to small bowel injury. Retroperitoneal rupture, however has a latent period before presenting with full-blown signs of peritonitis.

Large intestinal injury [1,4]

Large bowel injury presents similar to small bowel injury except in delayed variety of closed caecal rupture where there is a latent period after the injury, leading to right iliac fossa symptoms and signs culminating in catastrophic faecal peritonitis. There may be per rectal bleed in left colonic and rectal injuries. Late presentation includes other features of intraabdominal sepsis and shock.

Renal injuries [1,4]

Gross or microscopic haematuria is usually present and specific for urinary tract injuries. Other clinical features include profuse abdominal pain, associated lower rib or vertebral fractures and flank contusions. Palpable abdominal mass with associated shock may indicate a rapidly developing retroperitoneal haematoma from a major renal parenchymal or renal vascular injury.

Urinary bladder injuries [1, 4]

Symptoms and signs are usually non-specific. Patient may present with suprapubic pain and failure of attempt to void urine. Haematuria is a hallmark finding of bladder injuries. Tenderness is present in suprapubic region and bowel sounds are absent in intraperitoneal rupture.

Vascular injuries [1, 4]

Patients present with persistent hypotension and abdominal distension. On laparotomy, haemoperitoneum will be present which may hinder the visualization of the site of vessel injury and other injuries

INITIAL EVALUATION AND RESUSCITATION [4]

Initial management is resuscitation of the patient which includes establishment of circulation, airway and breathing and is done even before specific diagnosis is made. Multiple injuries co-exist, requiring triage which is followed by diagnostic and therapeutic interventions.

Primary survery (life sustaining priorities)

First and foremost priorities are to establish circulation, secure airway and optimize ventilation. Hypotension is considered to be due to acute blood loss and rapid fluid infusion is given. Refractory hypotension could be due to ongoing bleeding, myocardial dysfunction, myocardial contusion, tension pneumothorax, cardiac tamponade.

Secondary survey (Triage and diagnosis)

This comprises of detailed assessment of the patient and identification of potential life-threatening injuries.

History

Eliciting proper history is important for diagnosis of intra-abdominal injuries. Mechanism of injury is one of the most important determinants in

predicting the likelihood of intra-abdominal injuries and the likely organ involved. Accurate information regarding the weapon used, thrust, site of trauma, position of the victim, height of fall should be gathered when recording the history.

Physical Examination

Mental status, vital signs which include pulse rate, blood pressure should be recorded. External injuries should be looked for which can give valuable clue regarding underlying intra-abdominal injuries. Examination of spine, back and flanks should be done. Per rectal examination, inspection of perineum, back and axillae are often missed and should be done.

Prompt insertion of nasogastric tube can detect occult injury to the stomach by the presence of blood and it also decompresses the stomach. Insertion of Foley's catheter is essential to detect haematuria and diagnose urinary tract injuries and also to monitor urine output. Occult haemorrhages may occur in the pleural cavity, abdomen and retroperitoneum and monitoring urine output can detect shock in early stage.

In multiple injuries, abdominal examination is unreliable in detecting intra-peritoneal haemorrhage or visceral perforation. Head injury and intoxication mask the signs of peritoneal irritation resulting in missed abdominal injuries. Abdominal wall contusion, acute gastric dilatation, referred pain from spinal fractures result in false positive examination.

INVESTIGATIONS IN BLUNT TRAUMA ABDOMEN

Basic investigations

1. Haemoglobin
2. Blood urea, serum creatinine
3. Blood sugar
4. Blood group and type
5. Serum amylase in suspected pancreatic injury
6. Urine examination to rule out microscopic haematuria

Diagnostic methods

1. Plain X-ray
2. Ultrasound abdomen & pelvis
3. Four quadrant abdomen tap
4. Diagnostic peritoneal lavage
5. CECT abdomen & pelvis
6. Laparoscopy
7. Intravenous urogaphy

Plain X-Ray [2]

Plain X-ray is a simple first line investigation in blunt trauma.

Chest X-ray is an essential investigation and can reveal the following features:

a) Air under diaphragm,
b) Associated rib fractures
c) Diaphragmatic rupture.

Abdominal X-ray erect is another useful radiographic investigation. In non-ambulant patients it can be taken in supine or lateral decubitus position. It reveals:

a) Air in-between bowel loops as seen in hollow viscus perforation
b) Retroperitoneal air as seen in duodenal perforation
c) Displacement of bowel loops or viscera
d) Haemoperitoneum for which >800 ml blood is required to be seen on plain x-ray as ground glass appearance
e) Signs associated with haoemoperitoneum:
    i. Flank stripe sign: fluid separating the lateral peritoneal wall and ascending or descending colons displacing them medially
    ii. Dog ear sign: fluid between the lateral bladder walls and pelvic viscera

iii. Hepatic angle sign: fluid accumulation between right peritoneal wall and liver obscuring the clear right and inferior margins

f) Free fluid

g) Blurring of left psoas margin or colon cut off sign may be seen in pancreatic injuries

h) Diaphragmatic rupture as seen by following signs:

i. First sign is usually malposition of nasogastric tube

ii. Bowel loops above the diaphragm

Ultrasound abdomen [1]

Focused Abdominal Sonography for Trauma is a valuable diagnostic tool in blunt trauma abdomen. It can be performed at bed-side alongside resuscitation, is less time-consuming and non-invasive.

Minimum of 200 ml fluid must be present for detection. Presence of free fluid or haemoperitoneum makes it more sensitive in detecting intraabominal injuries. Presence of a solid organ injury can be detected but grading is not possible which is a major limitation and subsequent CT scan will be required in a stable patient. In the presence of extensive soft tissue

injuries over the abdomen, placement of probe is hindered and interpretation cannot be made.

Four quadrant abdominal tap [1]

Using a 18G needle right and left hypochondrium and iliac fossae was aspirated for presence of fluid or blood. No fluid or <0.5ml clear serous fluid is considered negative. Presence of blood, bile or faeculent fluid is considered positive based on naked eye examination. Negative tap does not rule out abdominal injury.

Diagnostic peritoneal lavage [4]

DPL is done in equivocal cases or in cases with unexplained hypotension. When laparotomy is clearly indicated, DPL is not needed. It can be done by closed, open or semi-open method. Presence of blood or enteric contents is considered positive. Analysis is done microscopically and biochemically.

CECT abdomen and pelvis [3]

CECT abdomen is a sensitive radiological investigation which can give valuable information regarding presence of injuries and grading. It is invaluable in avoiding negative laparotomies. CT scan is indicated in

a) Delayed presentation without signs of peritonitis and haemodynamically stable patients
b) Clinical signs and investigations are equivocal
c) Suspected retroperitoneal injury

>100 ml free fluid can be accurately detected by CT scan.

Diagnosis of retroperitoneal and early pancreatic injuries is a major limitation. Disadvantages are increased time consumption, difficulty in monitoring the patient during the procedure and use of contrast media is contraindicated in patients with chronic kidney disease. Hence it cannot be used in hypotensive or unstable patients where clinical diagnosis and FAST are more helpful.

Laparoscopy [1]

Organ injuries can be directly visualized and it is the final tool in equivocal cases. However it requires good expertise which if available, can prevent negative laparotomies.

Intravenous Urography [30]

Preliminary plain X-ray KUB will delineate any haematoma or urinoma. Ill-defined psoas outline indicates a haematoma overlying the psoas. Muscle spasm can cause lumbar scoliosis which also can be visualized. IVU helps us to assess the integrity and functioning of the contralateral kidney. Site and size of laceration as well as rupture will be visualized by extravasation of contrast. If renal pedicle is injured, the kidney will be non-functional which can be visualized in IVU

MANAGEMENT OF INDIVIDUAL ORGAN INJURIES

Splenic injury [4]

Rapid resuscitation and nasogastric tube decompression of stomach is needed prior to proceeding with operative treatment.

Midline laparotomy incision is preferred. Spleen should be mobilized and blood clots evacuated for thorough assessment. In case of ongoing haemorrhage hindering assessment, spleen can be manually compressed or the splenic pedicle can be compressed using thumb and index finger.

In haemodynamically unstable patients and those with multiple co-morbids, splenectomy should be done irrespective of age or grade of injury. Splenorrhaphy may be considered in young, haemodynamically stable patients with salvageable spleen because it is time consuming. However, grade of injury decides the operative management.

Grade I – Compression for 5 minutes or a topical haemostatic agent will suffice.

Grade II – Compression or use of a topical haemostatic agent like surgical, gel foam soaked in thrombin, microfibillar collagen. Injuries that continue bleeding despite above measures can be managed by splenorrhaphy. Monofilament absorbable or non-absorbable mattress sutures

placed over omental buttress will approximate the laceration effectively. Teflon pledgets can be used to minimize capsular tear.

Grade III – Splenorrhaphy by take wide and deep sutures obliterating any dead space. Suture ligating any arterial bleed. Use of polyglycolic acid mesh wrap around the spleen will achieve haemostasis to a certain extent. In unresponsive cases, partial splenectomy may be considered.

Grade IV – Ligation of the bleeding segmental artery and partial spenectomy. The raw splenic surface can be sealed with an omental plug or haemostatic agents and capsular sutures applied. Absorbable mesh wrap can be considered. If unsuccessful, splenectomy should be done.

Grade V – Splenectomy is indicated. Careful attention is to be given to preserve the tail of pancreas.

Non-operative management

Grade I-III injuries can be managed conservatively depending on the age, condition of the patient and co-morbids. Conservative management gives good results in children because of haemostatic property of splenic

capsules. In children, splenic capsules are thicker and contain myoepthelial cells which have the ability to contract.

Patient is closely monitored and CT is repeated after 48-72 hours. Persistent bleeding or haemodynamic instability necessitate conversion to operative management.

In centres which do not have facilities for careful monitoring, splenectomy can be done. It is the most commonly performed procedure for splenic injuries.

Postoperative complications and sequel

1. Pulmonary complications

   Common complications of splenectomy include atelectasis of left lower lobe, left pleural effusion, pneumonia. Early mobilization and chest physiotherapy may prevent these complications.

2. Left subphrenic abscess or effusion

   Usually resolves spontaneously, percutaneous drainage should be done in cases that do not resolve.

3. Thrombocytosis

   Platelets count rises to >4,00,000/cu.mm in 2-10 days and resolves within 2-12 weeks. Thromoembolic complications are unusual but in patients at high risk, subcutaneous heparin prophylaxis may be given.

4. Overwhelming Post Splenectomy Infections(OPSI)

   Fulminant bacterial infections that do not present with usual prodromal symptoms, and manifest with nausea, malaise, vomiting and rapidly progress to hypotension, coma and death within 24 hours of detection. It is associated with high mortality of 50-80% and children are particularly susceptible. Encapsulated bacteria have been implicated which include Hemophilus influenza, Streptococcus pneumonia and Nisseria meningitides. Other bacteria have also been isolated from these patients. Post-splenectomy vaccination against encapsulated bacteria should be given to all patients.

Liver [3]

Rapid resuscitation is essential to proceed to the next level of organ specific management. Death in liver injury occurs due to haemorrage, hypovolemic shock and complications of massive transfusion and is

common in the peri-operative period. Indications of operative treatment include:

1. Haemodynamical instability
2. Failure of non-operative management which include:
    a) Clinical deterioration
    b) Haemodynamic instability
    c) Expanding haematoma or increase in size of laceration as documented by repeat USG or CT
    d) Infected intrahepatic or subcapsular haematoma

Operative treatment [4]

For exploration of liver, upper midline is an ideal incision. When hepatic injury is suspected, right thoraco-abdominal incision provides better access. In the presence of associated colon injury and faecal peritonitis, extension of incision to thorax should be considered only under life-threatening circumstamces.

Presence of blood clots in the right hypochondrium may indicate hepatic injury. Priority in liver injury is to arrest the haemorrhage. This can be achieved by:

1. Manual compression

Liver is compressed from right and left margins towards the centre with posterior directional force. It is a life-saving maneuver which can be easily attempted.

2. Perihepatic packs

   Insertion of pads or gauze rolls around the injured liver. Packs should not be inserted into the laceration and excessive packing should be avoided for fear of occluding the inferior vena cava. Pack removal is attempted 24 hours later, within 72 hours. During re-operation, pack is removed, specific bleeding points ligated and peritoneal lavage done.

3. Occlusion of portal triad

   Pringles maneuver is the usually adopted method which is particularly helpful in arterial bleed. Left thumb is placed over the anterior surface of hepato-duodenal ligament and middle and index fingers placed in foramen of Winslow and compressed until clamps can be applied or tourniquet can be placed. Compression can be maximally applied for 1 hour, although results can be seen in 10 minutes. Specific bleeding points may then be ligated or fibrin glue be used. If right hepatic

artery is ligated, cholecystectomy is done to prevent gangrenous cholecystitis.

4. Clamping liver parenchyma

   Liver has to be dissected from surrounding structures for successful placement of clamps. Occluding non-crushing clamps arrest bleeding and definitive surgery can be undertaken.

5. Omental packs

   It is a live pack which prevents dead space formation, controls minor haemorrhages and provides immunogenic coverage.

6. Application of liver tourniquet

7. Liver suturing

   It is a definitive procedure and should not be attempted in the emergency setting. Sutures should be placed parallel to the laceration, thus compressing the bleeding points and not perpendicular to the laceration. Parallel sutures also leave the wound open allowing drainage and prevent formation of dead space which can become

secondarily infected. If opposing the wound edges, sutures must be taken wide and deep. Figure of eight sutures or bolster suturing may be attempted.

8. Mesh hepatorrhaphy

   Prosthetic encapsulation is done to achieve haemostasis. Absorbable mesh is used especially for grade 3 and 4 injuries.

Devitalised tissue should be debrided using Harmonic scalpel. Other modalities include Cavitron Ultrasonic Surgical Aspirator, Waterjet knife, Suction knife, Laser knife. Major hepatic resections carry high morbidity and mortality.

Drainage: Closed drain is used for draining blood, bile and devitalized tissues. 10-12 Fr T-tube is inserted in case of bile duct injuries and a cholecystostomy may be performed.

Juxta Hepatic Venous Injuries

In haemodynamically unstable patients, packing is advocated. After control of haemorrhage, definitive procedure may be planned. This requires vascular isolation of liver which includes three techniques:

1. Atrial caval shunt through right atrium
2. Intracaval shunt below the liver
3. Multiple occlusive clamps

Once bleeding is controlled, vessel injury is identified. Vascular clamps are placed to the torn vena cava or hepatic vein. For major vena caval defects, Satinsky clamps are used. Suturing is done with 5-0 or 6-0 polypropylene. Ligation of a major hepatic vein may require hepatic lobe resection.

Postoperative course and complications

Liver injuries are complicated by hypoalbuminemia, hypoglycemia, dehydration, sepsis, pleural effusion, atelectasis and deficiency of coagulation factors. Adequate intravenous fluids, 10% dextrose, albumin infusion should be given. Careful monitoring is required to identify clinical signs of respiratory compromise or systemic infection and management should be done accordingly.

Complications and sequel include:

1. Postoperative haemorrhage

   This is due to ongoing haemorrhage, coagulation abnormalities arising due to deficiency, massive blood transfusions, transfusion

reactions, disseminated intravascular coagulation, sepsis. Re-surgery may be done in cases of insufficient haemostasis and bleeding vessel ligated. In patients not fit to tolerate operative procedure, angiography and selective embolization of the bleeding vessel can be done. Coagulopathy may be combatted by transfusion of fresh frozen plasma and platelets, vitamin K injections, control of sepsis.

2. Hemobilia

Delayed haemorrhage usually occurs in the form of hemobilia and it indicates a pseudoaneurysm. It may occur from days to months after trauma. Gastrointestinal bleeding, jaundice and right upper quadrant pain forms the classical triad of haemobilia.

3. Hyperpyrexia

Exact etiology is unclear. It is thought to occur due to reabsorption of devitalized tissues. Spontaneous resolution is seen in 3- 5 days in most patients. Persistent fever should rise the suspicion of intra-abdominal abscess and sepsis

4. Intraabdominal abscess

Postoperative fever beyond 3 days should be investigated to rule out the possibility of intrahepatic or perihepatic abscess. CT is a

useful investigation to assess the site and size of abscess which can be drained using percutaneous catheter. Surgical drainage of abscess is indicated when percutaneous drainage fails or there is sequestrum.

5. Biliary fistula

Persistent biliary leak may be due to missed biliary duct disruption. In the absence of distal obstruction, most biliary fistulas close within six weeks. Site of fistula can be identified by HIDA scan, cholangiography or fistulogram. In case of disruption of a large intrahepatic duct, resection or intrahepatic Roux-en-y hepaticojejunostomy can be done.

Non-operative management [4]

Minor hepatic injuries with haemodynamic stability can be managed conservatively with close monitoring.

Non-operative management can be tried in the following cases:

1. Grade I or II liver injuries
2. Controlled haemorrhage with intraabdominal bleeding <250ml
3. Facilities for repeat radiological interpretation, close monitoring and re-surgery are available

4. Absence of other injuries requiring laparotomy

Repeated clinical evaluation should be done with periodic monitoring of vitals. Complete haemogram is done every 12 hourly and repeat USG done after 24 hours. Continuance of conservative management or shift to operative management is based on the repeat evaluation. Static injury is managed conservatively and if any worsening occurs, laparotomy should be considered. Patient may be kept under observation for varying periods depending on the size of the injury and discharged when improved, advising bed-rest. A repeat CT scan may be done after 4 weeks to assess the progress of the injury. Most wounds would heal by this time and patient may return to his work.

Recent trend is towards conservative management of minor abdominal injuries with close monitoring. This avoids unnecessary laparotomy and decreases morbidity and mortality.

Bile Duct Injuries

These are usually associated with duodenal or pancreatic injuries. Commonest site to be injured is the common bile duct at the junction of the flexible portion in the hepatoduodenal ligament and fixed portion within the

pancreas. Proximal injuries can be diagnosed by intra-operative cholangiogram and distal injuries by intraoperative cholangiogram or ERCP.

Treatment of various injuries

1. Gall bladder injury – managed by cholecystectomy
2. Incomplete transection of CBD – Proximal choledochotomy, insertion of T-tube and repairing the duct over the T-tube.
3. Complete transection – Anastomosis over a T-tube
4. Long segment ductal disruption – Choledocho-enteric anastomosis
5. Ductal injury with haemodynamic instability – Proximal duct can be inserted with a catheter and brought out as external fistula.
6. Complete division of intra-pancreatic bile duct – choledocho-jejunostomy and ligation of distal duct.

Hepatic artery, Portal vein injury [3]

Liver can survive even after hepatic artery ligation. Gall bladder should be removed if hepatic artery is ligated proximal to origin of cystic artery. Portal vein can be ligated if injured provided hepatic artery is viable, even then prognosis is guarded. Portal vein ligation is preferred over portocaval shunt or suturing which may compromise the lumen. If both are

severely damaged, vein graft may be used as a conduit to establish flow in one of the vessels.

Pancreas [4]

Pancreatic injuries are usually associated with other injuries which should be identified. Grading of the pancreatic injury and extent of ductal injury will decide the operative management. Main priority is control of haemorrhage. Devitalized tissues should be removed. Adequate drainage of pancreatic secretions should be ensured.

Grade I – Haemostasis and simple external drainage. Upto 15% patients may develop pancreatic fistula. Mostly they are low output fistulas and resolve spontaneously within 2 weeks.

Grade II – These injuries will require omental pancreatorrhaphy and drainage. Pancreatic fistula and pseudocyst are complications associated with this type of repair. Pseudocyst may secondarily get infected to form abscess.

Grade III – Distal pancreatectomy with or without splenectomy can be done. Splenic preservation is considered in children and haemodynamically stable patients. Transected pancreatic duct should be separately identified and ligated. Proximal cut end of pancreas should be sutured for full

thickness from anterior to posterior capsule using non-absorbable sutures. It is time-consuming to preserve spleen and should not be attempted in unstable patients. Alternately, Roux-en-y pancreaticojejunostomy can be done.

Grade IV – These injuries require pancreatico-duodenectomy or placement of an endoscopic stent for proximal ductal injuries. For transections to the right of superior mesenteric vessels, subtotal pancreatectomy can be done. Removing >80% gland might result in endocrine insufficiency. To combat this the distal transected fragment may be anastomosed to the jejunum in a roux-en-y fashion. In damage control situations, simple drainage can be done.

Grade V – These injuries are managed by pancreatico-duodenectomy. When injuries are less extensive and Whipple's procedure can be avoided, duodenal diversion by pyloric exclusion or tube duodenostomy and gastrojejunostomy can be attempted in selected cases. Overall grade V injuries are associated with high morbidity and mortality.

In all pancreatic surgeries wide drainage is required.

Complications

1. Fistula

   Commonest complication arising after pancreatic injuries. It occurs in upto 20% patients and usually resolves spontaneously. Wide drainage and supportive care is required. Some advocate the use of somatostatin analogue, Octreotide. Should surgical treatment be necessary, the injured pancreatic region may be anastomosed to the roux-en-y jejunal loop.

2. Pseudocyst formation

   There is collection of pancreatic fluid in lesser sac which is lined by fibrous tissue and granulation tissue. Usually occurs 4 weeks after injury.

3. Abscess

   They require percutaneous drainage or re-surgery. Unless diagnosed and treated early, they carry high morbidity and mortality.

Gastric injuries [4]

Midline laparotomy incision is preferred and all surfaces should be carefully inspected after control of haemorrhage. Haematomas should be explored. Most perforations can be primarily closed and they heal well due to abundant blood supply. Extensive gastric wounds may require gastrectomy. Drainage procedure is required in cases of vagal nerve injury.

Duodenum [4]

Urgent laparotomy is required when duodenal injury is suspected. Retroperitoneal haematoma in right upper quadrant, bile staining of duodenal wall and retroperitoneal fat necrosis are few signs indicating an underlying duodenal injury. Duodenum should be mobilized using Kocher's maneuver and all parts completely examined.

If the perforation is small, primary closure can be attempted. It can be done in single or double layer closure. It is successful in 70-85% patients. If the perforation is large that primary closure may cause luminal narrowing, patch closure with omentum or jejunal serosal patch may be kept. In duodenal transections away from the ampulla, edges can be resected and anastomosed in two layers. These repairs may be supplemented by pyloric exclusion and gastrojejunostomy. In associated injuries to pancreas,

Whipple's procedure may be needed. These cases are associated with high mortality and morbidity.

Management of intramural haematoma is conservative and it usually settles in 5 days in most patients. Surgery is indicated when there are signs of obstruction beyond 7 days.

Small intestine [9, 18]

In small bowel injury there is no role for conservative management. Thorough laparotomy is done through a midline incision and possibility of multiple perforations should be ruled out after identifying one. Small perforations may be primarily closed without affecting the patency of the lumen. Large or multiple perforations require resection and anastomosis of involved segment giving due importance to blood supply. Abdomen should be irrigated with normal saline prior to closure.

Small, non-expanding intramural haematomas may be turned in using interrupted sutures. Large or expanding haematomas require debridement and resection anastomosis based on bowel viability.

If a mesenteric haematoma is visualized, assessment should be made regarding the size, site, expanding or non-expanding, contained or has

caused mesenteric rupture. Exploration is needed for large, expanding, uncontained haematoma. At exploration, haematoma is evacuated and bleeding points ligated. Viability of bowel at the site of haematoma is assessed. If non-viable, resection and anastomosis is done. If the haematoma is at the root of mesentery, entire small bowel may be ischaemic. In such cases, vascular repair or vascular patch graft may be required. When in doubt regarding the viability of ischaemic bowel, second look laparotomy may be opted for.

Complications

1. Haemorrhage

   May occur at anastomotic site, contusions. If there is failure of conservative management, re-laparotomy may be necessary.

2. Anastomotic leak :

   Clinical improvement will not be seen in these patients in postoperative period and may also have fever. High index of clinical suspicion is needed. If suspected, re-anastomosis can be done after debriding the edges. In cases of late recognition with sepsis, loop jejunostomy or ileostomy may be helpful.

3. Fistula formation

   In the absence of distal obstruction, these heal spontaneously.

4. Abscess formation

Large intestine [18, 25]

The choice of treatment depends on factors like faecal contamination, interval between injury and presentation, severity of injury and associated injuries.

Treatment options include primary repair with or without colostomy, resection and anastomosis, colostomy or exteriorized repair.

1. Primary repair is for clean wounds with less faecal contamination, that present early and involving <25% bowel circumference. Peritoneal lavage is mandatory prior to closure.
2. Resection and anastomosis can be undertaken for wounds extending >25% of bowel circumference. Left colonic anastomoses will require a defunctioning colostomy.
3. Colostomy is done in patients who are haemodynamically unstable for a resection anastomosis and in low rectal injuries. It can be done by

exteriorization of the injured bowel as double-barrel colostomy, defunctioning colostomy or end colostomy with Hartmann's procedure.

Rectal injuries [1, 4]

For injuries above the dentate line, diversion colostomy is needed. Rectal injuries may be closed with a laparotomy incision after mobilizing the rectum or through transanal approach if accessible. Sphincter complex if injured is to be repaired. Drainage is through the perineum with the help of suction drains. Distal colostomy loop washout is done using dilute povidone iodine solution.

Kidney [1, 4]

Minor injuries with haemodynamic stability can be conservatively managed. Indications for surgery include expanding or pulsatile haematoma, extravasation of urine and vascular injury with non-viable parenchyma.

Total avulsion of renal vessels is a serious injury due to high risk of haemorrhage. Sometimes a retroperitoneal haematoma may surround the

kidney. Exploration of the haematoma is dangerous and often ends in nephrectomy. In these cases an excretory urogram should be done intraoperatively. In vascular injuries, arteriography and CT may be needed. Further exploration of haematoma is not needed if excretory urogram is normal. Exploration of the haematoma should be done if excretory urogram is inconclusive.

Midline transabdominal approach is preferred as it allows for examination of other viscera and vascular control in cases of subcapsular haematoma which might dislodge and bleed in posterior approach.

Intrarenal haematomas should be removed and lacerations' margins inspected and any bleeding should be controlled and non-viable tissue removed. Any breach in collecting duct system should be sutured with 4-0 chromic or polydioxanone, water-tight sutures. Renal parenchyma should be closed over the suture which provides additional barrier against urine leak. In cases where renal capsule is damaged, polyglycolic acid mesh plug can be placed which holds the kidney together until healing. Retroperitoneal drains must be kept when urine leak is a possibility.

Complications

1. Delayed bleeding

   Maybe managed by angioembolisation or nephrectomy in severe cases.

2. Abscess

   Occurs in perinephric space and usually within 7 days

3. Sepsis
4. Urine leak and urinoma
5. Urinary fistula
6. Hypertension
7. AV fistula
8. Chronic pyelonephritis
9. Calculus
10. Hydronephrosis

CT scan should be performed after 6 weeks to detect these complications.

Ureteral injuries [1, 4]

In haemodynamically unstable patients, percutaneous nephrostomy is done, postponing definitive procedure later, until after stabilization.

Placement of a double J stent for 4-6 weeks allows sufficient time for ureter to heal without stricture. Surgical options include uretero-neocystostomy, uretero-ureterostomy or ileal substitute. But these are time-consuming procedures.

Urinary bladder injuries [1, 4]

Extra-peritoneal rupture is managed by catheterization for minimum 2 weeks and allowing it to heal spontaneously. Intraperitoneal rupture requires laparotomy and suturing in two layers, suprapubic catherterisation in prevesical space and cystogram 14 days later to look for urinary leak.

Retroperitoneal haematoma [1,4]

Central retroperitoneal haematomas should be explored for major vessel injury or pancreatico-duodenal injuries. They are associated with high mortality and morbidity.

Non-expanding flank haematomas may be managed conservatively. Expanding haematomas, haematomas adjacent to colon

should be explored. In exploring perinephric haematomas, proximal control over renal pedicle is necessary.

Pelvic haematomas should be explored if they are expanding to rule out vascular injury. Exploring pelvic haematoma may be dangerous when presacral veins are injured because securing haemostasis becomes difficult.

Vascular injuries [1, 4]

Most vessels are retroperitoneal and for direct visualization, certain maneuvers are needed.

Mattox maneuver or left sided medial visceral rotation exposes the entire aorta except renal artery.

Extended Kocher's or Catell Braasch maneuver or right sided medial visceral rotation exposes the infrarenal aorta, vena cava, renal and iliac vessels.

In massive haemoperitoneum where exploration is hindered, aortic occlude can be applied at diaphragmatic hiatus.

Aortic injuries carry high mortality rate of 40%. Origin of inferior mesenteric artery is the commonest location. Simple tears can be

primarily sutured using non-absorbable sutures. Large tears require a prosthetic graft which should be covered with omentum.

Iliac artery injury requires suturing, end to end anastomosis, graft placement or ligation with femoro-femoral bypass grafting. Iliac veins lie close to arteries and are more prone to combined injury. Injured veins may be ligated or sutured if possible.

Superior mesenteric artery in addition to above maneuvers for exposure also requires pancreatic transection and distal pancreatectomy to explore the retropancreatic part. Reconstruction or repair is difficult and carry high mortality. Suturing or grafting may be attempted if possible. Inferior mesenteric artery if injured can be ligated.

Inferior vena caval injuries can be primarily repaired in most cases. Infrarenal vena cava may be ligated if extensively injured. Suprarenal vena cava injury is best repaired either by suturing or using graft materials. Repair of retrohepatic vena caval injury is challenging. Aorta should be clamped at the diaphragmatic hiatus, portal triad at the

hepatoduodenal ligament and vena cava below the liver. Liver should be rotated medially and the vena caval injury can be sutured.

Portal vein and superior mesenteric vein injury is best repaired. Ligation causes intestinal ischaemia.

OTHER STUDIES

There were 4 other similar studies conducted in India. One was done in Srinagar from July 2000 to March 2001on 63 patients[57]. Two other studies[58,59] were done in Bangalore from May 2009 to November 2010 on 71 patients and from September 2010 to September 2013 on 100 patients. Recent study[60] was done in Eluru from April 2013 to March 2014 on 59 patients. Road traffic accident was the leading cause of blunt abdominal trauma in all these studies. Spleen was the commonest injured organ in three of the four series and majority cases were managed by surgery.

METHODOLOGY

50 consecutive cases of blunt trauma abdomen presenting to Government Royapettah Hospital from April 2014 to September 2014 were prospectively studied.

Patients with head, chest and orthopaedic injuries that require immediate surgical intervention were excluded from the study.

After initial resuscitation, detailed history was elicited, patients were examined for symptoms and signs, X-Ray and Ultrasound abdomen were done to arrive at a diagnosis. CECT abdomen was done in patients in whom diagnosis was equivocal, provided they were haemodynamically stable.

Haemodynamically unstable patients, those with hollow viscus injuries were taken up for laparotomy without CT scan. Conservative management was tried for minor injuries as per the AAST organ injury scale.

Those managed conservatively were closely monitored for vitals and USG or CT scan was repeated after 72 hours. Those failing to respond to conservative management were taken up for laparotomy.

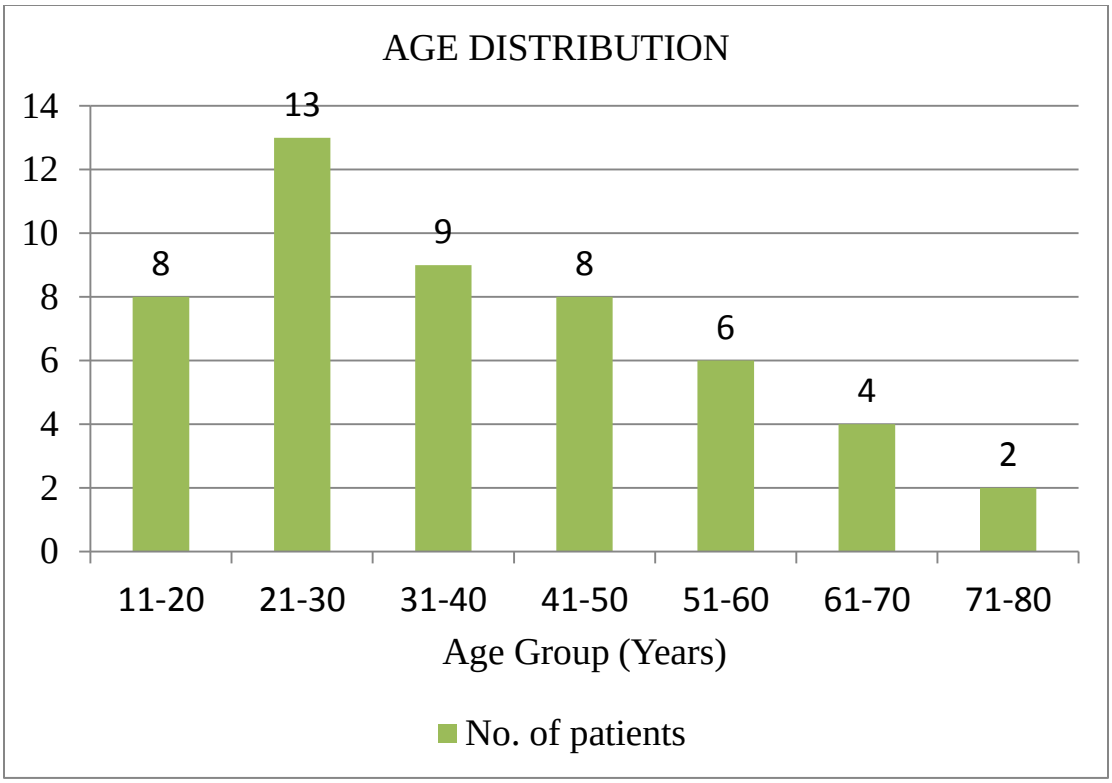
Various parameters were analysed, ie, age, sex, etiology of blunt abdominal trauma, latent period before presentation, symptoms, signs, prevalence of different organ injuries, investigations, choice of treatment, operative procedures employed, complications, duration of stay in the hospital and final outcome and inferences made.

OBSERVATIONS AND RESULTS

From April 2014 to September 2014, 50 consecutive cases of blunt trauma abdomen presenting to Government Royapettah Hospital were studied.

1. AGE DISTRIBUTION

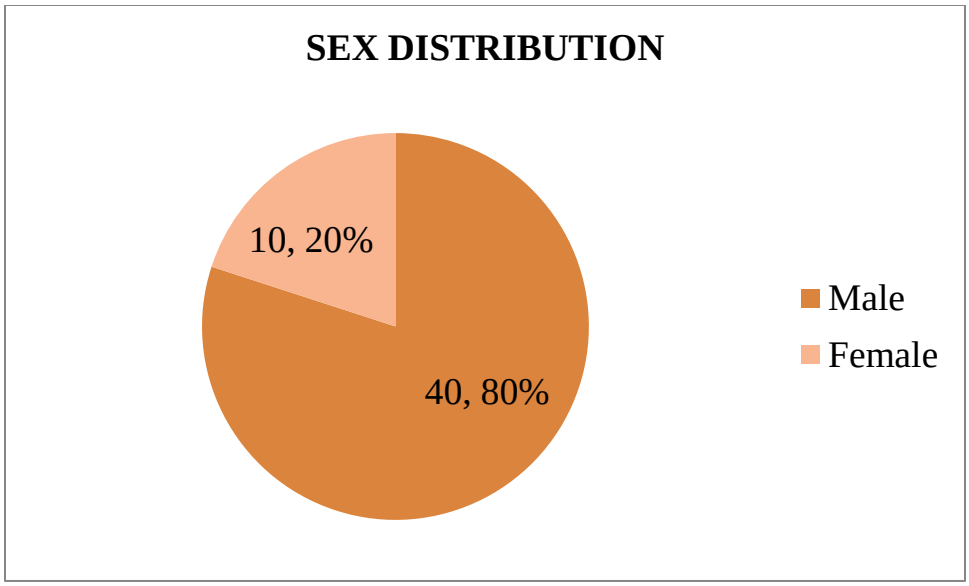
Age (years)	No. of patients	Percentage
11-20	8	16
21-30	13	26
31-40	9	18
41-50	8	16
51-60	6	12
61-70	4	8
71-80	2	4



Majority of patients sustaining blunt abdominal trauma belonged to 21-30 years of age followed by 31-40 years. Mean age was 38 years.

2. SEX DISTRIBUTION

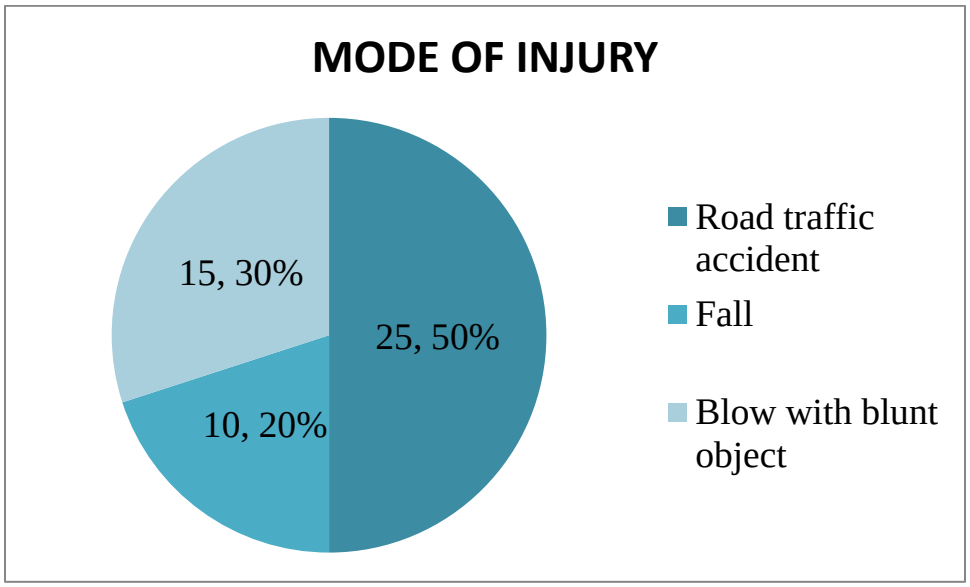
Gender	No. of patients	Percentage
Male	40	80
Female	10	20



Males were most commonly affected and constituted 80%.

3. ETIOLOGY

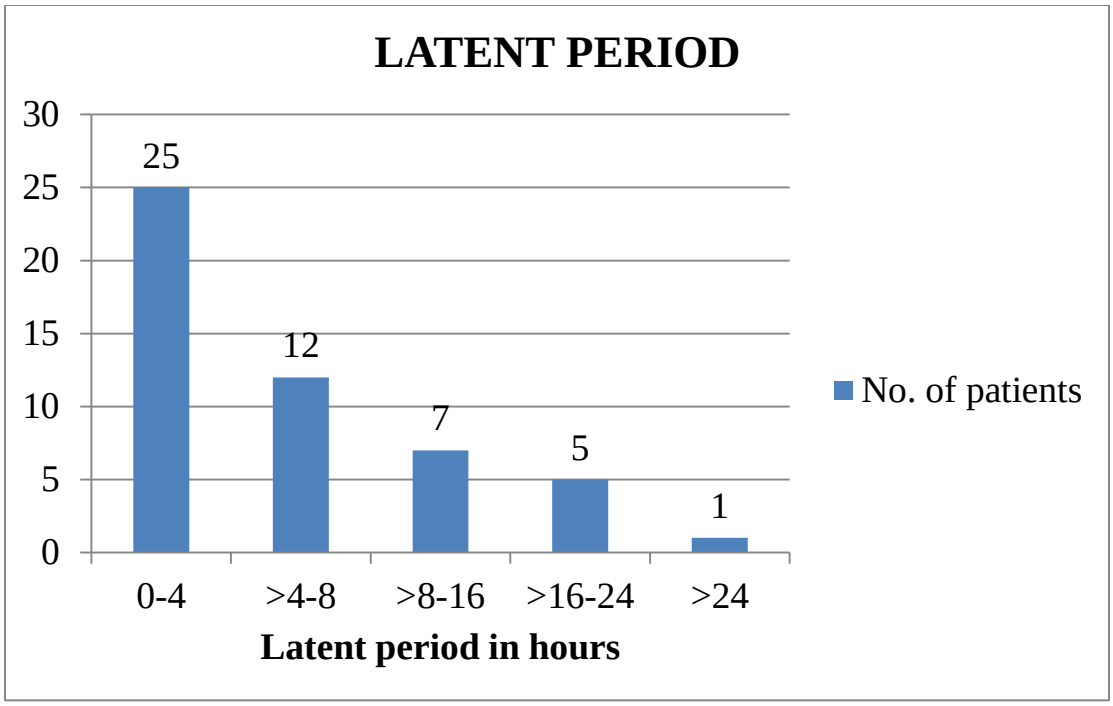
Etiology	No. of patients	Percentage
Road traffic accident	25	50
Fall	10	20
Blow with blunt object	15	30



Road traffic accidents was the commonest mode of blunt abdominal trauma accounting for 50 % followed by blow with blunt object.

4. LATENT PERIOD

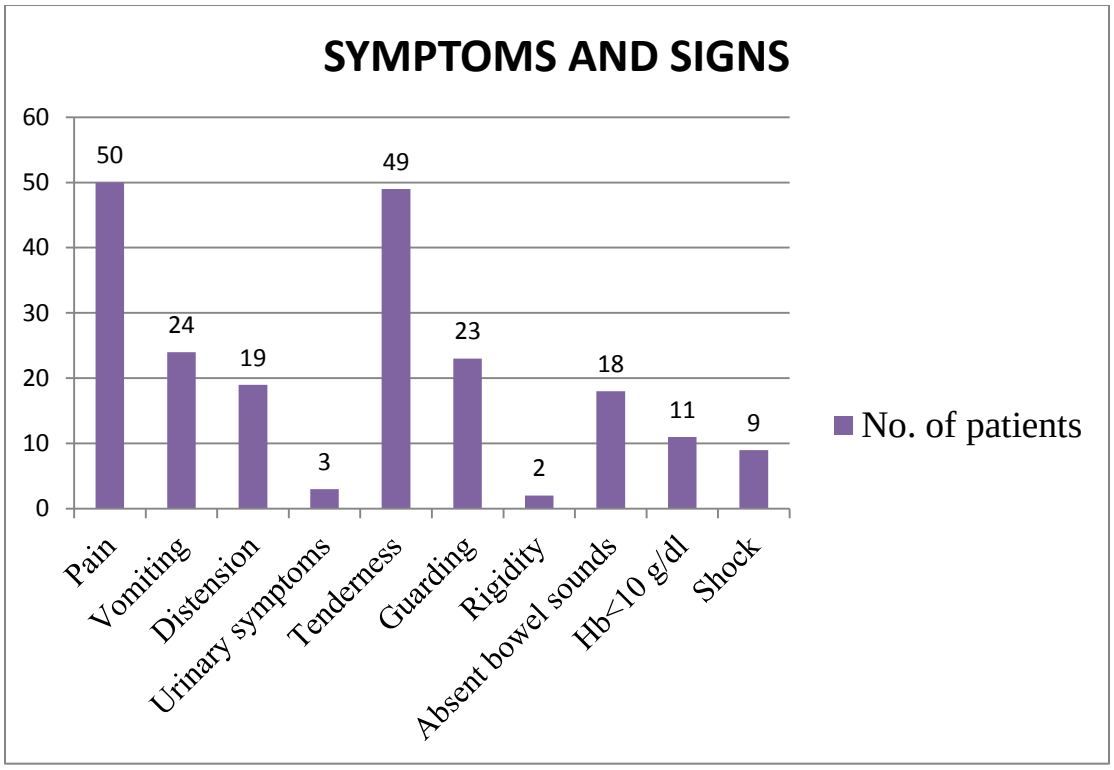
Latent period (hours)	No. of patients	Percentage
0-4	25	50
>4-8	12	24
>8-16	7	14
>16-24	5	10
>24	1	2



Latent period is the time interval between injury and presentation to the hospital. 50% patients presented in the first 4 hours of injury and only 2 % presented after 24 hours.

5. SYMPTOMS AND SIGNS

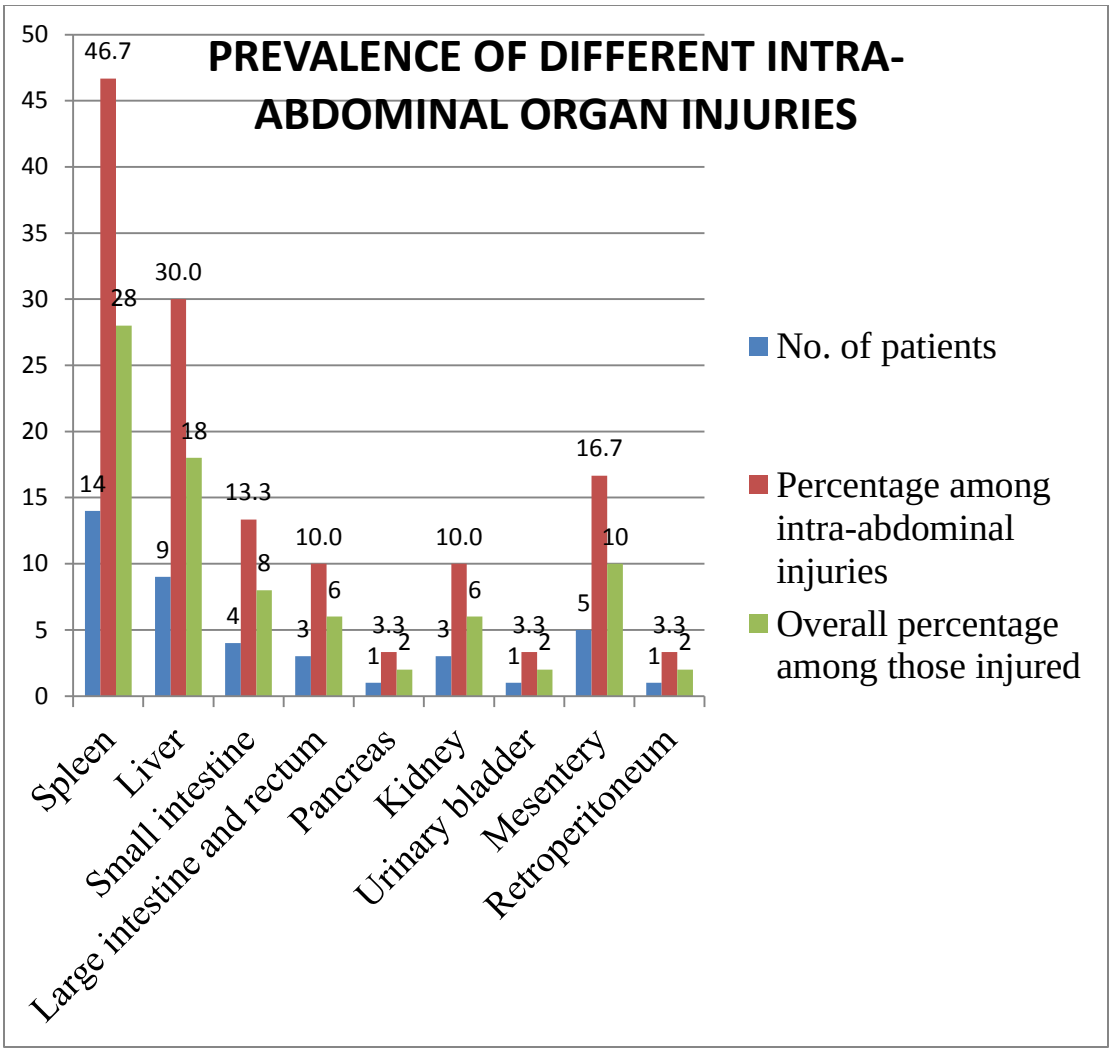
Clinical features	No. of patients	Percentage
Pain	50	100
Vomiting	24	48
Distension	19	38
Urinary symptoms	3	6
Tenderness	49	98
Guarding	23	46
Rigidity	2	4
Absent bowel sounds	18	36
Hb<10 g/dl	11	22
Shock	9	18



Pain is the commonest symptom present in 100% patients followed by vomiting and distension. Tenderness is the most common clinical sign present in 98% patients followed by guarding and absent bowel sounds. 22% patients had haemoglobin of less than 10g/dl and 18% patients presented with hypovolemic shock.

6. Different intra-abdominal organ injuries

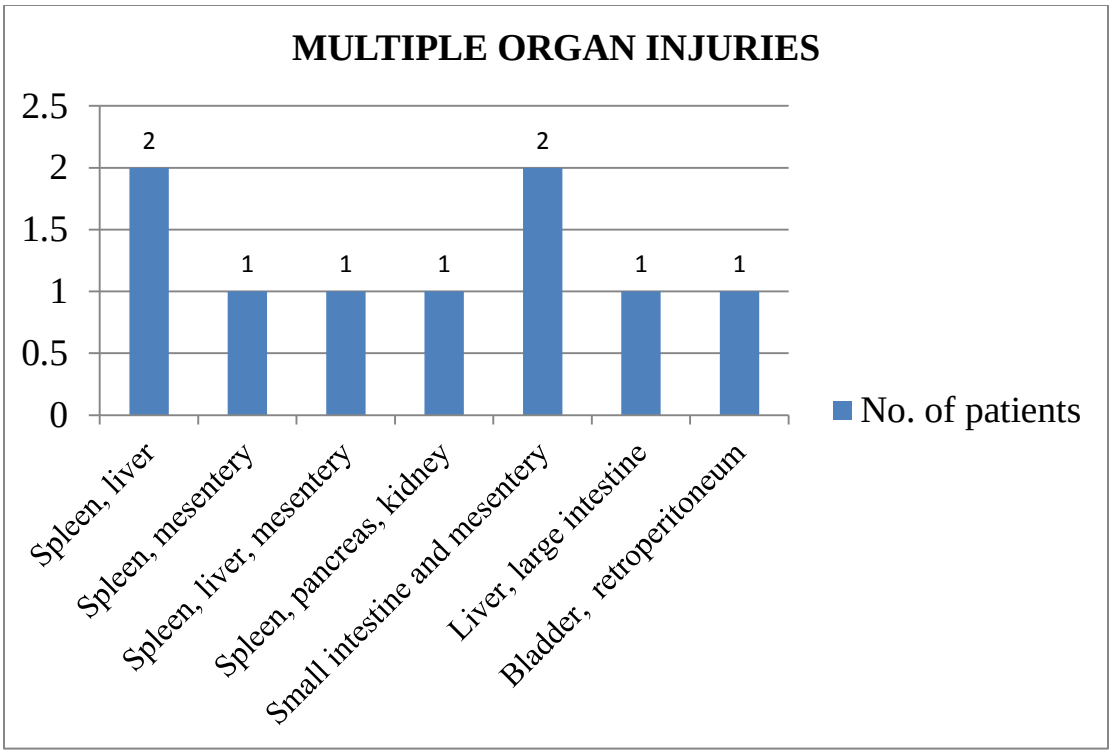
Organ injured	No. of patients	Percentage among intra-abdominal injuries	Overall percentage among those injured
Spleen	14	46.7	28
Liver	9	30	18
Small intestine	4	13.3	8
Large intestine and rectum	3	10	6
Pancreas	1	3.3	2
Kidney	3	10	6
Urinary bladder	1	3.3	2
Mesentery	5	16.7	10
Retroperitoneum	1	3.3	2



60% patients presented with injury to intra-abdominal organs. Spleen was the most commonly injured intra-abdominal organ followed by liver. Most commonly injured hollow viscus was small intestine, jejunum the most. Soft tissue injuries to the abdomen were seen in 30% patients, 10% were associated with intraabdominal organ injuries.

7. Multiple organ injuries

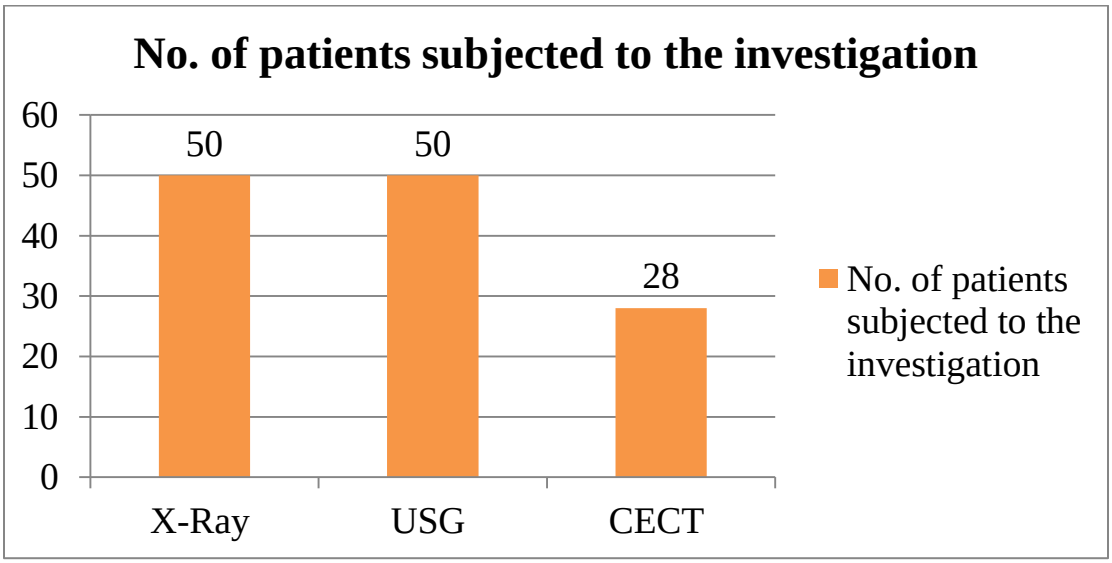
Organs injured	No. of patients	Percentage
Spleen, liver	2	4
Spleen, mesentery	1	2
Spleen, liver, mesentery	1	2
Spleen, pancreas, kidney	1	2
Small intestine and mesentery	2	4
Liver, large intestine	1	2
Bladder, retroperitoneum	1	2



18% patients presented with injuries to multiple abdominal organs, commonest combinations being spleen and liver; small bowel and mesentery.

8. Investigation

Investigation	No. of patients subjected to the investigation	Percentage
X-Ray	50	100
USG	50	100
CECT	28	56



All patients underwent X-ray abdomen and USG abdomen. CECT abdomen was done in 56% cases.

a) USG Abdomen and pelvis

	Organ injuries +	Organ injuries -	Total
+	22	0	22
-	8	20	28
Total	30	20	50

Sensitivity of ultrasound in our study was 73.3% and specificity was 100%.

a) X-ray abdomen

	Hollow viscus injuries +	Hollow viscus injuries -	Total
+	6	0	6
-	1	43	44
Total	7	43	50

Sensitivity of X-Ray in detecting hollow viscus injuries was 85.7% and specificity was 100%.

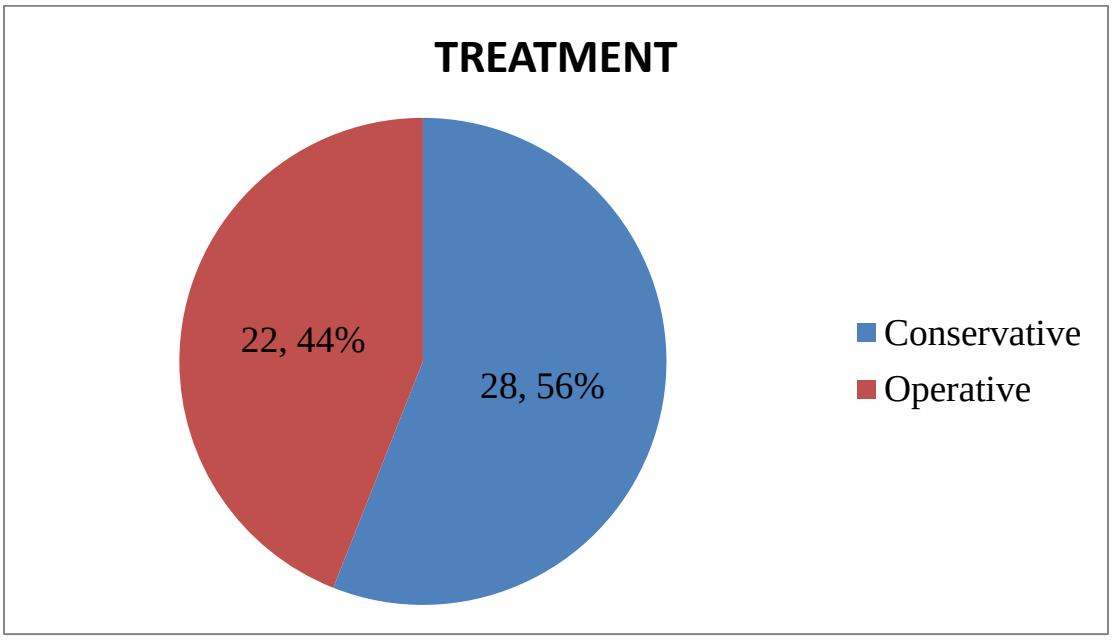
b) CECT abdomen

	Organ injuries +	Organ injuries -	Total
+	18	0	18
-	0	10	10
Total	18	10	28

Sensitivity and specificity of CECT abdomen were 100% in our study.

9. Treatment

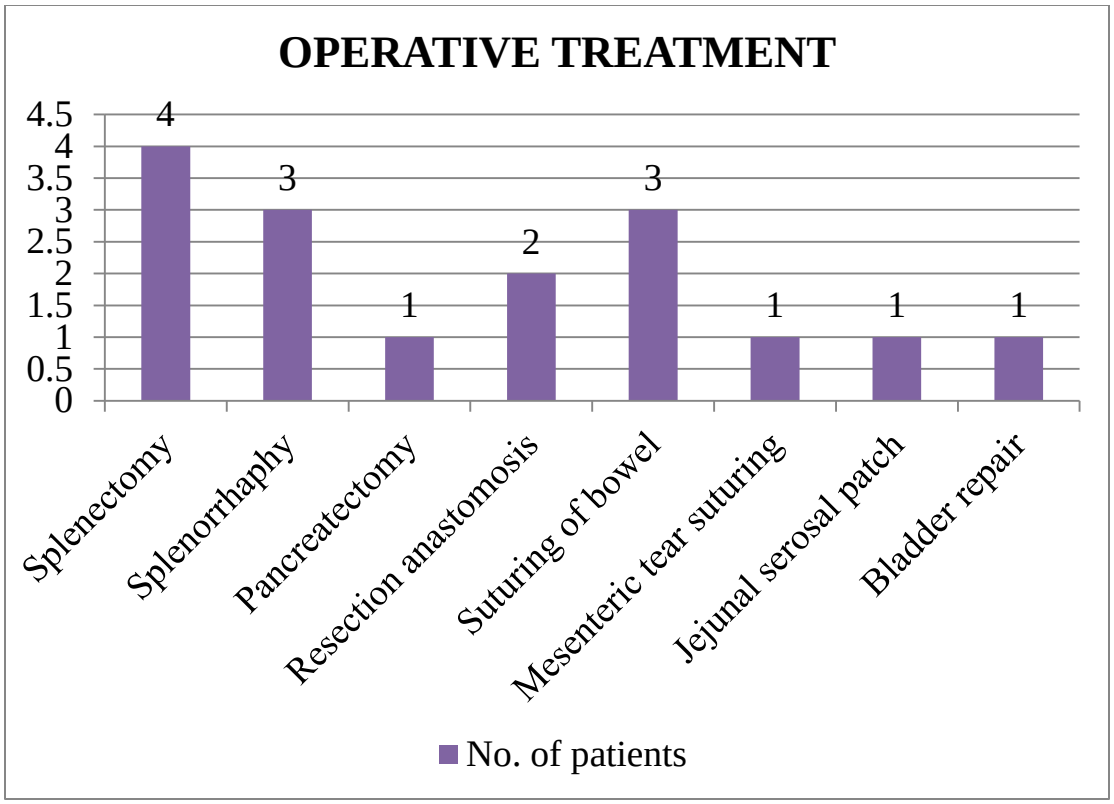
Treatment	No. of patients	Percentage
Conservative	28	56
Operative	22	44



56% patients were conservatively managed. 44% were subjected to surgery.

10.Operative procedures

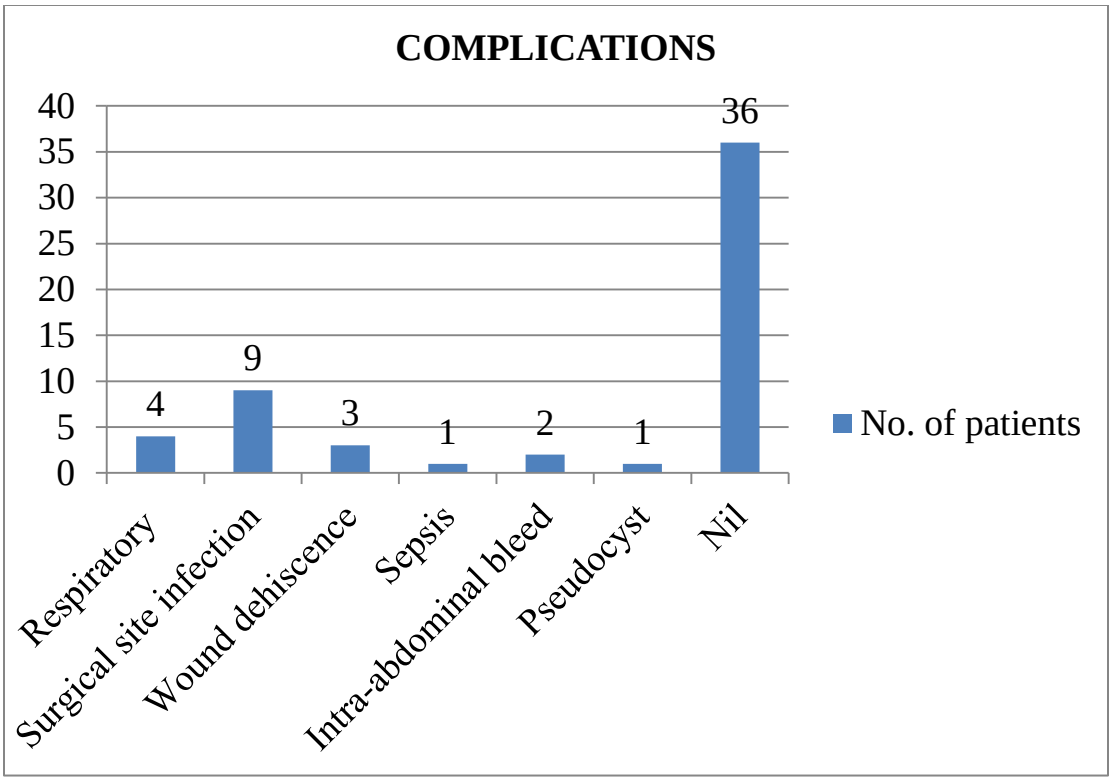
Procedure	No. of patients	Percentage
Splenectomy	4	8
Splenorrhaphy	3	6
Pancreatectomy	1	2
Resection anastomosis	2	4
Suturing of bowel	3	6
Mesenteric tear suturing	1	2
Jejunal serosal patch	1	2
Bladder repair	1	2



Splenectomy was the commonly performed procedure in 8% followed by splenorrhaphy(6%) and suturing of bowel (6%).

11.Complications

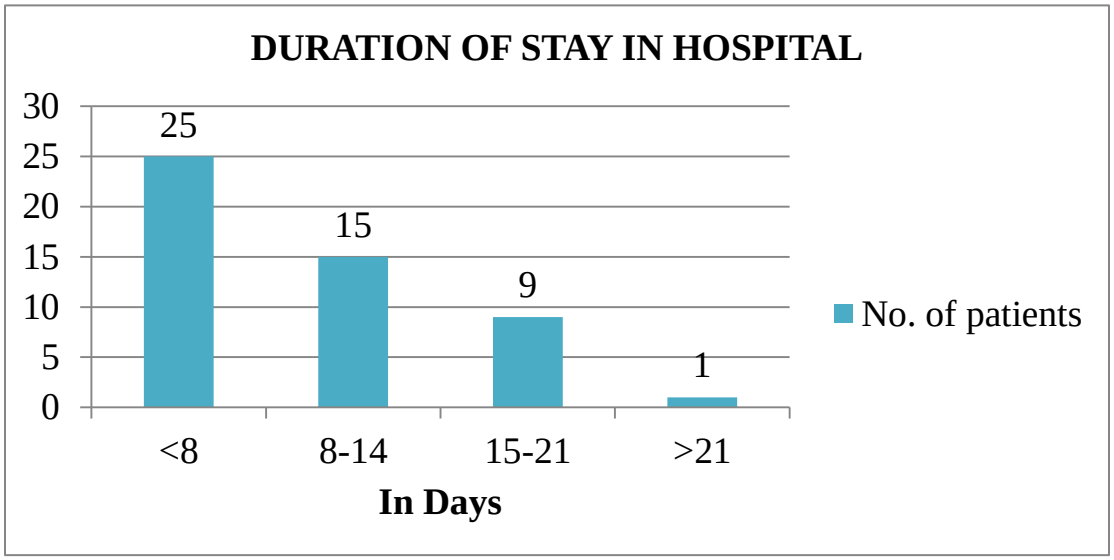
Complications	No. of patients	Percentage
Respiratory	4	8
Surgical site infection	9	18
Wound dehiscence	3	6
Sepsis	1	2
Intra-abdominal bleed	2	4
Pseudocyst	1	2
Nil	36	72



Surgical site infection was the commonest complication seen in 18% patients followed by respiratory complications (8%) and wound dehiscence (6%). 72% patients were discharged without any complications.

12. Duration of stay in hospital

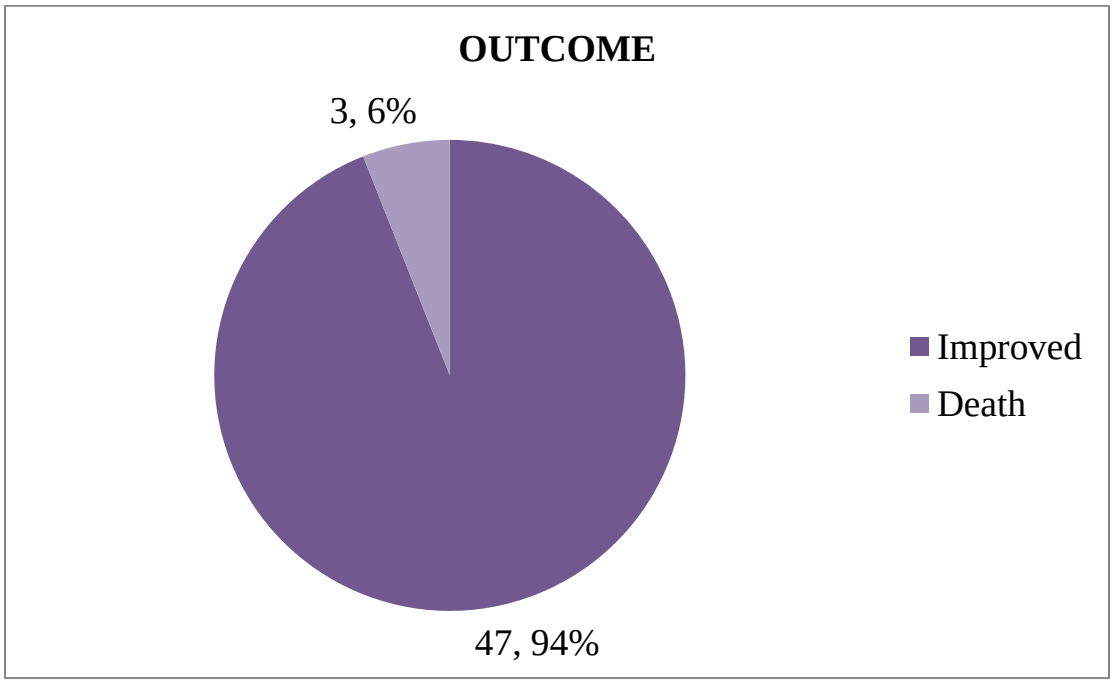
Duration of stay (days)	No. of patients	Percentage
<8	25	50
8-14	15	30
15-21	9	18
>21	1	2



50% patients were discharged within 7 days and only 2% percentage patients were in hospital stay for more than 3 weeks. Mean duration of stay for patients who were conservatively managed was 3.9 while it was 13 for those who were operatively managed.

13. Outcome

Outcome	No. of patients	Percentage
Improved	47	94
Death	3	6



6% patients died after blunt abdominal trauma.

DISCUSSION

Age distribution

In our study majority of patients belonged to 21-30 age group which is similar to the results obtained in study by N.Mehta et al [58]. In the study done by Suhas et al [60] and Sreenidhi et al [59], people in 11-20 years of age were most commonly involved which is the second commonest age group in our study.

76% belonged to 11-50 years of age. The mean age in our study was 38. It can be said that most of the victims belonged to the student and working community.

Sex distribution

Males are more affected in blunt abdominal trauma. 80% were males in our study and 79% in N.Mehta et al [58] study and 79.4% in Fazili et all [57] study. Ratio of males to females was 4:1. In the study done by Suhas et al [60] and Sreenidhi et al [59], 90% males were involved. All studies [57,58,59,60] showed a male preponderance.

There is a male preponderance because they are the bread-winners and do most of the outdoor activities including travel.

Etiology

In all the series [57,58,59,60], road traffic accident was the commonest etiology. It caused blunt abdominal trauma in 50% patients in our study and in 53% patients in N.Mehta et al [58] study. This is due to modernisation and increase in automobile usage.

Prevention of road traffic accidents can significantly reduce the incidence of blunt abdominal trauma. This is followed by blow with blunt objects(30%) which is comparable to that obtained in Fazili et al study [57](28.4%).

Latent period

50% patients presented in the first 4 hours of injury and 24% in the next 4 hours, in our study. In study conducted by N.Mehta et al [58], 53.5% presented in the first 4 hours of injury. 26% patients presented after 8 hours which resulted in clinical deterioration and increased morbidity. The lesser the latent period, better the prognosis.

Clinical symptoms and signs

Pain was the commonest symptom in our series present in 100% cases while it was present in 92.9% in N.Mehta et al study [58],

which was similar to the other 2 studies [59,60]. Vomiting was present in 48%. Pain was a reliable symptom and it should not be overlooked. Localised pain may also indicate the possible organ injured.

Tenderness was the commonest sign present in 98% patients in our study. In other studies [57,58,59,60] also, it was the commonest sign present in more than 80% cases.

In our study, 18% patients in hypovolemic shock. Shock indicates an intra-abdominal or retro-peritoneal bleed which if not detected and adequately resuscitated will result in death of the patient. Shock also hinders complete preoperative evaluation of the patient and laparotomy is justified in cases presenting with unexplained hypotension without CT scan.

Organ injuries

60% patients presented with injury to intra-abdominal organs, 28% having splenic involvement. The commonest injured organ in three series [57,58,59] was spleen, though the percentages are variable, which is consistent with the international series [4]. The reason for the variation is the difference in inclusion and exclusion criteria. In our

study we excluded all head, chest and orthopaedic injuries that require immediate intervention as they would affect the morbidity and mortality. Spleen was followed by liver in our series.

Solid organ injury was more common than hollow viscus injury, spleen being the commonest among solid organs and small intestine being common among hollow viscus injuries. In genito-urinary tract kidney was most commonly injured. Among retroperitoneal organs, kidney was the commonest.

Multiple organ injuries were seen in 18% patients which emphasis the need to look for other injuries when a single injury has been visualized.

In our study 40% patients did not have any intra-abdominal organ injuries. 30% patients presented with superficial injuries. 10% superficial injuries were associated with underlying organ injury. This emphasizes the importance of superficial injuries which can be a valuable clue to underlying serious injury.

Investigations

X-Ray, Ultrasound and CECT abdomen were the three main investigations in our study. X-Ray and ultrasound were performed in all patients because they were simple, quick, available at bed-side and could be performed alongside resuscitation.

X-Ray was more helpful in identifying hollow viscus injuries having a sensitivity of 85.7%.

Ultrasound was good at detecting solid organ injuries and had an overall sensitivity of 73.3%. Grade 1 injuries could not be efficiently picked up by USG, in which case CECT was helpful.

CECT was not done in patients with hollow viscus injuries in whom diagnosis was already made and those with solid organ injuries who were haemodynamically unstable. CECT is time-consuming, requires good renal function and a stable patient. Hence it may be reserved for equivocal cases when absence of intra-abdominal injury cannot be ruled out. Though it is a second line investigation it was more helpful in detecting grade I injuries and gave necessary information for deciding the mode of management.

Treatment

56% patients were conservatively managed. Of which, 16% patients had injury to intra-abdominal organs as diagnosed by CECT abdomen. Conservative management was successful in these patients. Thus laparotomy was avoided in 16% patients.

There is a shift in trend towards conservative management which has been successful in our study and has avoided negative laparotomies and unnecessary increase in morbidity.

Procedures done

Splenectomy was the most common procedure done which is consistent with that obtained in the series by N.Mehta et al [58] and Fazili et al [57]. In the study done by Suhas et al [60] and Sreenidhi et al [59], primary closure of perforation was the commonest procedure which was the 2nd commonest in our series along with splenorrhaphy.

Procedure done depends on the organ injured, grade of injury, latent period and haemodynamic status. Major reconstruction procedures or time-consuming procedures should not be undertaken in the emergency setting. Primary aim in trauma surgeries is control of

haemorrhage and definitive surgery can be undertaken once patient is stabilized and bleeding controlled.

Morbidity and mortality

28% patients developed complications in our study. 18% was due to surgical site infections, which was the leading complication in other studies [57, 58, 59, 60] as well. Surgical site infections most commonly occurred in patients with bowel injuries. This was followed by respiratory complications which were seen in 8% patients and wound dehiscence seen in 6%.

50% patients were discharged within 7 days and only 2% stayed beyond 2 weeks. . Mean duration of stay for patients who were conservatively managed was 3.9 while it was 13 for those who were operatively managed. Duration of stay was considerably prolonged when patients developed complications. Maximum duration of stay was 32 days for a patient who sustained injury to transverse colon and developed wound infection and dehiscence.

6% patients died in our series, while it was 4% in study by N.Mehta et al [58]. All 3 patients died postoperatively of which 2

patients died due to intraabdominal bleed and shock secondary to liver injury, and one due to duodenal rupture and subsequent sepsis.

SUMMARY

50 consecutive cases of blunt abdominal trauma that presented to Government Royapettah hospital from April 2014 to September 2014 were analysed on the following paramters: age, sex,etiology, latent period, symptoms and signs, organ injured, investigations done, choice of treatment, procedure employed, complications, duration of stay in hospital and outcome, and the following results were obtained.

1. Blunt abdominal trauma was more common in 21-30 years of age and 76% cases occurred in 2^{nd} to 5^{th} decade, thus affecting the working population.

2. There was a male preponderance with 80% cases being men and a male:female ratio of 4:1.

3. Road traffic accidents were the commonest cause of blunt abdominal trauma accounting for 50%.

4. 74% patients presented within the first 8 hours of injury.

5. Pain was the commonest symptom present in 100% cases and tenderness was the commonest sign present in 98% cases.

6. Overall, spleen was the most commonly injured organ. Spleen was also the most commonly injured intra-abdominal and solid organ seen in 28% cases. Small intestine (8%) was the most commonly injured hollow viscus, jejunum (4%) being the commonest. Most commonly injured retroperitoneal organ was kidney (6%). Multiple organs were injured in 18%.

7. X-Ray and USG were done in all patients. CECT was done in 56%. X-Ray was 85.7% sensitive in diagnosing hollow viscus injuries, USG was 73.3% sensitive and CECT was 100% sensitive in diagnosing organ injuries.

8. 56% were conservatively managed. Among the 44% who were operated on, splenectomy was the commonest procedure done(8%).

9. Complications were seen in 28% patients, surgical site infections being the leading cause seen in 18%.

10. 50% patients were discharged within 7 days and only 2% patients were in hospital stay for more than 3 weeks. Mean duration of stay for

patients who were conservatively managed was 3.9 while it was 13 for those who were operatively managed.

Mortality was 6% in our study.

CONCLUSION

Blunt trauma abdomen is a challenging entity for every surgeon due to its vague presentation, subtle clinical findings in early cases and rapid deterioration in the condition of the patient. Prevention of road traffic accidents can considerably reduce the incidence of blunt abdominal trauma. In trauma setting, clinical suspicion is more important which could be complemented with investigations. Main aim in trauma surgery is control of haemorrhage. Thorough laparotomy is needed to identify the site of haemorrhage and retroperitoneum should not be ignored. Major reconstruction procedures are not justified when the patient is hamodynamically unstable and a simple packing may even save the life of the patient. In haemodynamically stable patients with low-grade injuries, conservative management can be tried with careful monitoring. The present trend is towards conservative management and avoidance of negative laparotomies.

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ANNEXURE - I

ABBREVIATIONS

AAST - American Association for the Surgery of Trauma

CBD - Common bile duct

CECT - Contrast enhanced computed tomography

CHD - Common hepatic duct

CPR - Cardiopulmonary resuscitation

CT - Computed tomography

CVP - Central venous pressure

DPL - Diagnostic peritoneal lavage

ECG - Electrocardiogram

ERCP - Endoscopic retrograde cholangiopancreatography

FQA – Four quadrant aspiration

Fr - French

G - Gauge

GCS - Glasgow coma scale

HIDA – Hepatobiliary Iminodiacetic Acid

ICS - Intercostal space

ICU - Intensive care unit

IV - Intravenous

IVC - Inferior venacava

IVU – Intravenous urography

KUB - Kidney, ureter, bladder x ray film

MRI - Magnetic resonance imaging

PCN - Percutaneous nephrostomy

RTA – Road traffic accidents

USG – Ultrasonography

cm – Centimetre

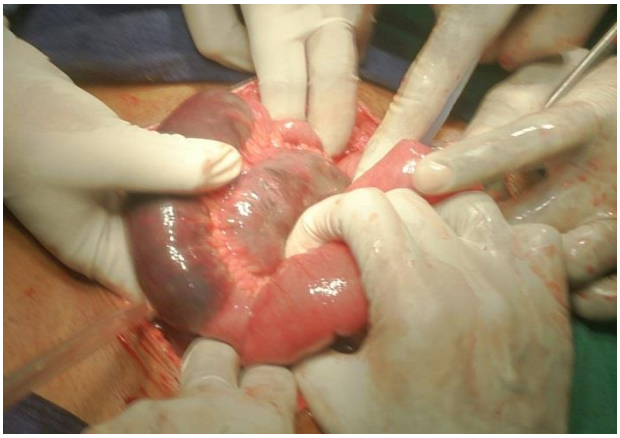
cu.mm – Cubic millimetres

m – Metre

ml – Milli litre

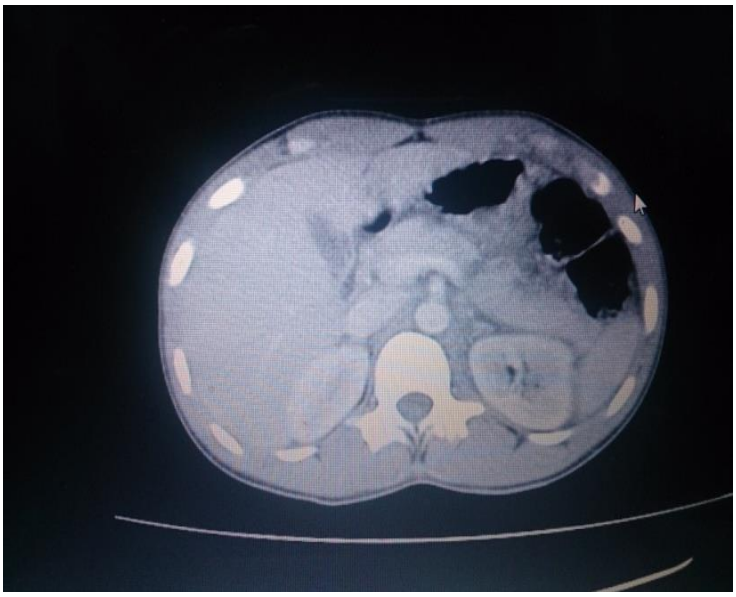
i.e. – that is

ANNEXURE - II

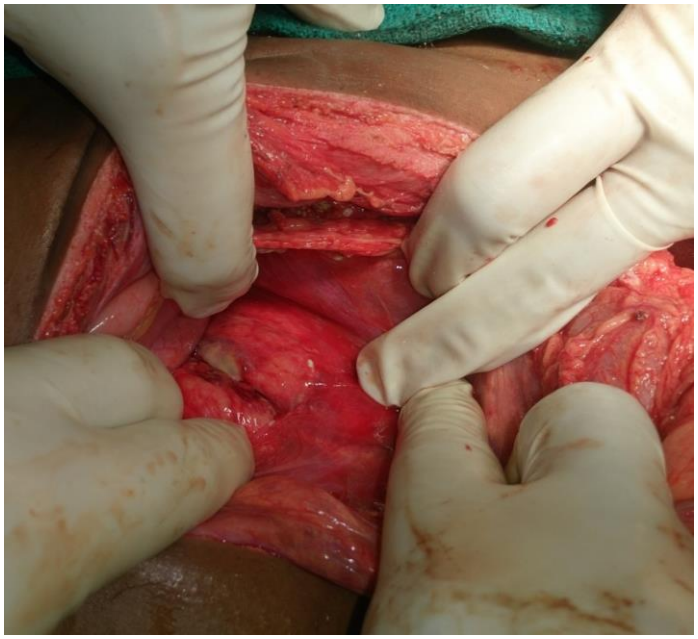


Mesenteric haematoma with ischaemic jejunum

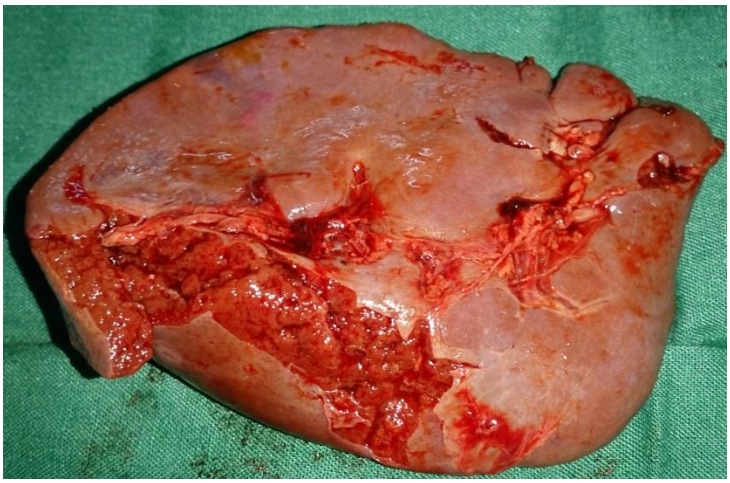
Intraperitoneal bladder rupture



Pancreatic body transection to the left of superior mesenteric vessels



Pancreatic transection noted on opening lesser sac



Grade II splenic laceration

ANNEXURE - III

PROFORMA

Name: Age/Sex: IP No.:

Interval between injury and admission:

Date of admission:

Chief Complains:

Injury- Time : Place: Mode of injury:

Presenting symptoms:

General Examination

Level of consciousness:

Pulse rate: Blood pressure: Temperature: Respiratory rate:

Pallor:

Per Abdomen Examination

Visible injuries

Tenderness

Guarding/Rigidity

Bowel sounds

Associated Injuries:

Ryles tube aspirate:

Urine colour and output:

Investigations

Hb: Platelets:

X ray chest

X ray abdomen erect

USG abdomen and pelvis

CECT abdomen and pelvis

Management

Conservative/ Surgical

Indication for surgery

Time interval between admission and surgery

Intraoperative findings

Procedure done

Postoperative complications during the period of stay in hospital

Date of discharge/death:

Duration of stay in hospital:

Cause of death(if applicable):

ANNEXURE - IV

KEY TO MASTER CHART

AUD – Air Under Diaphragm

BWB – Blow With Blunt object

C – Conservative

D – Death

F – Female

FF – Free fluid

Gr – Grade

HP – Haemoperitoneum

I – Improved

IAB – Intra-abdominal bleed

L – Left

LHC – Left Hypochondrium

LK – Left Kidney

LL – Left loin

M – Male

MAFL – Multiple Air Fluid Levels

NA – Not applicable

NAD – No Abnormality Detected

ND – Not done

O – Operative

PE – Pleural Effusion

PL – Peritoneal Lavage

PP - Pneumoperitoneum

R – Right

RA – Resection and Anastomosis

RHC – Right Hypochondrium

RIF – Right Iliac Fossa

RK – Right Kidney

RL – Right Loin

RTA – Road Traffic Accident

SPC – Suprapubic Cystostomy

SSI – Surgical Site Infection

WD – Wound Dehiscence

S.No.	Name & IP no.	Age & sex	Mode of injury	LP (hrs)	Pain	Vomiting	Distention	Urinary symptoms	Pulse	BP	Tenderness	Guarding	Rigidity	Bowel sounds	Associated abdominal injuries	Shock	Hb%	USG	X RAY ABD	CECT abdomen	Treatment	Laparotomy findings	Procedure	Complications	Duration of stay	Outcome
1	Chandra (4045)	55/F	Fall	6	+	-	-	-	86	120/80	+	-	-	+	Contusion RL	-	11	NAD	NAD	NAD	C	ND	NA	Nil	3	I
2	Padmanabhan (4082)	28/M	Fall	10	+	-	+	-	104	110/80	+	+	-	-	-	-	10.8	HP	NAD	Liver laceration Gr 1	O	Liver Laceration Gr 1, HP	PL, Surgicel application	SSI	18	I
3	Dinesh (4201)	26/M	RTA	2	+	+	-	-	120	110/60	+	+	-	+	-	-	11.5	HP	NAD	HP	O	Mesenteric tear, HP	Suturing of tear	Nil	9	I
4	Arumugam (4242)	60/M	RTA	24	+	-	-	-	98	110/60	+	-	-	+	Abrasion RHC	-	12.4	NAD	NAD	Liver haematoma Gr 1	C	ND	NA	Nil	8	I
5	Manimaran (4446)	18/M	BWB	12	+	+	+	-	120	100/70	+	+	-	-	-	-	10.5	HP	NAD	Splenic laceration Gr 2	O	Splenic laceration Gr 2, HP	Splenorrhaphy	Nil	12	I
6	Sharif (4471)	58/M	RTA	4	+	-	-	-	100	140/90	+	-	-	+	Contusion L hip	-	13	NAD	NAD	ND	C	ND	NA	Nil	2	I
7	Panchavarnam (4489)	40/F	BWB	4	+	+	+	-	104	110/70	+	+	-	-	-	-	9	PP	AUD	ND	O	Jejunal perforation, Mesenteric haematoma	Primary closure	SSI	14	I
8	Manikandan (4504)	43/M	RTA	7	+	-	-	-	86	120/80	+	-	-	+	Abrasion LHC	-	14	NAD	NAD	ND	C	ND	NA	Nil	2	I
9	Karthik (4523)	16/M	BWB	24	+	+	-	-	112	110/70	+	+	-	-	-	-	10.5	HP	NAD	Pancreatic transection Gr 3	O	Splenic laceration Gr 1, Pancreatic transection Gr 3, LK haematoma Gr1, HP	Distal pancreatectomy, splenectomy	Pseudocyst	13	I
10	Muthusamy (4578)	47/M	RTA	3	+	-	-	-	84	120/80	+	-	-	+	Contusion LHC	-	13.3	NAD	NAD	NAD	C	ND	NA	Nil	2	I
11	Sivagami (4640)	55/F	BWB	16	+	-	-	-	90	120/80	+	-	-	+	Abrasion epigastrium	-	11.7	NAD	NAD	NAD	C	ND	NA	Nil	3	I
12	Suresh Babu (4777)	40/M	RTA	1	+	+	+	-	124	90/60	+	+	-	-	-	+	9	HP	NAD	ND	O	Liver Laceration Gr 2 , Ascending colon intramural haematoma, HP	PL, Packing	Nil	15	I

S.No.	Name & IP no.	Age & sex	Mode of injury	LP (hrs)	Pain	Vomiting	Distention	Urinary symptoms	Pulse	BP	Tenderness	Guarding	Rigidity	Bowel sounds	Associated abdominal injuries	Shock	Hb%	USG	X RAY ABD	CECT abdomen	Treatment	Laparotomy findings	Procedure	Complications	Duration of stay	Outcome
13	Velmurugan (4837)	22/M	RTA	2	+	+	-	-	88	130/80	+	-	-	+	-	-	12.9	NAD	NAD	ND	C	ND	NA	Nil	1	I
14	Ajith (4840)	17/M	RTA	36	+	-	+	-	122	90/60	+	+	-	-	-	+	8.7	HP	NAD	ND	O	Splenic laceration Gr 2, Liver haematoma Gr 1, HP	Splenectomy	PE, SSI	17	I
15	Arun (4888)	25/M	RTA	2	+	+	+	-	136	80/50	+	+	-	-	Contusion RHC	+	7	HP	NAD	ND	O	Liver laceration Gr 3, HP	PL, Packing	IAB	1	D
16	Sivanesan (5067)	20/M	BWB	5	+	+	-	-	98	110/70	+	-	-	+	-	-	14	NAD	NAD	NAD	C	ND	NA	Nil	2	I
17	Gopal (5112)	30/M	BWB	5	+	-	-	-	90	140/80	+	-	-	+	-	-	12.9	NAD	NAD	NAD	C	ND	NA	Nil	2	I
18	Ezhumalai (5361)	50/M	Fall	20	+	+	+	-	128	90/50	+	+	+	-	-	+	8.5	PP	AUD	ND	O	Transverse colon perforation	Extended right hemicolectomy, ileocolic anastomosis, loop ileostomy	SSI, WD	32	I
19	Srinivasan (5589)	33/M	RTA	3	+	-	-	-	80	120/80	+	-	-	+	-	-	12	NAD	NAD	Splenic haematoma Gr 1	C	ND	NA	Nil	7	I
20	Sathish (5599)	12/M	Fall	1	+	+	-	-	112	110/70	+	+	-	+	-	-	11.2	HP	NAD	Splenic laceration Gr 2	O	Splenic laceration Gr 2, HP	Splenorrhaphy	Nil	9	I
21	Senthil (5670)	48/M	RTA	2	+	-	+	-	96	120/80	+	-	-	+	-	-	12	NAD	NAD	Liver haematoma Gr 1	C	ND	NA	Nil	10	I
22	Rajesh (5774)	20/M	BWB	10	+	+	+	-	124	120/90	+	+	-	-	-	-	11.4	NAD	MAFL	ND	O	Mesenteric haematoma, ischaemic jejunum	Resection & anastomosis	SSI, WD	15	I
23	Balaji (5825)	45/M	BWB	3	+	+	-	-	80	130/80	+	-	-	+	Contusion R hip	-	12.8	NAD	NAD	ND	C	ND	NA	Nil	2	I
24	Shahin (5874)	20/F	RTA	1	+	-	-	-	86	120/80	-	-	-	+	Abrasion RL	-	10.3	NAD	NAD	ND	C	ND	NA	Nil	1	I
25	Manoj kumar (5913)	21/M	BWB	1	+	+	+	-	114	110/70	+	+	-	-	-	-	11.8	PP	AUD	ND	O	Transverse colon perforation	Primary closure, loop ileostomy	SSI, WD	18	I
26	Patchaiyammal (5974)	31/F	BWB	1	+	-	-	-	98	150/90	+	-	-	+	-	-	9.9	NAD	NAD	ND	C	ND	NA	Nil	1	I

S.No.	Name & IP no.	Age & sex	Mode of injury	LP (hrs)	Pain	Vomiting	Distention	Urinary symptoms	Pulse	BP	Tenderness	Guarding	Rigidity	Bowel sounds	Associated abdominal injuries	Shock	Hb%	USG	X RAY ABD	CECT abdomen	Treatment	Laparotomy findings	Procedure	Complications	Duration of stay	Outcome
27	Raja (6053)	28/M	RTA	5	+	+	+	-	104	110/70	+	+	-	-	-	-	12.4	PP	AUD	ND	O	Ileal perforation	Primary closure	SSI	13	I
28	Hasin (6079)	64/F	Fall	7	+	-	+	-	108	120/90	+	-	-	+	-	-	11.7	Splenic haematoma	NAD	Splenic haematoma Gr 2	C	ND	NA	Nil	8	I
29	Kaleem (6167)	35/M	RTA	4	+	+	-	+	96	120/70	+	-	-	+	Contusion LL	-	12.5	NAD	NAD	LK haematoma Gr 1	C	ND	NA	Nil	10	I
30	Jahir Hussain (6227)	25/M	RTA	6	+	-	+	-	118	90/70	+	+	-	-	-	+	9.7	HP	NAD	ND	O	Splenic laceration Gr 2 , HP, Liver haematoma Gr 1	Splenectomy	Nil	11	I
31	Ganesh (6293)	17/M	BWB	3	+	-	-	-	96	110/70	+	-	-	+	-	-	12.9	NAD	NAD	NAD	C	ND	NA	Nil	2	I
32	Madhan Kumar (6351)	39/M	RTA	7	+	-	+	-	118	100/70	+	+	-	-	Contusion LHC	-	11.9	HP	NAD	Splenic laceration Gr 2	O	Splenic laceration Gr 2, HP	Splenorrhaphy	PE	10	I
33	NagoorMeeran (6402)	30/M	BWB	3	+	-	-	-	94	120/80	+	-	-	+	-	-	12.5	NAD	NAD	ND	C	ND	NA	Nil	2	I
34	Ajay (6572)	45/M	Fall	8	+	+	+	-	136	90/60	+	+	+	-	-	+	8	PP	AUD	ND	O	Duodenal perforation	Jejunal serosal patch	Sepsis	2	D
35	Vijay (6641)	23/M	RTA	2	+	+	+	+	128	80/50	+	+	-	+	-	+	8.7	FF in pelvis	NAD	Bladder rupture, FF abdomen	O	Intraperitoneal bladder rupture, Retroperitoneal haematoma	Bladder repair, SPC	SSI	20	I
36	Kannan (6712)	32/M	RTA	4	+	-	-	-	98	110/70	+	-	-	+	-	-	12.9	NAD	NAD	ND	C	ND	NA	Nil	2	I
37	Ganapathy (6793)	80/M	Fall	8	+	+	+	-	120	90/60	+	+	-	-	-	+	8.5	HP	NAD	ND	O	Splenic laceration Gr 2, HP, Liver haematoma Gr 1, Mesenteric haematoma	Splenectomy	SSI, pneumonia	17	I
38	Sethu (6835)	45/M	Fall	24	+	-	+	-	112	100/70	+	+	-	-	-	-	10.5	HP	NAD	Splenic laceration Gr 1	O	Splenic laceration Gr 1, HP	PL, Surgicel application	PE	15	I
39	Parvathi (6883)	52/F	RTA	4	+	-	-	+	92	130/80	+	-	-	+	-	-	12	NAD	NAD	RK Haematoma Gr 1	C	ND	NA	Nil	8	I

S.No.	Name & IP no.	Age & sex	Mode of injury	LP (hrs)	Pain	Vomiting	Distention	Urinary symptoms	Pulse	BP	Tenderness	Guarding	Rigidity	Bowel sounds	Associated abdominal injuries	Shock	Hb%	USG	X RAY ABD	CECT abdomen	Treatment	Laparotomy findings	Procedure	Complications	Duration of stay	Outcome
40	Ravi (6951)	37/M	RTA	7	+	-	-	-	98	120/80	+	-	-	+	Contusion LL	-	13	NAD	NAD	NAD	C	ND	NA	Nil	3	I
41	Ahmed Basha (6982)	66/M	Fall	5	+	+	-	-	102	110/70	+	-	-	+	-	-	12	NAD	NAD	NAD	C	ND	NA	Nil	3	I
42	Sivakumar (7052)	43/M	RTA	12	+	-	-	-	104	110/80	+	-	-	+	-	-	12.5	Splenic haematoma	NAD	Splenic haematoma, Gr 2	C	ND	NA	Nil	7	I
43	Anandavalli (7223)	73/F	Fall	1	+	-	-	-	110	110/60	+	-	-	+	-	-	10	NAD	NAD	NAD	C	ND	NA	Nil	4	I
44	Parveen (7346)	65/F	RTA	2	+	+	+	-	136	80/50	+	+	-	-	Contusions RHC, RL	+	6	HP	NAD	ND	O	Liver laceration Gr 3, HP	Packing, PL	IAB	1	D
45	Muthuraj (7401)	58/M	BWB	3	+	+	-	-	96	120/70	+	-	-	+	Contusion RL	-	12.2	NAD	NAD	NAD	C	ND	NA	Nil	2	I
46	Mani (7432)	30/M	RTA	9	+	+	-	-	120	110/80	+	+	-	-	-	-	11.6	HP	NAD	Splenic laceration Gr 1	O	Splenic laceration Gr 1, HP, Mesenteric haematoma	PL, Surgicel application	Nil	15	I
47	Janani (7486)	23/F	RTA	12	+	-	-	-	102	110/80	+	-	-	+	Abrasion RL, RIF	-	11.1	NAD	NAD	ND	C	ND	NA	Nil	2	I
48	Hariharan (7574)	27/M	BWB	4	+	+	-	-	104	120/70	+	+	-	+	-	-	12.9	NAD	NAD	Splenic haematoma Gr 1	C	ND	NA	Nil	8	I
49	Suresh (7716)	32/M	RTA	22	+	-	-	-	92	120/90	+	-	-	+	-	-	13.5	NAD	NAD	ND	C	ND	NA	Nil	2	I
50	Raghavan (7860)	68/M	BWB	3	+	+	-	-	112	110/60	+	+	-	+	-	-	10.4	NAD	NAD	Splenic laceration Gr 1	O	Splenic laceration Gr 1, HP	PL, Surgicel application	Nil	10	I