

A Study of Penetrating Thoracic and Abdominal Injuries

Dr. Hardik Dodia, Dr. Keval Sansiya

¹(General Surgery department, B.J. Medical College/ Gujarat University, India)

²(General Surgery department, B.J. Medical College/ Gujarat University, India)

Abstract : In view of increasing number of penetrating thoracic or abdominal or combined injuries, this study has been chosen with reference to the patients presenting at Civil Hospitals Ahmedabad, affiliated with B.J. Medical college. This is a study of 25 cases. Age/Sex Incidence, Common viscera involved depending on site involved, operative procedures to be carried out according to viscera involved, Complications related to procedure and injuries, common cause of death have been highlighted in this study.

Keywords: Penetrating injuries to thorax, penetrating abdominal injuries, common cause of death in penetrating trauma, Complications related to penetrating trauma.

1. INTRODUCTION

Trauma remains the most common cause of death for all individuals between the ages of 1 and 44 years and is the third most common cause of death regardless of age. Penetrating thoracic or abdominal or combined injuries are one of the common injuries caused by assault. These injuries are associated with high risk of life threatening intra abdominal or intra thoracic organ injury. Due to the inadequate treatment of the injuries, many of the cases are fatal. The knowledge in the management of Penetrating trauma is progressively increasing due to the in-patient data gathered from different parts of the world.

INDEX

- 1) Table of contents
- 2) Aims and objectives of study
- 3) Materials and methods / Data Collection
- 4) Review of literature
 - a. Historical aspects
 - b. Aetiology and mechanism of injury
 - c. Clinical features
 - d. Diagnosis and investigations
 - e. Management
- 5) Observation and discussion
- 6) Summary
- 7) Conclusion
- 8) References
- 9) Acknowledgements

2. Aims Of Study

- To study the cases of penetrating abdominal and thoracic trauma in context of :
 - Age/sex distribution
 - Mode of injury (homicide, suicide, accidents,)
 - Pattern of injury
 - Clinical presentation
 - Diagnosis and investigations
 - Area involvement
 - Area wise organ involvement
 - Pattern of organ damage
 - Surgical Intervention and criteria for non operative and operative management
 - Post operative Morbidity and Mortality
 - Final outcome

3. Material And Method

Source of data:

This is a prospective study of penetrating thoracic and abdominal or combined injuries during the period from June 2012 to December 2014 in Civil Hospital, Asarwa, Ahmedabad attached to B.J. Medical college Ahmedabad. Number of cases studied is 25.

Method of collection of Data:

- After initial resuscitation of the trauma victims, a careful history was taken to document any associated medical problem.
- Documentation of patients ,which included identification, history, clinical findings, diagnostic test, operative findings, operative procedures, complications during the stay in the hospital and during subsequent follow-up period, were all recorded on a proforma specially prepared.
- Demographic data collected included the age, sex, occupation and nature and time of accident leading to the injury.
- Routine blood and urine tests, radiological investigations were carried out in all the patients.
- After initial resuscitation and achieving hemodynamic stability, all patients were subjected to careful examination, depending on the clinical findings; decision was taken for further investigations such as four-quadrant aspiration, diagnostic peritoneal lavage, x ray abdomen and ultrasound as and when required.
- The decision for operative or non operative management depended on the outcome of the clinical examination and results of diagnostic tests.
- Patients selected for non operative or conservative management were placed on strict bed rest, were subjected to serial clinical examination which included hourly pulse rate, blood pressure, respiratory rate and repeated examination of abdomen and other systems.
- Appropriate diagnostic tests especially ultrasound of abdomen was repeated as and when required.
- Post operative follow up was done to note for complications.

Inclusion criteria:

1. All patients, who have penetrating thoracic or abdominal or combined injury and hospitalized for the same.
2. Penetrating abdominal injury should have peritoneal breach
3. Penetrating thoracic injury should reach pleural cavity or mediastinal space.

Exclusion criteria:

1. All patients who have penetrating thoracic or abdominal or combined injury and not hospitalized for the same.
2. Patient having penetrating injury but no peritoneal breach or pleural cavity breach.
3. All deaths on arrivalCases who were so severely injured that they did not survive attempts at resuscitation in emergency department.
4. Patients who have taken discharged against medical advice and lost to follow ups.

4. Review of literature

a.) Historical aspects

Injury to the Abdomen and thorax has always been considered as one of the most critical injuries inflicted upon the body. The historical documentation of abdomino-thoracic trauma is probably as old as history itself.

The oldest medical and scientific document known is the Edwin Smith Surgical Papyrus. This is thought to be an undated version of documents prepared by Imhotep around 3000 BC. Greek soldiers in the Trojan War, in the 1st century AD, were removed from the battle field and looked after in certain barracks or ships which seemed to be the earliest trauma centres. Valetudinaria had been established along the frontiers of the Roman Empire to treat legionaries who had suffered trauma.

Physicians were referred to by the Ionian Greeks as "In Ipos" meaning an "Extractors of arrows" (Loria, 1948). Xenophon in his Anabasis speaks of a Greek army captain who returned to his camp literally holding his bowels in his hands after an eviscerating wound of the abdomen. From the Homeric epics, we learn of the death of Polydorus at the hands of Achilles whose weapon on entering the back of the victim protruded out in front thereby leaving the boy "bending with his bowels clasped in his hands". Eurymachus succumbed to the effects of a liver wound which was inflicted by an arrow from powerful bow of Odysseus.Hippocrates (460-355 BC) recognized the high incidence of mortality ensuing from intra-abdominal and intra-thoracic injuries, and postulated that 'A severe wound of the bladder, small intestine, stomach, and the liver is deadly' (Adams 1886). Several of the twenty three stab wounds inflicted on the person of Julius Caesar were situated in the

abdomen (Buchan, 1932). In the famous old Indian books of Medicine, Charaka and Susruta described the management of holes in the intestine. Bishop (1960) quotes Susruta about the management of perforating injuries of the abdomen wherein he says that in a case of protrusion of the intestines, they should be carefully examined and washed with milk; lubricated with clarified butter (ghee), and gently reintroduced back into the abdomen. Any perforations or tears, when identified, should be closed by applying black ants. Suicidal injuries covered another aspect of penetrating abdomino-thoracic injuries. The self disembowelment of the Japanese known as 'Hara-kiri', is a vestige of old feudal Japan which has gone down in records as the 'Natural Form of Suicide'. After the preliminaries in the ritual, the suicide plunges a dagger into the left side of the abdomen, below the costal margin, draws it slowly across the right, and finally turns it up giving a sharp upward bend.

Although murder by stabbing was chiefly superseded by poisoning during the Dark Ages, sharp weapons like dagger, arrow, spear, lance, and sword continued to be responsible for causing many fatal wounds of the abdomen. In those ancient days, with almost a total lack of mechanized industries and modes of transport, cases of non-penetrating trauma to the abdomen and thorax were rare. The dagger continued to serve as the principal weapon of assassination especially in the European Countries till Schwartz in 1354 heralded the era of gunpowder firearms. With further modifications of these weapons, came the pistol in 1500 and was improved upon into the revolver in the 17th century. With these came on record cases of gunshot injuries of the abdomen and thorax.

The Artasastra, a book written during the reign of Ashoka, documented that the Indian army had an ambulance service, with well-equipped surgeons, and women to prepare food and beverages and bandage wounds. Indian medicine was specialized, and it was the "shalyarara" (surgeon) who would be called on to treat wounds. "Shalyarara" literally means "arrow-remover," because the bow and arrow was the traditional weapon for Indians

With the development of more effective management of injuries, the concept of a flying hospital or ambulance volante was developed by Napoleon's army surgeons when it became obvious that rapid transfer, together with early active management, produced the best results. In terms of the historical management of chest injuries, it is interesting that De Chauliac, the "Father of Surgery", was surprised to see such paucity of literature in the management of chest injuries when he wrote his *Chirurgia Magna* in 1365. Only Hippocrates had mentioned the association of chest wall injuries and haemoptysis as a result usually of rib fracture.

The importance of pneumothorax and haemothorax was realized in the 18th Century and many devices were devised to suck wounds out of the chest, sometimes using the mouth of a specialist to use his own inspiration to suck air or fluid from that of the injured. Later devices such as the Arel Syringe were developed which certainly improved the hygiene of this technique. Although trocars had been developed, caution in the use of these instruments was urged as early as the 18th Century and it was felt, even then, that the insertion of a finger in a carefully made incision was preferable to introducing a sharp pointed trocar which may damage the lung and other intra-thoracic structures.

There has been much misinterpretation in recent literature as to the nature of contusions, but it is interesting that Morgagni refused to use the concept of contusion when it came to lung injury, even though he was familiar with it elsewhere in the body. He, rather wisely, described lacerations of the lung as the mode of injury in blunt chest wall damage. Perhaps if we had learnt from Morgagni we would not have gone through the cycle of attempting to treat lacerations of the lung with steroids and diuretics as we have in the past when the word "contusion" was loosely applied to such injuries.

Underwater seal systems owe their development to a series of English physicians, and flutter valves were also used in the American Civil War. The Heimlich valve was a successor of these early flutter valve and the more effective flutter valve incorporated in the 'Portex Emergency Chest Drainage Bag' is the ultimate outcome of many less effective systems which have undergone development. The first scientific description of the flutter valve was by R. McDonald in *Dublin Quarterly of Medical Science* in 1864. Since that time, however, the underwater seal has become the mainstay of safe drainage of the thorax.

Operations were carried out in the 19th Century notably by Dupuytren and Kafstein who were repairing major lacerations of the lung with early recovery and good outcome. At the outbreak of World War 1 there were few surgeons with wide experience in the management of chest trauma and it was felt that the best treatment for the vast majority of chest injuries was conservative. However, it was felt by medical specialists in all armies that an unnecessarily high mortality resulted when conservative management was used for virtually all injuries. Quite independently, Moynihan in the British Army, Sauerbruch in the German and Pierre Duval in the French Army decided that better results could be obtained if early thoracotomies were carried out for lung lacerations. At the time of such operations other injured areas of the thorax were actively treated and the mortality rates in these very ill patients treated in those primitive circumstances was less than 20%. These surgeons were undoubtedly brave, skilled and experienced and were therefore prepared to operate. Today however, less brave, less skilled and less experienced surgeons who are not familiar with the thorax on a day-to-day basis, and do not have large experience of thoracic injuries, may prefer to treat almost every thoracic injury conservatively.

Undoubtedly with improved diagnostic techniques, better training of intensivists and vastly superior monitoring devices, together with the advent of effective cardiac inotropic agents and antibiotics, conservative management of many thoracic injuries has become safer than it was even a few decades ago. Although only 15% of patients in the Vietnam War had thoracotomy for penetrating chest injuries, the trend throughout the war was from an early adherence to the dogma of conservative management to a later inclination towards more active intervention. In one centre, after the deaths of four young men who had pulmonary contusions following missile injury to the lung, it was decided that further patients with similar contusion, with or without other indications for thoracotomy, should in fact have exploration of the chest. The majority of patients in the subsequent group did not have other indications for thoracotomy and the mortality in this series was reduced to 11%, casting doubt on the adherence to conservative management in the first group (Fischer RP). The tendency towards active management of selected lung injuries where "contusion" was the main injury was noted by other medical teams in the Vietnam War.

More recently, as a result of the major conflict in Lebanon, Dr. Zacharia (Zakharia AT) and his colleagues carried out early thoracotomy in the majority of their patients with tube thoracostomy only being used in less than 30%. In those patients undergoing surgery, 22% required pulmonary resection. Only 2% of those patients undergoing thoracotomy for major injuries resulted in mortality. In Belfast in 300 consecutive admissions with major thoracic injuries, both penetrating and blunt, we have carried out thoracotomy within two hours of admission on 82% of penetrating gunshot wounds to the chest, 41% of stab wounds to the chest and 23% of blunt injuries to the chest. Of 90 patients who had thoracotomy for penetrating injuries of the lung, there was only one death. Overall, for 300 patients in our series, there were 11 deaths, giving an overall mortality of 3.6%.

Unfortunately, recent studies of outcome in trauma in the U.K. have emphasised avoidable causes of death due to intra-abdominal haemorrhage. Many patients with intra-thoracic injuries, which are the cause of inevitable death in the hands of the inexperienced who are not prepared to carry out thoracotomy early, may have their lives saved. They are admitted to specialist units with experienced thoracic surgeons. Equally good results are obtained when these patients are managed by surgeons who have less detailed thoracic training than we have been fortunate to have in Belfast, but who have immense experience in trauma surgery, as was seen in Lebanon and in Vietnam.

With increased mechanization of life, abdomino-thoracic injuries have more taken a different turn. Penetrating injuries can now be caused by accidental impaction of pointed objects attached to machines or other structures. Blunt injuries following fall from heights such as scaffoldings of buildings under construction or following run over under wheels of heavy vehicles have become commoner. Firearm injuries take the biggest toll in warfare. The advent of rockets, and guided missiles have brought further risks in their wake. Davis et al have mentioned a case of through and through penetration of the abdominal cavity by a rocket which back fired and hit its designer in his belly.

It is thus seen that the mode of sustaining abdominal and thoracic injuries have undergone a change over the course of history.

b.) Aetiology and Mechanism of injury

Objects that penetrate the human body lacerate, disrupt, destroy, and contuse tissue. It can be classified into Stab Wound (SW) and Gun Shot Wound (GSW). It can also be classified depending on the energy transfer involved.

- **Low energy** (knife, scissors, razor, dagger, sickle, gupti) : Stab wounds are low energy transfer injury that causes direct tissue damage along a straight tract. Knives are the commonest weapon.
- **Medium energy**: conventional handguns, swords
- **High energy** : (blast injury, assault rifles, arrows, spears)

The injuries caused by knife, scissor, sword, dagger are low energy transfer injury. They mostly affect organs just beneath the entry point. These wounds have only entry wounds most of the times. One can probably conclude the amount of damage and organ involved most of the times by physical examination which is not possible in case of projectile injury.

The injuries caused by these projectiles depend on their physical makeup, the speed the range and the characteristic of their flight and nature of the tissue impacted. As the missile penetrates the body, the transfer of the energy expands the tissues and forces them out of the way, creating a temporary cavity, which then collapses on itself. The tissues displaced to form a cavity may be devitalized and may require extensive debridement. My study deals with majority of cases of stab wound.



Fig. 1 and 2 Penetrating injury with evisceration of bowel & Multiple stab wound over abdomen

c.) Clinical Features

Symptoms

(1) Pain in abdomen/chest:-

This symptom is present in almost all the cases of penetrating abdominal and thoracic trauma. The site of the pain will give clue to the organ involved. Referred pain may suggest irritation at a specific site (shoulder pain in case of subdiaphragmatic collection).

(2) Bleeding from wound

Bleeding from wound is seen in most cases but active bleeding is present in few cases. Active bleeding from wound indicates some form of vascular involvement.

(3) Distension of abdomen:-

Increasing abdominal distention indicates continuous hemorrhage, content spillage or gaseous distention due to perforation of hollow viscera. So the repeated measurement of abdominal girth is very important along with vital parameters if patient is managed conservatively.

(4) Protrusion of viscera from wound:-

This symptom is present in many cases of penetrating abdominal and trauma. Mostly small bowel protrusion occurs from the wound site.

(5) Vomiting:-

It is usually due to peritonitis or central in origin, if there is associated head injury. Hematemesis suggests bleeding in upper g.i. tract.

(6) Hematuria:-

Frank hematuria suggests major urinary tract injury, while retention suggests urethral or urinary bladder injury. In case of retention of urine, neurological examination is necessary to rule out spinal cord injury. Blood at tip of external meatus suggests urethral injury.

(7) Bleeding per rectum:-

Bleeding per rectum or blood in stool suggests possibility of some intestinal injury. If blood is bright red in colour, then it is from lower intestinal tract like sigmoid colon or rectum. If it is brown to black in colour then it is from upper g.i. tract.

(8) Associated injuries:-

It may be in form of head injury, chest injury with multiple rib fractures, major bone fractures of extremities, spine or other injuries. All these associated injuries should be assessed and treated accordingly.

(9) Breathlessness:-

Patients with thoracic injury present with complaints of breathlessness. Symptom may be due to collected hemothorax, pneumothorax, pain. Cardiac injury should be kept in mind depending on site of injury.

Signs

(1) General:-

Altered level of consciousness in a case of penetrating injury is usually due to:-

- a) Blood loss.

- b) Head injury.
- c) Consumption of alcohol or drugs before the accident should be kept in mind.

(2) Vital data:-

Cold extremities, tachycardia, tachypnea, hypotension and severe pallor suggests ongoing blood loss.

Examination findings

Local per abdominal examination :-

• **Inspection:-**

- Site of penetrating mark
- Detailed inspection of mark angles of wound, search for exit wound
- Search for trajectory in case of foreign body (bullet, glass, pellet) in situ
- Fullness in flanks
- Generalized distention
- Absence of respiratory movement
- External genitals and back

• **Palpation:-**

- Angles of entry acute/obtuse
- Peritoneal breach should be looked by palpation under Local anesthesia
- If any organs injured/ involved should be looked for and palpated from the wound under local anesthesia.
- Tenderness
- Guarding
- Rigidity
- Lump

Tenderness, guarding and rigidity suggestive of peritonitis.

• **Percussion:-**

- Signs of free fluid
- Liver and splenic dullness

• **Auscultation:-**

- Peristalsis :
- Bruit :

Absent peristalsis will suggest paralytic ileus or peritonitis.

• **Per rectal and per vaginal examination:-**

Fullness in rectovaginal or rectovesical pouch will indicate pelvic collection. It will also show local rectal or vaginal injury. In ruptured urethra, prostate may be displaced from its normal site, which can be assessed in per rectal examination.

Thoracic/respiratory examination :-

• **Inspection:-**

- Site of penetrating mark
- Detailed inspection of mark angles of wound, search for exit wound.
- Pattern of respiration
- Respiratory rate
- Tracheal shift
- Apex Beat of heart

• **Palpation:-**

- Tenderness
- Subcutaneous emphysema
- Bruit

• **Percussion:-**

- Tympanic / Dull note
- **Auscultation:-**
- Respiratory sounds :

Systemic examination:-

Rapid general examination is mandatory in all the cases. “More is missed by not looking than by not knowing”. Neurological evaluation and distal neurovascular evaluation in case of fractures should be done.

d.) Diagnosis And Investigation^[1,2,3,6,7]

Laboratory

Hb-PCV :

It will show the amount of blood loss. Decreasing haematocrit value indicates persistent blood loss.

Renal Function Test:

It will show the status of kidney. Prerenal ARF may be seen in patient with severe blood loss.

Liver Function Test:

In case of biliary tract injury and liver parenchymal injury, Liver function test may be altered.

Serum amylase :

Elevated level suggests pancreatic or bowel injury, but it is not a very sensitive test as, it is also increases in other conditions.

Conditions like pancreatitis, choledocolithiasis, etc.

Serum transaminase :

Elevated level suggests hepatic injury.

Urine Examination :

Presence of RBC suggests urinary tract injury.

Diagnostic Peritoneal Lavage :^[6,14]

It is controversial. Risk vs Benefit ratio should be considered in mind. It was first described in 1960. Introducing peritoneal dialysis catheter through infraumbilical incision, and about 1 litre of normal saline is run into peritoneal cavity (in children 10-15 ml/kg). Then patient is rolled from side to side. Returning fluid is collected and sent for investigation.

It is positive if :-

1	Blood in catheter
2	Fluid studies revealing RBC more than 1,00,000/m ³ indicate solid organ injury.
3	WBC more than 500/m ³ indicate peritonitis – a late feature of trauma.
4	Amylase more than 175 IU/dl is suggestive of pancreatic injury.
5	Fluid should also be examined for presence of faecal material, bile etc.

Radiological

1. Plain X-Rays :^[15]

Plain X-rays of abdomen supine and standing :

Free gas under diaphragm suggestive perforation of hollow viscera.

In some cases even in perforation of hollow viscera free gas under diaphragm may not be seen.

Ground glass appearance suggests free fluid.

Air bubbles in right upper quadrant just medial to kidney suggest retroperitoneal duodenal injury.

Elevation or abnormality of diaphragm will suggest collection under the diaphragm.

Plain X-Ray of Chest :

It will show rib fracture, hemothorax, pneumothorax or both. It will also show an elevated diaphragm or with abdominal viscera or Ryle’s tube in case of rupture of diaphragm.

2. Ultrasound :^[3,6]

Most frequently used investigation now-a-days. It detects intraperitoneal and retroperitoneal collection of fluid, solid organ injury with surrounding hematoma.

Disadvantages :-

Lower sensitivity for free fluid <500 ml.

False negative for hollow viscera injury.

Advantages :-

Rapid
Non invasive
No radiation
Low cost
Easily available

Focused assessment with sonography for trauma (fast):-^[3,6]

It is a limited ultrasound examination directed solely at identifying the presence of free intraperitoneal or pericardial fluid. In the context of traumatic injury, free fluid is usually due to haemorrhage and contributes to the assessment of the circulation.

The Focused Assessment with Sonography for Trauma is a rapid, bedside, ultrasound examination performed to identify intra-peritoneal hemorrhage or pericardial tamponade.

FAST examines four areas for free fluid :

1. Perihepatic&hepato-renal space
2. Perisplenic
3. Pelvis
4. Pericardium

3. CT Scan:^[3,6]

Now-a-days the role of CT Scan is very much increasing because of its accuracy. It has very much use in thoracic injuries. It is also useful investigation in evaluation of retroperitoneal structures like kidneys and pancreas. It quantitates free fluid, gas and defines severity and staging of solid organ injury and identifies breach in bowel continuity. Accuracy from 92% to 98%. In case of urinary tract injury, CT IVU has virtually replaced conventional IVU. It provides better details on anatomy and function.

CT scan is done in selected patients depending upon clinical examination.

Indications :

Penetrating injury with a projectile
Persistent high ICD output
Haemodynamic stability
Duodenal or pancreatic trauma
Normal or unreliable physical examination

Contraindications :

Haemodynamic instability
Allergy to contrast media

Advantage :

Quick assessment
Noninvasive
Retroperitoneum well assessed
Renal perfusion assessed

Disadvantage :

Non availability at different centres
Higher cost
Hollow viscus injuries
Radiation exposure

Angiography :

Selective catheterization of cardiac, mesenteric and renal vessels done to reveal site of bleeding. It may be helpful in case of pelvic fracture with ongoing bleeding and retroperitoneal extension.

Indication :-

Polytrauma with suspected vascular injury.

Non operative management of liver and splenic injury.

Disadvantage :-

- Splenic infarcts
- Hepatic infarction
- Failure rates are higher
- Require expertise

4. Contrast Study :^[16,17]

In case of urinary tract injury, IVP is done to confirm presence of functioning contralateral kidney and site of injury. If one kidney is not visualized, then angiography is done to see if an intimal flap with subsequent thrombosis has developed on non visualized sided kidney. Cystogram will show ruptured bladder. Usually done in patients when CT Scan is not available and USG findings of other organs are normal.

Operative

(1) Diagnostic Laparoscopy :^[3,6]

In a hemodynamically stable patient with no signs of peritonitis. One can think of this management option to look for internal organ injury and in this way patient can be saved from unnecessary laparotomy.

Indication :-

Penetrating injury with peritoneal breach and no signs of peritonitis.

Disadvantage :-

- Unavailability
- Require expertise and set up
- Small perforations may be missed

e.) Management

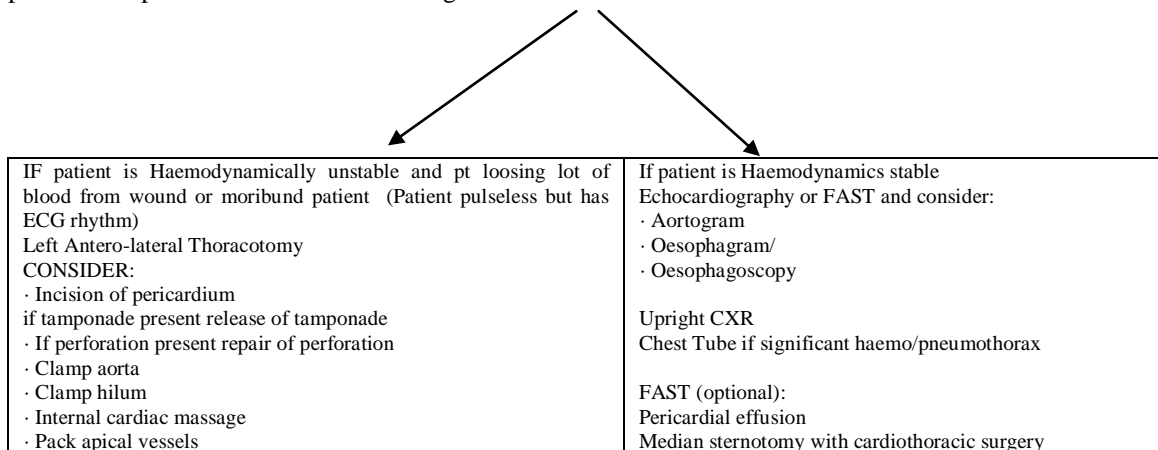
Thoracic Trauma^[1,3,6,22]

Penetrating chest trauma deals with two major vital organs lungs and heart. It also includes major vessels aorta, vena cava and pulmonary vessels.

Penetrating chest trauma can be divided in to Central Chest trauma and Lateral Chest Wall trauma.

A) Heart and Mediastinum^[1,3,22]

It mainly occurs due to Central Chest trauma between nipple lines Xiphisternum to clavicles. Mostly bullet injury causes this type of injury. Knife seldom penetrates sternum. So penetrating injury caused by projectile weapons causes this injury. Necessary to assess trajectory of projectile clinically soot present in track. If possible simple CXR can be done. Management described below



B) Lungs and Pleural cavity^[1,3,22]

Lateral Chest wall injury (Lateral to nipple lines) mainly by short knives causes' lung or pleural cavity injury. A projectile weapon with clearly defined entry and exit wounds with trajectory in lateral chest causes such injury. Management includes

<p>IF patient is hemodynamically unstable Urgent CXR (if not possible) Chest Tube to side of injury If output is 1500ml stat or output >200ml/ hr then urgent thoracotomy</p> <p>FAST (optional): Pericardial effusion present Urgent Thoracotomy</p>	<p>IF patient Hemodynamically stable Upright CXR IF minimal pneumothorax present then observe pt Repeat upright CXR in 4 hours Pneumothorax increasing Then ICD insertion, watch for output</p> <p>If moderate to large Pneumo or haemothorax Chest tube placement (minimum 32Fr) Bleeding >1500 mls immediately, or, >200mls/hour ·Call Cardiothoracic surgeon ·Arrange thoracotomy IF not then observe pt vital parameters. Follow up chest xray are required Elective 2D echo at later date.</p>
---	--



Fig 3. Right Lateral Chest injury - Stab wound over right 10 th Intercostal space



Fig 4. ICD insertion in case of chestwall trauma with abdominal drain for laparotomy

Abdominal Trauma

A) **Solid organ injury :**

Liver [2,3,6]

The liver is commonly involved organ following penetrating abdominal injury. Liver injury results from penetrating injury over epigastrium, right hypochondrium, less commonly with back and left hypochondrium.

Liver injury grade : [2,3,6,18]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, < 1 cm depth
II	Hematoma	Subcapsular. 10 - 50% surface area Intraparenchymal < 10 cm diameter
	Laceration	Capsular, 1 – 3 cm depth, < 10 cm length
III	Hematoma	Subcapsular, < 50% surface area, or ruptured with active bleeding. Intraparenchymal > 10 cm diameter
	Laceration	Capsular tear, < 3 cm depth
IV	Laceration	Parenchymal disruption involving 25 – 75% hepatic lobe or 1 – 3 Couinaud segments (with one lobe)
V	Laceration	Parenchymal disruption involving > 75% hepatic lobe or > 3 Couinaud segments (with one lobe).
	Vascular	Juxtrahepatic venous injuries (IVC, Major hepatic vein)
VI	Vascular	Hepatic avulsion

CT Grading : [3,18]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Subcapsular haematoma (< 1 cm thick), isolated periportal blood tracking.
	Laceration	Capsular avulsion Superficial laceration(s) (< 1 cm deep)
II	Hematoma	Central/subcapsular haematoma(s) 1–3cm.
	Laceration	Parenchymal laceration(s) 1–3cm deep
III	Hematoma	Central/subcapsular haematoma(s) >3cm
	Laceration	Laceration(s) >3cm deep
IV	Hematoma	Massive Central/subcapsular haematoma(s) (>10cm)
	Vascular	Devascularised (non enhancing) spleen. lobar tissue destruction or devascularisation.
IV	Vascular	Bilobar tissue destruction or devascularisation

Management of liver injury :

- If hemodynamically stable grade I and II patients can be managed nonoperatively.
- Grade I and II : Most blunt and penetrating hepatic injuries are grade I and II (70% to 90%) and can be managed with simple techniques (e.g., electrocautery, simple suture, or hemostatic agents).
- Grade III : Major intraparenchymal injuries with active bleeding can best be managed by figure fracturing the hepatic parenchyma and ligating or repairing lacerated blood vessels and bile ducts under direct vision.
- Grade IV : extensive intraparenchymal injuries with major rapid blood loss require occlusion of portal triad to control hemorrhage.
- Advanced technique of repair (III & IV) are performed with Pringle maneuver in place
 - Extensive hepatorrhaphy
 - Hepatotomy with selective vascular ligation
 - Resectional debridement with selective vascular ligation
 - Selective hepatic artery ligation
 - Perihepatic packing

Spleen [2,3,6,12,18]

The spleen is involved in patients who have suffered penetrating abdominal trauma over epigastrium and left hypochondrium, projectile injury can affect from other quadrants. Impact from both front and back can

affect spleen because of its attachments to many of the structures in the left upper quadrant and its position and intimate contact with the ninth to eleventh ribs. In disease like malaria which is very common in our country, spleen is often enlarged, which is also more prone to injury.

Ct grading of splenic injury :-^[2,3,6,12]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Subcapsularhaematoma < 1 cm.
	Laceration	Capsular avulsion, superficial laceration(s)
II	Hematoma	Central/Subcapsularhaematoma(s) < 3 cm
	Laceration	Parenchymal laceration(s) 1-3 cm deep
III	Hematoma	Subcapsularhaematoma(s) > 3 cms
	Laceration	Laceration(s) > 3 cm deep, central
IV	Fragmentation	Fragmentation (> 3 segments)
	Devascularisation	Devascularised (non enhancing) spleen.

Grade of injury:-^[2,3,6,18]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1 cm in parenchymal depth
II	Hematoma	Subcapsular, 10%-50% surface area; intraparenchymal, <5 cm in diameter
	Laceration	Capsular tear, 1-3 cm in parenchymal depth and not involving a trabecular vessel
III	Hematoma	Subcapsular, >50% surface area or expanding, ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma, ≥5 cm or expanding
	Laceration	>3 cm in parenchymal depth or involving the trabecular vessels
IV	Laceration	Laceration involving the segmental or hilar vessels and producing major devascularization (>25% of spleen)
V	Laceration	Completely shattered spleen
	Vascular	Hilarvascular injury that devascularizes the spleen

Management of splenic injury:

- In hemodynamically stable, adult patients with grade I or II injury can often be treated nonoperatively
- If the patient is not hemodynamically stable, operative treatment is required. The operative therapy of choice is splenic conservation where possible to avoid the risk of death from overwhelming postsplenectomy sepsis that can occur after splenectomy for trauma. However, in the presence of multiple injuries or critical instability, splenectomy is more rapid and judicious.
- Nonbleeding grade I splenic injury may require no further treatment. Topical hemostatic agents, an argon beam coagulator, or electrocautery may suffice.
- Grade II to III splenic injury may require the aforementioned interventions, suture repair, or mesh wrap of capsular defects. Suture repair in adults often requires Teflon pledgets to avoid tearing of the splenic capsule
- Grade IV to V splenic injury may require anatomic resection, including ligation of the lobar artery

Kidney^[2,3,6,15,18]

The kidney is often involved in penetrating abdominal injuries by impact from behind, and in front in lumbar region.

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
-------	----------------	-----------------------

I	Hematoma	Subcapsular, non-expanding, without parenchymal laceration
	Contusion	Microscopic or gross hematuria, urological studies normal
II	Hematoma	Nonexpanding perirenal hematoma confined to renal retroperitoneum
	Laceration	<1 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation.
III	Laceration	>1 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 haemorrhage
V	Laceration	Completely shattered kidney
	Vascular	Avulsion of renal hilum that devascularises the kidney.

Ct grading : ^[3,6,18]

Categories of renal injuries :

1. Renal contusion or bruising of the renal parenchyma, Microscopic haematuria is common but gross haematuria can occur rarely.
2. Renal parenchymal laceration into renal cortex. Peri renal haematoma is usually small.
3. Renal parenchymal laceration extending through the cortex and into renal medulla.
4. Renal parenchymal laceration extending into renal collecting system, also, main renal artery thrombosis from blunt trauma, segmental renal vein or both; or artery injury with contained bleeding.
5. Multiple grade 4 parenchymal lacerations, renal pedicle avulsion, or both; main renal vein or artery injury from penetrating trauma.

Management of renal injury: ^[3,19,20]

- Nonoperative treatment of renal trauma (grades I to III) has become standard. If the injury is properly staged, nonoperative management is successful for contusions, contained lacerations, most lesions with moderate extravasation of urine, or when blood is seen in hemodynamically stable patients.
- In the stable patient, obtaining proximal vascular control before unroofing the perirenal hematoma may be helpful.
- In the unstable patient, it may be necessary to proceed with nephrectomy.
- Repair of the renal parenchyma, with or without heminephrectomy, can have excellent results. Reinforcement of the repair with omentum or mesh can be a useful alternative. Wide drainage is indicated.
- Traumatic renal arterial thrombosis usually results in renal loss.

Ureteral injury :

- Most ureteral injuries are treated with primary repair and stenting. The ureter should be repaired with interrupted, absorbable sutures in a watertight fashion using spatulated ends. Diverting nephrostomies are sometimes necessary for large proximal ureteral injuries.
- A distal ureteral injury may require tunneling of the distal ureter into the bladder or mobilization of a small portion of the bladder to facilitate the anastomosis. If a large segment of ureter is missing, autotransplantation of the kidney to the pelvis can be done.
- In patients who are profoundly unstable, particularly within the framework of damage control, the ureter can be exteriorized with a catheter as a ureterostomy or ligated with proximal diversion by nephrostomy

Pancreas ^[2,3,6]

Pancreatic injuries are relatively rare. Penetrating injuries to the pancreas generally result from deep infliction of weapon on epigastrium. The pancreas extends across the upper abdomen and situated deep beneath bowel. Injury range from simple capsular contusions to ductal transections,

Pancreatic injury grade: ^[2,3,18,21]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
-------	----------------	-----------------------

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Minor contusion without duct injury.
	Laceration	Superficial laceration without duct injury
II	Hematoma	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 the ampulla.
V	Laceration	Massive disruption of head of pancreas.

Management of pancreatic injury:

- Grade I :Pancreatic contusion or capsular laceration without ductal injury wide drainage is required. Do not repair capsular lacerations; this can produce a pseudocyst. The operative goal is to develop a controlled pancreatic fistula postoperatively, which will generally close spontaneously.
- Grade II :Pancreatic transection distal to the SMA , distal pancreatectomy can be done. Attempt splenic conservation in the stable patient.
- Grade III : For Pancreatic transection to the right of the SMA (not involving the ampulla), there is no optimal operation. The options include wide drainage of the area of injury to develop a controlled pancreatic fistula; ligation of both ends of the distal duct and wide drainage; and oversewing the proximal pancreas and performing a Roux-en-Y jejunostomy to the distal pancreas (indicated uncommonly).
- Grade IV :Severe injury to both the head of the pancreas and the duodenum may require pancreaticoduodenectomy.



Fig 5 The Liver injury has been opened to control bleeding.(Liver laceration)

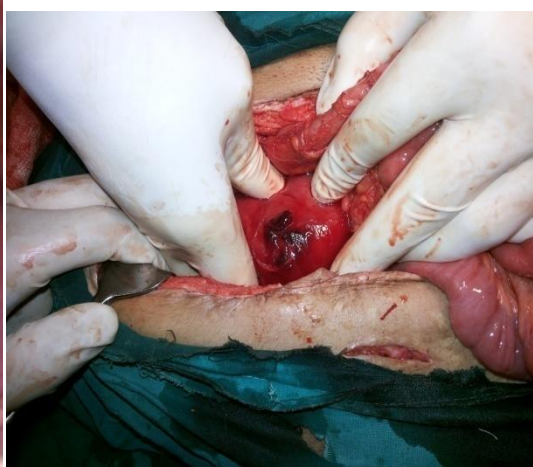


Fig 6 Penetrating injury causing Renal trauma as seen during laparotomy

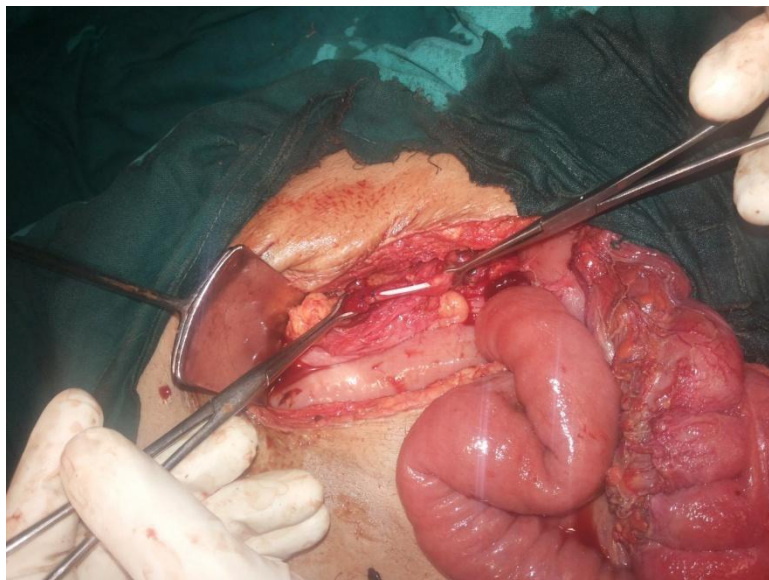


Fig 7 Ureteral injury repaired over DJ Stent

B) Hollow organ injury :-

Stomach^[2,3,6,21]

It commonly occurs in penetrating injury over epigastrium in full stomach patients. Stomach is commonly involved because of its size and accessibility. Rupture usually occurs along body part, pylorus where it is most accessible.

Stomach Injury Grading :-^[2,3,6]

Grade	Description of injury	AIS-90
I	Contusion or hematoma	2
	Partial thickness laceration	2
II	Laceration on GE junction or pylorus <2 cm	3
	In proximal 1/3 of stomach <5 cm	3
	In distal 2/3 of stomach <10 cm	3
III	Laceration on GE junction or pylorus >2 cm	3
	In proximal 1/3 of stomach ≥5 cm	3
	In distal 2/3 of stomach ≥10 cm	3
IV	Tissue loss or devascularisation <2/3 of stomach	4
V	Tissue loss or devascularisation >2/3 of stomach	4

Management:

- Debride and repair the stomach in two layers with silk 2-0,1-0 with or without live or dead omentopexy. Gastric resection is rarely required. Irrigate and remove gastric contents from the peritoneal cavity.
- Sometimes feeding jejunostomy is also required.
- Pyloroplasty may be required to avoid stenosis, or, rarely resection and esophagogastrostomy are necessary for gastroesophageal junction injuries

Duodenum^[2,3,6,21]

It is infrequently involved organ in penetrating injury over epigastrium and rthypochondrium.

Duodenal Injury Grading :-^[2,3,6]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Involving a single portion of the duodenum.
	Laceration	Partial thickness, no perforation.
II	Hematoma	Involving more than one portion of duodenum.
	Laceration	Disruption < 50% of the circumference.

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
III	Laceration	Disruption 50%-75% of the circumference of D2 Disruption 50%-100% of the circumference of D1,D3,D4.
IV	Laceration	Disruption >75% of the circumference of D2 and involving the ampulla or distal common bile duct.
V	Laceration	Massive disruption of the duodenopancreatic complex.
	Vascular	Devascularisation of the duodenum.

Management:

- Grade I,II : primary repair or decompression (if late presentation)should be done.
- Grade III : repair with pyloric exclusion
- Grade IV : repair with choledochoenteric anastomosis
- Extensive duodenal injuries require one of the patch and bypass procedures like :
- Side to side patch duodenojejunosomy
- Gastrojejunosomy with duodenal exclusion
- Rou-en-y duodenojejunosomy with duodenal resection or division.
- Suction decompression can be done via :
- Transpyloric nasogastric tube
- Tube duodenostomy
- Retrograde jejunostomy
- Pylorus exclusion with stapler through gastrotomy
- Jejuna augmentation of duodenum
- Pancreaticoduodenectomy (Whipples procedure) done only in stable patients :
- Devascularisation of entire ‘C’ loop
- Total maceration with multiple perforations
- Associated pancreatic head injuries
- Destruction of ampulla of water

Small and Large Intestine^[3,21]

It is most frequently involved organ in penetrating trauma due to vast area it covers. Any quadrant injury in abdomen can cause bowel injury. It can be full thickness, serosal, partial tear, through and through injury. Fecal peritonitis can occur due to leakage of contents of bowel in peritoneum.

Small Bowel Injury Grading:-^[21]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Contusion or hematoma without devascularisation.
	Laceration	Partial thickness, no perforation.
II	Laceration	Laceration <50% of circumference
III	Laceration	Laceration >50% of circumference without transaction
IV	Laceration	Transection of small bowel.
V	Laceration	Transection of small bowel with segmental tissue loss
	Vascular	Devascularised segment.

Large Bowel Injury Grading:-^[21]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Contusion or hematoma without devascularisation.
	Laceration	Partial thickness, no perforation.
II	Laceration	Laceration <50% of circumference
III	Laceration	Laceration >50% of circumference without transection
IV	Laceration	Transection of colon.
V	Laceration	Transection of colon with segmental tissue loss

	Vascular	Devascularised segment.
--	----------	-------------------------

Management:-

Jejunum and Ileum :

- Imbricate antimesenteric wall hematomas with serosal injuries with Lembert stitches to reduce the risk of delayed perforation.
- Debride simple lacerations and close transversely to avoid stenosis.
- Resect larger injuries and perform an end-to-end anastomosis
- Injuries to the mesentery of the small bowel, which can bleed massively, must be rapidly controlled.

Colon :

The conventional treatment for colonic injury involves exteriorization or repair with a proximal diverting colostomy. Current operative options include primary repair of the injury, resection and anastomosis, and colostomy.

Rectum :

- Injuries to the rectum should be defined as intraperitoneal rectum or extraperitoneal rectal injuries.
- Often, intraperitoneal rectal injuries can be primarily repaired.
- Treat extraperitoneal rectal tears by diverting sigmoid colostomy.
- Other procedures include Hartmann resection with end colostomy, end colostomy with a mucus fistula, or loop colostomy with a stapled distal end.

Gall Bladder and Common Bile duct^[3,6,19,21]

Gall bladder and bile duct injury grading:-^[19,21]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Gall bladder hematoma. Portal triad hematoma.
II	Laceration	Partial avulsion of gall bladder from liver bed, cystic duct intact. Laceration or perforation of gall bladder.
III	Laceration	Complete avulsion of gall bladder from liver bed, Cystic duct laceration.
IV	Laceration	Partial or complete right hepatic duct laceration. Partial or complete left hepatic duct laceration. Partial common hepatic duct laceration (<50%). Partial common bile duct laceration (<50%).
V	Laceration	>50% transection of common hepatic duct. >50% transection of common bile duct.

Management:-

(a) Gall bladder injury : It is uncommon kind of injury. Deep RHC and Epigastric impact leads to this type of injury. Cholecystectomy is procedure of choice.

(b) Common bile duct injury :

Partial or minor injuries involving less than 50% of circumference are treated by primary repair and T tube placement.

Major injury or complete transection are treated with choledochoenteric anastomosis.

Urinary Bladder^[15,16]

It is injured particularly when distended. Bladder perforations may be either extraperitoneal or intraperitoneal. Extraperitoneal rupture is usually associated with pelvic bone fracture. Intraperitoneal rupture occurs when there is blow on dome of bladder when it is full.

Urinary Bladder Injury Grade:-^[15,16,21]

GRADE	TYPE OF INJURY	DESCRIPTION OF INJURY
I	Hematoma	Contusion or intramural hematoma.

	Laceration	Partial thickness.
II	Laceration	Extraperitoneal bladder wall laceration < 2 cm.
III	Laceration	Extraperitoneal (> 2 cm) or Intraperitoneal (< 2 cm) bladder wall laceration.
IV	Laceration	Intraperitoneal bladder wall laceration > 2 cm.
V	Laceration	Intraperitoneal or extraperitoneal bladder wall laceration extending into bladder neck or ureteral orifice (trigone).

Management :-

- Intraperitoneal bladder rupture requires exploratory laparotomy and repair.
- Repair should be done in multiple layers, absorbable watertight sutures, bladder drainage
- Small extraperitoneal bladder ruptures can be managed with bladder drainage alone, but tears with marked extravasation usually are repaired.
- A suprapubic tube is placed if the patient is going to remain supine, whereas a urinary catheter may be all that is necessary for the mobile patient.

Retroperitoneal Injury^[2,3]

Retroperitoneal haematoma occurs at five sites.

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Midline suprarenal 2. Midline infrarenal 3. Portal 4. Lateral perirenal, usually renal injury is the cause. 5. Pelvic : Loss of blood injuries to deep pelvic arteries and veins. | <p>Due to disruption of small branches of aorta or/and IVC</p> |
|--|--|

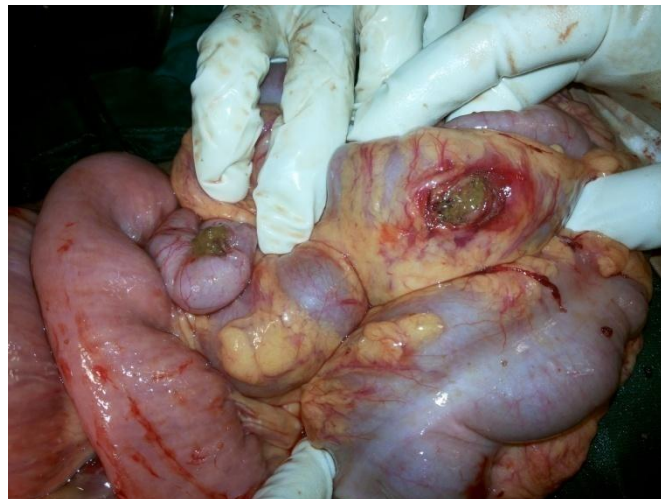


Fig 8 Transverse Colon injury



Fig 9 Small Bowel perforation



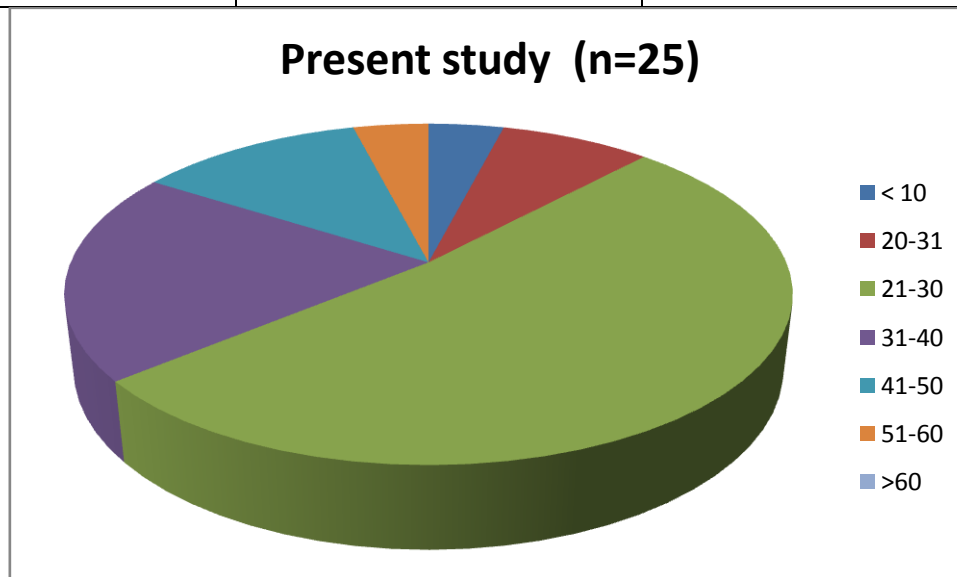
Fig 10 Retroperitoneal hematoma

5) Observations and discussion

In present study 25 cases of penetrating thoracic and abdominal trauma has been studied and following are the relevant observations and discussions:

Table 01 : Age

Age (years)	Present study (n=25)	Percentage
< 10	01	04
11-20	02	08
21-30	13	52
31-40	05	20
41-50	03	12
51-60	01	04
>60	00	00
Total	25	100



In present study 01 (04%) patient less than 10 years, 02 (08%) were from 11 to 20 years, 13 (52%) were from 21 to 30 years, 05 (20%) were from 31 to 40 years, 03 (12%) were from 41 to 50 years, 01 (04%) from 51 to 60 years, and 00 (00%) were above 60 years.

years and 00 (00%) more than 60 years. It is observed that 18 (72%) patients were from 21-40 years age group with a mean age group of 29.5 years.

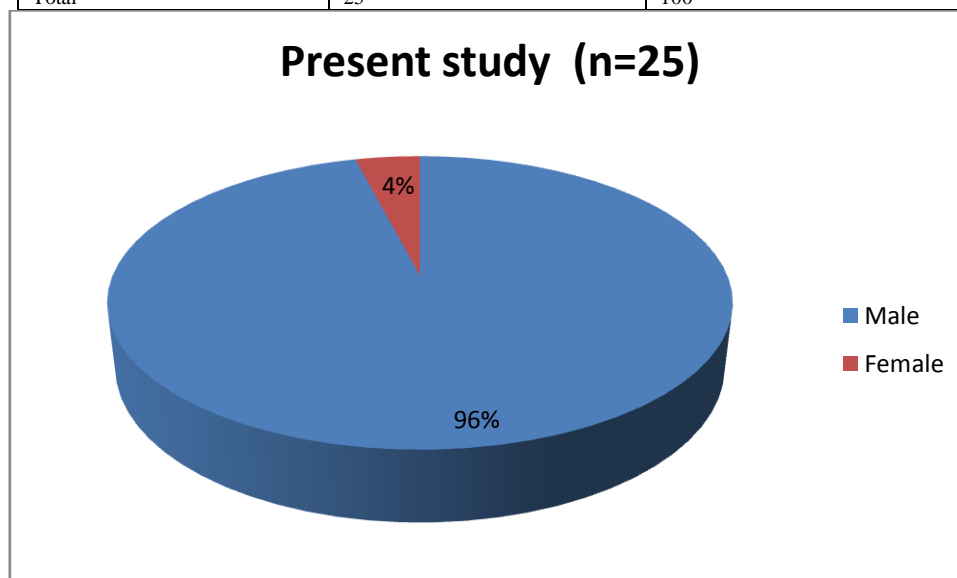
Ari Leppaniemi, JarmoSalo and ReijoHaapiainen (1995) reviewed 172 cases of penetrating chest and abdominal trauma the mean age group involved was 33 years (range, 15 - 83). Results were found comparable

Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid Ahsan Malik. This study included 79 patients with abdominal trauma who presented in the Accident and Emergency department of Civil hospital Karachi and underwent exploratory laparotomy from October 2011 to April 2013. A proforma was used to document patient’s demography, findings and final outcome with mean age group 21-30 (41.70%) . Results found similar to my study.

Penetrating Chest Trauma In North Of Jordan: A Prospective Study by M Khammash, F El Rabee published in The Internet Journal of Thoracic and Cardiovascular Surgery Volume 8 Number 1 during the year 2004, 26 patients were managed, mean age group was 22.5 years which was comparable.

• **Table 02: Sex**

Sex	Present study (n=25)	Percentage
Male	24	96
Female	01	04
Total	25	100



In present study there were 24(96%) male and 01(4%) female with a ratio of 24:1.

Ari Leppaniemi, JarmoSalo and ReijoHaapiainen (1995) reviewed 172 cases of penetrating chest and abdominal trauma 144 (83.73%) cases were male and 28 (16.27%) cases were female with ratio of 5.14:1.

Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid Ahsan Malik. This study included 79 patients with abdominal trauma who presented in the Accident and Emergency department of Civil hospital Karachi and underwent exploratory laparotomy from October 2011 to April 2013. A proforma was used to document patient’s demography, findings and final outcome 76 (96.2%) patients were male and 3 patients were female. Results found similar to my study.

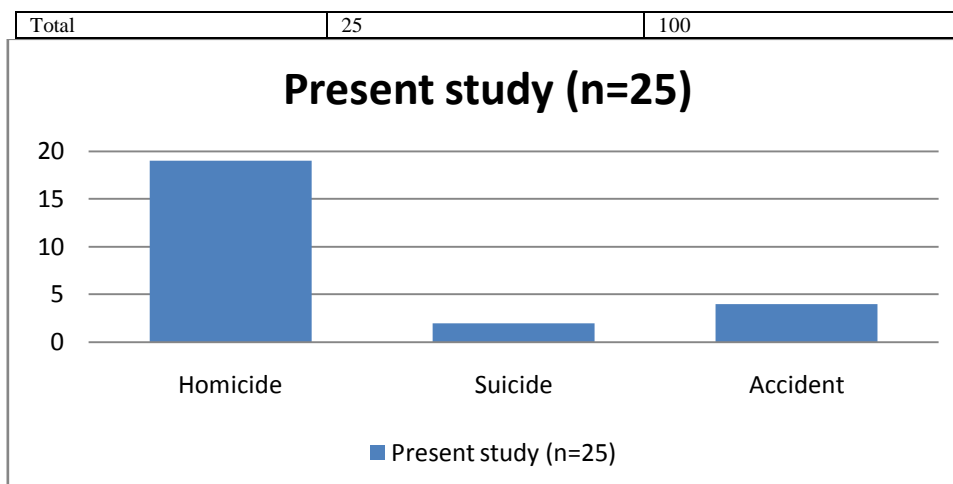
Penetrating Chest Trauma In North Of Jordan: A Prospective Study by M Khammash, F El Rabee published in The Internet Journal of Thoracic and Cardiovascular Surgery Volume 8 Number 1 during the year 2004, 26 patients were managed, 25 males and one female

With results comparable to my study.

The penetrating thoracic and abdominal trauma is more common in age group 21-40 years (n=18,72%) with male predominance (M:F:24:1) as they are economically productive, more active, and more liable to undergo rage and homicidal attempts and sustain injuries.

• **Table 03: Mode of injury**

Mode of injury	Present study (n=25)	Percentage
Homicide	19	76
Suicide	02	08
Accident	04	16



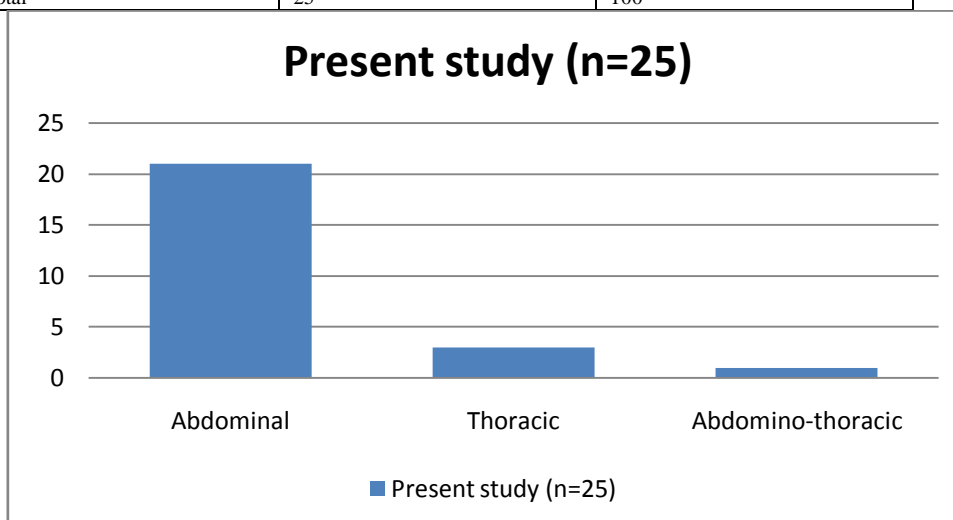
In present study there were 19(76%) cases of homicide, 2(08%) cases were suicide and 04(16%) cases were accident. Homicide accounting for maximum number of cases (76%).

Ari Leppaniemi, JarmoSalo and ReijoHaapiainen (1995) reviewed 172 cases of penetrating chest and abdominal trauma 120(69.74) cases were homicidal rest wounds were self-inflicted in 52 cases (30.26).

It is commonly seen in society that penetrating mode of injury is associated with homicidal attempt, most commonly practiced is stabbing.

• **Table 04: Area of injury**

Area of injury	Present study (n=25)	Percentage
Abdominal	21	84
Thoracic	3	12
Abdomino-thoracic	1	4
Total	25	100



In present study injury pattern showed that 21(84%) cases were abdominal injuries, 3(12%) cases were thoracic injuries and 01(04%) case was abdomino-thoracic. Abdominal injury accounting for maximum number of cases (76%).

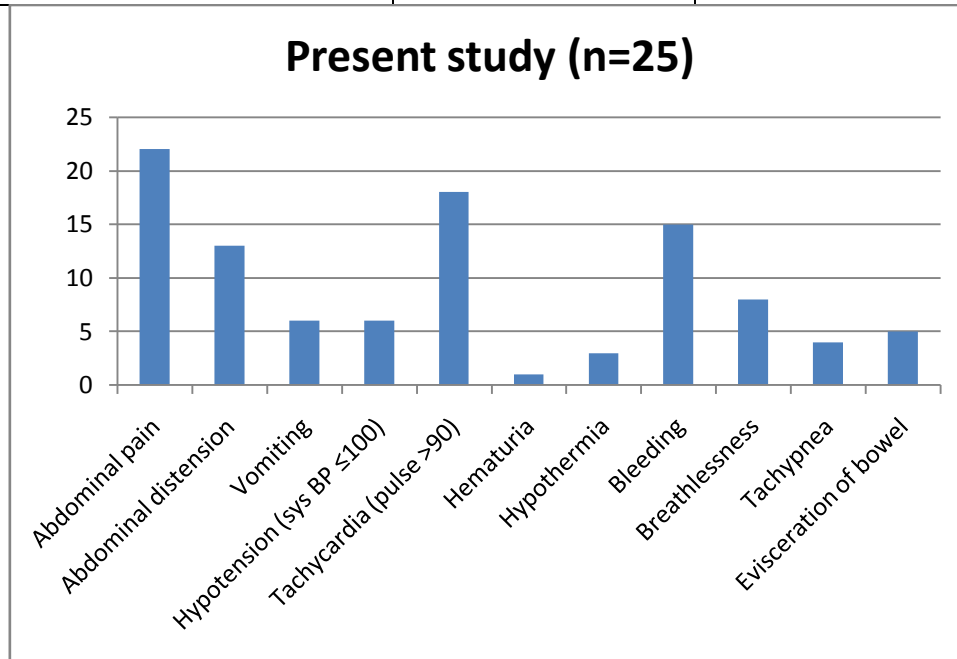
Ari Leppaniemi, JarmoSalo and ReijoHaapiainen (1995) reviewed 172 cases of penetrating chest and abdominal trauma 147 cases showed abdominal injuries. thethoraco-abdominal region in 11 cases, 14 cases in thoracic region.

Study : The persistent diagnostic challenge of thoracoabdominal stab wounds by Regan J. Berg, MD, EfsthiosKaramanos, MD, Kenji Inaba, MD, Obi Okoye, MD, Pedro G. Teixeira, MD, and DemetriosDemetriades, MD, PhD, Los Angeles, California . The trauma registry of a major level 1 center was queried for all adult patients admitted with thoracoabdominal stab wounds between January 1996 and December 2011.The study identified 617 patients, The majority of stab and GSWs were located in the anterior or posterior abdominal wall, followed by both flanks and the buttocks. Six patients had combined thoraco-abdominal trauma, with the primary wound in the chest. Results comparable to my study.

Most cases seen in injury pattern are abdominal trauma.

Table 05: Presenting symptoms

Presentation	Present study (n=25)	Percentage
Abdominal pain	22	88
Abdominal distension	13	52
Vomiting	6	24
Hypotension (sys BP ≤100)	6	24
Tachycardia (pulse >90)	18	72
Hematuria	01	4
Hypothermia	03	12
Bleeding	15	60
Breathlessness	8	32
Tachypnea	4	16
Evisceration of bowel	5	20



In my study 22 (88%) patients presented with abdominal pain and 5(20%) patients had history of evisceration of bowel,6 (24%) patients had vomiting,15(60%) patients had history of bleeding from local site, 13 (52%) patients presented with abdominal distension, 6(24%) patients were in hypotension and 18 (76%) patients had tachycardia at the time of presentation, 8 (32%) patients had associated chest pain and breathlessness while 1(04%) patient had history of unconsciousness.

When patient presents with abdominal pain with features of shock (tachycardia, hypotension), it should arouse the suspicion of active intra-abdominal bleeding and immediate evaluation and treatment should be started. Patients with evisceration of bowel loop should be generously examined and should be taken to OT as soon as possible due to risk of strangulation and prevent changes of peritonitis. Hematuria in a patient with penetrating abdominal trauma suggests injury to kidney, ureter, bladder or urethra and should be managed accordingly. In a penetrating thoracic and abdominothoracic trauma patient with the complain of chest pain and breathlessness thorough evaluation should be done to rule out hemothorax, pneumothorax, hemopneumothorax, lung contusion, subcutaneous emphysema, pericardial effusion, cardiac tamponade . Vomiting or history of LOC are indicators of probable head injury in the patient of trauma and should be managed accordingly. Results were comparable to other studies.

Table 06: Associated injury

Associated injury	Number out of 25	Percentage
CLW	6	24
Tendon rupture	1	4
Head injury	1	4

In my study 6 (24%) patients presented with associated CLW, 1 patient had tendon rupture and 1 had head injury.

CLW is seen mostly on arms indicating sign of defending himself from penetrating trauma and head injury is post syncope from penetrating trauma.

Associated injuries were found in 8 (32%) cases result comparable to Study Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid Ahsan Malik, Where associated injuries were present in 50% cases.

• **Table 07: Significant Past History and illness**

Past history/ major illness	Number out of 25	Percentage
Anemia	5	20
Surgery	2	8
Psychiatric illness	1	4

In my study 5(20%) patients had anemia on presentation which may be due to blood loss or pre-existing condition. 1 had some psychiatric illness who presented with suicide and 2 patients had history of some surgery in past.

• **Table 08: Number of entry wounds and their angles**

○ **Table 8.1: Number of entry wounds**

Number of entry wounds	Number out of 25	Percentage
1	18	72
2-5	6	36
>5	1	4

In my study 18(72%) patients had single entry wound, 6(36%) patients had 2-5 entry wounds and 1 patient had more than 5 wounds on presentation.

○ **Table 8.2: Angle of entry centring midline**

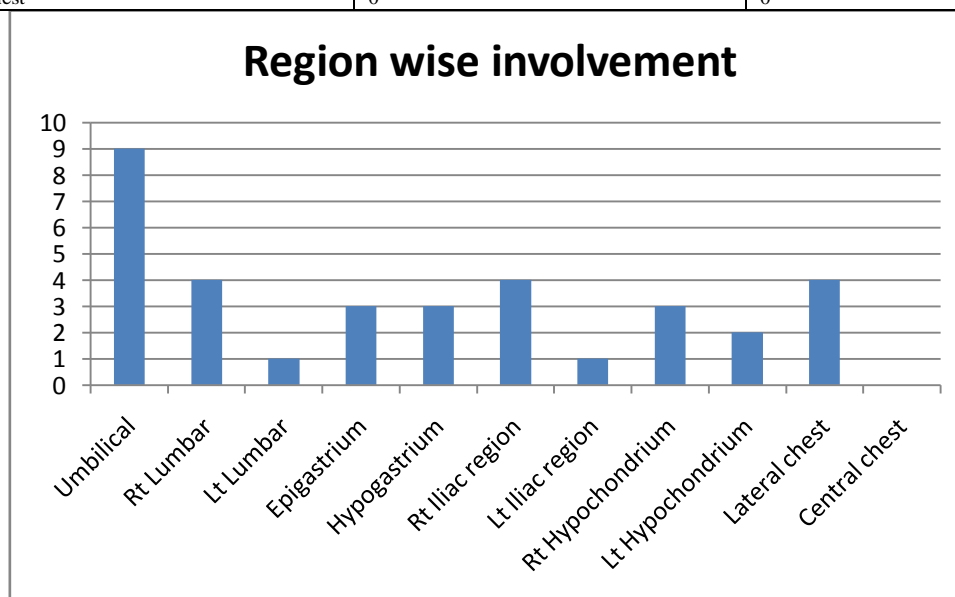
Angles of entry	Number out of 25	Percentage
Acute angle	20	80
Right angle	4	16
Obtuse	1	4

My study showed 20(80%) patients had acute angle wound centring midline, 4(16%) patients had direct right angle entry wound and 1 patient had obtuse angle.

This states that wound impacted were most of the times directed towards centre.

• **Table 09: Areas involved**

Areas	Number out of 25	Percentage
Umbilical	9	36
Rt Lumbar	4	16
Lt Lumbar	1	04
Epigastrium	3	12
Hypogastrum	3	12
Rt Iliac region	4	20
Lt Iliac region	1	04
RtHypochondrium	3	12
Lt Hypochondrium	2	08
Lateral chest	4	16
Central chest	0	0



In present study injury pattern showed that 9(36%) cases had entry wound in umbilical region, followed by right iliac, right lumbar and lateral chest with 4(16%) cases each. Lt iliac, lt lumbar, hypogastrum and central chest showed least impact.

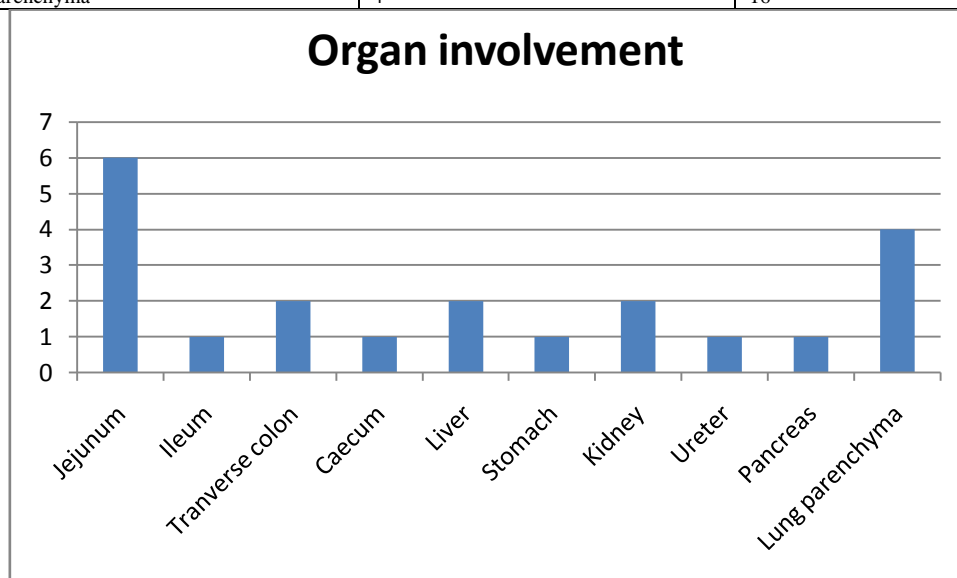
Umbilical region being at centre of abdomen was found to be corresponding with maximum insults impacted on it, followed by right lumbar and rt iliac and epigastrum.

In thorax all injuries were associated with lateral chest wall. Central chest wall injury were not found.

Results comparable with study Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid AhsanMalik, where most entry wounds were found on ventral abdominal wall (57%), involving the right upper quadrant in majority (31.6%) of patients.

• **Table 10: Organs involved**

Organ involved	Number out of 25	Percentage
Jejunum	6	24
Ileum	1	4
Tranverse colon	2	8
Caecum	1	4
Liver	2	8
Stomach	1	4
Kidney	2	4
Ureter	1	4
Pancreas	1	4
Lung parenchyma	4	16



In my study 6(24%) patients had jejunal injuries, followed by tranverse colon, Liver and Kidney 2(8%) cases each.

All thoracic injury were associated with lung parenchymal injuries as all of them were lateral chest wall injuries. No cases were associated with major thoracic vessel and heart.

J.E. Pridgen and A.F. Heriff (1967) reviewed 776 cases of penetrating abdominal wounds and found colonic injuries in 15.33%, gall bladder rupture in 2.9% and mesenteric injuries in 3.47% of cases. Vascular injuries, involving aorta were present in 0.5% and iliac vein in 0.64% cases. The other injuries include- 2.57% bladder injuries, 4.12% pancreatic injuries, 13.14% stomach injuries, 22.8% liver injuries and 21.26% small bowel injuries. Thus results were found comparable.

Results comparable to study Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid Ahsan Malik, where Intra-abdominal injuries, included liver (n = 14, 17.7%), spleen (n = 12, 15.2%), kidney (n = 4, 5.1%), pancreas (n = 4, 5.1%), stomach (n = 12, 15.2%), small bowel (n = 34, 43%) and large bowel (n = 35, 44.3%).

Penetrating chest injuries: analysis of 99 cases by Ülkü YAZICI, Alkn YAZICIOĞLU, Ertan AYDIN, Koray AYDOĞDU, Sadi KAYA, Nurettin KARAOĞLANOĞLU The study retrospectively reviewed the records of 99 patients presenting to our hospital with penetrating chest trauma during the previous 4 years (April 2007to June 2011) from all over Ankara, the capital of the Republic of Turkey. The group comprised 90 male (90.9%) and 9 female (9.1%) patients, with a mean age of 29.0 years. Of these patients, 62 (62.6%) had left -sided, 33 (33.3%)

had right-sided, and 4 (4%) had bilateral penetrating injury with affection of lung parenchyma in most cases with 3 case with major vessel involvement and 1 cardiac injury. Results comparable to my study found.

• **Table 11: Areawise organ involvement**

Stab injury over area	Organ involved in decreasing order
Epigastric region	Liver>stomach>only hemoperitoneum
Umbilical region	Jejunum>transversecolon>omentum>liver
Hypogastrium	Retroperitoneal hematoma
Lt Hypochondrium	Stomach > jejunum
Rthypochondrium	Liver
Lt lumbar region	Kidney>ureter>jejunum
Rt lumbar region	Jejunum
Rt iliac region	Hemoperitoneum> ileum
Lt iliac region	Jejunum
Lateral chest wall	Lung parenchyma
Central chest wall	-

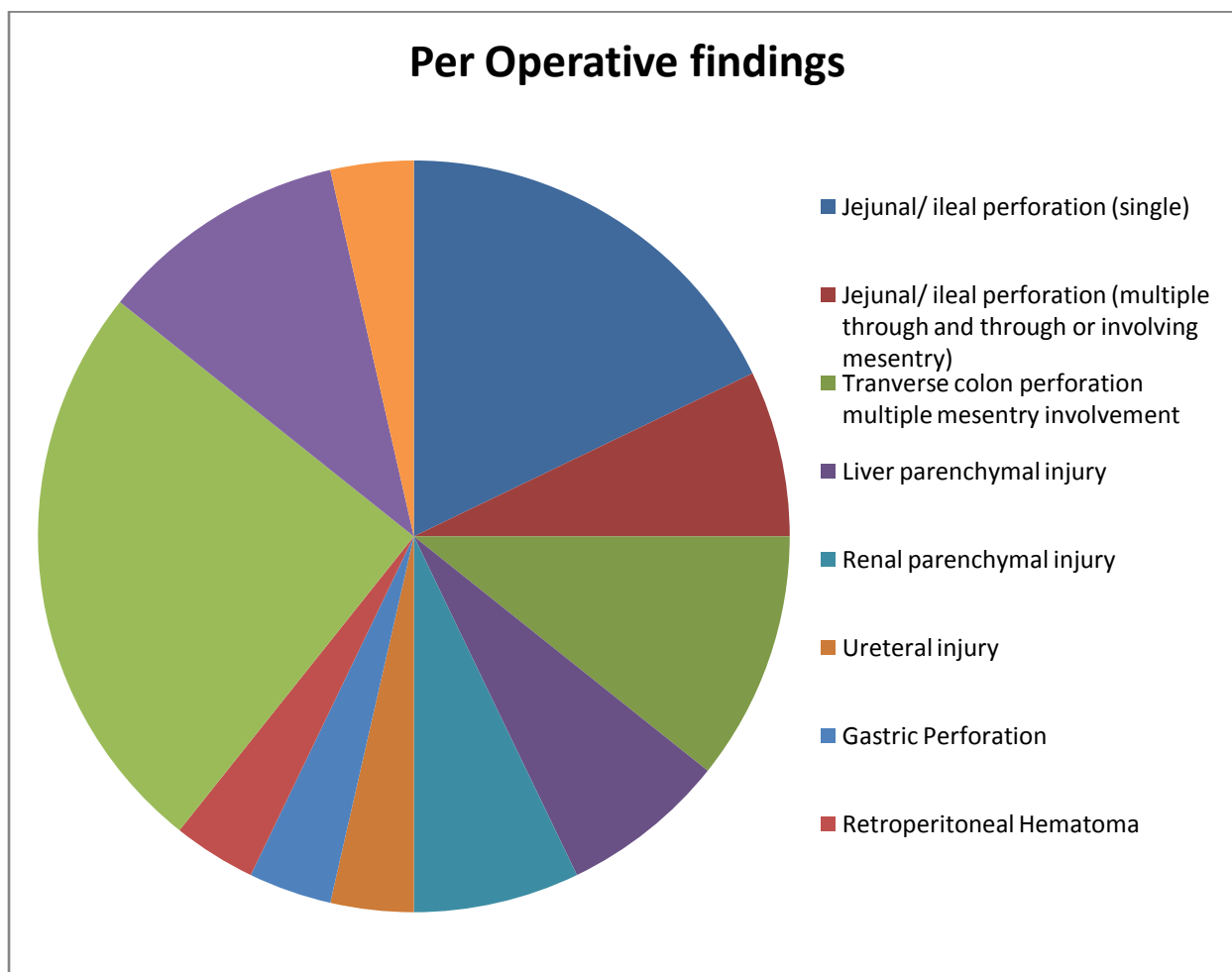
In my study as depicted by table jejunum followed by transverse colon was most commonly affected organ in umbilical region, epigastrium was associated with injury in liver followed by stomach, lumbar and iliac region were associated with kidney and ureter injuries.

Results comparable to study Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid AhsanMalik, Most entry wounds were found on ventral abdominal wall (57%), involving the right upper quadrant in majority (31.6%) of patients where Intra-abdominal injuries, included liver (n = 14, 17.7%), spleen (n = 12, 15.2%), kidney (n = 4, 5.1%), pancreas (n = 4, 5.1%), stomach (n = 12, 15.2%), small bowel (n = 34, 43%) and large bowel (n = 35, 44.3%).

Penetrating chest injuries: analysis of 99 cases by Ülkü YAZICI, Alkın YAZICIOĞLU, Ertan AYDIN, Koray AYDOĞDU, Sadi KAYA, Nurettin KARAOĞLANOĞLU The study retrospectively reviewed the records of 99 patients presenting to our hospital with penetrating chest trauma during the previous 4 years (April 2007to June 2011) from all over Ankara, the capital of the Republic of Turkey. The group comprised 90 male (90.9%) and 9 female (9.1%) patients, with a mean age of 29.0 years. Of these patients, 62 (62.6%) had left -sided, 33 (33.3%) had right-sided, and 4 (4%) had central penetrating injury . Results were comparable to my study.

• **Table 12: Operative Findings and Procedure done**

Operative findings	Number of cases	Procedure done
Jejunal/ ileal perforation (single)	5	Primary closure of perforation
Jejunal/ ileal perforation (multiple through and through or involving mesentery)	2	Resection and anastomosis of affected segment
Transverse colon perforation multiple mesentery involvement	3	Resection and anastomosis of affected segment
Liver parenchymal injury	2	Closure (hepatorrhaphy) and Abgel packing
Renal parenchymal injury	2	Primary repair (renorrhaphy) and abgel packing
Ureteral injury	1	Primary repair and DJ stenting
Gastric Perforation	1	Primary repair
Retroperitoneal Hematoma	1	Lavage and Closure
Hemoperitoneum (Anterior abdominal wall bleeding)	7	Drainage and Lavage
Lateral chest wall trauma ICD output < 1500 ml stat output	3	ICD insertion and monitoring
Lateral Chest wall trauma ICD Output stat > 1500 ml	1	Thoracotomy and internal mammary artery ligation



In present study most common peroperative finding was hemoperitoneum which was treated by drainage and lavage, followed by jejunal perforation (single) treated by primary repair, then followed by multiple small bowel perforation treated by resection anastomosis of affected segment, transverse colon, liver and kidney came next in incidence which were repaired primarily.

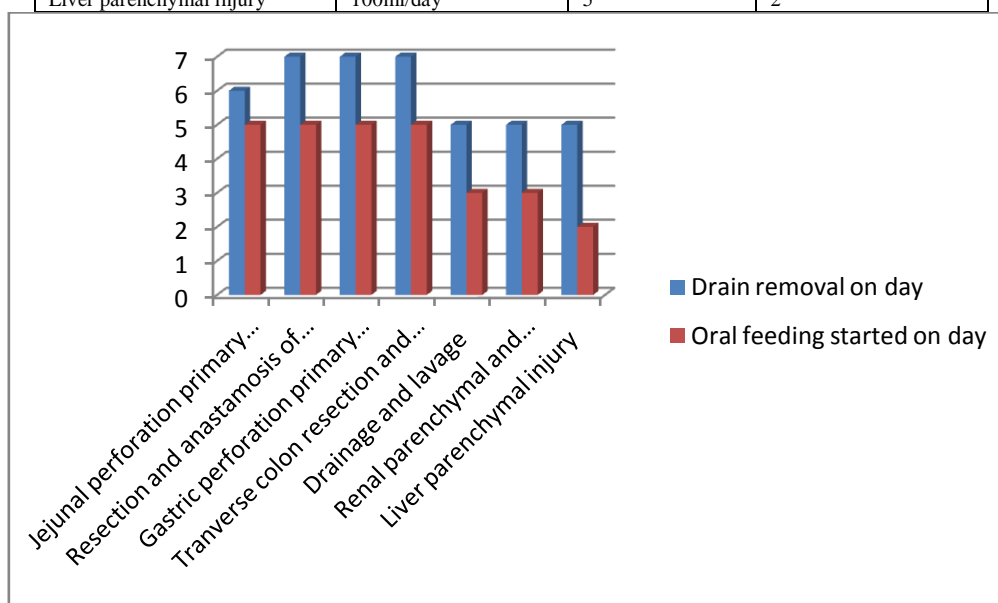
In thoracic injury out of 4 cases 3 were managed conservatively by ICD insertion and monitoring, 1 thoracotomy was done which showed internal mammary artery tear, which was ligated and ICD insertion was done.

Results were comparable to study Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, KhalidAhsan Malik, where small bowel perforation were commonly found followed by large bowel and liver.

Penetrating chest injuries: analysis of 99 cases by Ülkü YAZICI, Alkn YAZICIOĞLU, Ertan AYDIN, Koray AYDOĞDU, Sadi KAYA, Nurettin KARAOĞLANOĞLU The study retrospectively reviewed the records of 99 patients presenting to our hospital with penetrating chest trauma during the previous 4 years (April 2007to June 2011) from all over Ankara, the capital of the Republic of Turkey. Intercostal tube thoracostomy was the only therapy required in 68 patients (68.7%), whereas 21 patients (21.2%) had conservative management and only 10 patients (10.1%) underwent thoracotomy and exploration. Conclusion: In this study we emphasize that chest tube thoracostomy should remain by far the most common and appropriate method of treating penetrating injury to the thorax. Results were comparable.

• **Table 13: Postoperative management For laparotomy**

Procedure done	Average drain output/day	Drain removal on day	Oral feeding started on day
Jejunal perforation primary repair	70ml/day	6	5
Resection and anastomosis of small bowel perforation	70ml/day	7	5
Gastric perforation primary repair	50ml/day	7	5
Transverse colon resection and anastomosis	70ml/day	7	5
Drainage and lavage	30ml/day	5	3
Renal parenchymal and ureteral injury	100ml/day	5	3
Liver parenchymal injury	100ml/day	5	2



In present study it was found that average drain output was 70ml/day for small bowel perforation and patient started oral feeding on POD 5, removal day of drain was averaging sixth day after starting orally, for hemoperitoneum alone drainage average drain output 30ml/day, patient started oral feeding on POD 3 and drain removed on 5th day, Liver parenchymal injury was associated with high drain output averaging 100ml/day, oral feeds allowed from 2nd post op day and drain removal on 5th day. Renal parenchymal injuries were associated with high drain output and patient started orally on 3rd day.

Results were comparable to study Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid Ahsan Malik, where average drain period and output were found similar.

In present study 25 cases of penetrating thoracic and abdominal trauma has been studied and following are the relevant observations and discussions:

For Thoracotomy

Procedure done	Average ICD output/day	Drain removal on day	Oral feeding started on day
Thoracotomy and internal mammary artery ligation	100ml/day	-	3

For thoracotomy average ICD output per day was 100ml/day till the patient had ICD tube. ICD tube was not removed so no data on removal day found. Patient died with ICD in situ.

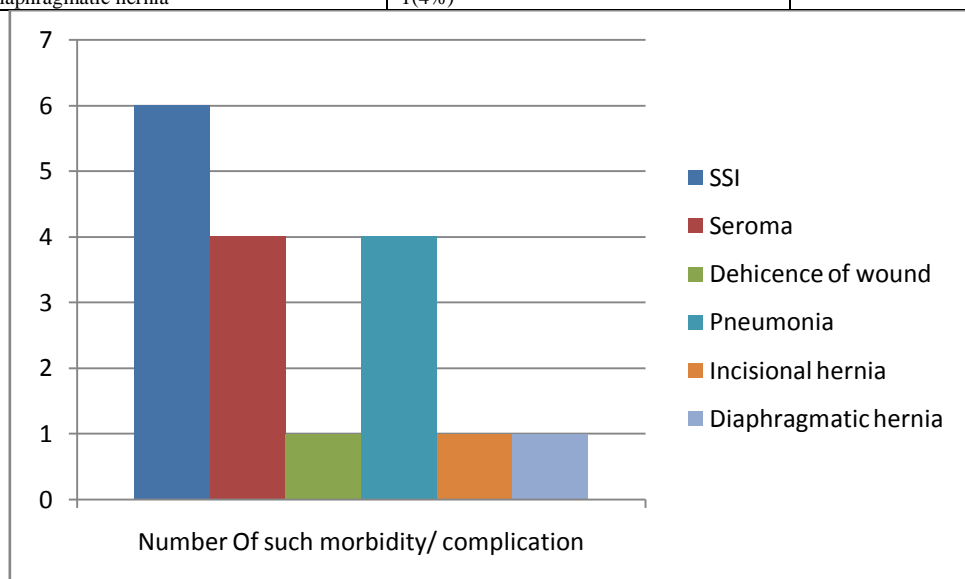
• **Table 14: Complications and morbidity**

○ **Table 14.1 Early complications**

Complication/ Morbidity	Number Of early complications in present study (n=25)	Number of complications in study by AnizZaman (n=79)
SSI	6(24%)	30.6 %
Seroma	4(16%)	12.8%
Dehiscence of wound	1(4%)	6.3 %
Pneumonia	4(16%)	-

○ **Table 14.2 Late complications and Sequel**

Complication/ Morbidity	Number Of late complications and sequel in present study (n=25)	Number of complications in study by AnizZaman (n=79)
Incisional hernia	1(4%)	-
Diaphragmatic hernia	1(4%)	-



Most common complication found was SSI (Surgical Site Infection) accounting for 6(24%) cases followed by seroma and pneumonia accounting for 4 (16%) cases each. The reason of this observation appears to be related to surgery performed in category 3 and 4 where there is gross peritoneal contamination with bile and fecal material. Also all surgeries were performed in emergency so there was no adequate bowel preparation and optimization of pre operative factors affecting wound management like diabetes, hypoproteinemia, anaemia etc. Thus this all factors flare up the wound infection rate. Post Operative ventilator associated pneumonia and chest infection in post op stay account for pneumonia.

Incisional hernia and Diaphragmatic hernia were reported complications. Incisional hernia was present in patient with wound dehiscence in follow up and diaphragmatic hernia was found in patient with thoracic stab injury who presented with complication at 1 year follow up.

Results were comparable to study Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid Ahsan Malik, Postoperative complication recorded were wound infection 30.4%, wound dehiscence 6.3%, abdominal sepsis 3.8%.

• **Table 15: Mortality rate and Cause of death**

Cause of death	Number of deaths in present study (n=25)	Number of deaths in study by AnizZaman (n=79)
DIC and Shock	2 (8%)	7.2%
Ventilator Associated Pneumonia	1 (4%)	-
Septicemia	1 (4%)	3.9%

In present study it was found that mortality rate was 16 percentage in compare to study by AnizZaman where it was 10.1 percentage.

Hemorrhage leading to DIC and Shock are the most common cause of death worldwide in cases of penetrating trauma. Amount of blood loss before presenting to hospital and blood loss during surgery accounts maximum. First factor cannot be controlled that is blood loss before reaching to hospital but second factor can be controlled by proper resuscitation and definite surgery. In cases damage control surgery may be required, where control of bleeding is primary aim and definite surgery at later time. In emergency set up surgeries are carried out in night

hours and many comorbidities are not optimized, moreover due to lack of expertise and setup limitations there is very high risk of complications including mortality.

Ventilator associated pneumonia is most common cause of death inpatients on ventilator support. In my case a patient of thoracotomy was post operatively managed on ventilator who succumbed to pneumonia on 22nd day in ICU. Such complications are preventable with adequate post operative management.

Septicemia is common cause of death in patients with peritonitis which was found in one of my patient with biliary peritonitis due to penetrating injury which is unavoidable complication. Antibiotics according to organism and culture report, and life supports forms the mainstay of treatment.

Results were comparable to study Penetrating abdominal injury: A tertiary care hospital experience by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, Khalid Ahsan Malik, where mortality was seen in 8 cases (10%). In my study which is 16%. Also sepsis was found in 3.9% comparable to my study.

• **Table 16: Hospital stay**

Hospital stay	Present study (n=25)	Percentage
≤ 5 days	09	36
6-10 days	11	44
11-15days	2	8
≥ 16days	3	12

80 percentage patients were discharged within 10 days. The cause of prolonged post operative stay was pneumonia in 2 cases and wound related complication in 3 cases. Factors affecting post op stay are peritonitis and contamination at time of presentation, other comorbid condition like diabetes, IHD, Malnutrition which impairs wound healing.

Average hospital stay in my study was found to be 8 days comparable to study by AnisUzZaman, Muhammad Iqbal, FarhanZaheer, Rehan Abbas Khan, KhalidAhsan Malik.

• **Table 17:Outcome**

Outcome	Present study	Percentage
Survival	21	84
Death	04	16
Morbidity	07	28
Total	25	100

Overall survival rate was 84 % with mortality 16 %. Early Morbidity was found in form of wound related complications SSI and wound dehiscence, reasons for such complication appears to be emergency surgery in case of category 3 and 4 where bilious and fecal peritonitis have set in at time of presentation. Other factors like inadequate bowel preparation and no or minimal optimization of comorbid condition like diabetes, malnutrition,IHD etc.

Late morbidity and sequel in form of incisional hernia and diaphragmatic hernia were found due to wound related complications.

Morbidity rate in my study is 28 percentage was comparable to study by AnisUzZaman, where morbidity was 30.6 percentage including early and late complications .

I have observed mortality rate of 16% (n=04) and Persistent shock and hemorrhage (n=2,50%) is the most common cause of death in my study. The reason was extensive hemorrhage leading to DIC and Shock. Other causes were septicemia and Pneumonia. The average hospital stay in my study is 8 days which is comparable with other studies. The above findings were comparable to study by AnisUzZaman where mortality was 10.2 and morbidity 30.6 percentage with average hospital stay 8 days. Out of 25 trauma patients 21 (86%) has survived and shown good prognosis on follow ups.

6) Summary

- In present study we have considered randomly selected 25 cases of penetrating thoracic and abdominal trauma according to our inclusion and exclusion criteria. Study was conducted during period of 30 months (July 2012 to December 2014).
- After filling details in proforma, master chart was prepared. A detailed analysis was done and various observations were derived, discussed and concluded.
- The penetrating thoracic and abdominal trauma is more common in age group 21-40 years (n=18,72%) with male predominance (M:F:24:1) as they are economically productive, more active, and more liable to undergo rage and homicidal attempts and sustain injuries.

- In present study injury pattern showed that 21(84%) cases were pure abdominal injuries, followed by 3(12%) cases of thoracic injuries and 01(04%) case was abdomino-thoracic. Abdominal injury accounting for maximum number of cases (76%).
- Homicidal injury abdomen (n=19,76%) is more common than Accidental injuries (n=4,16%) and Suicidal injury (n=2,08%). Concluding that penetrating injury is most common form of homicidal injury.
- 22 (88%) patients presented with abdominal pain and 5(20%) patients had history of evisceration of bowel,6 (24%) patients had vomiting,15(60%) patients had history of bleeding from local site, 13 (52%) patients presented with abdominal distension, 6(24%) patients were in hypotension and 18 (76%) patients had tachycardia at the time of presentation, 8 (32%) patients had associated chest pain and breathlessness Abdominal pain ,tachycardia and abdominal distension is the most common clinical feature in all abdominal trauma patients. Presence of these signs and symptoms warrants immediate attention (prompt primary resuscitation and timely definitive treatment) in abdominal trauma.
- In my study 6 (24%) patients presented with associated CLW, 1 patient had tendon rupture and 1 had head injury. Representing defense wounds and post syncope injuries.
- In my study 5(20%) patients had anemia on presentation which might be due to blood loss or pre-existing condition. 1 had some psychiatric illness who presented with suicide and 2 patients had history of some surgery in past.
- Study showed that 18(72%) patients had single entry wound, 6(36%) patients had 2-5 entry wounds and 1 patient had more than 5 wounds on presentation. Suggesting dominance of single entry wound on presentation. Study also showed 20(80%) patients had acute angle wound centring midline, 4(16%) patients had direct right angle entry wound and 1(04%) patient had obtuse angle. This states that wound impacted were most of the times towards center.
- In present study injury pattern showed that 9(36%) cases had entry wound in umbilical region, followed by right iliac, right lumbar and lateral chest with 4(16%) cases each. Lt iliac, Lt lumbar, hypogastrium and central chest showed least impact. Umbilical area involved the most.
- In my study 6(24%) patients had jejunal injuries, followed by tranverse colon, Liver and Kidney 2(8%) cases each. All thoracic injury were associated with lung parenchymal injuries as all of them were lateral chest wall injuries. No cases were associated with major thoracic vessel and heart. Thus small bowel being the most frequently involved organ in abdomen and lung parenchyma due to its site and vast area it covers. Finding was consistent with other studies.
- Most common peroperative finding was hemoperitoneum due to anterior abdominal wall injury or trivial trauma to omentum which was treated by simple drainage and lavage, the second common finding was jejunal perforation (single) treated by primary repair, then followed by multiple small bowel perforation with mesentric involvement treated by resection anastomosis of affected segment. Then came in order transverse colon, liver and kidney with similar incidences which were repaired primarily.
- In case of thoracic injury out of 4 cases 3 were managed conservatively by ICD insertion and monitoring, 1 thoracotomy was done which showed internal mammary artery tear, which was ligated and ICD insertion was done. Findings were similar to other studies where most of thoracic trauma is managed conservatively by simple intercostal drainage.
- In Post operative stay it was found that average drain output was 70ml/day for small bowel perforation and patient was started oral feeding on POD 5, removal day of drain was averaging sixth day after starting orally, for hemoperitoneum alone drainage average drain output 30ml/day, patient started oral feeding on POD 3 and drain removed on 5th day, Liver parenchymal injury was associated with high drain output averaging 100ml/day, oral feeds allowed from 2nd post op day and drain removal on 5th day. Renal parenchymal injuries were associated with high drain output and patient started orally on 3rd day.
- Post operative recovery in this study was associated with good amount of complication rate of 28% (n=7) and most of the complications were wound related, reasons for such complication appears to be emergency surgery in case of category 3 and 4 where bilious and fecal peritonitis have set in at time of presentation. Other factors like inadequate bowel preparation and no or minimal optimization of comorbid condition like diabetes, malnutrition,IHD etc.
- Post operative morbidity in this study was found in form of incisional hernia and diaphragmatic hernia one case each. Incisional hernia was complication related to wound dehiscence and diaphragmatic hernia was due to lack of diagnosis.
- I have observed mortality rate of 16% (n=04) and Persistent shock and hemorrhage (n=2,50%) is the most common cause of death in my study. The reason was extensive hemorrhage leading to DIC and Shock. Other causes were septicemia and Pneumonia.

- The average hospital stay in my study is 8 days which is comparable with other studies. 80 percentage patients were discharged within 10 days. The cause of prolonged post operative stay was pneumonia in 2 cases and wound related complication in 3 cases. Factors affecting post op stay are peritonitis and contamination at time of presentation, other comorbid condition like diabetes, IHD, Malnutrition which impairs wound healing.
- Out of 25 trauma patients 21 (86%) has survived and shown good prognosis on follow ups. These data suggests that good outcome can be achieved if proper evaluation done and timely definitive treatment is given to the trauma victims.

7) Conclusions

- In present study I have concluded that penetrating trauma is common in young males between 20 to 40 years age group most commonly homicidal injury, they are economically productive, more active, and more liable to undergo rage and homicidal attempts and sustain injuries.
- Most common pattern of injury is abdominal, umbilical region most commonly involved and in thorax lateral chest wall.
- Most common presentation found to be pain, tachycardia and bleeding from local site followed by vomiting, evisceration of bowel, breathlessness and hypotension.
- Organ involved most commonly was jejunum and most common procedure done was drainage and lavage.
- Almost all procedure and surgery were performed in emergency, many of them in middle of night when there is lack of expertise and some facilities add up to the risk of more complication rates.
- Wound complications were higher, reasons for such complication appears to be emergency surgery in case of category 3 and 4 where bilious and fecal peritonitis have set in at time of presentation. Other factors like inadequate bowel preparation and no or minimal optimization of comorbid condition like diabetes, malnutrition, IHD etc.
- So for good outcome thorough clinical assessment, expertise, primary resuscitation, timely definitive treatment is of prime importance.

8) References

- [1]. Swartz's principles of surgery, 9th edition, chapter 7th, page no. 135-196
- [2]. Sabiston's textbook of surgery, 19th edition, section III, chapter 18, page no. 430-470
- [3]. Bailey and Love's short practice of surgery, 26th edition, chapter 23-32, page no. 306-434
- [4]. Trauma manual by Peitzman, Rhodes, Schwab, Yealy, Fabian, 2nd edition (may 2002)
- [5]. Trauma manual by Mattox, Felliciano, Moore, 5th edition (2004)
- [6]. Maingot's abdominal operations, 11th edition, section 1- 5.
- [7]. Mastery of surgery, 6th edition, volume 1 and 2, chapter 54-160
- [8]. Smith's urology, 17th edition, chapter 17, page no. 278-296
- [9]. Park's manual of preventive and social medicine, 20th edition, chapter 3, page no. 49
- [10]. The Washington manual of surgery, 5th edition, chapter 22
- [11]. ACS surgery principles and practice, 6th edition, chapter 7
- [12]. Recent Advances in Surgery -29 by Irving Taylor Colin Johnson
- [13]. DONALD D TRUNKEY ; The Emerging Crisis in Trauma Care: A History and Definition of the Problem; Clinical Neurosurgery. Volume 54, 2007:200-205
- [14]. Root HD, Houser CW, McKinley CR et al; Diagnostic peritoneal lavage, Surgery May 1965; 57: 633-7
- [15]. Hamilton bailey (Emergency Surgery), 13th edition.
- [16]. Smith's Urology, 16th edition.
- [17]. Campell's Urology 9th edition.
- [18]. Moore EE, Shackford SR, Pachter HL, et al : Organ injury scaling- spleen, liver and Kidney. 29:1664,1989
- [19]. Textbook of Radiology and Imaging (7th edition) by David Sutton.
- [20]. Toutouzas KG, Karaiskakis M, Kaminski AV, Elmahos GC, Division of Trauma and Critical care, Department of surgery, Keck School of Medicine of the University of South California, Los Angeles, California, USA. Non operative management of blunt renal and prospective study, Ann. Surg. 2002, Dec, 68 (12) : 1097-103.
- [21]. Moore EE, Cogill, TH, Malangoni MA, et al: Organ injury scaling II: Pancreas, duodenum, small bowel, colon and rectum. J Trauma 30 : 1427, 1990.
- [22]. The American Association for the Surgery of Trauma 2014 organ injury scaling and guidelines for thoracic injuries.
- [23]. Ari Leppaniemi, Jarmo Salo and Reijo Haapiainen (1995) reviewed 172 cases of penetrating chest and abdominal trauma. J Trauma 56: 1995
- [24]. Study : The persistent diagnostic challenge of thoracoabdominal stab wounds by Regan J. Berg, MD, Efstathios Karamanos, MD, Kenji Inaba, MD, Obi Okoye, MD, Pedro G. Teixeira, MD, and Demetrios Demetriades, MD, PhD, Los Angeles, California . J Trauma Acute Care Surg. 2014;76: 418Y423.
- [25]. Penetrating abdominal injury: A tertiary care hospital experience by Anis Uz Zaman, Muhammad Iqbal, Farhan Zaheer, Rehan Abbas Khan, Khalid Ahsan Malik, RMIJ; 2014, 39(1), 68-71.

- [26]. J.E. Pridgen and A.F. Heriff (1967) reviewed 776 cases of penetrating abdominal wounds 1967 June; 165(6): 901–907. PMID: PMC1617535.
- [27]. Penetrating chest injuries: analysis of 99 cases by Ülku YAZICI, Alkın YAZICIOĞLU, Ertan AYDIN, Koray AYDOĞDU, Sadi KAYA, Nurettin KARAOĞLANOĞLU. Turk J Med Sci 2012; 42(6): 1082-1085
- [28]. Penetrating Chest Trauma In North Of Jordan: A Prospective Study by M Khammash, F El Rabee published in The Internet Journal of Thoracic and Cardiovascular Surgery Volume 8 Number 1 during the year 2005.

9) Acknowledgements

I wish to extend my heart felt gratitude and respect to my esteemed guide and mentor my P.G. Teacher **Dr. Gunvant H. Rathod (M.S)**, Professor and Head of Department Of Surgery, B.J. Medical college and Civil Hospital, Ahmedabad, who has been my unfailing source of inspiration, strength and moral support. I am highly obliged to him who guided me throughout this endeavour. I am lucky enough to share a bit of his experience, knowledge and enthusiasm.

I am greatly thankful to **Dr. Rakesh A. Makwana (M.S.)**, **Dr. Ravi P. Gadani**, and **Dr. Rajesh K. Patel** Assistant Professor in department of General Surgery, B.J. Medical college and Civil Hospital, Ahmedabad.

In a deeply appreciated manner I acknowledge my thanks to the entire staff of library, B.J. Medical college, Ahmedabad, staff members of the dept. of surgery and my colleagues for their selfless help.

Last but not the least, it would be ingratitude, if I fail to thank all my patients, who form the actual skeleton of this subject.