

A DISSERTATION ON
**“COMPARATIVE ANALYSIS OF NONPENETRATING
AND PENETRATING ABDOMINAL INJURIES”**

Dissertation submitted to
THE TAMIL NADU Dr.M.G.R.MEDICAL UNIVERISTY
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with partial fulfilment of the regulations

for the Award of the degree

M.S. (General Surgery)

Branch –I



**INSTITUTE OF GENERAL SURGERY,
MADRAS MEDICAL COLLEGE,
CHENNAI**

APRIL - 2017

CERTIFICATE

This is to certify that this dissertation titled “**COMPARATIVE ANALYSIS OF NONPENETRATING AND PENETRATING ABDOMINAL INJURIES**” is the bonafide work done by **Dr.K.VELMURUGAN**, Post Graduate Student (2014 - 2017) in the Institute of General Surgery, Madras Medical College, Chennai, under the direct guidance and supervision, and in partial fulfillment of the regulations laid down by the Tamilnadu Dr.M.G.R.Medical university, Chennai for M.S Branch I, General Surgery degree examination.

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DECLARATION

I, declare that this dissertation titled “**COMPARATIVE ANALYSIS OF NONPENETRATING AND PENETRATING ABDOMINAL INJURIES**” represents a genuine work of mine. The contributions of any supervisors to the research are consistent with normal supervisory practice, and are acknowledged.

I also affirm that this bonafide work or part of this work was not submitted by me or any others for any award , degree or diploma to any other University board , either in India or abroad. This is submitted to The Tamil Nadu Dr. M.G.R Medical University, Chennai in partial fulfillment of the rules and regulations for the award of Master of Surgery Degree Branch- I (General Surgery).

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CERTIFICATE OF APPROVAL

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Dear Dr.K.Velmurugan,

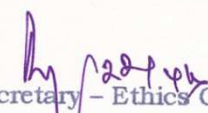
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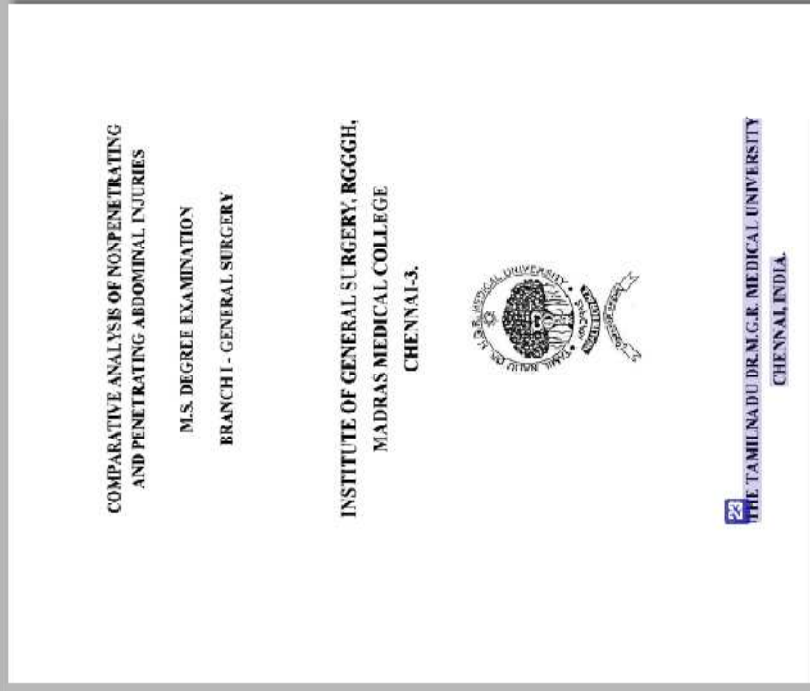
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COMPARATIVE ANALYSIS OF NONPENETRATING
AND PENETRATING ABDOMINAL INJURIES

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INSTITUTE OF GENERAL SURGERY, RGGGH,
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Dr.K.VELMURUGAN

CONTENTS

S.No.	TITLE	Page No.
1	INTRODUCTION	1
2	AIMS AND OBJECTIVES	2
3	REVIEW OF LITERATURE	3
4	MATERIALS AND METHODS	55
5	OBSERVATION AND DISCUSSION	57
6	CONCLUSION	76
	ANNEXURES	

INTRODUCTION

INTRODUCTION

Trauma is an accidental or intentional injury caused by of energy which is usually mechanical in nature to a victim 1% of hospital admissions for trauma involve the Abdomen. Several abdominal injuries are common in patients with multiple injuries.

Trauma to the abdomen are classified as PENETRATING and NON - PENETRATING. While penetrating injuries are common in urban Places, non-penetrating is common in civilian trauma victims. Damage to organs can occur in both penetrating and non-penetrating trauma The sudden application of pressure in non penetrating trauma is more likely to rupture solid Organ. While penetrating trauma causes more injury to hallow viscus.

Two major life threatening situations occur following organ injury in both penetrating and non-penetrating trauma are HAEMORRHAGE and HOLLOW VISCUS PERFORATION with associated chemical and bacterial peritonitis.

Principles of treatment for various organ injuries are also directed towards control of Haemorrhage and peritoneal contaminations.

Knowledge of the mechanism of injury together with the presence of associated injuries such as fracture ribs, fracture long bones, fracture pelvis will provide high index of suspicion of various organ involvement in abdominal injury.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

To do a comparative observational study of organ injuries and sequelae in penetrating and non penetrating abdominal trauma patients admitting in trauma ward, Rajiv Gandhi Government General Hospital and emergency laparotomy done in the following aspects.

- Single & Multiple Organ injuries - incidence, effects and sequelae.
- To know the various epidemiological factors related to trauma
- To know the cause and mode of injury in organ injuries
- Complications of various organ injuries.
- To determine the cause, presentation, anatomical distribution of abdominal trauma.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

HISTORICAL BACK GROUND

Aristotle has been given the credit of being the first to describe visceral injury from non penetrating trauma by noting that the intestine of the deer was so delicate that it might be ruptured by a slight external blow without injuring the skin.

The management of abdominal organ injuries has been extensively discussed in literature. Most of the ancient accounts concerns about penetrating organ injuries and their well known Mortality. Conservative management was usually adhered to from time to time of the Egyptians, to the early 1800's operative intervention was limited and of great magnitude during this period.

In 1836 Baudens published the results of his experiences in the French-Algerian war and suggested "Bold operations" in some cases of gun shot wounds of the abdomen. He was probably the first to have performed Laprotomy for gunshot wounds of the abdomen having operated on two patients in 1830, one of whom survived.

Sims was the first in the United States to advocate surgical intervention for penetrating organ injury. Walter, in 1859, and Kinlock in 1863, were the first to perform abdominal operations for nonpenetrating and penetrating injuries respectively.

Pre-hospital Care of Injured Victim :

Emergency Medical Services (EMS) system are trained to resuscitate the injured patient and shift patient to the nearest competent regionalized trauma center as quickly as possible. We should try to move the injured to nearest possible competent hospital where resuscitation and definitive care can be started immediately. Mortality rate can be lowered if patient is operated upon as early as possible. Patients operated upon within 18 hours of trauma have better outcome compared to those operated after 18 hour.

The principles of pre-hospital care of trauma victim is as follows:

- Securing the area
- Determining the need for emergency treatment
- Initiating treatment according to protocol for medical direction.
- Communicating with medical control.
- Rapid transfer of patient to trauma center.

At the site of accident following measures should be undertaken to stabilize the patient.

- Protect spine
- Endotracheal intubation
- Splints
- Intravenous fluids

- Stop and arrest external bleed
- Pneumatic anti-shock aments.

The need for pre-hospital administration of intravenous fluids has recently been challenged and use of pneumatic anti-shock garments largely abandoned. Starting an intravenous line may delay the transport of patients and one might agree that intravenous fluids does not have to be started prior to transport and attempted en- route. This is theoretically right but practically impossible.

Priorities in Emergency Room

- Airway :
 - Suction of nasopharynx
 - Remove artificial entures.
 - Endotracheal intubation after stabilizing the neck with hard cervical collar.
 - Tracheostomy may be necessary.
- Ventilation - Mechanical may be required
- Cardiovascular system
 - Look for cardiac arrest
 - Give external cardiac massage when required.
 - Monitor blood pressure, pulse rate, skin perfusion, mental status and maintain chart.

- Gain intravenous access through large bore cannula..
- Assess degree of blood volume loss.
- Start central line after getting access to peripheral vein and check central venous pressure.
- Crystalloids, colloids or blood to be transfused as indicated.
- Bladder catheterisation to measure urine output.
- Arrest any external bleeding by pressure, ligation or elevation of limb.
- Assess the air entry in the lung.
 - Look for pneumothorax or haemothorax. Intercostal Drainage Tube insertion when required and done simultaneously with other resuscitatory efforts.
- Look for
 - Haemoperitoneum
 - Distended abdomen
 - Signs of peritoneal irritation
 - Shifting or non-shifting dullness
 - Four-Quadrant paracentesis
 - Diagnostic peritoneal lavage.
 - Emergency room ultrasonography
- History and Physical Examination

After determining that patient is not in imminent danger from airway or circulatory problems, a quick comprehensive survey should be

undertaken.

Estimation of blood volume loss :

The indicators that are commonly used for assessment of shock in emergency setting are :

Blood Pressure :

Remains normal in young adults till the first 15 - 20% of intravascular volume is lost. After 20% volume loss, BP begins to decline, will be in 60 - 80 mm Hg range. With 30% volume loss, decline in BP becomes more precipitous.

Pulse Rate :

It is second commonly used indicator and indeed more sensitive than BP. A sustained tachycardia of more than 120/min, should be considered as an indicator of hypovolemia.

Skin perfusion :

Is a reliable sign to assess hypovolemia but seldom used. The lower extremities are the first to manifest due to release of epinephrine and hypovolemia perse'.

This is the best early warning sign of impending shock.

Urine Output :

Is the most reliable indicator of volume loss. Minimally adequate urine output is 0.5 ml/kg/hr.

□ **Mental Status :**

Mental changes are seen in preterminal degree of hypovolemia.

The changes usually seen are agitation, confusion and irritability.

Emergency Treatment:

Order in which the initial treatment that should be undertaken in the emergency department.

□ Splint the cervical vertebrae

□ Airway management

- Intubate if in apnoea or respiratory rate $> 35/\text{min}$.

- Suction of nasopharynx and trachea

- Tracheostomy may be required when endotracheal intubation is not possible.

□ Tube thoracotomy for haemothorax or pneumothorax should be done before any X-rays.

□ Placement of Intravenous catheter.

Preferred site - low saphenous, antecubital and high saphenous vein.

□ Intravenous fluid - Balanced salt solution alone or in conjugation with colloid solution is the initial fluid therapy of choice. Fluid therapy should be adjusted to achieve an end result of correction of all features of hypovolemia and to maintain an urine output of 0.5 ml/kg/hr . Blood - whole or packed cells, should be transfused to maintain the haematocrit

around 30%. When cross matching is not possible, type specific blood or O +ve or O-ve universal donor may be used.

- Urinary catheterization done to monitor hourly urinary output

Evaluation of Traumatic Perforation and Management

Etiology and Mechanism of Penetrating abdominal injuries

Causative agent

-Stab Wounds

-knife, razor, broken bottles, scizzors, crew drivers

-Missile Wounds

-Gun shot wound

-Shot gun wounds

-Bomb, grenades, etc.

-Iatrogenic

-Abdominal paracentesis

-Peritoneoscopy

-Liver biopsy

-Peritoneal dialysis

Miscellaneous

Automobile accidents

Industrial accidents

Building collapse

Bullgore injury

Fall on sharp pointed object

Injuries due to wooden/glass splinters

Flying missile in explosion / storm

Stab Wounds :

Nearly 1/3 of abdominal stab wounds do not penetrate peritoneal cavity and only 50% of those that penetrate require surgical treatment. Most of the stab wounds are produced by knife, broken glass bottles and razors. The size, shape and length of instrument is important in estimating the amount of damage which might have been caused. The injury to intra-abdominal viscera is confined to the immediate area of penetration. Stab wounds to abdomen are in general less damaging than gun shot wounds⁴ and result in few complications. The abdominal septic complications are significantly lower with stab wounds.

Bull gore injuries :

Common in rural setup. Such injuries may also be associated with blunt component. Extent of injury varies and may have more than one organ affected⁵.

Miscellaneous:

- Flighted penetrating arrow (Tribals)
- Air gun injuries
- Fire works
- Bomb fragment (war zones)
- Shrapnel wounds

Iatrogenic :**Abdominal paracentesis :**

Needle puncture of wounds of intestine quickly seal without leakage, except in presence of intestinal obstruction. Laceration of intestine can occur and will require operative repair.

Trocar insertion can cause serious laceration or perforation of bowel, particularly where bowel is fixed by adhesions. Withdrawal of intestinal contents during paracentesis is diagnostic of this complication.

Trauma to vascular structures also occur and require immediate exploration to prevent exsanguination and vascular thrombosis.

Peritoneal dialysis :

Insertion of abdominal catheter during peritoneal dialysis has same potential complications as abdominal trocar paracentesis.

Thoracentesis and tube thoracostomy :

Both procedures have been associated with injuries to liver and spleen.

Peritoneoscopy (Laparoscopy) :

As in perforation of small bowel during electrocoagulation of fallopian tube.

Perforation not necessarily immediate and symptoms appear after several days as necrotic areas sloughs, resulting in leakage of intestinal contents.

Liver biopsy / percutaneous transhepatic cholangiography :

When performed in presence of obstruction of common bile duct, will usually result in bile leak.

Diagnosis :

History :

A detailed history must always be part of initial assessment. Of interest in the history are, the size and shape of the weapon, severity of impact forces and the presence of concomitant systemic disease.

Most of the times, history may be inaccurate or impossible to obtain. Shock, semi-stupor and drunkenness all tend to prevent a clear recitation of events leading to hospitalization.

Further more the history may be inaccurate because of legal

problems raised by the nature of the accidents.

Physical Examination :

This is best done in a logical sequence in order to avoid serious oversights. This can be complicated by presence of shock, coma or drunkenness. It should be modified to fit the needs of the particular situation. A patient with stab injury to abdomen and who is haemodynamically unstable and examination of abdomen to document tenderness, guarding or hypoactive bowel sounds, doesn't need a detailed examination, since, immediate laparotomy is mandatory. Often resuscitative measure should be combined with physical examination.

Abdominal Examination :

Inspection will reveal entry and exit wounds, lacerations, abdominal distension, evisceration, impaled objects.

Palpation should focus on eliciting signs of peritonitis, tenderness away from wound site, involuntary guarding, rebound tenderness and rigidity. Localised tenderness may be caused by wounding agent without any underlying organ injury.

Pelvis should be palpated by applying gentle pressure over both anterior superior iliac spine and over pubic symphysis to elicit instability or movement, which would indicate the presence of pelvic fracture. Approximately 75% of all penetrating injuries to abdomen occur in upper

quadrant. Majority are in the left upper quadrant reflecting the fact that, when two assailants face each other, the right handed opponent is most likely to inflict left upper quadrant injury. Location of wound will help surgeon to gain a rough idea preoperatively of the extent of abdominal injury. The back, perineum, rectum and vagina should always be examined for wounds of entrance and exit. Classically the injured abdomen is described as silent on auscultation.

It is also been demonstrated that normal peristaltic sounds can be heard both in the presence of active intra peritoneal bleeding and rupture of hollow abdominal organ.

Presence of peristaltic sounds as an assurance that no intra abdominal injury exists is fallacious and dangerous. However, absence of peristaltic sounds, should be given serious consideration. About 14 - 28% patients with peritoneal violation has positive examination⁵. In stable patients, there is a need for repeated abdominal examination, as they may develop peritoneal signs at a later stage⁶.

Rectal examination : Can detect blood as well as anal sphincter tone. Presence of blood provides evidence of colorectal injury whereas a flaccid bladder is indicative of spinal cord injury.

Associated condition : Other factors that may have an important bearing on the diagnosis, treatment and prognosis, deserve comment.

They are :

- Extra abdominal injuries
- Alcohol intoxication
- Narcotics and other drug abuse
- Shock and Psychosis

All these lead to added problem is diagnosing intra abdominal trauma and also in the management of the same. Presence of extra abdominal condition will increase the mortality rate.

Abdominal examination should be completed by inserting nasogastric tube and foleys catheter.

Local Wound Exploration : In the stable patient without obvious signs (eg: peritonitis), local wound exploration remains a viable screening option. Local wound exploration is a well-defined procedure done under local anaesthesia to assess whether peritoneal tear is present. Simultaneous wound debridement is done by extending the wound as necessary to follow its track. Local wound exploration is difficult in stab wounds between nipple and costal margin, which may lead to pneumothorax and stab in back region because of bulky musculature. If wound exploration is positive or equivocal the incidence of negative laparotomy is still 50%⁷. Roentgenological Studies:

a) Chest X-ray :

Considered an integral part of abdominal examination, because thoracic injuries are frequently associated with abdominal trauma.

b) Abdominal Film :

Examine the skeletal structure, look for fracture of vertebral bodies, transverse process of vertebra, fractures of pelvis and ribs. Free Intra-peritoneal air - Stomach and colon perforations frequently give rise to free air, whereas small bowel perforations only occasionally do so. Free air under diaphragm may have entered through the stab wound and may not be "bowel air". Therefore abdominal films contribute little to evaluation of stab wound of abdomen.

Absence of psoas shadow may indicate retroperitoneal bleeding.

Features indicating accumulation of intra peritoneal bleed are :

1. Separation of gas filled right or left colon from preperitoneal fat lines
2. Flootation of small bowel towards centre of abdomen
3. Increase spaces between loops of small intestine
4. General ground glass appearance

c) Ultrasound :

This has been used more frequently in recent years. The objective of ultrasound evaluation is to search for free intra peritoneal fluid. It can be done expeditiously and is as accurate as diagnostic peritoneal lavage. Portable machines can be used in resuscitation area or in the emergency department in a haemodynamically unstable patient without delaying the resuscitation. The advantages and disadvantages of ultrasound are

Advantages:

- Non invasive
- Does not require radiation
- Useful in resuscitation room or emergency department
- Can be repeated
- Used during initial evaluation
- Low cost

Disadvantages :

- Examiner dependant
- Obesity
- Gas interposition
- Lower sensitivity for free fluid < 500 ml
- False negatives : retroperitoneal and hollow viscus perforation

The accuracy rate for detecting haemorrhage with an ultrasonography

ranges from 91 - 97%. Abdominal computed tomography :

Computed Tomography, in case of penetrating injuries can be used to evaluate.

- Blunt trauma
- Haemodynamic stability
- Normal or unreliable physical examination
- Mechanism : Duodenal and pancreatic trauma

The contra indications :

- Clear indication for exploratory laparotomy
- Haemodynamic instability
- Agitation
- Allergy to contrast media

If contrast extravasation is seen, even with minor hepatic or splenic injuries, exploratory laparotomy or more recently angiography and embolisation are indicated.

The advantages of abdominal computed tomography are

- Adequate assessment of the retroperitoneum
- Non-operative management of solid organ injuries
- Assessment of renal perfusion
- Non-invasive
- High specificity

Disadvantages :

- Requires specialized personnel
- Hardware
- Duration : Helical versus conventional
- Hollow viscus injuries
- Cost

The sensitivity of CT to diagnosing hollow viscus injury is marginal. As technology evolves, diagnosis of mesenteric and hollow viscus injury by CT will be facilitated. Two and three-dimensional reconstruction may help in the identification of bowel thickening, small bubbles of free air in proximity of the area of injury and small amounts of free fluid between loops of bowel or in the mesentery.

The accuracy of CT ranges from 92 - 98% with low false positive and false negative results.

Although use of abdominal computed tomography for evaluation of penetrating abdominal trauma has been limited because of low sensitivity in diagnosing bowel and diaphragmatic injuries, newer technology (multi slice spiral CT) has been evaluated in selected cases, when non-operative management is being considered.

e) Other diagnostic modalities :

Diagnostic laparoscopy :

Used to evaluate intra thoracic and abdomen after penetrating trauma, especially to detect diaphragmatic injury can also detect peritoneal penetration, injuries to liver, spleen and diaphragm. Role of diagnosing hollow viscus injury is limited. Potential complications are - hypercarbia, tension pneumothorax and air embolus. It should not be performed in haemodynamically unstable patients. Angiography is used to evaluate renal artery thrombosis and to manage pelvic haemorrhage in patients with pelvic fractures and bleeding from minor hepatic and splenic injuries.

ETIOLOGICAL CLASSIFICATION OF ABDOMINAL INJURIES

Abdominal injuries can be classified as

- (i) PENETRATING
- (ii) NON-PENETRATING

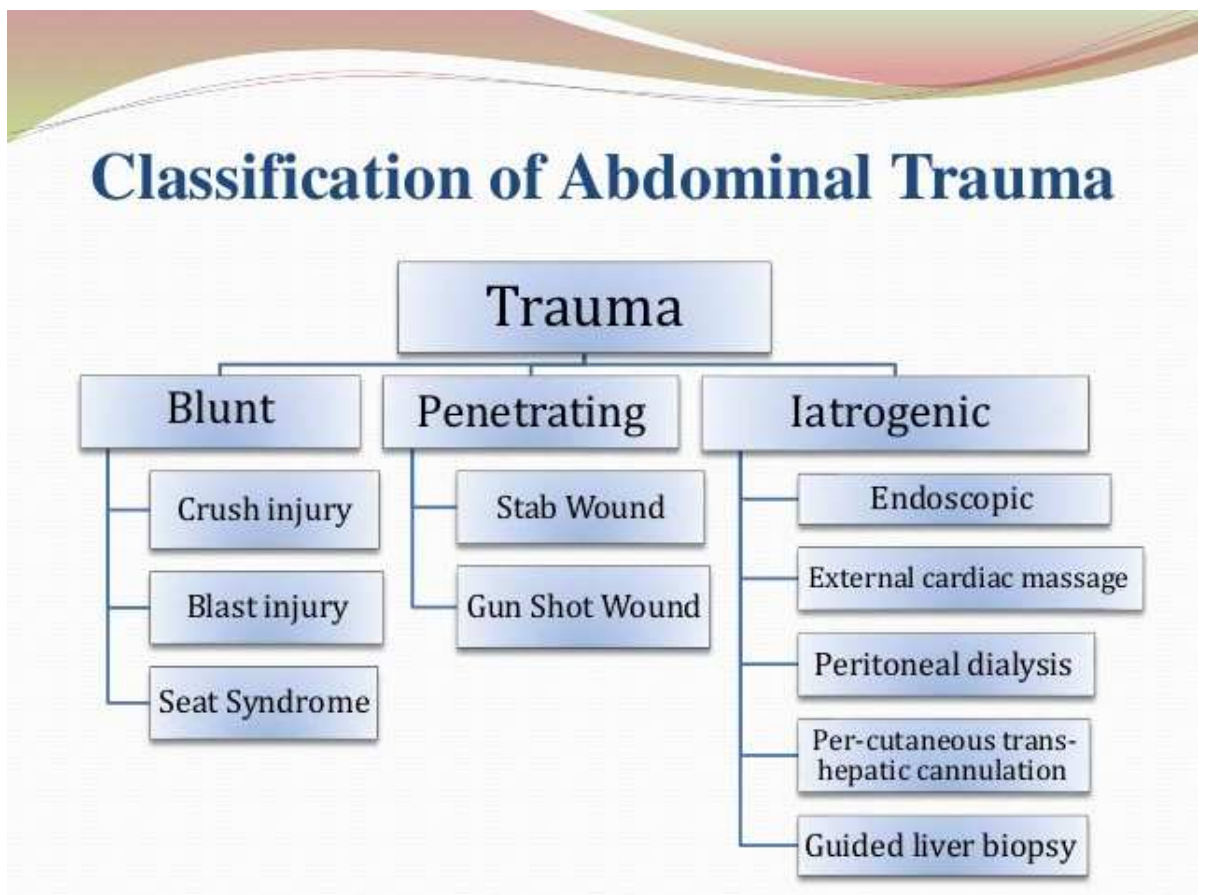
PENETRATING

- a. Stab wounds
- b. Gun shot wounds (Velocity)
- c. Shot gun wounds(Range)
- d. Other(Shrapnel, Picket, Stake,Glass)

NON PENETRATING

- a. Blunt injury
- b. Crush injury
- c. Blast injury
- d. Seatbelt injury

Knives, Screw drivers, scissors, Pencil, Glass bottles are commonly used to inflict stab wounds in our country.

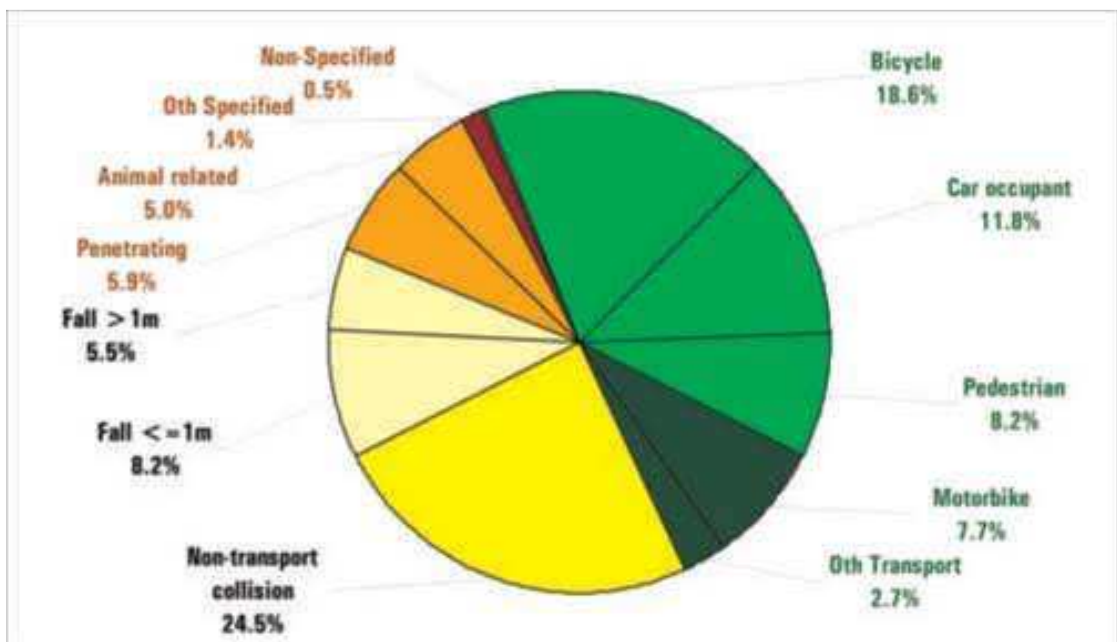


Contrary to the west countries gun shot wounds are less common than stab wounds.

Today the incidence of non penetrating abdominal trauma, is increasing primarily because of the soaring automobile accidents. Automobile is responsible for at least 50% of non penetrating abdominal injuries.

According to DiVincenti and associates report:

Road Traffic Accidents	-	74%
Blow to the abdomen	-	14%
Falls	-	9%
Other causes	-	3%



Non penetrating abdominal trauma is associated with 20 to 30 percent mortality rate. Much of which is attributed to associated injuries of head and chest and fractures of the extremities.

MECHANISM OF INJURY PENETRATING INJURIES

Gun Shot Wound –Civilian gun shot wounds are usually caused by low velocity pistols, whereas, military bullet wounds are of the high velocity type and result in extreme tissue destruction that requires wide and thorough debridement. Physical factors involve the Kinetic energy imparted to the body by the missile. Kinetic energy of a missile is expressed by the formula

$$E = 0.5 \times mv^2 \times g \times 7000m = \text{mass of missile}$$

v = Velocity of missile

g = gravitational acceleration

The amount of energy imparted to the body is the difference between the kinetic energy of the missile entering minus that when leaving the body. This energy is dissipated by the movement of the tissues in a perpendicular direction from the trajectory of the bullet.

Characteristics of the tissue determine the extent of destruction. Fascia, skin and Lung reveal little devitalisation when struck by high velocity missile, whereas solid tissues such as muscle, bone, liver and spleen are violently disorganized and devitalized.

The common low velocity injury is stabbing. In this injury the kinetic energy is low. Thus deep penetration of the abdominal cavity is statistically the exception rather than the rule.

The shape, size and length of the instruments are important in estimating the amount of the damage that might have caused.

NON-PENETRATING INJURIES

Mechanism of non penetrating visceral injuries include crushing, shearing and bursting forces. First is the crushing of the organ against the posterior abdominal wall, especially the anterior ridge in the midline produced by the vertebral bodies. A sharp shearing force may suddenly be applied to both solid and hollow organs resulting in tears with perforation or haemorrhage or both.

Thirdly an intra-abdominal hollow viscus can be burst open by a sudden increase in its intra-luminal pressure.

A sudden application of pressure is more apt to rupture solid than hollow viscera, thus accounting for the greater incidence of solid organ injury.

The more elastic tissue of the young tolerate, trauma better than the resilient tissues of the aged. A strong firmly muscled abdominal wall constitutes a better barrier than the flaccid ,relaxed abdomen of the old or intoxicated.

SEATBELT INJURIES

Since Kulowski and Rost in 1956 first attributed a case of intestinal obstruction to a previously occurred seatbelt injury. Numerous cases of the seatbelt Syndrome have appeared in the literature.

The method of injury to the Bowel in this syndrome involves direct trauma that results in seromuscular tears and closed-loop obstructions that temporarily increases intra luminal pressure, resulting in intestinal rupture .Shearing and torsion forces are probably also active. Besides the intestines and mesentry, practically all abdominal structures, including the gravid uterus, have been injured by seat belts. The terminal ileum is the most common location for the intestinal injuries.

The incidence of organ injury in penetrating wounds of the abdomen is as follows according to **Charles.B.Anderson** and **Walter F.Ballinger**.

Viscera	Percent
Liver	37
Small Bowel	26
Stomach	19
Colon	16.5
Major vascular and Retro peritoneal	11
Mesentry and omentum	9.5

Spleen	7
Diaphragm	5.5
Kidney	5
Pancreas	3.5
Duodenum	2.5
Biliary System	1
Others(Bladder)	1

Penetrating abdominal trauma is associated with high incidence of post injury infection which can be reduced by appropriate surgical management and short term antibiotic therapy. The patient at high risk of developing infection complications may be identified on the basis of operative findings.

Number of organs injured, age, and mode of injury have little or no additional impact on infection rates Colonic injury is the most important determinant of infection complications.

The incidence of a specific organ injuries in non penetrating trauma, according to Blaisdell and Trunkey is as follows.

VISCERA	PERCENT
Spleen	25
Kidney	12

Intestine	12
Liver	15
Retro peritoneal Haematoma	13
Mesentry	5
Pancreas	3
Diaphragm	2
Urinary Bladder	6
Vascular	2

1. DIAGNOSTIC MODALITIES OF ORGAN INJURIES

Physical examination plays a vital role in diagnosing organ injuries in both penetrating and non penetrating trauma.

In penetrating injuries patients who present with wounds below the nipple line should undergo a careful abdominal examination.

Presence of peritoneal irritation, absent bowel sounds or shock indicates severe injury either to solid or hollow viscus.

Patients without above mentioned physical findings may undergo local wounds exploration, to rule out peritoneal penetration and major organ involvement. Blood in the nasogastric aspirate, blood in stool, or haematuria indicate major organ injury.

Patient with signs of increasing peritoneal irritation also indicate major organ involvement.

In large wounds evisceration of omentum or the other intra abdominal structure may clinch the diagnosis of the organ involved.

As far as non penetrating injuries concern much is learnt from the abdominal wall. Localised bruise may overlies fractured ribs, or injury to a particular viscus. Scaphoid abdomen may suggest diaphragmatic rupture with herniation of abdominal contents into the chest. An expanding haematoma in the abdominal wall may result from the rupture of the epigastric artery.

Abdominal girth should be measured initially and at intervals of 15 minutes. Rapid increase in girth measurement is probably due to severe intra abdominal haemorrhage from the liver or spleen.

Localised tenderness and guarding are may be and again indicate injury to the particular viscus. Generalized tenderness and guarding or board like abdomen indicate generalized irritation from extensive bleeding or ruptured viscus.

Patients seen with shock, or gross hemodynamic instability after non penetrating trauma is suggestive of hepatic or splenic rupture.

OTHER DIAGNOSTIC MODALITIES IN ABDOMINAL TRAUMA

In abdominal trauma, as trauma to other areas of the body the type and extent of injury and clinical condition of the patient dictate which diagnostic modalities are the most appropriate.

ROENTGENOGRAPHIC STUDY:

The basic roentgen graphic examination consists of an upright posterior anterior chest roentgenogram, an anterior posterior supine abdominal film, and a left lateral decubitus abdominal film

The following routine has been useful:

- a. Examine the skeletal structures, looking for fractures of vertebral bodies, transverse processes, pelvis and ribs. Fractures of the transverse process are often associated with retroperitoneal hematoma and left sided rib fractures with splenic injury.
- b. Inspect for intra peritoneal air, indicative of a ruptured hollow viscus, which may be seen sub diaphragmatically beneath the lateral abdominal wall on lateral decubitus film or as the 'dome sign', falciform ligament sign, or the 'double wall sign' on a supine film. Both wall of the Bowel(inner and outer)stand out sharply when there is air inside and outside the bowel. Stomach and colon perforation frequently give rise to free air,where as small bowel perforations only occasionally do so.
- c. Look for the classic 'stippling' of retroperitoneal air, usually indicating rupture of the retroperitoneal portion of the duodenum or rectum.

- d. Delineate the Psoas shadows whose absence may indicate retroperitoneal bleeding.
- e. Examine the separation of the gas filled right or left colon from the preperitoneal fat line, indicating intraperitoneal blood or fluid in the flanks. Floatation of the small bowel towards the centre of the abdomen increased space between loops of small bowel, and general ground glass appearance are all compatible with intraperitoneal accumulation of blood. With intraperitoneal bleeding the retroperitoneal structure will remain sharp.
- f. Look for enlargement or distortion of the outlines of the spleen, kidneys, or liver indicating a subcapsular haematoma.

DIAGNOSTIC PERITONEAL LAVAGE

The introduction of DPL by Root in 1965 as an adjunctive method was an diagnostic accuracy ranging from 42 to 84% in non penetrating trauma with significant intraabdominal injuries.

INDICATIONS FOR DPL

- Altered mental status
- Equivocal physical examination
- Hypotension of unclear origin
- Need for general anaesthesia and surgery for associated injuries.

DISADVANTAGES

The disadvantages of DPL in non penetrating injuries are its oversensitivity, lack of specificity and failure to detect retroperitoneal and diaphragmatic injuries.

The ability of the peritoneal lavage to detect small amounts of bleeding from clinically insignificant injuries resulted in unnecessary operations. coupled with this oversensitivity has been the lack of specificity in that the exact visceral injury is not identified by either a positive tap or diagnostic lavage.

It is well accepted that significant injuries to retroperitoneal viscera such as the second and third positions of the duodenum or the diaphragm may not cause enough bleeding to make a diagnostic peritoneal lavage positive.

For this reason the individual sustaining a direct abdominal blow who subsequently has a negative peritoneal lavage should undergo duodenography.

ULTRASONOGRAPHY

The indication for ultrasonography are the same as those for Diagnostic peritoneal lavage, namely the presence of factors that compromise the physical examination of the patient.

Advantages of ultrasonography are that it is non invasive, can be performed by surgical residents, examine the thorax and retroperitoneum in addition to the peritoneal cavity and confirms the presence of haemoperitoneum and defines the intra abdominal injuries.

Ultrasonography is contraindicated in patients with an obvious need for celiotomy or significant obesity and in those with widespread subcutaneous emphysema, as the images are compromised.

FAST exam (Focused Abdominal Sonography for Trauma)

Forefront cornerstone initial evaluation of abdominal trauma victims. Its primary role is detection of free intraperitoneal fluid. It first appeared in literature in 1996 as a screening bedside investigation with a goal of detection of haemoperitonium and haemopericardium based on the assumption that they are associated with free fluid.

FAST consensus conference committee unanimously agreed that hypotensive patients with positive FAST require emergency laprotomy. FAST consensus is also in agreement that normotensive patients with positive FAST require CT scanning to define the nature of injury and to avoid nontherapeutic laprotomy. Haemodynamically stable patients with a negative FAST requires observation for minimum of 6 hours and follow up.

FAST will miss the patients with visceral injury without intra peritoneal bleed and haemoperitoneum below the minimal threshold,(for example hollow viscous injury)Fluid between 200-250ml can be detected.

CT SCAN

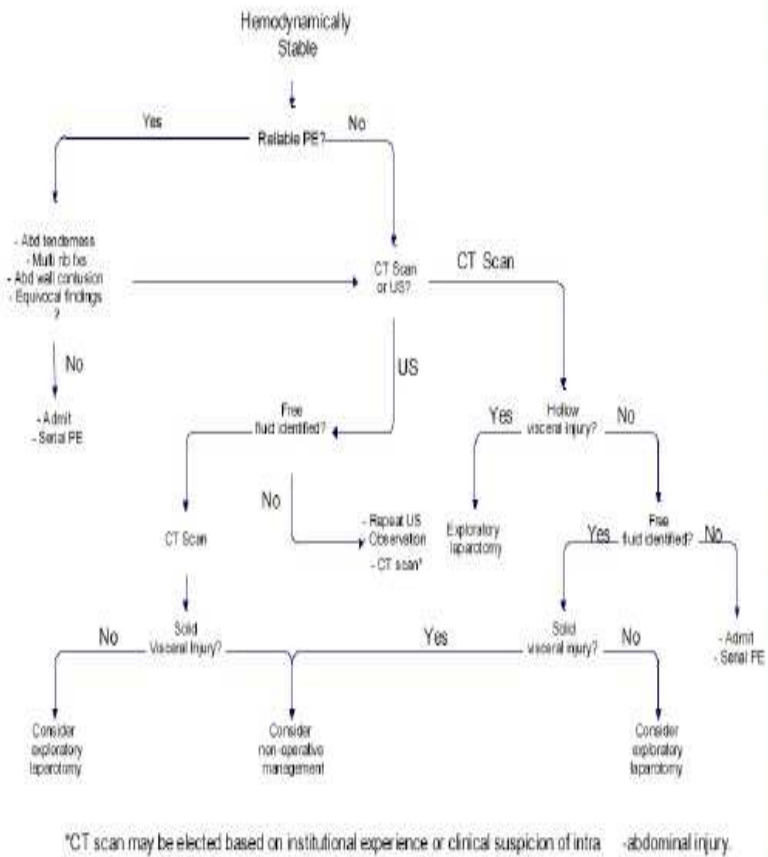
The principle advantages of CT have been summarized by Trunkey and Federle in their editorial in the journal of trauma in 1986.They stated CT is noninvasive,shows the organs injured with great specificity and sensitivity quantitates to some degree the amount of free fluid in the peritoneal cavity,and does give a good assessment of retroperitoneal organ injuries.

CT scan is unreliable in detection of bowel injury and doesnot demonstrate diaphragmatic injuries.

The role of CT scans on penetrating injuries are limited and restricted to flank and back wounds.

EAST Algorithm: Stable

Evaluation of Blunt Abdominal Trauma: Stable



Eastern Association for the Surgery of Trauma, 2001

2. SPECIFIC ORGAN INJURIES

SPLEEN

Spleen is the most commonly injured organ requiring operative intervention. If all trauma victims with non penetrating injuries to the spleen are included mortality ranges from 18-25%. Thus high death rates reflects the magnitude of multisystem injury.

Incidence of splenic injury in reported series of operative penetrating abdominal trauma approximates less than 10%. The frequency of penetrating splenic injury reflects the volume of intra peritoneal space occupied by the spleen as compared to other intra abdominal organs.

Mortality of the penetrating splenic trauma varies with mechanism of injury, ranging from 0-1% with stab wounds, upto 10% with gunshot wounds. Note worthy with penetrating splenic injury is the reported 90% incidence of associated intra abdominal injury. The majority of these associated injuries require surgical correction.

SPLENIC INJURY SCALE

GRADE	INJURY DESCRIPTION
I .Haematoma Laceration	Sub Capsular, Non expanding <10% surface area. Capsular tear, non bleeding < 1 cm parenchymal depth
II.Haematoma Laceration	Sub Capsular,Non expanding 10-50% surface area. Intra parenchymal, Non expanding <5cm in diameter, 1-3cm parenchymal depth. Not involving trabecular vessels
III.Haematoma Laceration	Sub Capsular >50% surface area ,or expanding Ruptured subcapsular haematoma, active bleeding Intra parenchymal haematoma,>5cm or expanding >3cm parenchymal depths or involving trabecular vessels.
IV.Haematoma	Ruptured Intra parenchymal haematoma with active bleeding Laceration involving segmental or hilar vessels producing major devascularisation >25% of spleen
V.Laceration Vascular	Complete and shattered spleen Hilar vascular injury that devascularises spleen.

GRADE-IV SPLENIC INJURY



CT SCORING SYSTEM FOR SPLENIC TRAUMA

RATIONALE FOR SPLENIC PRESERVATION

Spleen is a capable biological filter containing immunocompetent cells. It is capable of removing bacteria and senescent or diseased blood cells.

Spleen is a source of IgM and opsonins, which clears the intravascular antigen and bacteria.

Removal of spleen results in a decrease in resting IgM levels and a blunted IgM response to antigens.

COMPLICATIONS DUE TO SPLENECTOMY

- Atelectasis
- Pneumonia(left lower lobe)
- Pleural Effusion(left)
- Left sub phrenic abscess
- Acute dilation of stomach

Spleen plays a role in host immune defence. Asplenic patients can survive severe infection because the liver is capable of assuming the reticuloendothelial functions of spleen. Deficiency in the clearance of intra vascular antigens is the basis for the infectious complications associated with asplenic state.

Overwhelming post splenectomy infection(OPSI)

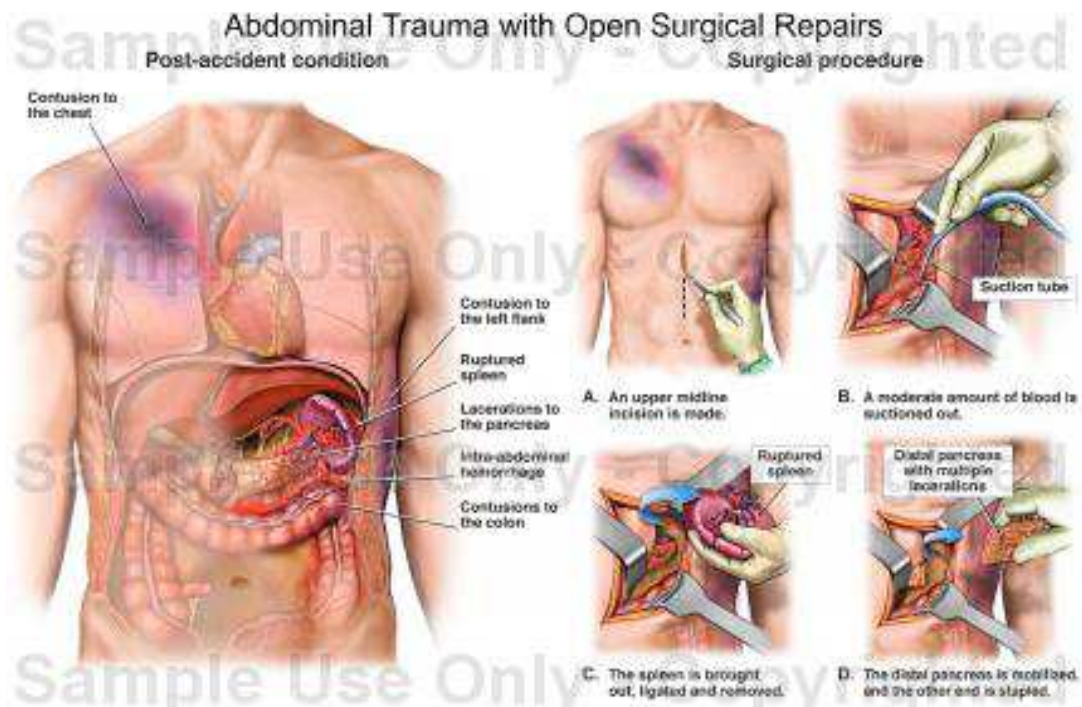
LIVER INJURY

Liver is the most common solid organ injured in patients suffering from abdominal trauma. The spectrum of injury is broad, with the majority of parenchymal injuries requiring little or no treatment. In the united states penetrating injuries to the liver are the type most frequently encountered. Stab wounds and low velocity gun shots wounds usually seen in civilian practice most commonly results in relatively minor parenchymal injury requiring modest treatment.

Occasionally associated major vascular injury to the hilar, or juxtahepatic vessel, colon, or intrathoracic organs may render the patient insalvageable.

Hepatic parenchymal injury, however, is injury of fatal consequence and about one third of deaths.

Next to spleen, liver is the most commonly injured solid organ in non penetrating trauma.



CT Grading of Hepatic Trauma

Grade 1	Capsular avulsion, superficial lacerations < 1 cm deep; subcapsular hematoma < 1 cm; periportal blood tracking only
Grade 2	Lacerations 1-3 cm deep; central or subcapsular hematomas 1-3cm diameter
Grade 3	Lacerations > 3 cm deep; central or subcapsular hematomas > 3cm diameter
Grade 4	Massive central or subcapsular hematoma > 10cm diameter, lobar tissue destruction (maceration) or devascularization.
Grade 5	Bilobar tissue destruction (maceration) or devascularization

The CT findings of hepatic trauma vary and a CT- scored severity grade similar to that of the American Association for the Surgery of trauma has been developed to guide non-operative therapy table.1. This grading system attempts to quantify liver lacerations, hematomas, fragmentation and intrahepatic perivascular injuries. As with splenic injuries, CT grade does not accurately predict patients requiring surgery, although the majority of patients with Grade 5 injuries tend to be unstable & require laparotomy

The complications of liver injury are

- Bleeding
- Consequent haematoma
- Abscess
- Sepsis
- Pneumonia
- Renal failure
- Haemobilia

Post-operative bleeding may not be of such magnitude as to prompt reoperation and yet result in haematoma formations. Any haematoma in association with bile leakage or Concomittant injury to the gastro intestinal tract, predisposes to development of intra abdominal sepsis.

Haemobilia, though rare condition is most often caused by liver trauma.

Classically the triad are

- 1.Right upper quadrant abdominal pain
- 2.Jaundice
- 3.Gastrointestinal tract bleeding in the form of haematemesis or malena.

GASTRIC INJURIES

In 1767, **NOLLESTON FICS** reported the first successful repair of gastric injury (penetrating).

Piacastelli is credited with describing the first case of non penetrating gastric rupture in 1922.

Blunt gastric trauma is rare and is estimated to occur in 0.4 – 1.7% of non penetrating trauma.

In non penetrating trauma gastric rupture and excessive contamination of the peritoneal cavity leads to intra abdominal abscess in upto 50% of patients. It commonly occurs due to RTA.

Yasjko stated that the most common mechanism of injury with a sudden increase in the intra luminal pressure resulting from a direct blow to full stomach. with this mechanism rupture was on the anterior wall of the greater curvature. with increase in the intraluminal pressure the sero

muscular layer is first disrupted followed by the mucosa and submucosa. Seromuscular tear of stomach occur frequently than rupture but they are seldom of clinical significance.

COMPLICATIONS

- Intra abdominal abscess
- Disruption of gastric repair
- Fistula formation
- Haemorrhage and obstruction

SMALL INTESTINE INJURIES

Pathology

Blunt trauma splits the antimesenteric border by drawing gut against the bony prominence of the posterior abdominal wall and this probably accounts for the concentration of injury at relatively proximal jejunum and terminal ileum.

Open injuries are more often multiple than single

Studies suggest that only 25% patients with traumatic bowel rupture have a positive lavage.

General guides for treatment

1. Short single tear (not more than 4 cm) are repaired in the transverse axis of the gut.
2. Longer single tear may be repaired in the long axis.
3. Contusions are better left alone

Resection is called for

1. When associated mesenteric lesion has devitalized the damaged section
2. When the injury has mangled the intestine
3. When several perforations are grouped close together

MESENTRIC INJURIES

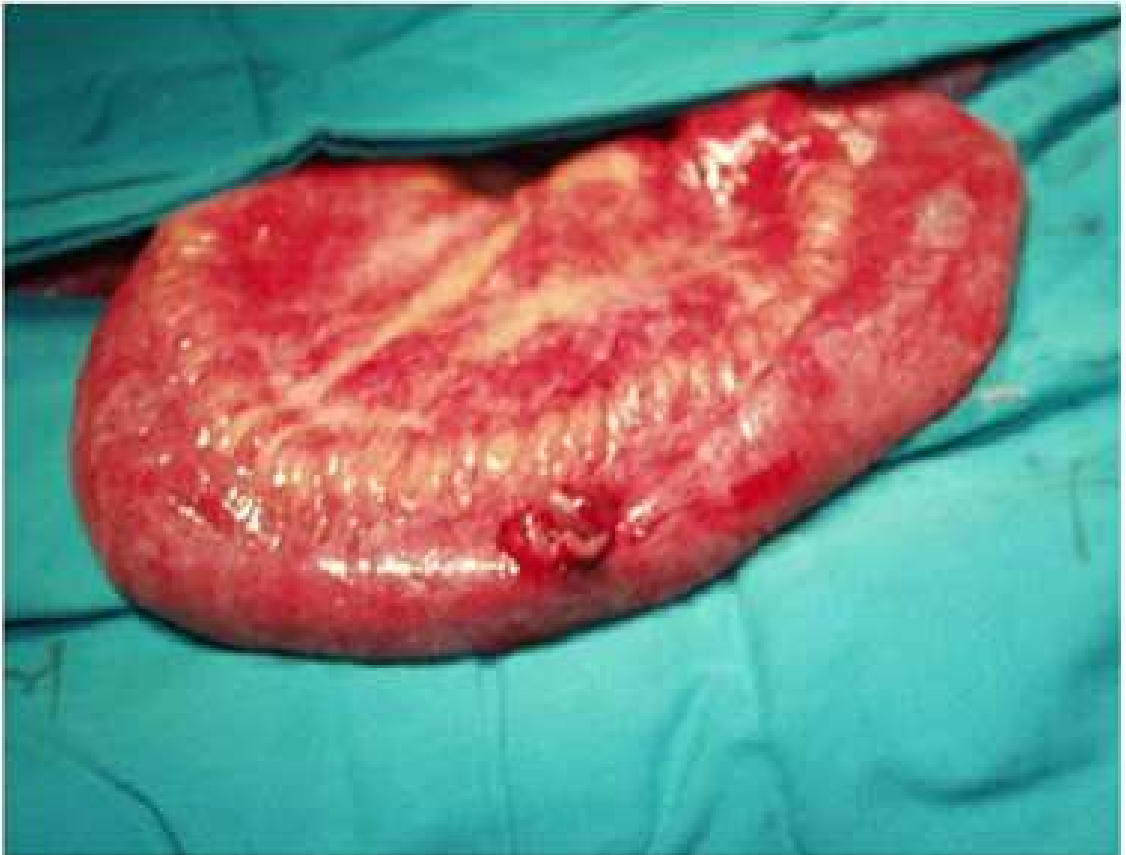
Both closed and open injury can result in mesenteric laceration. The hazards are expanding haematoma which compresses other arcades and so threatens the viability of a segment of intestine. A laceration in the axis of the bowel greater than 5 cm in length usually means the devitalisation and intestinal resection should be carried out.

Non expanding haematoma is best left alone.

OMENTAL PROLAPSE WITH BJECT IN-SITU



OMENTAL PROLAPSE WITH BJECT IN-SITU



COLON INJURIES

First reference to colon injuries can be found in the book of judges.

Non penetrating injuries

Injuries to the colon from this injury are particularly dangerous. There is no reliable method to establish early diagnosis of these injuries other than exploratory laprotomy. The inherent danger trend to treat stable patients with haemoperitoneum non operatively.

Certain type of blunt abdominal trauma like seat belt injuries, lead to delayed perforation as a result of ischaemia secondary to either contusion or extensive haematoma formation of the bowel wall or the mesenteric vessels. Treatment depends upon the type of injuries produced.

Type of damage may be

- Laceration
- Contusion
- Haematoma of the bowel wall
- Stripping of the sero muscular layer
- Necrosis of bowel from compression of haematoma or avulsion of mesentry.

RECTAL INJURIES

Injuries of rectum are the most serious of all intestinal injuries because of its extra peritoneal location. The rectum is surrounded by poorly vascularised fatty tissue without fixed anatomic boundaries so that wounds of rectum permit rapid spread of infection in the virtually unlimited retro peritoneal space.



All penetrating wounds of the perineum, buttocks and lower abdomen are a suspect for rectal injury.

RENAL INJURIES

Non penetrating injury.

Although kidney is well protected from direct injury by adjacent ribs, vertebral column and paravertebral musculature, distortion injuries are not unusual .The extent of damage varies from a simple subcapsular haematoma to a shattered kidney.

SHATTERED KIDNEY WITH DISRUPTED CAPSULE



Because the kidney is relatively mobile within the extra peritoneal space, deceleration injuries can jeopardise the renal pedicle and result in either thrombosis or disruption of the renal vessels.

Penetrating injury

Although Penetrating injuries of kidney are less common than non penetrating they are often more severe in their effects.

CLASSIFICATION OF RENAL TRAUMA

Six types of major injury

- Renal pedicle injury
- Deep parenchymal injury with an intact capsule
- Deep parenchymal injury with a disrupted capsule
- Shattered kidney with an intact capsule
- Shattered with a disrupted capsule
- Ureter or renal pelvis injury

Minor Injury

- Contusion
- Shallow cortical laceration
- Forniceal disruption

Long term sequelae

Occasionally a patient suffered a renal trauma subsequently develops hypertension. This may be the result of Renal Artery Stenosis or perirenal constriction due to capsular fibrosis.

Perirenal extravasation of urine may become encapsulated forming the 'Urinoma' that require surgical drainage.

Fibrosis in the hilar region can result in secondary pelvi-ureteric obstructions.

Arterio-venous fistulae sometimes occur after penetrating renal trauma.

BLADDER INJURIES

Patients with haematuria and pelvic fractures should be suspected for bladder injuries.

CLASSIFICATION OF RUPTURE OF BLADDER

- Intra peritoneal -20%
- Extra peritoneal -80%

A blow in full bladder results in sudden rise of intra vesicular pressure causing and longitudinal tear at its weakest point-along the peritonealised posterior wall.

Rupture of the bladder is occasional complication of pelvic fracture injury.

Bladder is generally torn along its antero lateral aspect either to direct laceration by bony spicules or disruption of its attachments.

RETRO-PERITONEAL HAEMATOMA

Retroperitoneal haematoma in trauma victim is a manifestation of an injury to the retroperitoneal structure. The magnitude of which will depend on the vascularity of the organs involved.

Non penetrating trauma is responsible for 70 – 80% of Retroperitoneal haematoma, and penetrating trauma for the remainder. Although incidence of Retro –peritoneal haematoma in trauma is difficult to establish, its presence has been reported in 13-44% of patients with penetrating abdominal trauma.

Kudsk and Sheldon proposed a classification for Retro –peritoneal haematoma by zones that has important clinical implications.

The retroperitoneum can be classified by zones

Zone –I – Central, Medial

Zone –II –Perirenal, Flank

Zone –III – Pelvis

INCLUSION CRITERIA

1. Patients undergoing emergency laparotomy belonging to age more than 12 years in both sexes
2. Patients with abdominal trauma - both MLC and NON-MLC cases with Irrespective of operative and non operative management
3. Patients consented for inclusion in the study according to designated proforma

EXCLUSION CRITERIA

1. Patients already operated outside for abdominal trauma management.
2. Patients not consented for inclusion in the study according to designated proforma.

METHODOLOGY

All patients belonging to age more than 12 years in both sexes admitted in trauma ward, Rajiv Gandhi General Hospital Chennai with abdominal trauma both penetrating and non penetrating injuries Irrespective of Operative and non operative management done, will be included in the study after obtaining written consent and the laparotomy per operative findings will be noted and analyzed.

DATA ANALYSIS

Using statistical analysis

Investigation Details : CBC, RFT, TFT, CXR, ECG, USG,
FAST, CT SCAN.

Principal Investigator : **Dr.K.VELMURUGAN,**
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MATERIALS AND METHODS

MATERIALS AND METHODS

This comparative study was done in RGGGH CHENNAI during the period October 2015 to September 2016.

45 consecutive cases of abdominal trauma were chosen from this department, these 45 cases were classified into penetrating and non penetrating types according to the standard classification.

All abdominal trauma patients were received by the Casualty Medical Officer (both MLC and non MLC) and these patients were admitted in Napier Ward , where the Duty Assistant Surgeon attended the patients.

Resuscitative measures and the baseline investigations were done simultaneously. Careful history was elicited from the patients, if consciousness was altered, history was elicited from the attender of the patient.

Thorough clinical examination was done. Age, Sex, IP No, mode of injury were noted.

General examination of the patient was carried out. Pallor and hydration looked for in particular. On gross examination head injury, fracture ribs, fracture long bones or Pelvic fracture were looked for.

A thorough abdominal examination was done. External bruise or abrasion were noted in particular for non penetrating trauma.

In case of penetrating trauma, external wounds, evidence of peritoneal penetration, evisceration of omentum or viscera were noted. Signs of peritonitis or internal haemorrhage was looked for and noted in both types of abdominal trauma.

Serial abdominal girth measurements, half hourly pulse, temperature, respiration and hourly BP chart were maintained in relevant cases.

Base line blood investigations and radiological examination done in all cases. Tetanus Toxoid was given to all patients.

All cases were given antibiotics parenterally. Diagnostic peritoneal tap was done in relevant cases.

OBSERVATION AND DISCUSSION

OBSERVATIONS AND DISCUSSION

Out of 45 consecutive cases of abdominal injuries,

- 28 cases were of Non penetrating type
- 17cases were of penetrating type

Thus the ratio of non penetrating type to penetrating types were 62% and 38% respectively.

NON PENETRATING INJURIES

The Major cause in non penetrating injuries were due to Road Traffic Accidents.

Total break-up of causes in non penetrating injuries were

Road Traffic Accidents	-21cases
Assault(including blow in the abdomen fall from height)	-6cases
Bull-gore Injury	-1cases

Major cause in penetrating injuries were due to STAB-INJURY.

NON PENETRATING INJURIES

The incidence of single organ injury in non penetrating type was in 25cases.

The incidence of Multi-Organ injury in non penetrating type was in 3cases.

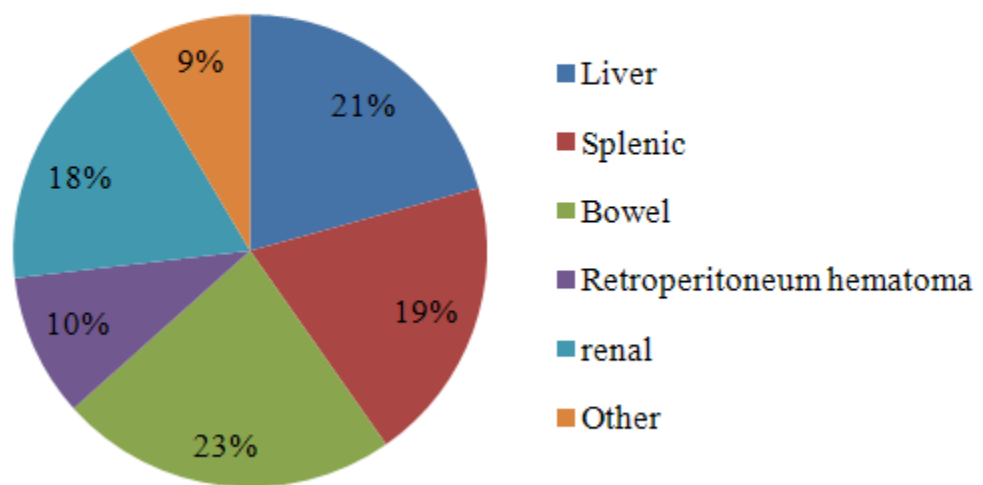
Thus the percentage of incidence of single organ injury in our study was 89%.

The percentage of Multi-Organ injury was 11%.

THE VARIOUS ORGAN INJURIES IN NON PENETRATING TYPE

- Spleen in 9 cases
- Liver in 2 cases
- Jejunum in 3 cases
- Ileum in 5 cases
- Large bowel in 2 cases
- Bladder in 3 cases
- Retro-peritoneal haematoma in 2 cases
- Mesentry in 2 cases
- Diaphragm in 1cases
- Stomach in 2 cases

Nature Injuries



Thus the percentage of various organ injuries were

Spleen	32.1%
Liver	7.1%
Jejunum	10.7%
Ileum	17.8%
Large bowel	7.1%
Bladder	10.7%
Retro-peritoneal haematoma	7.1%
Diaphragm	3.6%
Stomach	7.1%
Mesentry	7.1%

SPLEEN INJURIES

Spleen was injured in 9cases,out of which

4cases were of Grade III type

2cases were of Grade IV type

3cases were of Grade II type

9cases required preoperative blood transfusion and resuscitation, and were taken up for surgery. Splenectomy was done in all cases In all cases the post operative days were uneventful and wound healed well. And scar was healthy at discharge.

In 3 cases the spleen specimen was enlarged probably due to some preexisting pathology before injury.

All patients were advised prophylactic vaccination against OPSI

LIVER INJURIES

Liver was involved in 2 cases. In one case tear was very small. In another case the rent was about 4 x 2 cm in diameter. Both cases were positive for DPA.

Second case was associated with gastric perforation. Both the liver injury cases were repaired using gel foam.

Post operative days were uneventful in both cases.

Both cases were regularly reviewed. Second case, when ultra sound done after two months showed hypo echoic area in the repaired area, suggesting abscess formation .But this patient was treated conservatively.

Bowel Injuries

Totally there were bowel involvement in 10 cases. Jejunum was involved in 3cases. All three cases had perforations very close to the duodenal jejunal flexure. All cases were repaired. In one case three perforations was present, very close to each other and resection & anastomosis was done and this patient died in the postoperative period due to septicemia because of the delay of 2 days between the injury &admission.

Ileum was involved in 5 cases. 4 cases were repaired. one case resection and anastomosis was done.

Large bowel was involved in 2 cases.

One case was a single organ injury and contusion was present in the splenic flexure of colon. No active treatment was done and post operative days were uneventful. Regular follow up did not show any features suggesting obstruction, stricture, necrosis etc.

Second case was associated with multi organ injury, there was transverse colon perforation. Since the patient was diagnosed early, perforation closure was done. Post operative days were uneventful.

Bladder Injuries

Out of 3 cases

1 case had intra peritoneal rupture of Bladder.

1 case had injury in the bladder neck.

1 case had bladder wall contusion. This was associated with pelvic haematoma and retro pubic haematoma. For all cases bladder repair and SPC was done.

Diaphragm Injuries

1 case of diaphragm tear on the left side was seen .Repair was done and post operative follow up did not show any sequelae.

Mesentery

There were 2 cases of mesenteric involvement. There was a small nonexpanding haematoma in both cases.

Viability of intestine was checked and was found to be normal in both cases.No active treatment done. Post operative days were uneventful.

Regular follow up did not show any complication like obstruction, stricture, necrosis etc.

Retro – peritoneal haematoma

Two cases show non expanding haematoma during laprotomy. Both were left alone and no complication occurred later.

Stomach

Two cases stomach injuries were seen.

One case was associated with liver injury. Another was isolated gastric pylorus perforation measuring about 4 x 2 cm. They were closed and no postoperative complications like haemorrhage etc., occurred.

PENETRATING INJURIES

The incidence of single organ injury in penetrating trauma was	-	4
The incidence of multi organ injury was	-	10
The incidence of negative laprotomy was	-	3
Thus percentage of single organ injury was	-	23.5%
The percentage of multi organ injury was	-	58.8%
Percentage of negative findings was	-	17.6%

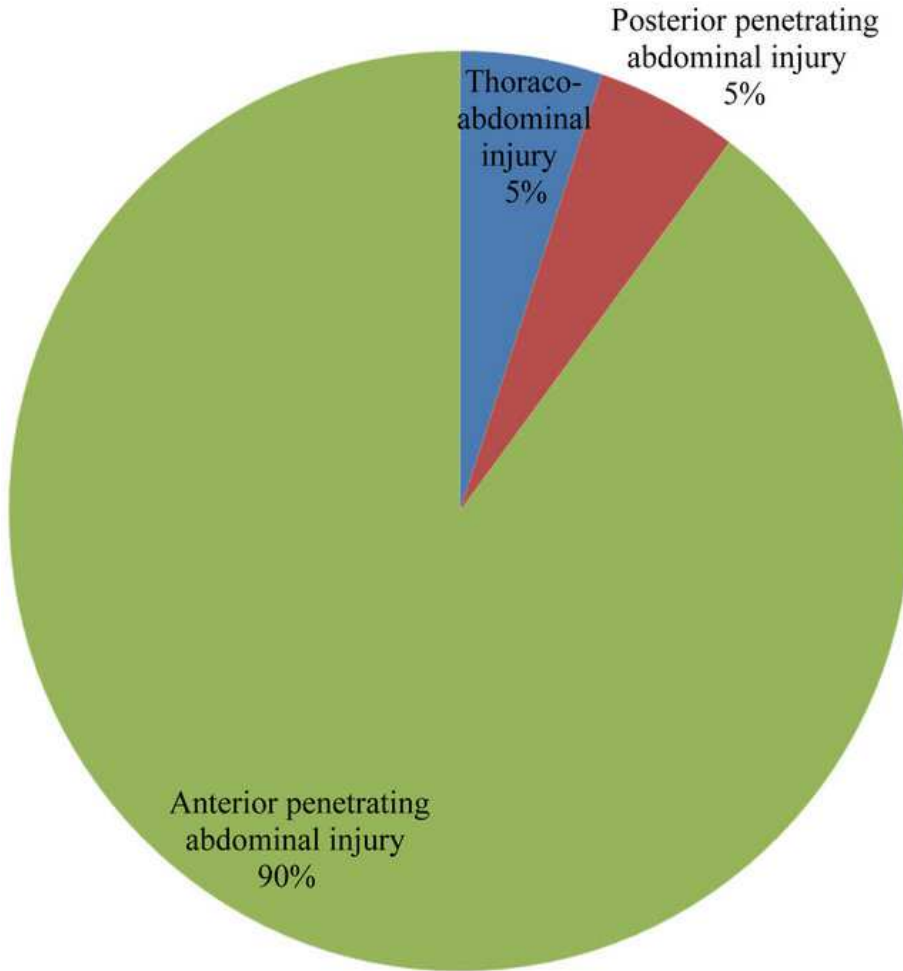
Incidence of various organ injury in penetrating trauma

Spleen	1 case
Liver	2 cases
Jejunum	3 cases
Ileum	3 cases
Large bowel	3 cases
Bladder	2 cases
Retro-peritoneal haematoma	2 cases
Mesentry	3cases
Omentum	3cases
Diaphragm	3cases
Stomach	2cases
Kidney	1case

The percentage of frequency of various organs in our study

Spleen	5.9%
Liver	11.8%
Jejunum	17.6%
Ileum	17.6%
Large bowel	17.6%
Bladder	11.8%
Retro-peritoneal haematoma	11.8%
Mesentry	17.6%
Omentum	17.6%
Diaphragm	17.6%
Stomach	11.8%
Kidney	5.9%

Mechanism of Injury



Multiple organ injuries were common than single organ injury in penetrating trauma.

Spleen was involved in 1 case. In that there was also a tear in the diaphragm due to stab injury. Splenectomy was done and diaphragm was repaired. No complication occurred.

Liver was involved in two cases. In one case injury was in the under surface of the liver and in the other small laceration on the anterior surface of the liver .First was associated with Retro-peritoneal haematoma and second with a tear in the diaphragm. Both cases were repaired and no complication was present during post operative days.

Bowel injury

Majority of injuries in penetrating trauma was in the bowel .In 10 cases, the bowel injuries occurred.

Of which in 3 cases , jejunum was involved and in 3 cases ileum was involved and in four cases large bowel was involved including one rectal injury. Repair of jejunum & ileum was done.For large bowel injury diversion colostomy was done in 3 cases due to peritoneal contamination & primary closure was done in one case because of earlier presentation.

Preoperative antibiotic coverage was given in all cases. Postoperatively 4 cases had wound infections and 2 patients developed bedsores.

Omental prolapse occurred in 4 cases through the stab wounds.

Omentectomy was done in all cases. there was no complication in all cases.

Mesocolon was involved in 3 cases. In 2 cases transverse mesocolon was involved and in 1 sigmoid mesocolon was involved. All were repaired and later during follow up there were no features suggestive of bowel necrosis, stricture, obstruction etc.,

Retro - peritoneal haematoma

Retroperitoneal haematoma occurred in 2 cases. Both were associated with other organ injury. No active treatment was done because they were of nonexpanding type. 1 patient died during post operative period.

Stomach and kidney

Stomach was involved in 2 cases and kidney in 1 case.

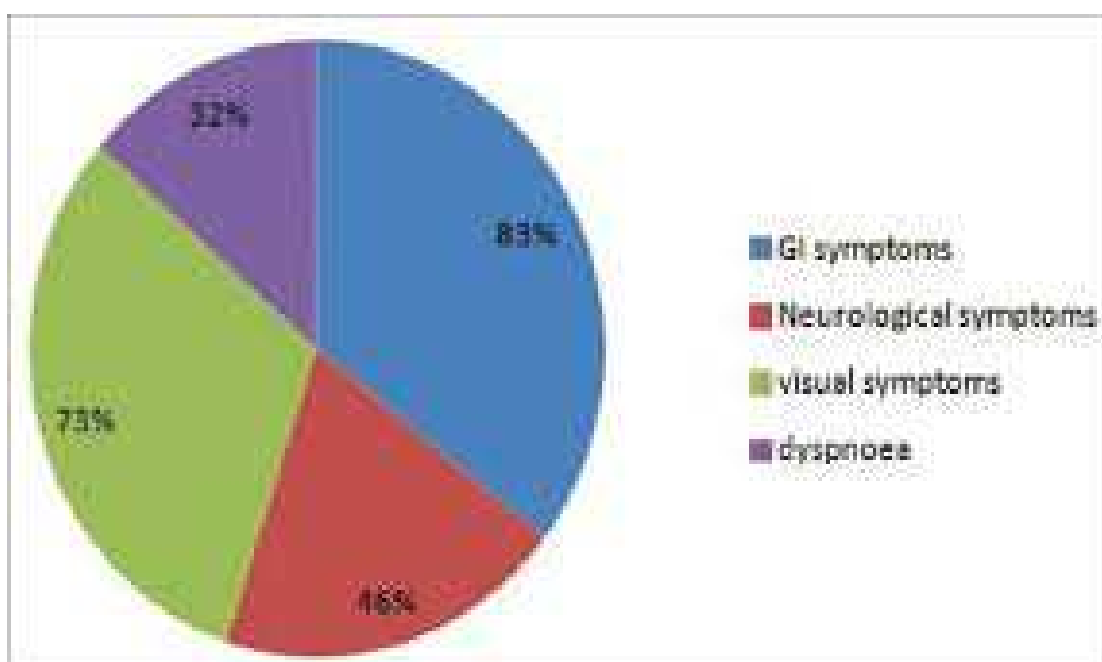
Both stomach injury were repaired.

It was a complete tear of the kidney & it was associated with other organ injury. Nephrectomy was done. This patient died during post operative period.

Bladder

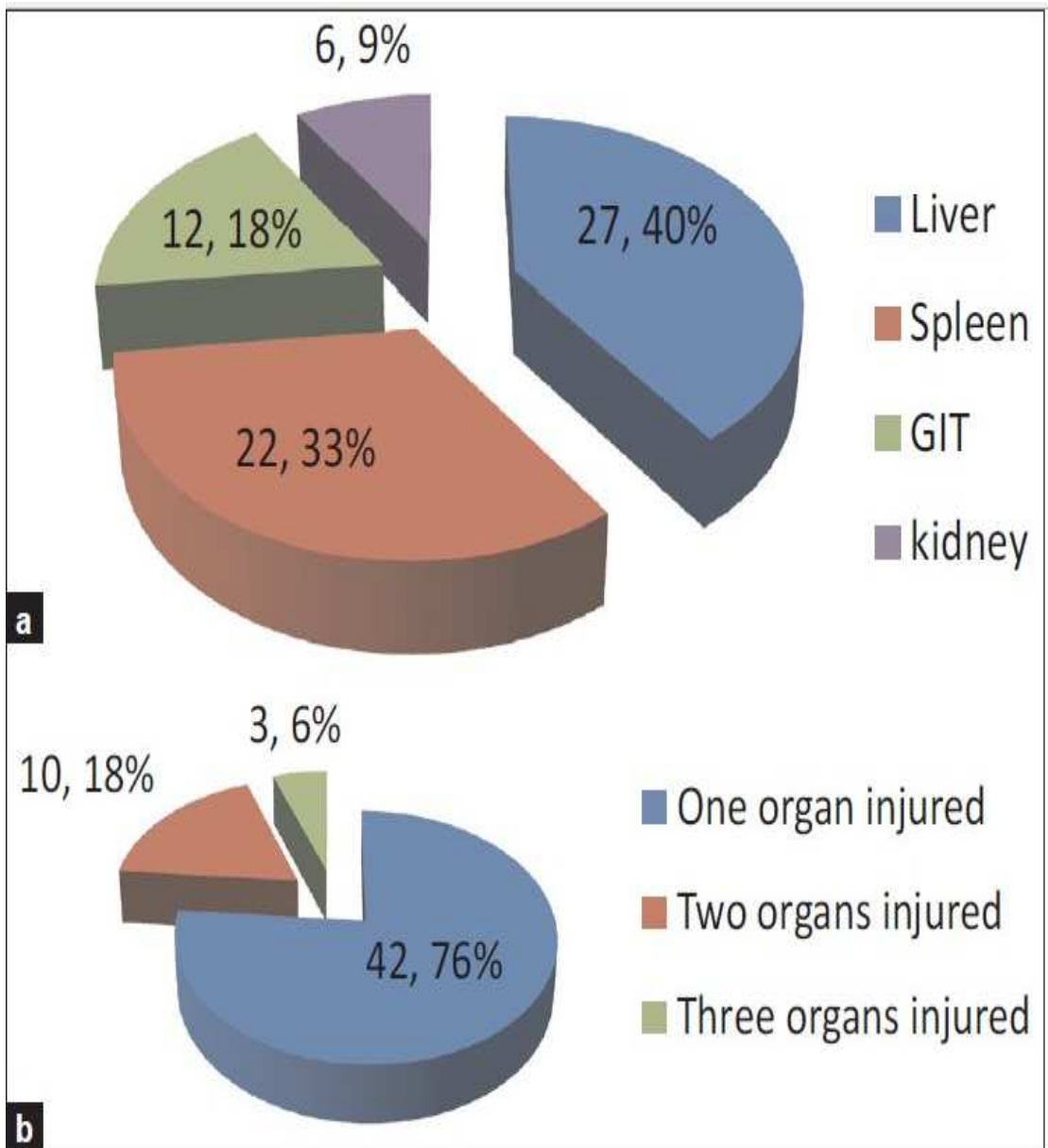
Bladder was involved in 2 cases. In 1 case there was a bladder tear. It was repaired & SPC was done. In another case there was a bladder contusion. Both developed wound infection during post operative period.

Symptoms of Signs



Non penetrating injury

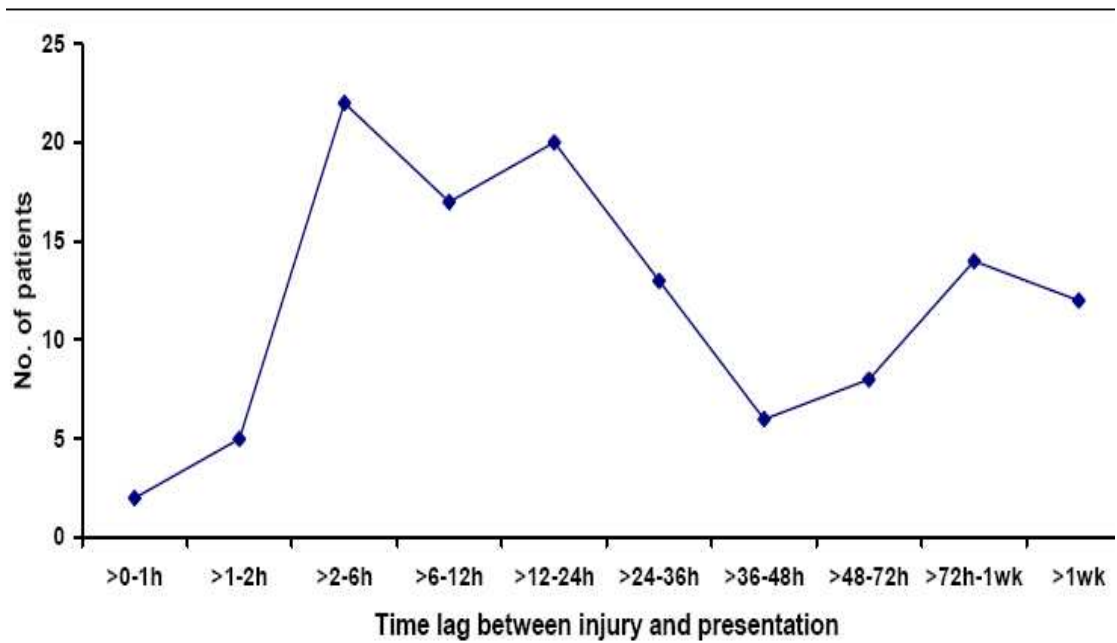
Organs involved	No	Pallor	Tachycardia	Hypotension	Tenderness & Guarding
Spleen	9	9	9	9	9
Liver	2	1	1	1	2
Small bowel	3 Jejunum & 5 Ileum	2	7	1	8
Mesentry	2	0	1	0	2



Penetrating Injury

Organs involved	No	Pallor	Tachycardia	Hypotension	Tenderness & Guarding
Spleen	1	1	1	1	1
Liver	2	2	2	2	2
Small bowel	10	7	10	7	10
Mesentry	3	2	2	2	7

	spleen	# Ribs		Bladder	# Pelvis
Non Penetrating	8	3		3	3
Penetrating	1	-		2	1



CONCLUSION

CONCLUSION

The following conclusions were drawn from this study

- Non penetrating trauma is more common than penetrating trauma.
- Solid organ injury is common in Non Penetrating Trauma.
- Hollow viscus injury is common in Penetrating Trauma
- Spleen is the commonest organ affected in Non Penetrating Trauma
- Liver injuries in this study are not very serious and they are treatable. Extensive liver injuries are potentially dangerous
- Hollow viscus like jejunum, ileum, colon, stomach are the common organs affected in penetrating trauma
- Mortality and morbidity depends on delay in treatment, number of organs affected, number of injuries in each organ and which organ is affected.
- Omentum is commonest structure to be prolapsed in wound site in penetrating trauma.
- Bladder is the common organ associated with pelvic bone fractures.
- wound infection is the common complication in the penetrating trauma.
- Young males in the productive age group of 20-30 years are predominantly affected.

- Careful and repeated clinical examination and appropriate diagnostic investigations lead to successful treatment.
- Majority of the patients require operative intervention particularly those with haemodynamic instability, generalized peritonitis, evisceration of omentum and bowel and continuing haemorrhage.

Peritoneal penetration as such, is a poor indicator of significant organ injury and requires direct organ specific evaluation, such as computed tomography or laparoscopy to identify patients who can be safely treated without operations.

- Abdominal roentgenograms are unreliable to predict the intestinal perforation or add to the management in patients with positive peritoneal signs.
- Majority of patients who present with evisceration after penetrating wound require a laparotomy. This is true regardless of what has eviscerated or the presence of other clinical indications to operate.

Evisceration continues to prompt operative intervention.

- The most commonly involved organ is small bowel, then followed by liver and stomach. Thus hollow viscus predominates over solid organ injury. Thus the operating surgeon should be well versed with technique of managing hollow viscus injury.

- Post operative complications is minimal even though it is an emergency operation. The postoperative complications in hollow viscus injury is more compared to solid organ injury, hinting that a better technique of management and broader antibiotics in hollow viscus injury should be advocated. Respiratory infection and intra abdominal sepsis were the frequent post operative complication in the present study followed by wound infection.
- Mortality rate can be reduced by proper management of shock and use of advanced resuscitatory measure and proper post operative care and systemic approach of management. Simultaneous treatment of associated injuries to other systems also reduce morbidity and mortality rates.

ANNEXURES

PROFORMA

Name :-	I. P. No
Age :-	Unit
Sex :-	D.O.A
Occupation :-	D.O.D
Address :-	D.O. surgery

Complaints :-

1. Pain Abdomen : 1 Duration

2 Mode of onset

3 Site

4 Character: colicky\ burning\
throbbing\gripping

5 Radiation

6 Aggravated by

7 Relieved by

2. Nausea and Vomiting :

1. Character: Bilious /Nonbilious /Coffee ground/

Projectile

2. Amount

3. Frequency

4. Relation to Food

5. Relief of Pain

3. trauma history :

4. duration since trauma :

5. Bowel Habit :

1. Bleeding P/R
2. Melena
3. Haematochezia
4. Constipation
5. Diarrhea

6. Fever :
1. Type : Continuous / Intermittent/remittent
 2. Severity
 3. Associated with Chills and rigors
 4. Aggravating and relieving factors

Past History :- Previous H/O Surgeries

Any H/O D/M / HTN / T.B / Inflammatory Bowel
Diseases

Personal History :- Smoker :- No of Beedis / Cigarettes per day

Alcoholic :- Average Amount per day

Food habits

Retroviral Disease

GENERAL EXAMINATION:-

General Condition:- at the time of admission

Pallor

GCS Score

Hydration status:

Clubbing

Cyanosis

Jaundice

Built of the pt

Pedal edema

Icterus

Generalized lymphadenopathy.

VITALS :- Pulse:

Blood pressure:

Temperature:

Respiratory rate:

SPO2:

Abdominal girth:

List of external injuries:

External bruise and abrasion& degloving injury:

Rib fracture :

Peritoneal penetration, evisceration of omentum or viscera :

Other injuries : head injury / pelvic fractures / fracture
long bones

SYSTEMIC EXAMINATION:-

Per abdomen :

Tenderness

Rebound Tenderness

Guarding/ Rigidity

Distension

Any mass palpable

Any organomegaly

Any free fluid

Bowel sounds

Per Rectal examination:

Per Vaginal examination:

C.V.S :- S₁ S₂

Any murmurs

R.S:- Bilateral air entry

N.V.B.S /Any added sounds

Chest wall Tenderness

C.N.S:-Neurological deficit , Pupillary reflex

INVESTIGATIONS:-

a) Blood Investigations :-

HB-	B.Urea:-	PT and INR
ESR	S. Creatinine	Amylase & Lipase
PCR	Bleeding Time	Electrolytes
LFT	Clotting Time	
	Blood Grouping	
	R.B.S	

a) Radiological investigation

1. Plain x-ray Abdomen
2. USG Abdomen
3. FAST
4. CT SCAN

PROVISIONAL DIAGNOSIS:-

ABDOMINAL GIRTH CHART

NPO and RTA

Higher antibiotics

½ Hourly TPR chart

I/O chart

Procedure done:

Per operative findings:

PATIENT CONSENT FORM

Study Detail: “**CLINICAL STUDY ON COMPARATIVE STUDY OF PENETRATING AND NONPENETRATING INURIES**”.

Study Centre : Rajiv Gandhi Government General Hospital, Chennai.

Patient's Name :

Patient's Age :

Identification

Number:

Patient may check (✓) these boxes

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction.

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected.

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information

released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results from this study.

d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or wellbeing or any unexpected or unusual symptoms.

e) I hereby consent to participate in this study.

f) I hereby give permission to undergo detailed clinical examination and blood investigations as required.

Signature/thumb
Impression

Signature of Investigator

Patient's Name
Name and Address

Study Investigators

Dr.K.VELMURUGAN

MASTER CHART

S. No	NAME	AGE/SEX	DIAGNOSIS	ORGAN INJURY	MANAGEMENT
1	MOHAN	28M	BLUNT INJURY	SPLEEN	SPLEENECTOMY
2	ASHOK	42M	BLUNT INJURY	MULTIORGAN	EMERGENCY LAPROTOMY
3	MATHAN	32M	PENETRATING INJURY	ILEUM	PRIMARY CLOSURE
4	SANTHANAM	64M	BLUNT INJURY	JEJUNUM	PRIMARY CLOSURE
5	MERCY	39F	BLUNT INJURY	SPLEEN	SPLEENECTOMY
6	PALANIYAMMAL	60F	PENETRATING INJURY	ILEUM	PRIMARY CLOSURE
7	ANDIYAPPAN	48M	PENETRATING INJURY	LIVER	CONSERVATIVE
8	DINESH	26M	PENETRATING INJURY	OMENTUM	OMENTECTOMY
9	SENTHIL	27M	BLUNT INJURY	RETROPERITONEAL	LAPROTOMY
10	SUGUMAR	54M	BLUNT INJURY	MULTIORGAN INJURY	EMERGENCY LAPROTOMY
11	ELIZABETH	38F	PENETRATING INJURY	JEJUNUM	PRIMARY CLOSURE
12	KUMAR	33M	PENETRATING INJUR	JEJUNUM	RESECTION ANASTOMOSIS
13	SAKTHI	41M	PENETRATING INJURY	ILEUM	PRIMARY CLOSURE
14	TIRUNALLARU	65M	BLUNT INJURY	ILEUM	RESECTION ANASTOMOSIS

15	PALANI	34M	BLUNT INJURY	SPLEEN	SPLEENECTOMY
16	ANANTH	40M	PENETRATING INJURY	LARGE BOWEL	PRIMARY CLOSURE
17	MURUGESAN	30M	BLUNT INJURY	JEJUNAM	RESECTION ANASTOMOSIS
18	RAVIKUMAR	36M	BLUNT INJURY	SPLEEN	SPLEENECTOMY
19	THANDAPANI	68M	BLUNT INJURY	ILEUM	PRIMARY REPAIR
20	RAJAN	57M	PENETRATING INJURY	LARGE BOWEL	PRIMARY CLOSURE
21	KARTHIK	43M	BLUNT INJURY	LIVER	CONSERVATIVE
22	IMMANUVEL	45M	PENETRATING INJURY	BLADDER	BLADDER REPAIR
23	BASHA	53M	BLUNT INJURY	SPLEEN	SPLEENECTOMY
24	FERNANDAZ	30M	PENETRATING INJURY	MESENTRY	CONSERVATIVE
25	KIRUBA	31M	BLUNT INJURY	MULTIORGAN INJURY	EMERGENCY LAPROTOMY
26	SINGARAM	64M	BLUNT INJURY	ILEUM	PRIMARY REPAIR
27	TIRUPATI	56M	PENETRATING INJURY	DIAPHRAGM	REPAIR
28	HARSHA	43M	BLUNT INJURY	BLADDER	BLADDER REPAIR

29	ISHABELLA	34M	PENETRATING INJURY	STOMACH	PATCH CLOSURE
30	ASAITHAMBI	32M	BLUNT INJURY	RETROPERITONEAL	LAPROTOMY
31	POOPATI	40M	BLUNT INJURY	MESENTRY	CONSERVATIVE
32	KUMARESAN	28M	BLUNT INJURY	STOMACH	CLOSURE
33	GOVINDHAN	60M	PENETRATING INJURY	KIDNEY	NEPHRECTOMY
34	JANAKI	45M	BLUNT INJURY	LARGE BOWEL	PRIMARY CLOSURE
35	LINGUSAMY	38M	BLUNT INJURY	JEJUNUM	RESECTION ANAASTOMOSIS
36	VIKRAM	41M	PENETRATING INJURY	MULTIORGAN INJURY	EMERGENCY LAPROTOMY
37	ARIVU	44M	BLUNT INJURY	BLADDER	BLADDER REPAIR
38	ANBUKUMAR	37M	BLUNT INJURY	ILEUM	REPAIR
39	SETHURAMAN	53M	BLUNT INJURY	DIAPHRAGM	REPAIR
40	MANIKANDAN	50M	BLUNT INJURY	STOMACH	PATCH CLOSURE
41	SUNDAR	36M	BLUNT INJURY	MESENTRY	CONSERVATIVE
42	RAJKUMAR	29M	PENETRATING INJURY	SPLEEN	SPLEENECTOMY
43	MUNIYAN	67M	PENETRATING INJURY	LIVER	CONSERVATIVE
44	AJITH	26M	BLUNT INJURY	MULTIORGAN INJURY	EMERGENCY LAPROTOMY
45	SIVANESAN	58M	BLUNT INJURY	LIVER	CONSERVATIVE