DISSERTATION ON

"A PROSPECTIVE STUDY ON BLUNT INJURY ABDOMEN"

M.S.DEGREE EXAMINATION
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A PROSPECTIVE STUDY ON BLUNT INJURY ABDOMEN

BY

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Dissertation submitted to the

THE TAMILNADU DR. M. G. R. MEDICAL UNIVERSITY

In partial fulfillment of the requirements for the degree of

M.S. GENERAL SURGERY – BRANCH I

Under the guidance of

Prof. Dr.V.KOPPERUNDEVI M.S.,

DEPARTMENT OF GENERAL SURGERY
THANJAVUR MEDICAL COLLEGE AND HOSPITAL

MAY, 2018

DECLARATION BY THE CANDIDATE

I solemnly declare that this Dissertation "**A PROSPECTIVE STUDY ON BLUNT INJURY ABDOMEN**" was done by me in the Department of General Surgery, Thanjavur Medical College, and Hospital, Thanjavur under the Guidance and Supervision of my Professor Dr.V.KOPPERUNDEVI M.S. Department of General Surgery, Thanjavur Medical College, Thanjavur between 2016 and 2017.

This Dissertation is submitted to the Tamilnadu Dr. M.G.R Medical University, Chennai in partial fulfillment of University requirements for the award of M.S Degree (GENERAL SURGERY).

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This is to certify that this dissertation titled **"A PROSPECTIVE STUDY ON BLUNT INJURY ABDOMEN"**is a bonafide research work done by **Dr.KIRUTHIGA. S,** in partial fulfillment of the requirement for the degree of **M.S.GENERAL SURGERY – BRANCH I.**

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Date:

Place:

CERTIFICATE

This is to certify that the dissertation titled **"A PROSPECTIVE STUDY ON BLUNT INJURY ABDOMEN"** is a bonafide research work done by **DR.KIRUTHIGA. S** under the guidance of **Dr.V.KOPPERUNDEVI M.S.,** (Associate Professor, Department of General Surgery) Thanjavur Medical College Hospital, Thanjavur.

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Dr.KIRUTHIGA. S

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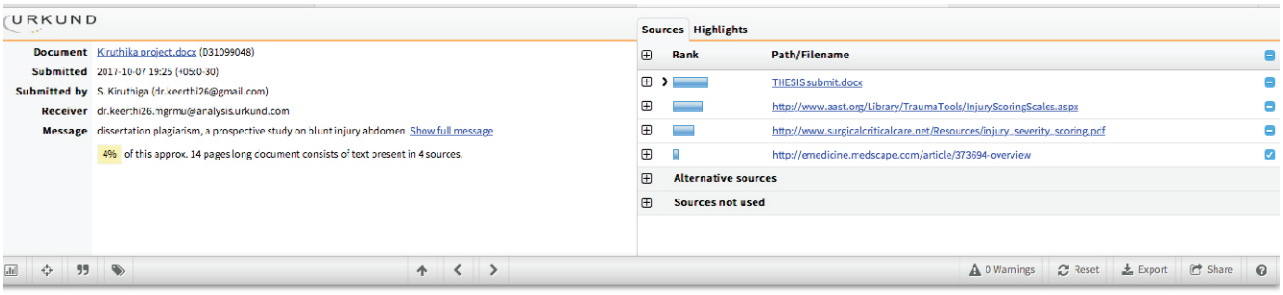

A PROSPECTIVE STUDY ON BLUNT INJURY ABDOMEN Introduction:

Abdominal trauma continues to account for a large number of trauma relatec injuries and deaths. Motor vehicle accidents, acc dental fall are leading causes of blunt and penetrating trauma to abdomen. Blunt abdominal trauma is one of the leacing preventable causes of the unnatural death in developed and developing countries. Blurt trauma is particularly deceptive as the clinical manifestations of the injury may be delayed for hours or days even though internal damage is serious and sometimes lethal. In open cases of abdominal trauma the clinical manifestations, diagnosis and management will be easier but closed cases of abdominal trauma offers a great challenge to the treating surgeon. Injuries to the abdominal viscera, caused by blurt trauma, are particularly common in civilian life. The blunt trauma differs from penetrating trauma, as the different organs are characteristically injured by compression from blunt straining. The solid organs such as spleen, liver, kidney, pancreas, etc., are the most vulnerable, while the hollow viscera like stomach, intestines and bladder are less likely to be involved. The outstanding features of injury to solid organ are the haemorrhage and shock, while in hollow visceral injury shock follows with the development of peritonitis. The aim of this study is to analyse the incidence of hollow viscus perforation and solid organ injuries and find out the morbidity and mortality in blunt abdominal trauma.

A PROSPECTIVE STUDY ON BLUNT INJURY ABDOMEN

INTRODUCTION

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Blunt abdominal trauma is a leading cause of morbidity and mortality among all age groups. Identification of serious intra-abdominal pathology is often challenging. Many injuries may not manifest during the initial assessment and treatment period. Mechanisms of injury often result in other associated injuries that may divert the physician's attention from potentially life-threatening intra-abdominal pathology. The most common causes of blunt abdominal trauma are from motor vehicle accidents and automobile-pedestrian accidents.

Trauma has been called the neglected disease of modern society, despite its close companionship with man. Trauma is the leading cause of death and disability in developing countries and the most common cause of death under 45 years of age.1 World over injury is the 7th cause of mortality and abdomen is the third most common injured organ. Abdominal injuries require surgery in about 25% of cases. 85% of abdominal traumas are of blunt character.2The spleen and liver are the most commonly injured organs as a result of blunt trauma. Clinical examination alone is inadequate because patients may have altered mental status and distracting injuries. Initial resuscitation along with focused assessment with sonography in trauma (FAST) and computed tomography (CT) abdomen are very beneficial to detect those patients with minimal and clinically undetectable signs of abdominal injury and are the part of recent management guidelines. Approach to trauma should be systemic and prioritized. About 10% of patients have persistent hypovolemic shock as a result of continuous blood loss in spite of aggressive fluid resuscitation and

require an urgent laparotomy. Damage control laparotomy is a life saving procedure for such patients with life-threatening injuries and to control hemorrhage and sepsis. On the other spectrum, there has been increasing trend towards non operative management (NOM) of blunt trauma amounting to 80% of the cases with failure rates of 2-3%.[3] NOM is a standard protocol for hemodynamically stable solid organ injuries.

Pre-hospital transportation, initial assessment, thorough resuscitative measures and correct diagnosis are of utmost importance in trauma management.

AIM OF THE STUDY

- To evaluate the age and sex incidence of the involved patient population.
- To evaluate the different organ systems involved in various modes of presentations as a primary tool in early diagnosis.
- To find a possible treatment protocol cases of blunt trauma to the abdomen following road traffic accident.

EVALUATION OF PATIENT WITH BLUNT ABDOMINAL TRAUMA FOLLOWING A ROAD TRAFFIC ACCIDENT

History of trauma as well as physical examination remains the corner stone of the diagnosis and decision making process. An accurate history with regards of the mode of injury, time elapsed since the incident, deceleration or acceleration, use of restraint devices, evidence of steering wheel or seat belt injury etc should provide a reasonable clue as to the organ or area involved. The clinical picture may be confounded by intoxication and associated injuries like head and thoracic trauma, major orthopedic trauma, initial resuscitatory efforts.

Physical examination

The general condition of the patient is the best initial guide to diagnosis. Pallor, shallow hurried respiration and other signs of shock should be looked for. Vital parameters have to be repeatedly documented. Abdominal guarding, tenderness and rigidity should be specifically looked for. Recording pulse and blood pressure to detect hypotension in a road traffic accident is a paramount importance.

Look for signs of peritonitis by abdominal examination.

Abdominal rigidity and / or involuntary guarding are a significant finding and it warrants repeated clinical examinations to rule out the possibility of peritonitis and intraperitoneal bleed.

Evidence of intraabdominal bleed by harvesting blood in four-quadrant tap is an absolute indication for a formal exploratory laparotomy in the given settings.

Contusions suggestive of pelvic injuries and suspected retroperitoneal injuries require a thorough radiological evaluation. Bladder cathetherzaiton after ruling out the possibility of urethral injury is important in assessing genitourinary trauma.

Profound hypotension is an indication of significant blood loss into the peritoneal cavity, pleural cavity, retropritoneum or extremities. Perform a thorough examination. It is very important to rule out a head injury.

Look : adequate assessment cannot be made without without adequately exposing the patient, therefore remove all the patients clothing. Look systematically at the anterior structures, including the urethral meatus flank and posterior structures-the back the buttocks and perineum-for bruises, lacerations, impressions of seatbelts or tyres. Look for movement of both hemi thoraces for evidence of any intrathoracic injuries, which might need more expedient attention.

Feel: palpation both superficial and deep should include all the abdominal structures. The upper level is the fifth interspace muscle rigidity might be slow

to develop hence repeated reexamination is applying compressive force can assess an absolute necessity instability of the pelvic ring. The superior pubic rami and the symphysis should always be palpated retroperitoneal injuries are difficult to diagnose but should be suspected if there is a spinal deformity or paravertebral haematoma, or the mechanism of injury suggests injury to retroperitoneal structures.In cases with hematuria urgent bladder catheterization should be done after ruling out urethral injury. Enquiry regarding the mode of injury might be contributory to the diagnosis.

Listen: the presence or absence of bowel sounds and their quality if present should be recorded. The presence of bowel sounds does not exclude major abdominal injury.

Rectal examination : rectal examination is essential. Loss of intergrity of the rectal wall is an indication of large bowel injury high lying prostate indicates urethral injury.

Vaginal examination : disruption of the pubic rami or symphysis may cause vaginal damage therefore vaginal examination is mandatory not only to detect the integrity of the vagina but also to detect possible pelvic fracture, particularly of the inferior rami.

Examination of the urethral meatus: In men the meatus should be examined for evidence of urethral injury. If there is blood at the meatus then a catheter should not be passed and an expert urological consultation should be obtained.

The surgeon should ensure that airway management with protection of the cervical spine; breathing and circulation are adequate before proceeding with special investigations. Inserting aoropharayngeal airway prevents falling back of the tongue and is critical in maintenance of airway in a unconscious patient.

Baseline investigations

Send a blood sample for blood grouping, typing and cross matching specifying the probable no of units needed.

Measure the hemoglobin concentration and if possible WBC and RBC count.

Measure serum urea and electrolyte concentrations, and if possible serum amylase activity and arterial blood tensions.

Pass a nasogastric tube : it will not only empty the stomach but also indicate upper gastrointestinal injury if blood is aspirated. The tube should be passed orally if there is suggestion of fracture of the cribriform plate.

Insert a urethral catheter : it is mandatory in all patients with severe trauma except in those whom the urethra is suspected to be injured, where the suprapubic route should be used. Hematuria might suggest the possibility of renal injury.

Perform radiography of the chest and abdomen: an erect chest radiograph is preferable to a supine abdominal film for excluding the possibility of pneumoperitoneum, which may suggest hollow viscus injury.

Abdominal radiographs may show fractures of the lower ribs, which may be the only sign of intra abdominal damage, or fractures of the transverse processes, which may suggest ureteric injury.

Additional imaging: imaging techniques such as ultrasonography and computed radiography are usually available for routine diagnosis in an accident and emergencyward only in major trauma centers and specialty institutes. Ultra sound is highly valuable in the assessment of the patient in assessment of solid organ injuries and intra abdominal bleed. Computerized tomography is invaluable is invaluable in diagnosing pancreatic and retroperitoneal injuries.

Indication for emergency laparotomy

- Radiological evidence of free intraperitoneal gas
- Radiological evidence of ruptured diaphragm
- Positive result for peritoneal lavage
- Rigid silent abdomen
- Unexplained shock

Four-quadrant aspiration

A simple and highly sensitive mode of assessing the presence of blood or fluid collections including faeces in the peritoneal cavity. The sensitivity ranges from 76-90%. A sterile 10cc syringe should be used for each quadrant, after ensuring sterile precautions. Needle used should be18-20G.

Peritoneal lavage

- Indications for peritoneal lavage –
- Equivocal clinical examination
- Difficulty in assessing the patient because of head injury, alcohol intoxication or drugs.
- Persistent hypotension inspite of adequate fluid replacement
- Multiple injuries especially those including the chest, pelvis and spinal cord.
- Frank visible breach in the peritoneum.

Contraindications to peritoneal lavage

- The only absolute contraindication to lavage is if there is as preexisting absolute indication for laparotomy. Relative contraindication are pregnancy, gross obesity, coagulopathy, and previous lower abdominal surgery.

Procedure

1. Explain the procedure to the patient if he or she is conscious.
2. Ensure that the urethral and nasogastric tube is in place.
3. Prepare the patient abdomen with antiseptic and drape sterile
4. Infiltrate the skin with 2% lignocaine and 1 in 100000 adrenaline.
5. Make vertical subumblical incision in the midline 5 cm in length and centered one third of the distance between umbilicus and symphysis pubis.

6. Under direct vision divide the lineaalba and identify the peritoneum.
7. Make an incision and introduce a peritoneal dialysis catheter towards the pelvis without the introducer.
8. Aspirate any free blood or bowel contents. If more than 5 ml of blood is aspirated then it is and indication for emergency laparotomy.
9. If no blood is aspirated then infuse 1 liter of warm physiological saline at 37 degree centigrade.
10. Allow the saline to equilibrate for three minutes and then place the bag and the giving set on the floor and recover as much of the initial 1 liter as possible.
11. Send a 20 ml sample to the laboratory for measurement o f RBC and WBC count and for microscopic examination.

Positive result

- Lavage leaks into the chest tube or urinary catheter
- Aspirate 5ml of dark blood
- Red blood cell count greater than 1000000/ml.
- Presence of bile, bacteria, or fecal matter.

False positive

Occurs in 2% of the cases, particularly when the lavage is performed blind, and is caused by traumatizing abdominal wall vessels or trochar injury to the viscera.

False negative

Occurs in 2% of the cases. Mostly attributable to injury to retroperitoneal organs or diaphragmatic injury.

Complications :

Perforation of a viscus.

Hemorrhage from mesenteric vessels

Infection

Radiological findings

X ray chest and x ray abdomen in erect posture provides some clue to associated thoracic diaphragmatic injuries. Look for lower rib fractures on either side. This my suggest splenic injuries on the left and hepatic injuries on the right side. Free air under the dome of the diaphrgam can be detected in hollow viscus perforation. Extensive haemoperitoneum gives the characteristic ground glass appearance. loss the psoas and renal opacities is suggestive of retroperitoneal haematomas. the injured spleen may indent the gastric and colonic air shadows.

A minimum of 700ml of free blood has to be present in the peritoneal cavity to give the ground glass appearance.

Flank strip sign-a fluid dense zone separating the ascending and descending colon from a distinctly visible lateral peritoneal wall.

Dog-ear sign-this results from accumulation of blood that gravitates between the pelvic walls on either side of the bladder.

Hepatic angle sign-loss of definition of the definite inferior and right lateral borders as blood accumulates between the hepatic angle and the right peritoneal wall.

Ultra sonogram

It is a non-invasive, investigative modality. Very sensitive for detecting intraperitoneal fluid collections. May detect retroperitoneal collections also. Solid organ injuries can be well delineated.

The principal limiting factors are availabitiy, low specificity and poor localization in the morbidly obese and in documenting hollow viscus injuries, pancreatic injuries and being highly operator dependent.

CT scan

A highly sensitive modality for retroperitoneal and solid parenchymal organ injury.canintraperitoneal hemorrhage also. However the principal limitations are the time factor, the ability to shift a shocked patient to the scan environment.

In appropriate clinical settings the lower grades of solid parenchymal injuries can be managed conservatively after CT evaluation. Superiority of CT over USG lies in its ability to asses pancreatic and renal injuries.

Arteriography

The primary indications are intraabdominal solid organ injury and major vascular breach as in pelvic injuries with arterial bleed. Once detected, then therapeutic embolisation can be carried out. Abdominal arteriograms may be needed in solid organ injuries and persistent major hematuria. The common complication is anaphylaxis to the contract agent and iatrogenic visceral arterial thrombosis. The contraindications are obvious need for explorative laparotomy, and unwilling patients.

Radio nuclide scanning

A highly specialized subgroup of patients can be submitted to this elaborate investigative work up.

- In the postoperative period for detecting renal arterial flow after primary repair of renal pedicle tear.
- Localization of biliary fistula after a major hepatic repair/ resection.
- Obvious afflication of a kidney as detected by a scout IVU.

Intravenous urography

It is indicated in patients with suspected renal injuries. The two main indications for this modality are gross haematuria that not seem to be of distal origin and hemodynamically unstable patient with microscopic hematuria. CT with contrast enhancement is more specific than IVU. As a rule

a positive IVU should be followed up with a CT and if necessary an arteriography.

The aim of this modality is detection of irreparable parenchymal injury, renovascular occlusion, avulsion of the renal pedicle and the functional status of the other kidney.

Contraindications are allergy to the dye. Relative contraindications are multiple myeloma and old age.

Laparoscopy

The principal argument in favour this procedure is ability for direct visualization. It should ideally be carried out on table with the facility for rapid conversion into a formal explorative laparotomy on the slightest indication of a major trauma requiring surgical intervention.

The abdominal cavity is examined in a standard fashion beginning in the right hypochondrium and proceeding in a clockwise manner. The pick up rates are low for splenic injures, small bowel injuries and in the presence of gross hemoperitoneum. Expertise and availability of experts limits its use in routine examination.

MATERIALS AND METHODS

I have analyzed 162 cases of blunt trauma following road traffic acidents admitted in all the surgical units at thanjavur medical college hospital during the period of september 2016 to september 2017

The cases were selected with accurate history of trauma including the mode of injury, the time elapsed since injury till admission and history of primary resusitation documented carefully. Based on a careful history and meticulous physical examination combined with adjunctive investigations, a decision to operate or to manage conservatively was taken.

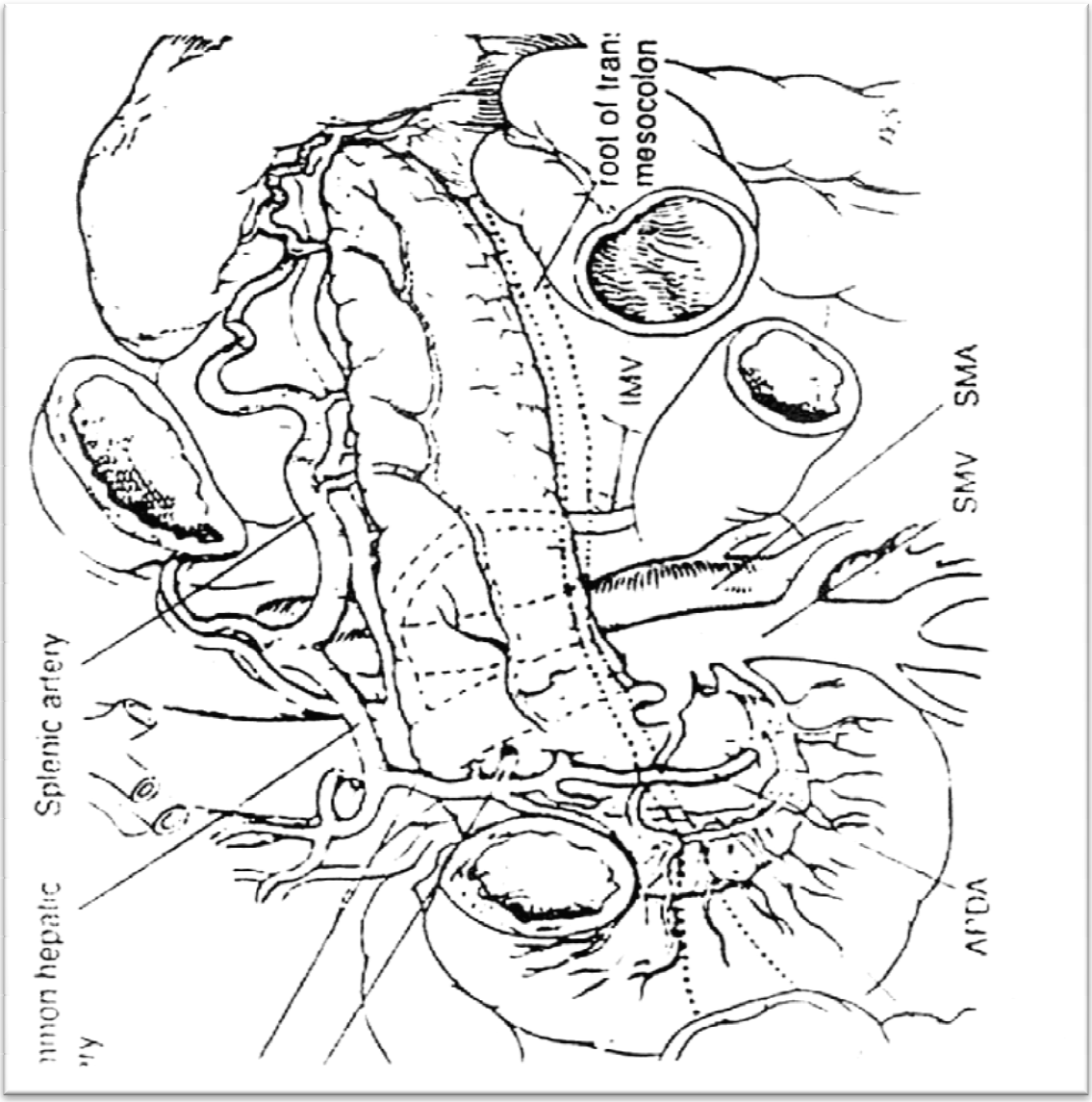
Baseline laboratory parameters like blood urea,blood sugar,serum electrolytes and blood grouping was done in all cases. Plain xray abdomen in an erect posture was taken for all stable patients. Other investigations appropriately taken for associated injuries.

Ultra sonogram and ct scan abdomen was not done as a routine diagnostic investigation, however few cases were subjected to the same in view of special circumstances.

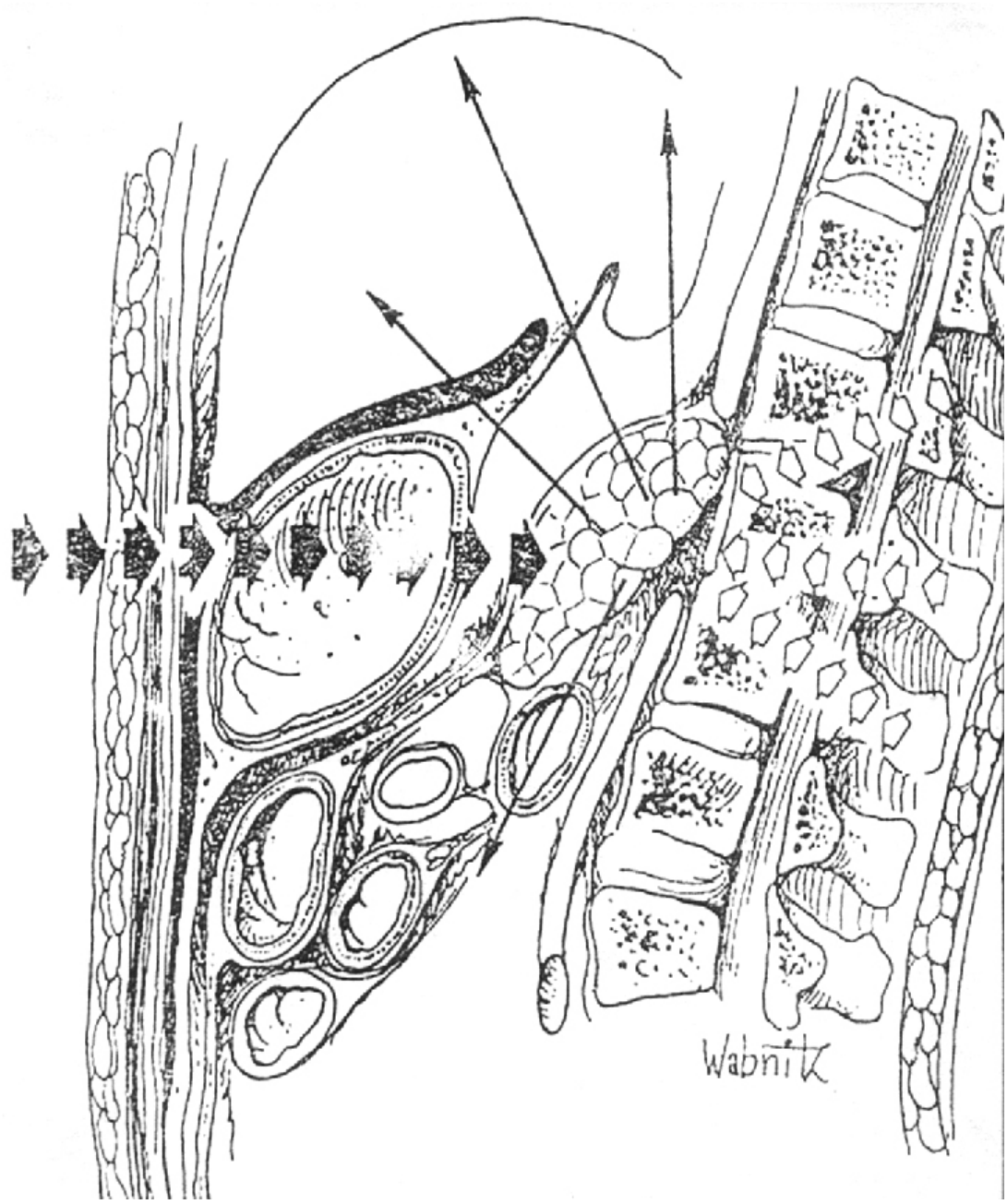
A performa of each case including the case ,sex,mode of injury, and an accurate history suggesting the mode of injury was compiled. Personal history of previous trauma or surgeries and alcohol or drug intoxication was specifically sought for. Plain skiagram of the abdomen and four quadrant aspiration was done in all the cases.

All the patients were resusitated with ringer lactate solution and blood before surgical intervention. All the patients were manadatorily maintained on nasogastric suction, intravenous fluid fluid replacement and broad spectrum antibiotics. Selected cases were catheterised. Post operative complications were specifically sought for and treated appropriately.

ANATOMY

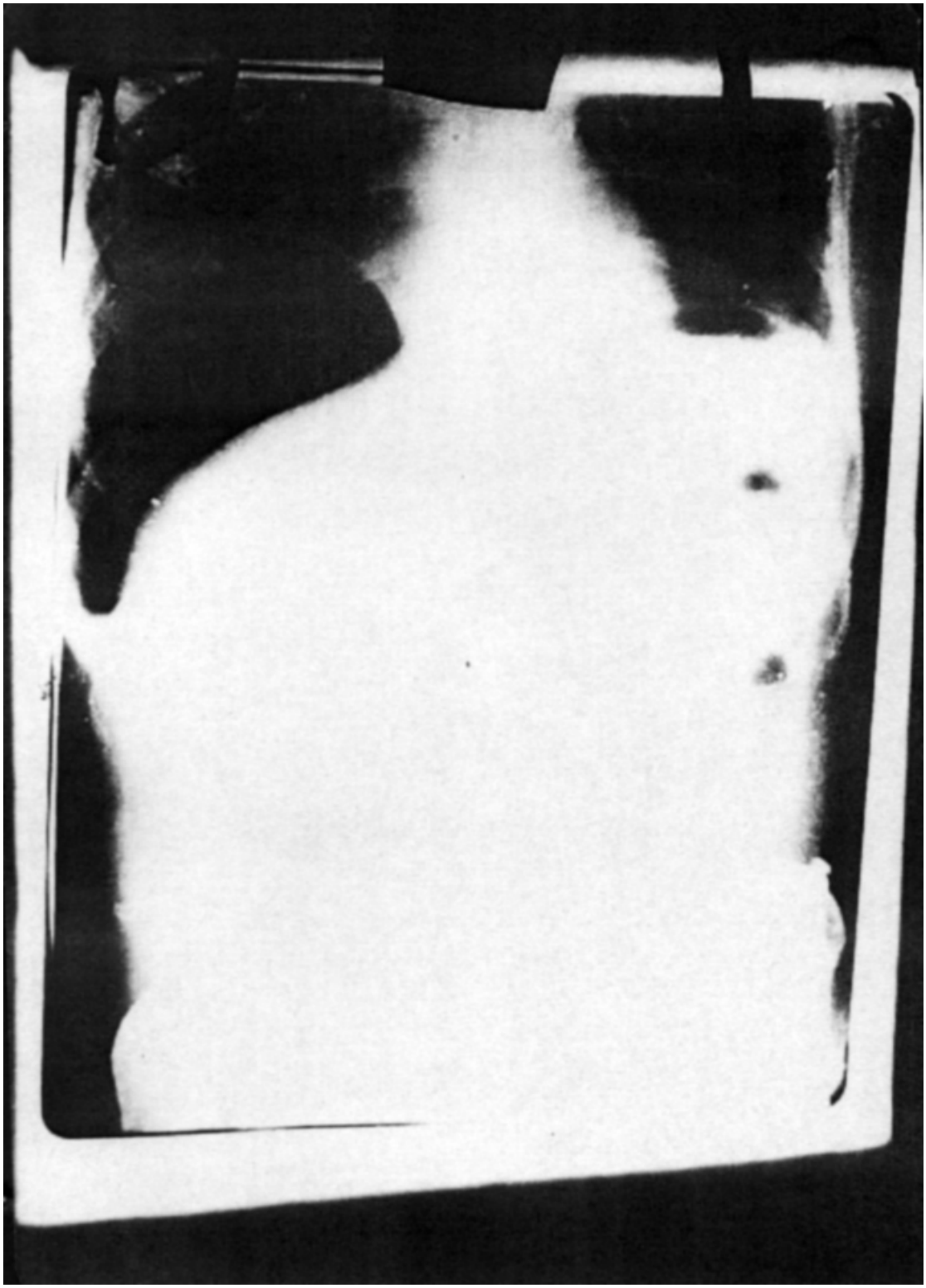


MECHANISM OF TRAUMA



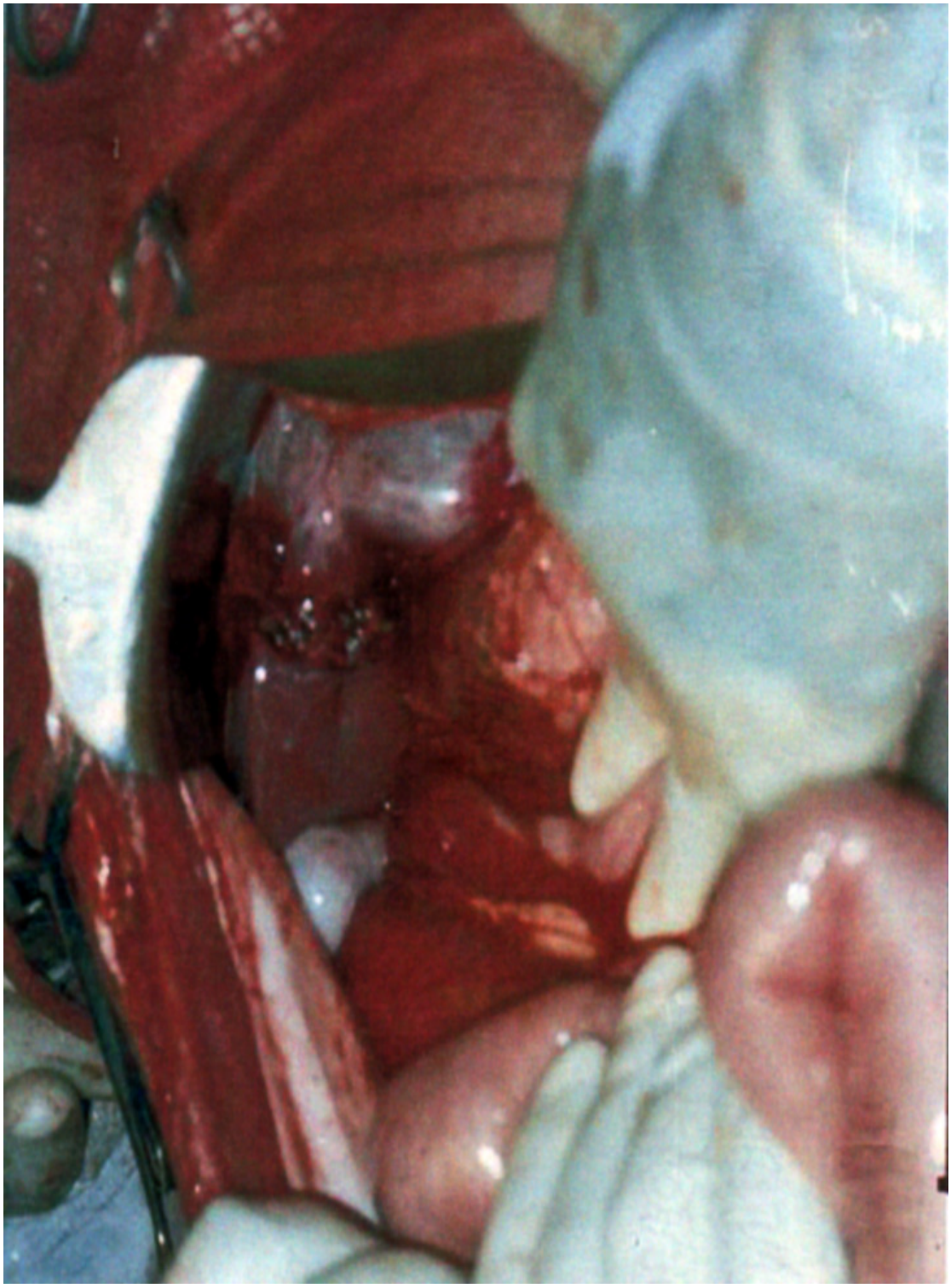
ABDOMINAL BRUISE

PNEUMOPERITONEUM

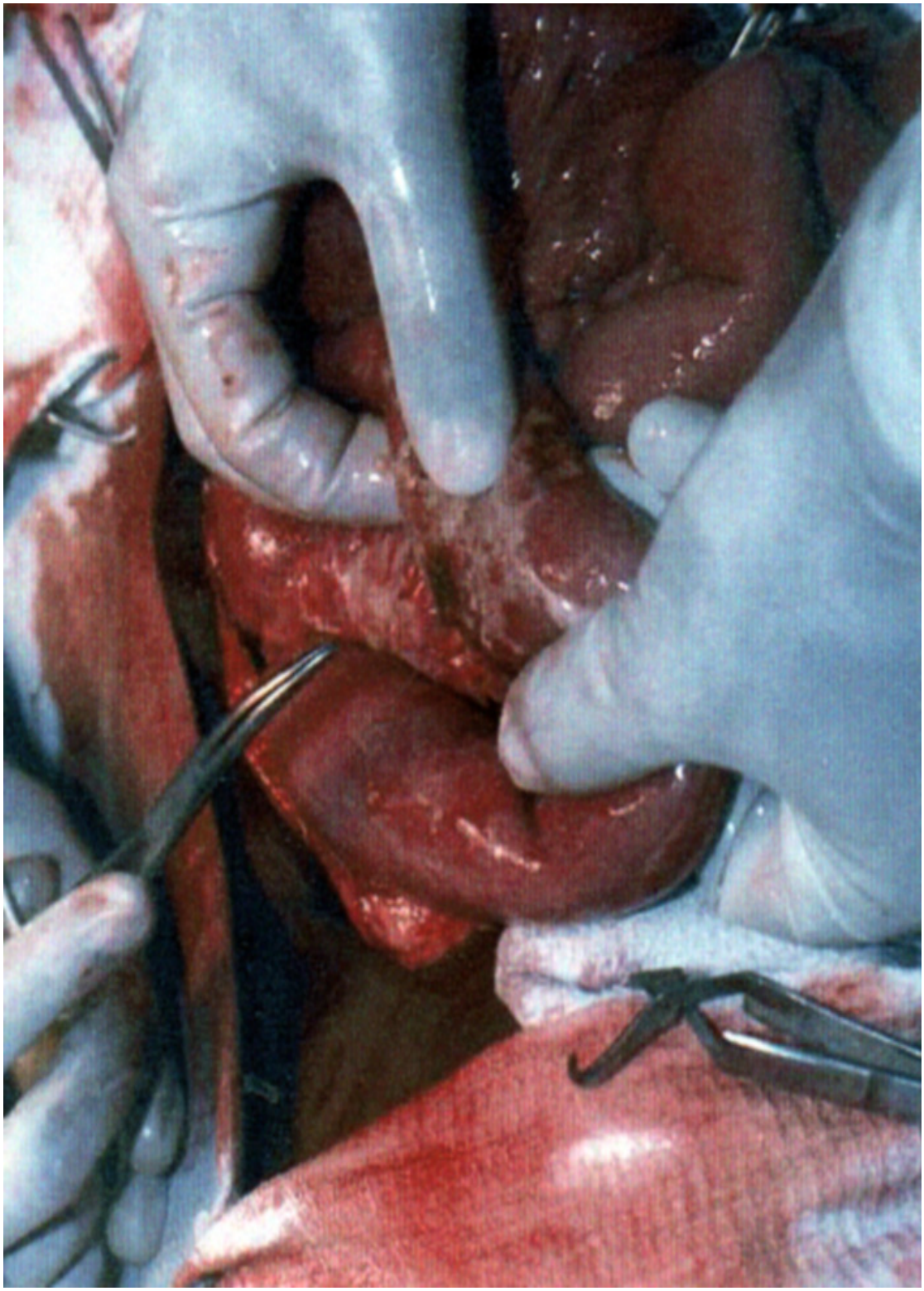


SPLENIC INJURY

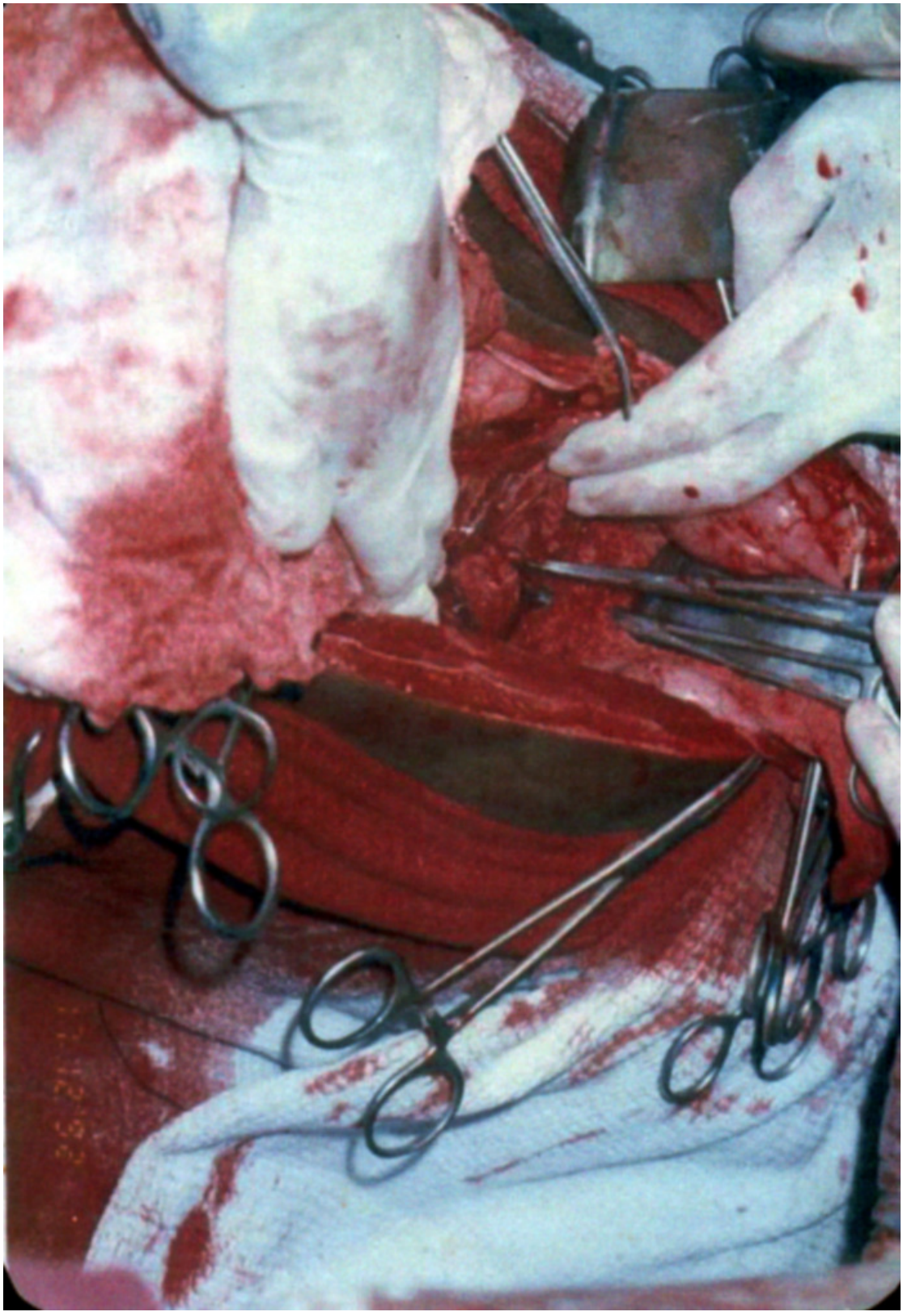
LIVER LACERATION



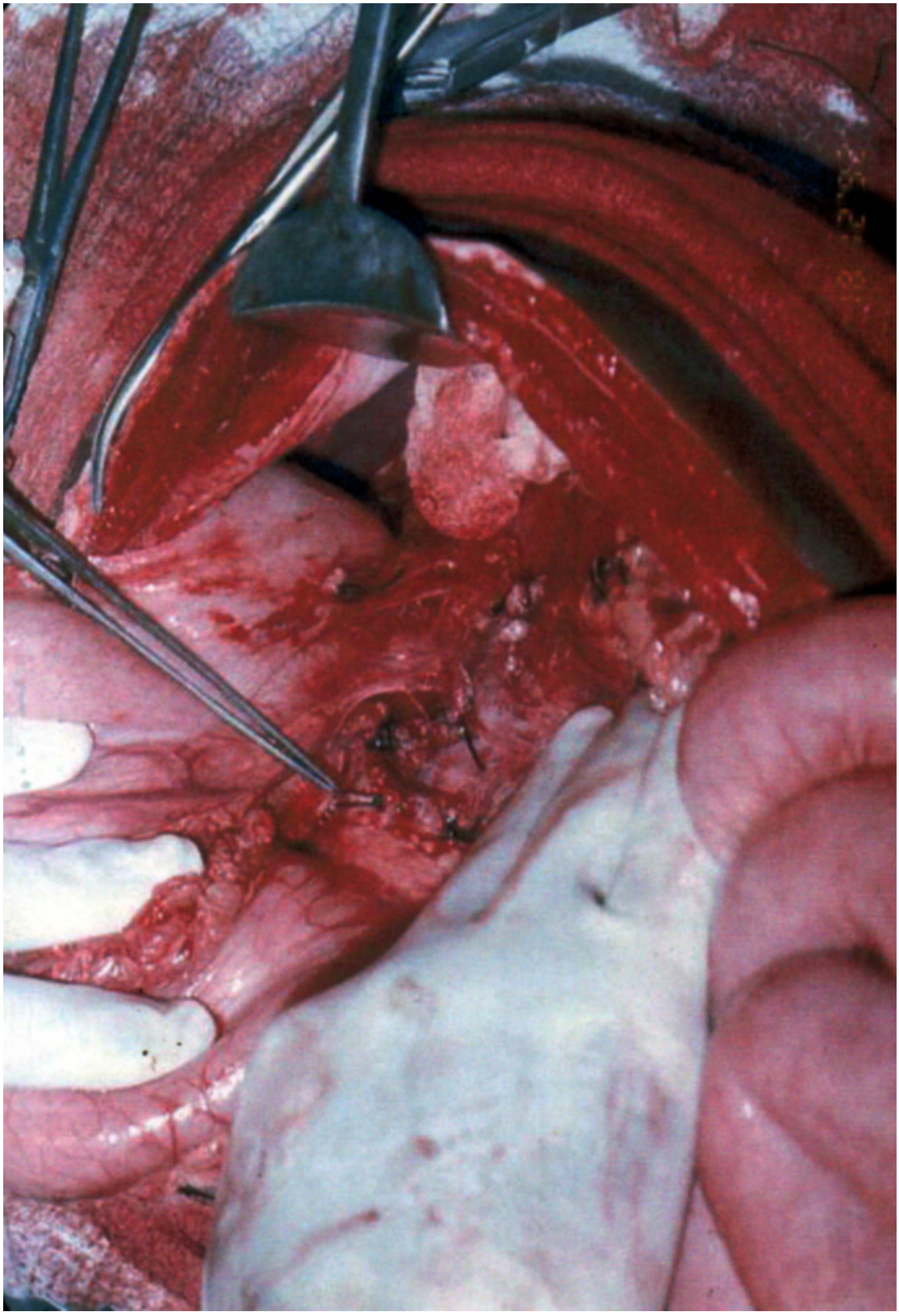
ILEAL PERFORATION



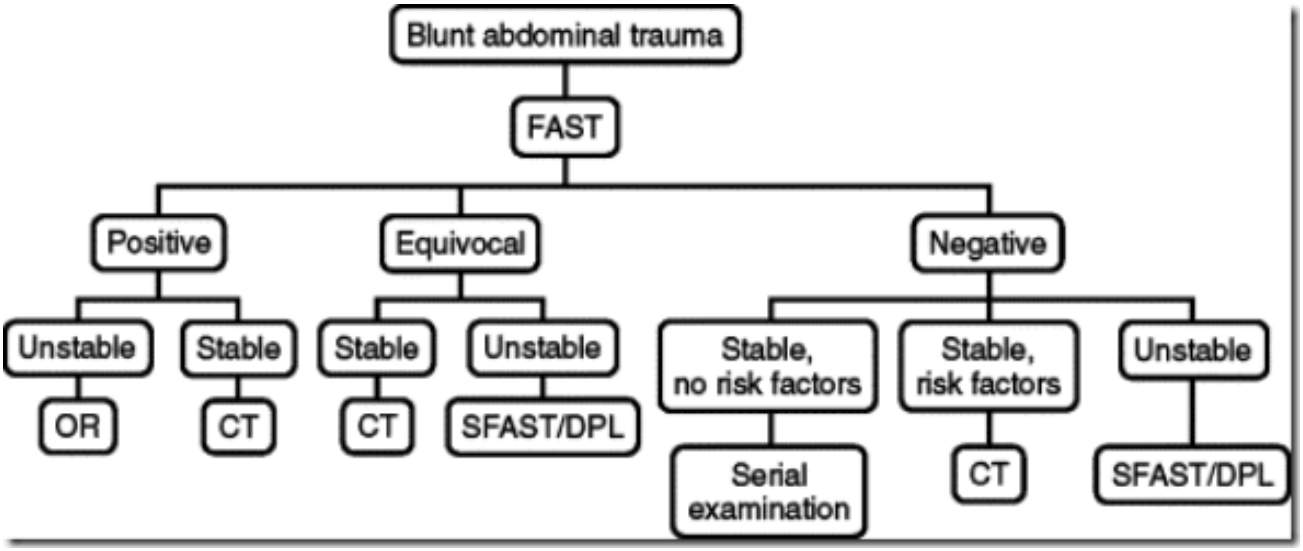
PANCREATIC INJURY



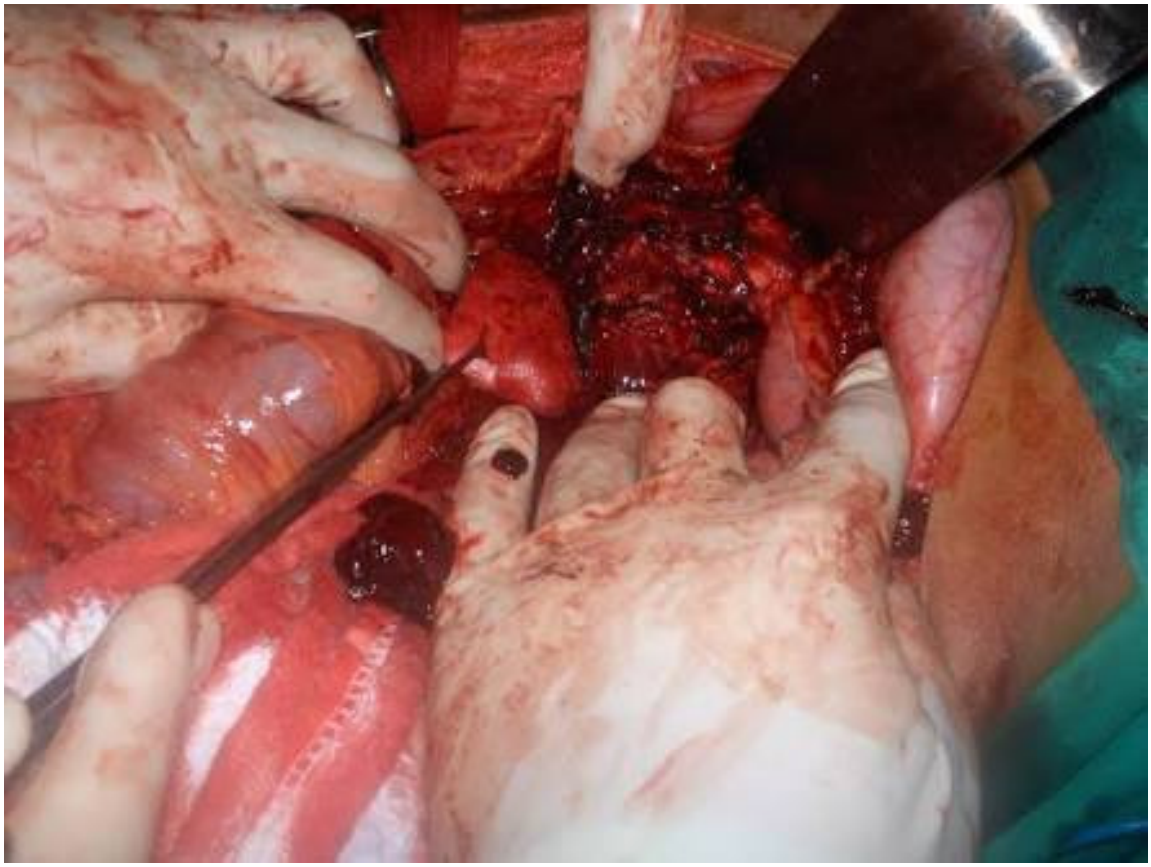
DISTAL PANCREATECTOMY



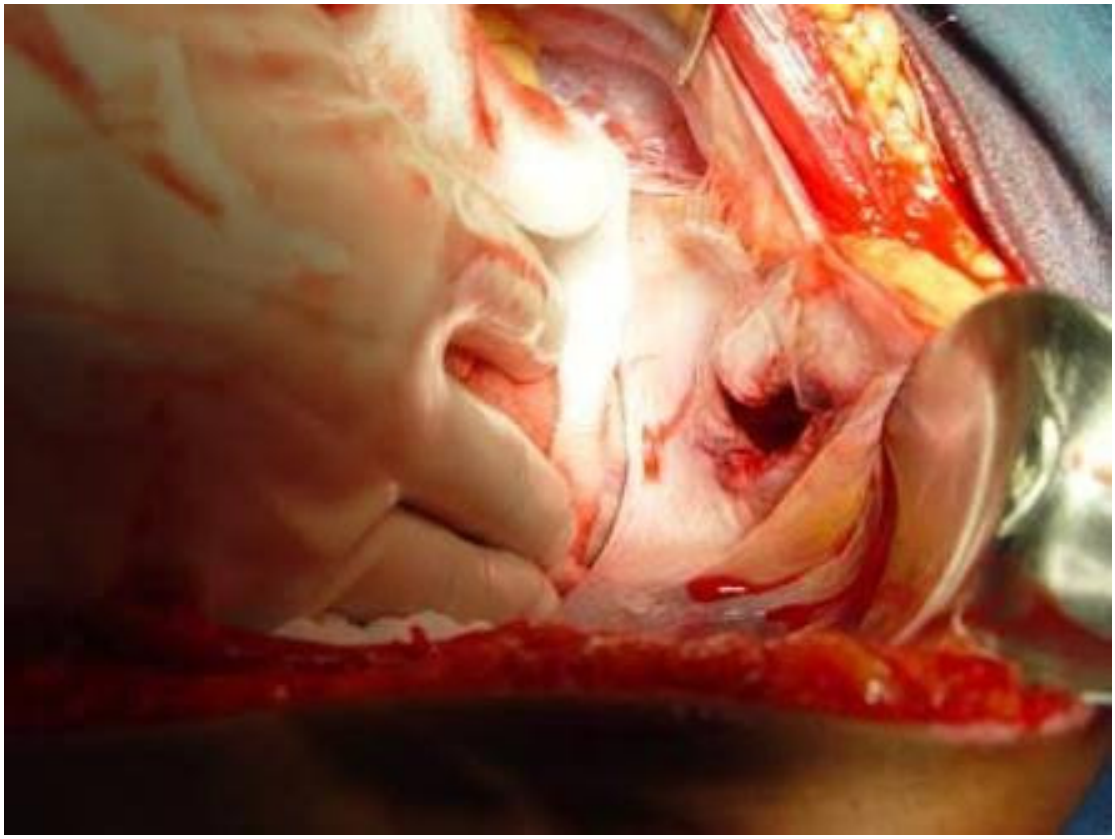

MECHANISM OF INJURY
CRUSHING
• Direct application of a blunt force to the abdomen
SHEARING
• Sudden decelerations apply a shearing force across organs with fixed attachments
BURSTING
• Raised intraluminal pressure by abdominal compression accurately in hollow organs can lead to rupture
PENETRATION
• Disruption of bony areas by blunt trauma may generate bony spicules that can cause secondary penetrating injury


Blunt abdominal trauma
FAST
Positive
Equivocal
Negative
Unstable
Stable
Stable
Unstable
Stable, no risk factors
Stable, risk factors
Unstable
OR
CT
CT
SFAST/DPL
Serial examination
CT
SFAST/DPL

RETROPERITONEAL HEMATOMA

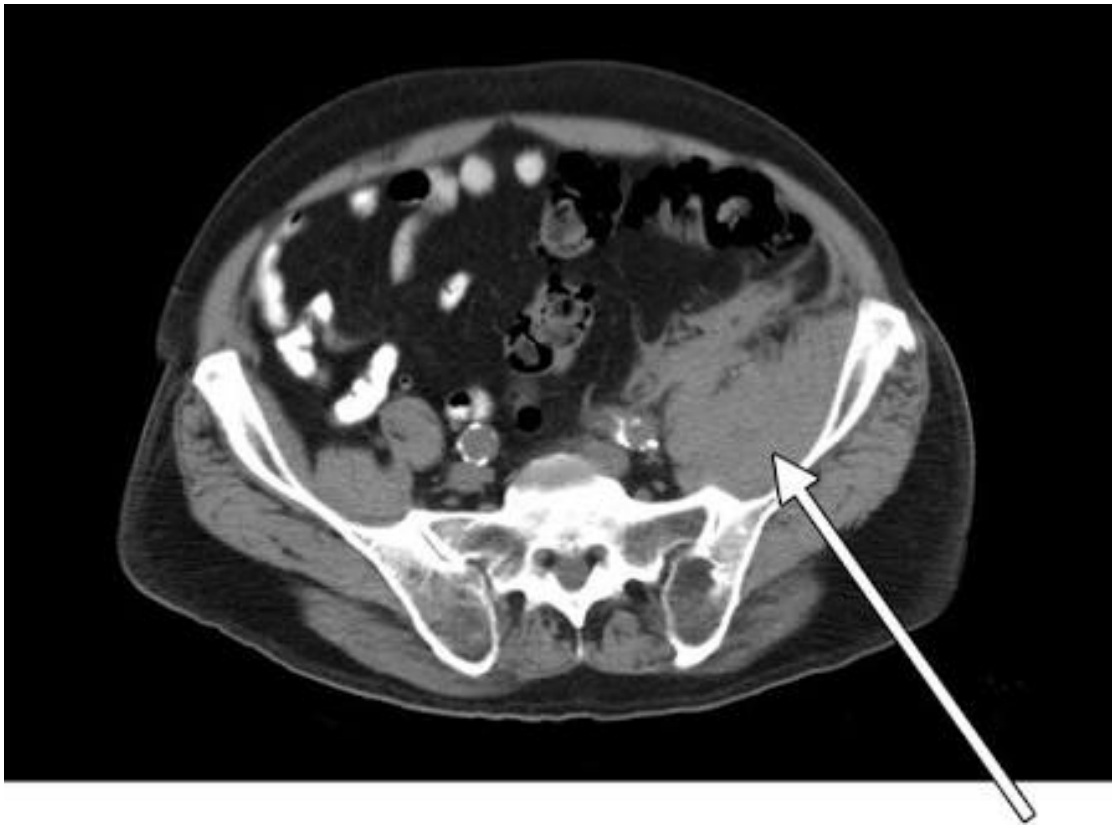


BLADDER INJURY

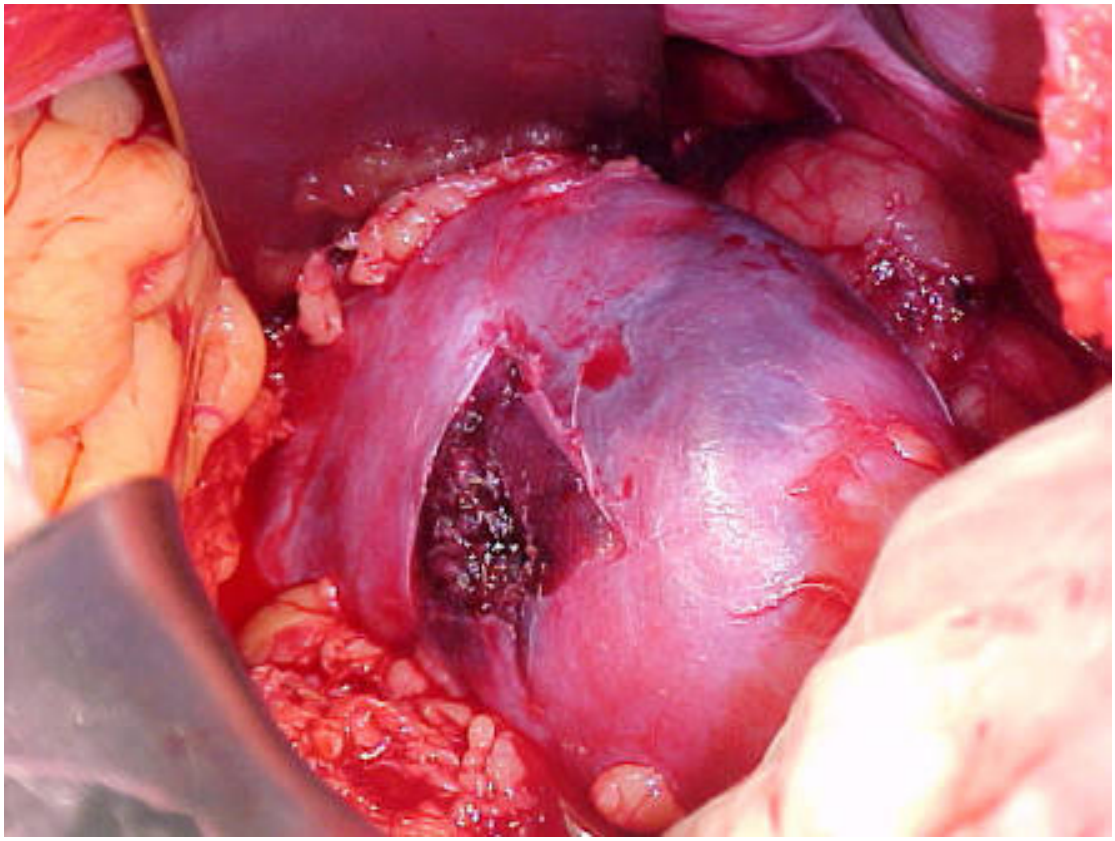


MESENTRY TEAR

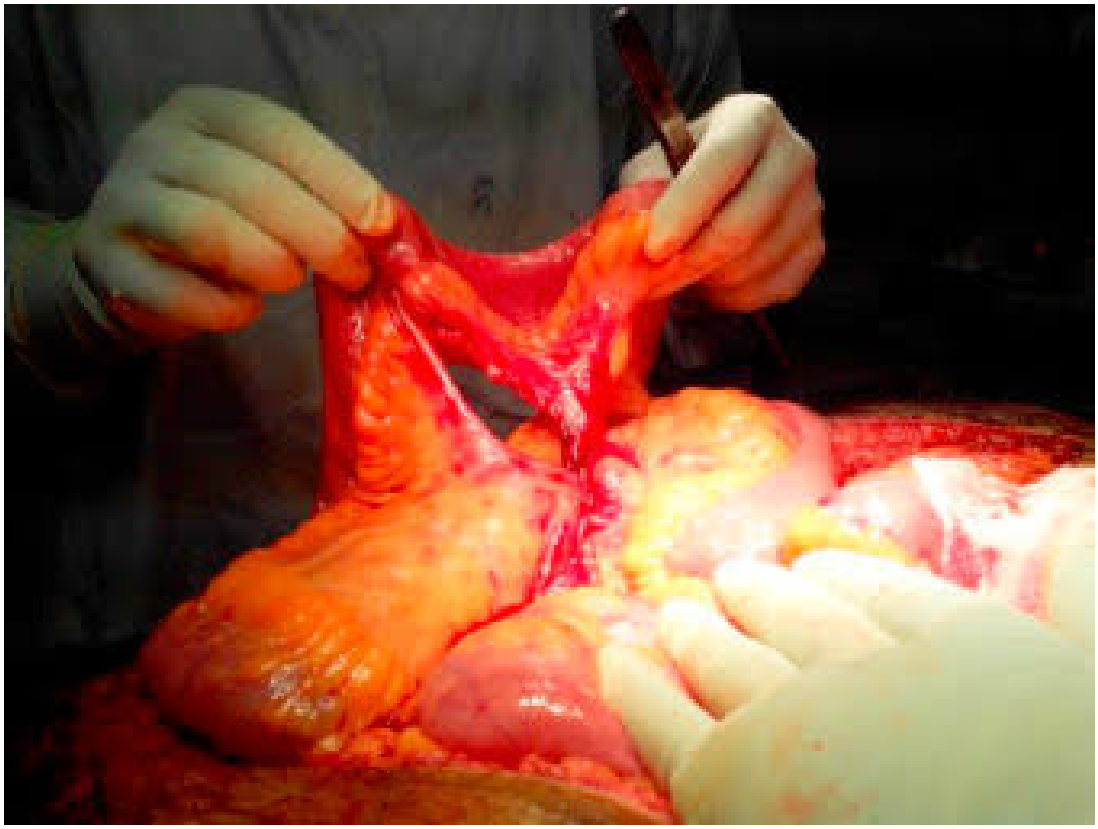
RETROPERITONEAL HEMATOMA



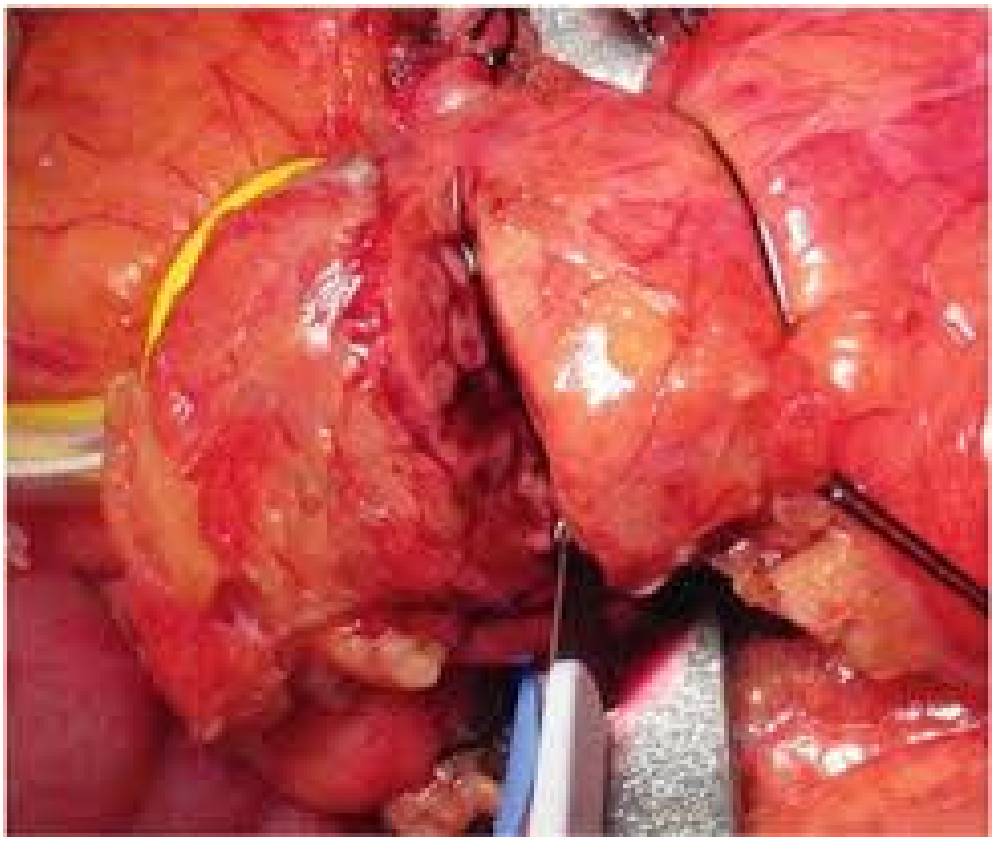
BLADDER INJURY



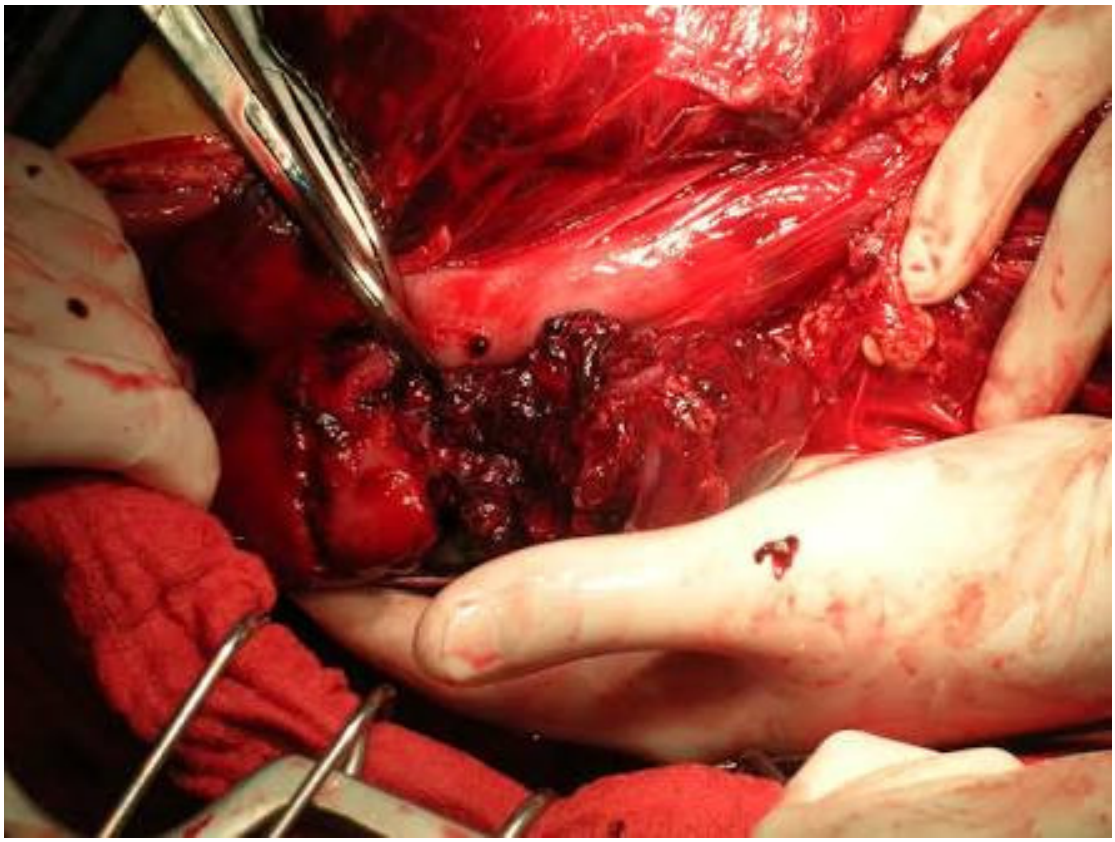
MESENTRY TEAR



PANCREAS TRANSECTION



RIGHT KIDNEY INJURY



Splenic injuries

Anatomy : Develops from mesenchymal cells in dorsal mesogastrium during 5th week of gestation. A dull red organ, measring 1x3x5 inches. It is held in position by phrenicocolic,gastrosplenic,linenorenal ligaments. Average weight is 150gms,supplied by splenic artery, a direct branch of coeliac trunk. The artery may divide 6 to 36 times before it enters the splenic hilum, hence facilitating segmental resection.

Function

-Part of reticuloendothelial system

-hematopoiesis

-immunocompentent system and reservoir of suppressor cells

Pathophysiology of splenic injury

Splenic injury usually results from blunt abdominal trauma. Patients often have abdominal pain, sometimes radiating to the shoulder, and tenderness. CT or ultrasonography makes diagnosis. Treatment is with observation and sometimes surgical repair, splenectomy is necessary.

The main immediate consequence is hemorrhage into the peritoneal cavity. The amount of hemorrhage ranges from small to massive, depending on the nature and degree of injury. Many small lacerations, particularly in children, cease bleeding spontaneously. Larger injuries hemorrhage extensively, often causing hemorrhagic shock. A splenic hematoma sometimes

ruptures, usually in the first few days, although rupture can occur from hours to even months after injury.

The manifestations of major hemorrhage, including hemorrhagic shock, abdominal pain, and distention, are usually clinically obvious. Lesser hemorrhage causes left upper quadrant abdominal pain, which sometimes radiates to the left shoulder,kehr sign, ballance sign may be positive. Patients with unexplained left upper quadrant pain, particularly if there is evidence of hypovolemia or shock, should be asked about recent trauma. Maintain a high index of suspicion for splenic injury in patients who have left rib fractures.

Plain radiogragph

May show:

-Left lower rib fracture

-Intrathoracic gastric air bubble

-elevation of left hemi diaphragm

-Pleural effusion on the left

in hemodynamically stable patient ultrasonogram and CT scan can be done. Ulrasonogram has few technical limitations like GIT ileus, however it has emerged as a primary investigative modality for suspected splenic trauma. CT scan shows laceration of spleen as irregular low density bands that produce a defect in the parenchyma on horizontal section. Subscapular hematoma is

seen as a peripheral low density lesion that flattens the contour of spleen. Splenic arteriography is highly sensitive for disruption of parenchyma.

SPLENIC INJURY SCALE:

Classification

Grade I

- subcapsularhaematoma<10% of surface area
- capsular laceration <1 cm depth

Grade II

- subcapsularhaematoma 10-50% of surface area
- intraparenchymalhaematoma<5 cm in diameter
- laceration 1-3 cm in depth not involving trabecular vessels

Grade III

- Sub capsularhaematoma>50% of surface area or expanding
- intraparenchymalhaematoma>5 cm or expanding
- laceration>3 cm in depth or involving trabecular vessels
- rupturedsubcapsular or parenchymal haematoma

Grade IV

- laceration involving segmental or hilar vessels with major devascularisation (>25% of spleen)

Grade V

- shattered spleen

hilar vascular injury with splenic devascularisation

Topical hemostatic agents can be used for grade 1 and grade 2 injuries.

Grade 3- total removal of clot, complete removal of clot, complete approximation of torn parenchymal edges, suture placement within fibrous capsule and if necessary suture ligation of bleeding vessel.

Grade4- partial splenectomy by ligation of appropriate segmental artery. Debridement is done by finger fracture technique or sharp resection. Absorbable vicryl mesh may be wrapped around for hemostasis.

Grade 5- needs splenectomy

Non operative management:

Done for

-hemodynamically stable

-no peritonitis

-blood transfusion less than 3 units

-grade 1-3 isolated splenic injuries

-in children

Complications

-atelectasis

-pneumonia

-left pleural effusion, are the most common complications of splenectomy

Dreaded complication is left diaphragmatic abscess. It occurs in 13% of patients.

-OPSI, is a dreaded complication that occurs in the peak incidence within 2 years of splenectomy.

-thrombocytosis can occur

-in pediatric age group it is very essential to salvage some amount of spleen.

LIVER INJURIES

The liver is the largest solid abdominal organ with a relatively fixed position, which makes it prone to injury. The liver is the second most commonly injured organ in abdominal trauma, but damage to the liver is the most common cause of death after abdominal injury (see the images below). The most common cause of liver injury is blunt abdominal trauma, which is secondary to motor vehicle accidents in most instances.

In the past, most of these injuries were treated surgically. However, surgical literature confirms that as many as 86% of liver injuries have stopped bleeding by the time surgical exploration is performed, and 67% of operations performed for blunt abdominal trauma are nontherapeutic.

AAST Liver Trauma Classification:

- Grade I: hematoma: subcapsular<10% surface area, laceration: capsular tear <1 cm parenchymal depth.
- Grade II: hematoma: subcapsular 10-50% surface area; intraparenchymal<10 cm diameter; laceration, capsular tear 1-3 cm parenchymal depth, <10 cm in length.
- Grade III: hematoma: subcapsular>50% surface area of ruptured subcapsular or parenchymal hematoma,intraparenchymal hematoma >10 cm or expanding; laceration: >3 cm parenchymal depth.
- Grade IV: laceration: parenchymal disruption involving 25-75% hepatic lobe or 1-3 Couinaud segments.
- Grade V: laceration- parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud segments within a single lobe, vascular: juxtahepatic venous injuries (ie, retrohepatic vena cava/central major hepatic veins).

Grade VI: hepatic avulsion.

The World Society of Emergency Surgery (WSES) has presented the following classifications utilizing the AAST grading system:

- Grade I (minor hepatic injury): AAST grade I-II hemodynamically stable either blunt or penetrating lesions.
- Grade II (moderate hepatic injury): AAST grade III hemodynamically stable either blunt or penetrating lesions.

- Grade III (severe hepatic injury): AAST grade IV-VI hemodynamically stable either blunt or penetrating lesions.

Grade IV (severe hepatic injury): AAST grade I-VI hemodynamically unstable either blunt or penetrating lesions

Signs and symtoms

Patients with liver injury and severe bleeding have symptoms of shock, rapid heart rate, rapid breathing, and cold, clammy, pale or bluish skin. People also have abdominal pain and tenderness because blood in the abdomen irritates the abdominal tissue. When bleeding is severe, the abdomen may also be distended.

Diagnosis

- Liver imaging tests
- surgery

computed tomography (CT) scan or ultrasonography is used to detect liver injuries. Sometimes surgery is needed to determine the extent of the injury and to stop the bleeding.

Treatment

Principles of management are same regardless of injury,

-control of bleeding,

-removal of devitalized tissue,

-establish adequate drainage,

-simple lacerations that has stopped bleeding does not require any drainage,

-subcapsular hematoma can be evacuated ,

-laceration that continues to bleed need open exploration,

-torrential bleeding can be controlled by pringles' maneuver,

-sometimes per hepatic packing and resuscitation is more appropriate ,subsequent removal of packs at 2 to 3 days postoperatively. Intra abdominal pressure should not raise more than 40mmhg. Infection rate is higher by this technique

Resectional debridement

Deep lacerations require debridement, this usually achieved by finger fracture technique removing the portion or whole of the affected segment or lobe.

Segmentectomy/lobectomy

Done after complete division of the capsular attachement,Usually used technique is the finger fracture. The harmonic scalpel may also be used.

No operative management for:

-grade 1 and 2 hepatic injuries,

-no active bleed,

-intraperitoneal blood loss less than 300ml,

-noassociated injuries requiring operation,

-indications for laparotomy are:

- need for blood transfusion greater than 5 units ,

-increasing abdominal tenderness,

-expansion of the hematoma,

-hematoma representing a septic a septic focus,

Complications

-pulmonary atelectasis,

-hypoglycemia,

-jaundice,

-biliary fistula,

-intraabdominal abscess,

-hemobilia,

HOLLOW VISCUS INJURIES

STOMACH INJURIES

The stomach is rarely injured in blunt abdominal trauma. Rupture of the stomach is due to sudden increase in intraluminal pressure by severe compressive forces, causing gross peritoneal contamination. The most commonly involved site is along the greater curvature or anterior surface of the stomach.

CLINICAL FEATURES

80% of cases presents as peritonitis. Tenderness over epigastrium, vomiting may also be present

MANAGEMENT

Contusion of stomach requires inversion with Lambert sutures. Severely lacerated stomach needs resection procedures. Healing is good due to good vascularity of the stomach. Pyloroplasty may be considered in pyloric injuries. Drainage procedures are in case of vagal injuries.

COMPLICATIONS

- Stump leak
- Lesser sac abscess
- Gastrocutaneous fistula

Gross contamination of the peritoneal cavity has a very high mortality and morbidity.

SMALL BOWEL INJURIES

Small bowel injuries occur in 10-20% of the cases of blunt injury andomen.

MECHANISM OF INJURIES

- Crush injury between spine and blunt object such as steering wheel
- Deceleration shearing of th bowel at its fixed points
- Decelaration shearing of mesentery
- Closed loop rupture due to increased intraluminal pressure.

CT scan is valuable in stable patients because it permits morphological and quantitative definition of the injury.

CT scan shows

- Intraperitoneal free fluid not adjacent to solid organ
- Intraperitoneal free gass
- Bowel wall thickening or mesentric hematoma

OPERATIVE MANAGEMENT

- Priorities at laparotomy is securing hemostasis, controlling contamination and repair of affected segment.

- The intestine is best inspected by evisceration
- Hematomas and serosal tears may be corrected by Lambert sutures
- Application of packs or non- crushing clamps to prevent contamination
- Antimesenteric wall contusion may produce delayed perforation hence imbrication of site is necessary
- Large segments with multiple tears and loss of vascularity sholuld be resected and primary anastomosis is done.

COMPLICATIONS

- Anastomotic leakage
- Intraabdominal abscess
- Sepsis
- Enterocutaneous fistula
- Intestinal obstruction

MESENTERIC INJURIES

These are infrequent occurences in blunt injury abdomen. Hematomas greater than 2cm and extending upto bowel must be incised and nearby bowel is assessed for viability. Rent parallel to long axis of the bowel causes gangrene. Proximal control must be obtained prior to exploring hematoma. Large hematoma involving SMA need exposure by Mattoux manouvere. Distal SMA repair is usually not mandated.

COLONIC INJURIES

Accounts for 5% of the blunt abdominal injuries. Procduces non specific signs and symptoms. Peritoneal irritation and tenderness develops early.

Blood on PR examination mandates sigmoidoscopic examination.

Radiological eveidence of pnemoperitoneum might be present

The principal guiding factors in the case of large bowel injuries is

-the extent of injury

-the period elapsed since since the time of injury

Try to operate as early as possible. In the cases of delayed presentation it iis a good stratery to exteriorize the wound as a colostomy.

Early injuries with suspected vascular compromise require formal resection and primary anastamosis. Drain the peritoneal cavity adequately and keep the patient on nasogastric suction and nil oral giving time for the anastamosis to heal.

Early injuries with suspected vascular compromise require formal resection and primary anastamosis. Drain the peritoneal cavity adequately and keep the patient on nasogastric suction and nil oral giving time for the anastamosis to heal.

Renal injuries

Incidence of kidneys getting injuried in blunt trauma abdomen is about 6%. It is classified as minor,major or critical based on clinical on clinical and radiological data

Minor

-contusions

-Superficial lacerations (capsule and pelvicaliceal system intact).

Major

- deep lacerations{capsular tears or pelvicaliceal involvement or both}.

critical

-renal fragmentation

-pedicle injuries {renal artery thrombosis,vessel avulsion,and pelviureteric rupture}.

Clinical signs of renal trauma

-regional skin lesions;

-loin tenderness;

-loss of loin contour;

-loin mass;

-gross hematuria (upto 90%of the cases).

Investigations

- intravenous urography
- USG in stable patients {parenchymal tears,perirenal collections,intrarenal and sub capsular hematomas}
- CT scan ,preferably contrast enhanced gives excellent delineation of the parenchymal and perirenal status also helps assessment of retroperitoneal collections.

Management of renal trauma:

-treat hypovolemia,

-stage renal injury radiologically,

-treat patients with minor and stable major injuries expectantly,

operate on patients with critical and unstable major injuries.

Expectant treatment:

-make serial clinical observations,

-institute strict bed rest

-appropriate analgesia

-appropriate antibiotics

-perform serial renal ultrasonography

Late complications:

-hypertension,

-arteriovenous fistula,

-hydronephrosis,

-formation of pseudocyst or calculi,

-chronic pyelonephritis,

-loss of renal function.

Bladder injuries

May be associated with pelvic fractures. Usual cause is a direct blow to the bladder that is fully especially in patients who are under the influence of alcohol. Lower abdominal peritonitism might be present, with inablity to pass urine. Gross hematuria might be present. Look at the plain radiograph for evidence of pelvic fractures. An IVU may show extravasation from a torn bladder. Cystography may be done in patients who are stable with 10% contrast must be primary investigative modality.

Treatment

Patients with important intraperitoneal ruptiure of bladder require laparotomy and repair with SPC and urethral drainage for a minimum of 10 days. The catheter size should be atleast 20 french and cystography to confirm healing, should be done before catheter removal.

PANCREATIC INJURIES

These may range from mild bruising to a total transection of the pancreas. There may be previous few signs until a spreading retroperitoneal abscess develops. Minor injuries can be managed conservatively. Major hematomas need to be drained which might eventually lead to a pancreatic fistula. Major injuries migfht warrant a pancreatectomy. The most sensitive investigative tool is a CT scan in a stable patient. At laparotomy te overlying peritoneum might appear bruised,edmatous with yellowish areas of fat necrosis.

RECENT CONCEPTS IN MANAGEMENT

The principal factor involved in mortality and morbidity associated with road traffic accidents is the time delay in transfer and multiple injuries.

As in all resuscitatory efforts for acute traumatic injuries the A[airway], B[breathing], C[circulation] of trauma should be strictly adhered to. It has been conclusively proven by the Edinburgh field trials that the oxygen tension of the arterial blood and vital organ perfusion is the single most important factor in deciding the outcome.

Initial airway capture and maintaining adequate oxygenation is the key to a better outcome. Intravascular volume resuscitation should be immediate and aggressive. A judicious use of crystalloids can maintain the volume till cross matching and group specific component / whole blood therapy can be begun.

It has been consistently observed that the outcome of major trauma is better in tertiary care institutes and specialized trauma team approaches. Hence all victims of major trauma should be transferred as fast as possible to the elite care unit after stabilizing the vital paramenters. The trauma team should be informed in advance about the transfer and it is almost imperative that the ideal team leader be a general surgeon with vas experience in management of varied injuries with the necessary back up of specialists.

All victims of major trauma should be resuscitated and maintained in a high dependency care unit or surgical intensive care unit, with a fixed protocol

both laboratory and clinical to asses outcome and warrant intervention in case of deterioration. Broad-spectrum antibiotic coverage guided by sensitivity reports is a major cornerstone of therapy.

Nutrition is the neglected specialty in major trauma. All trauma victims if kept starved beyond 48 hrs should have calorie replacement either enterally or parenterally, depending on the type of trauma sustained. Glutamine rich substrates have found to be particularly efficacious in maintaining gut integrity and preventing bacterial transmigration. TPN should be started after much forethought, in dynamic monitored settings with emphasis on micronutrient replacement. After the initial resuscitation it is wise to opt for component therapy rather than whole blood transfusion.

OBSERVATIONS

SPLENIC INJURIES – 17

LIVER INJURIES – 18

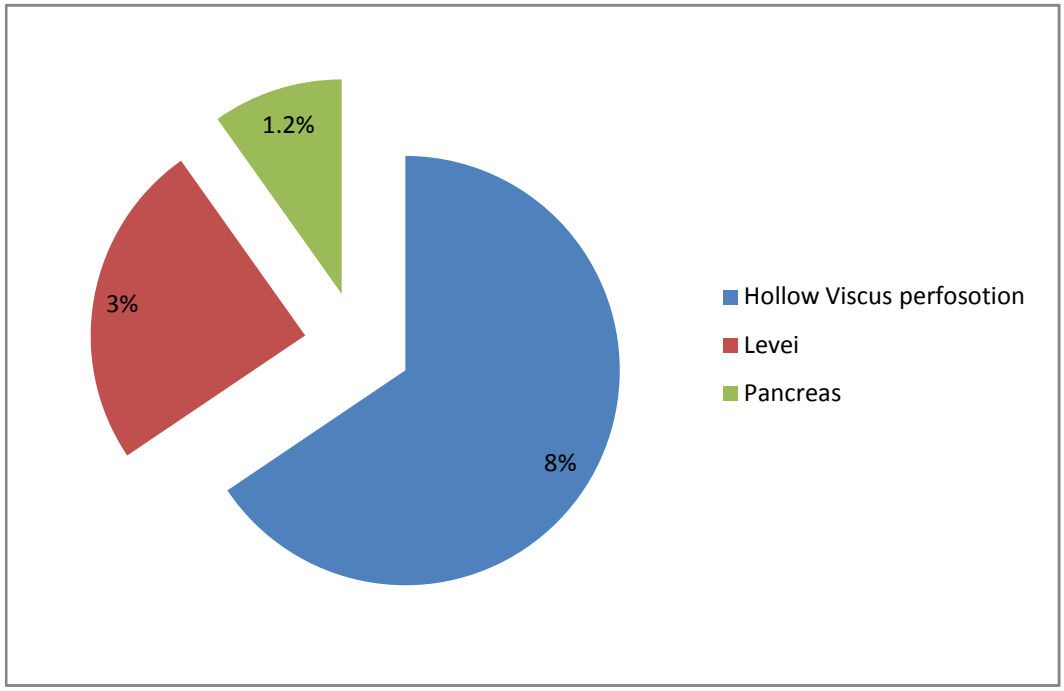
BOWEL INJURIES – 96

BLADDER INJURY – 12

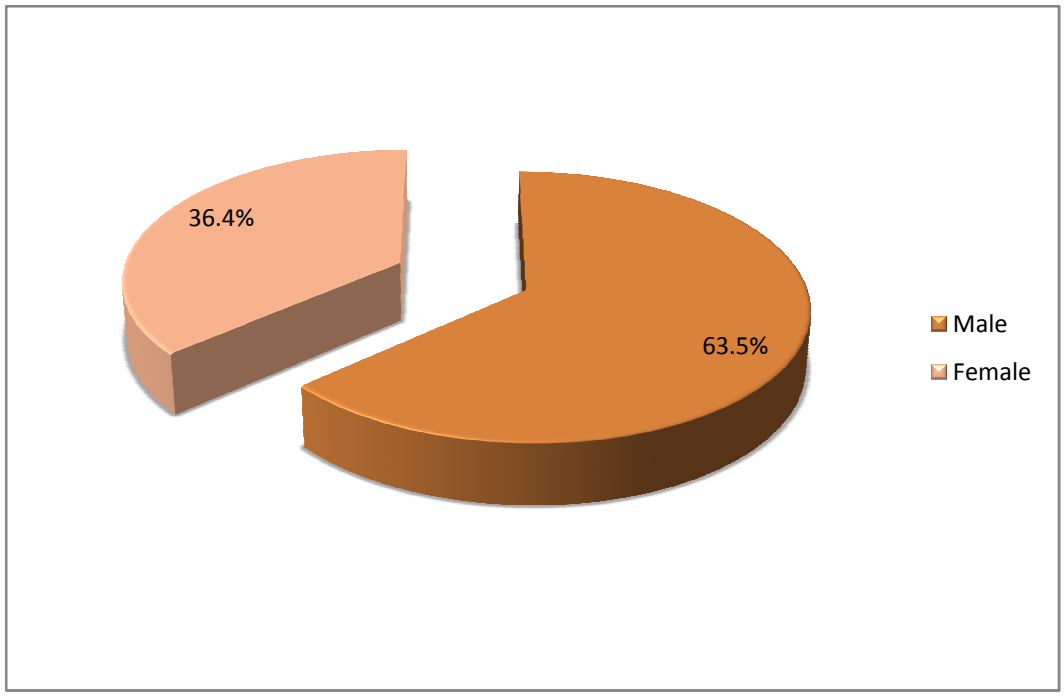
PANCREATIC INJURY – 2

RETROPETITONEAL HEMATOMA – 15

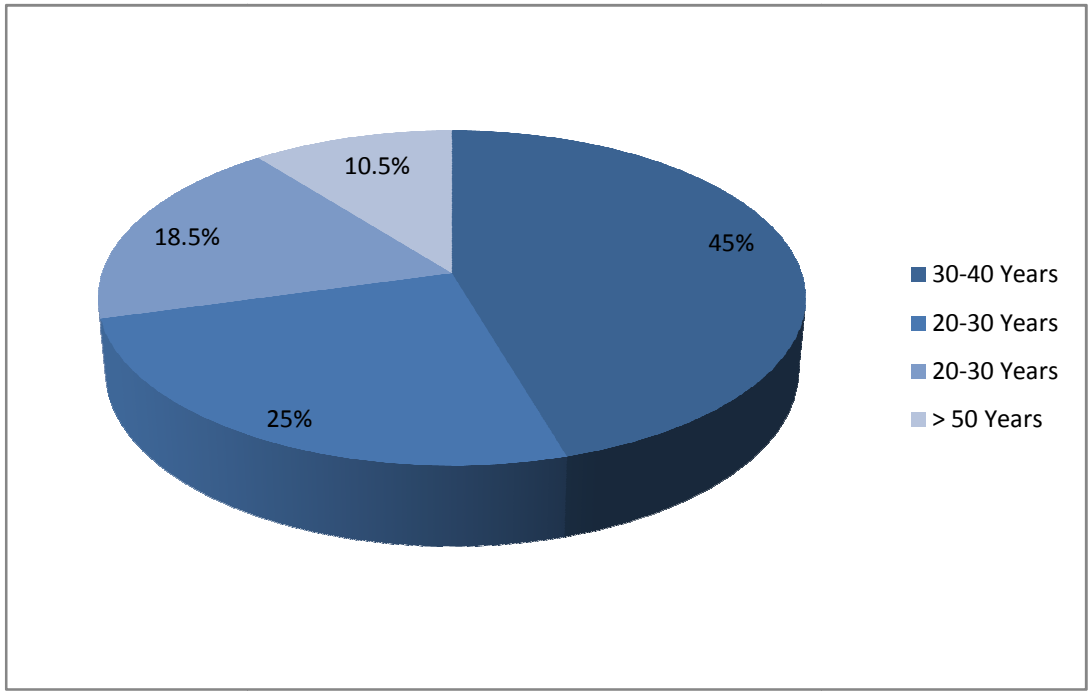
Organ Related Mortality



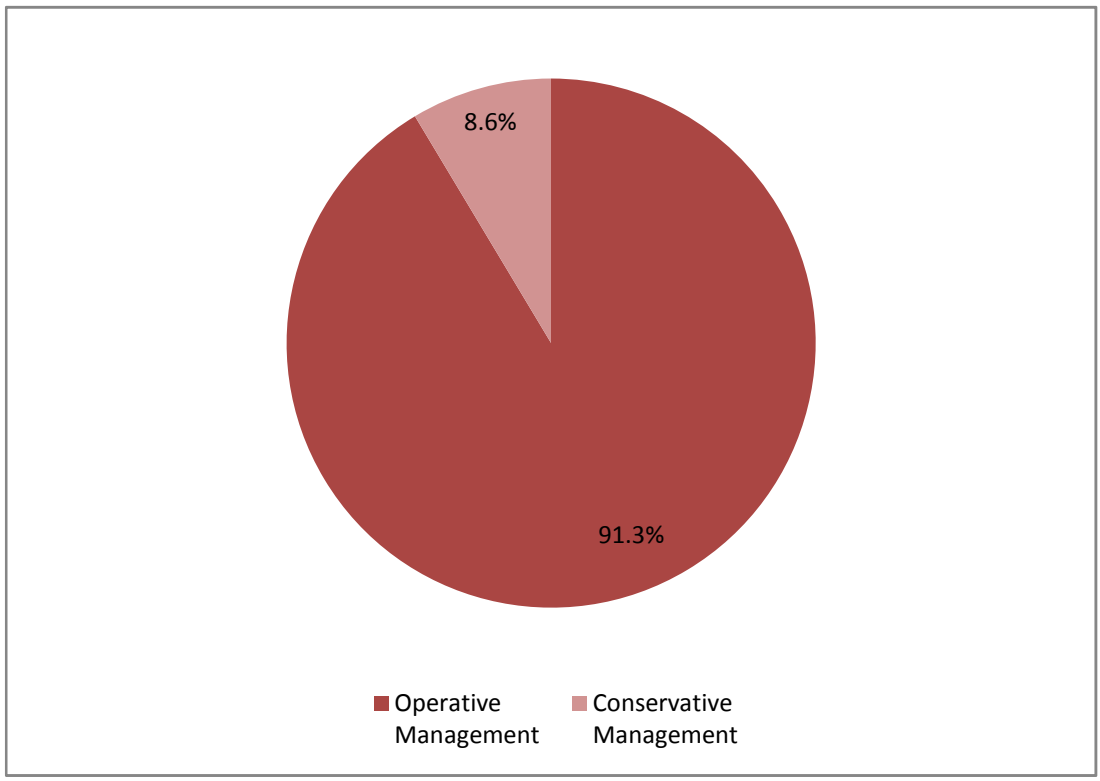
Sex Incidence



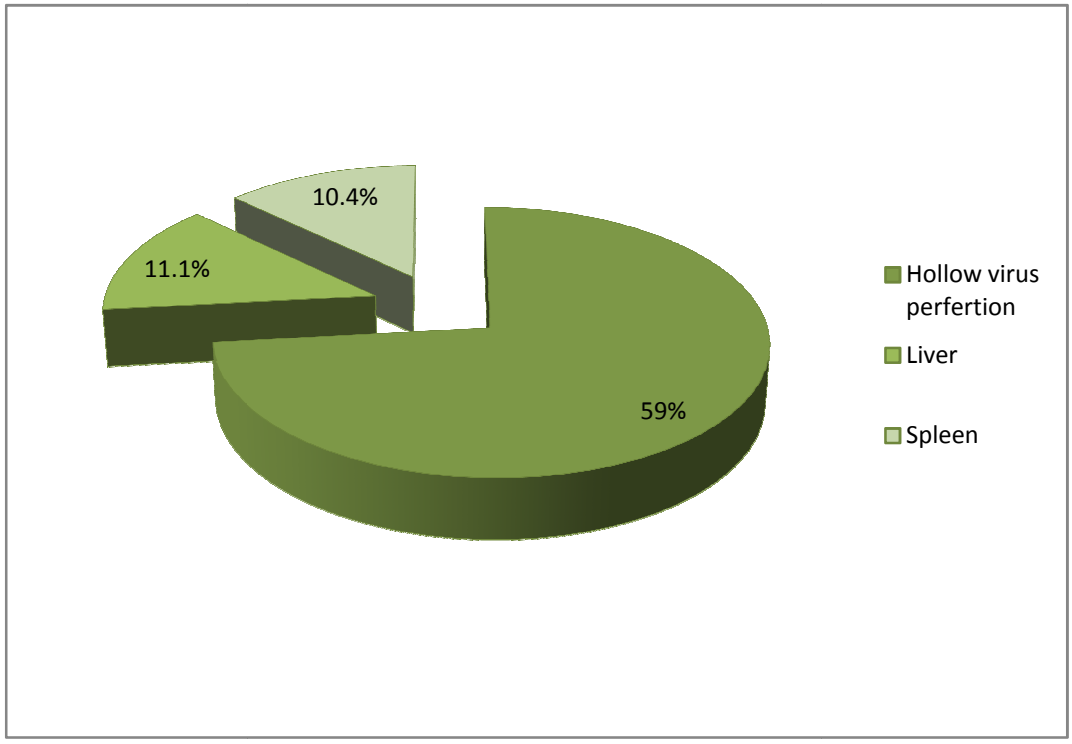
Age Incidence (Patients)



Type of Management



Organ Related Injury



Organ Related Injury

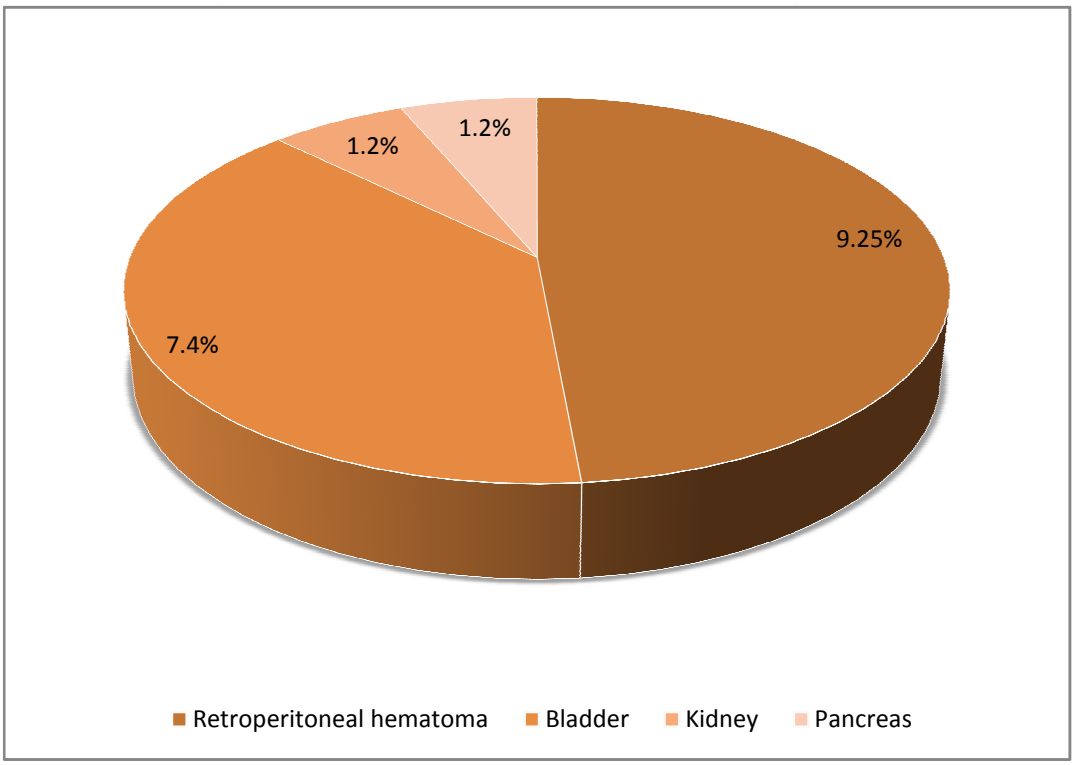


Table:1 – organ related mortality

S.no	ORGAN INJURY	NO. OF CASES	MORTALITY
1	Liver	18	5
2	Small bowel	65	13
3	Pancreas	2	2

Table : 2 – Age incidence

S.NO	AGE IN YEARS	NO. OF CASES	PERCENTAGE
1	30-40	73	45%
2	20-30	42	25%
3	40-50	30	18.5%
4	>50	17	10.5%

Table :3 – Sex Incidence

S.NO	SEX	NO. OF PATIENTS	PERCENTAGE
1	Male	103	63.5%
2	Female	59	36.4%

Table :4 –Frequency of Injured organs

S.NO	ORGAN INJURY	NO OF PATIENTS	PERCENTAGE
1	Ileum	39	40%
2	Jejunum	22	22.9%
3	Colon	15	15.9%
4	Stomach	10	6.1%
5	Duodenum	6	6.25%
6	Liver	18	11.1%
7	Spleen	17	10.4%
8	Retroperitoneal hematoma	15	9.25%
9	Bladder	12	7.4%
10	Kidney	2	1.2%
11	Pancreas	2	1.2%

DISCUSSION

In our study of blunt injury abdomen, caused due to road traffic accidents, 162 cases were admitted in thanjavur medical college and hospital from september 2016 to september 2017. Males accounted for 103 patients[45%]. Vijay malhotra et al also reported similar sex incidence in the landmark 1998 study. The proportionate majority of males could account for the male preponderance involved in road traffic accidents, also to a certain exten by their aggressive behaviour.

Solid organ injuries like liver and spleen injuries due to direct compressive forces resulting from collision. Bowel injuries might have been contributed by deceleration shear stess and sudden increase in abdominal pressure.

49 cases [30.2%] were hemodynamically unstable at presentation and required aggressive reusitation. The connectialt and suffolk show a 44% shock incidence at presentation.

20 cases died among 162 cases, in which peritonitis waas the cause of death in 15 cases and 5 patients died due to hypovolemic shock, this is due to late presentation after which they have treated in mofsul hospitals and was referred to TMCH.

Physical examination revealed abdominal bruises in 62 cases, abdominal pain and distension in 70 cases. Guarding found in all cases. Rigidity was

noticed in 20 patients . Davis et al reported abdominal pain in 75% of the patienst, rigidity and rebound tenderness in 25%.

Basic laboratory invstigations were of limited value. Plain skiagram of chest and abdomen revelaed pneumoperitoneum in 77 cases, 19 cases showed pneumoperitoneum in CT abdomen. Peritoneal tap has an accuracy of managing 50-90% as was reported in a university of Toronto study. In our series 55 patients [34%] had a positive peritoneal tap.

CT is the best investigation for both hollow viscus and solid organ injuries. With careful interpretation even suble visceral mesentric and retroperitoneal injuries can be detected. As per series of case studies by the department of radiology Virginia health science 1999, CT scan has sensitivity and specificity in excess of 95% in case of blunt trauma abdomen. Intraperitoneal fluid tends to collect in the pouch of douglas [60%] and in lesser sac [30%]. Small amount of fluid as a sole abnormality can be treated conservatively if the patient is clinically stable. [department of Radiology, Denver fort douglas military hospital, colarado 2002]. In our study a case of hematoma right lobe of liver was managed conservatively with serial Ct scan assessment.

USG is fast emerging as a emergency investigative procedure in trauma to the abdomen. The sensitivity for detectinf free fluid is 98% and for detecting solid organ injury is 80%[UCLA, 2002]. USG was done for 75 patients, 12

had bladder injury, 2 cases had pancreatic injury, 2 cases had kidney injury, 15 cases had retroperitoneal hematoma.

In our study, the emphasis was on a careful and accurate history, repaeated physical examination, four quadrant peritoneal tapping and radiography.

Bowel injury was the commonest injury detected in our series followed by hepatic and spleenic injuries. Multiorgan injuries increased the morbidity and mortality.

5 cases of liver injury died postoperatively due to combination of factors like shock, septicemia and coagulopathy. 2 cases of pancreatic injury, 13 cases of hollow viscus perforation cases died due to septicemic shock in the postoperative period.

Splenic injuries:

These amounted for 17 cases 25.7% among solid organ injury cases and 10.4% in total 162 cases. 12 were hemodynamically stable at presentation. Guarding and tenderness in the left hypochondrium was present in all 17 cases. Kehr sign was positive in 2 cases. Peritoneal tap was positive in all these cases. Splenectomy was done in 12 cases with class ¾ injury. Splenorraphy was done in 3 cases with tear near the anterior border. 2 cases were managed conservatively for grade 1.

Cobgil et al have reported that CT scan has a high sensitivity and specificity in detecting splenic trauma. Splenic salvage should be attempted if the condition of the patient , age and the spleen allows operative repair. Splenic injuries in our study were treated primarily by splenectomy.

Hepatic injuries

There were 18 cases in our study and all of them gave history of direct trauma to the right hypochondrium. Shock was seen in 10 cases. Peritoneal tap revealed hemoperitoneum in 11 cases. 5 cases were managed conservatively, 3 cases were managed by hepatorraphy, which was done with vicryl over a gel foam buttress. 10 cases were managed by packing. 5 cases of liver injury died postoperatively due to shock, septicemia and coagulopathy.

Bowel injuries

There were 96 cases of bowel injuries in our study. 5 patients presented 72 hours after injury and all the 5 cases expired in the post operative period due to the complications of the established peritonitis and multiorgan failure inspite of aggressive management. 39 cases (40%) were ileal injury ,primary closure was done in 14 cases and remaining 25 cases undergone resection and anastamosis. 2 patients of ileal injury expired on POD 2 due to septicemic shock.

22 cases (22.9%) were jejunal injury, all were seen within 15 cm of duodenojejunal flexure. 15 cases undergone resection and anastamosis and primary closure was done in 7 cases.

15 cases had colonic injury (15.9%). 4 cases had transverse colon injury, which was closed primarily. 6 cases had sigmoid colon injury, which was resected due to large nature of the tear and primary end to end anastamosis was performed. 5 cases had ascending colon injury which was closed primarily. Among the 15 cases, 4 cases who had transverse colon injury , proximal diversion colostomy was done.

6 cases (6.25%) had duodenal injury, one case had 1st part of duodenum perforation, for which primary closure was done in 2 layers with omental buttress. 5 cases had 2nd and 3rd part of duodenum injury which was closed primarily and feeding jejunostomy was done.

Bowel resection with primary enteroenterostomy is indicated if the length of the tear exceeds one half of the bowel diameter, multiple injuries, segment of bowel devascularization [richard et al]. small intestinal injuries had comparatively high mortality in our study. Repair was done either with 2-0 vicryl or chromic catgut . late presentation with established peritonitis or anastamotic site was the cause for mortality.

Pancreatic injuries

2 cases had pancreatic injury with transection, following which distal pancreatectomy and splenectomy was done. Both the cases expired due to septecemic shock , MODS, hyperglycemia in the postoperative period.

Bladder injury

12 cases had bladder injury. 5 cases had full thickness rupture of bladder, and 7 cases had partial thickness rupture of bladder. They all were closed in two layers with 1-0 vicryl. Suprapubic cystostomy was done. Patients got discharged uneventfully.

Kidney injury

2 patients had right kidney injury , following which right nephrectomy was done. There was no post operative complications.

Retroperitoneal hematoma

15 cases had retroperitoneal hematoma. All the cases had USG and CT scan evaluation durin the hospital stay. 2 cases were associated with kidney injury. 2 cases were associated with pancreatic injury and 6 cases with duodenal injury.

Mortality

Mortality occurred in 20 cases of our study accounting 12.3% of the studied population. Death occurred in 2 cases of pancreatic injury which had pancreatic transection, 13 cases of hollow viscus injury , death occurred in the postoperative period due to liver injury due to protracted hypovolemic shock, coagulopathy, MODS, and ARDS.

Delay in hospital admission , associated multiple organ injuries and established hypovolemic shock or peritonitis was the leading cause of mortality.

PROFORMA

NAME

AGE/SEX

MODE OF INJURY

MECHANISM OF INJURY – accurate history of position of the patient.

Injury admission interval

History of vomiting after injury and details

History of passing urine, hematuria

PHYSICAL EXAMINATION

Pulse

BP

Respiration

Temperature

Shock

LOCAL EXAMINATION

Tenderness, rigidity, patterned bruise, shifting dullness, obliteration of liver dullness, distension.

INVESTIGATIONS

Hb

Blood group and typing

Blood urea, s.creatinine, and blood sugar

Plain X ray abdomen, chest

Peritoneal tap

Ultra sonogram, CT abdomen

TREATMENT

NONOPERATIVE MANAGEMENT:

OPERATIVE PROCEDURE:

Liver-grading of injury

Hepatorraphy

Resectional debridement

Drains

Packing

Spleen-grade

Splenorraphy

Splenectomy

Bowel injury

Contusions and tears

Gangrene

Resection

Stoma

Drain

FOLLOW UP

IMMEDIATE POST OP

ROUTINE FOLLOW UP

BIBLIOGRAPHY

1. Ben-Menachem diagnostic and interventional radiology in trauma. 1999
2. Bailey and Love, short practice of surgery, 23rd edition 2002
3. Bosworth BM, perforation of small bowel in blunt trauma, 2000
4. Blumgart LH, hepatic resection for injuries, 2000
5. Cook DE, Vick CW, upper abdominal trauma, 2001
6. Feliciano, patterns of injury, b127 trial, mattox, 1999
7. Gold Stein AS, Scalefani et al, diagnostic superiority of CT, 2002
8. Grisworld RA, Colher GS, blunt trauma abdomen, American journal of traumatology, 2002
9. Das, clinical methods, examination of abdominal injuries, 2001
10. Gillmore D, McCain NE, hepatic trauma, packing and draining, 1997
11. Ghosh, Symes NM, splenic trauma, 2000
12. Gilanu AE, Lima RC, salvage in splenic trauma, 1999
13. Jhonson TA, Shancy AV, conservative management for splenic injury, 2000
14. Hamilton Bailey, abdominal and pelvic injuries, physical signs in clinical surgery, 20001
15. Herman hospital study of road traffic accidents, St Louis, 2003
16. Jain BL, Joshi et al, blunt trauma in urban India, Indian journal of surgery, 1999

17. King, Schumacher HB, splenic injury and susceptibility to infection, 2000
18. Kelly LL, Moor G, fibrin glue, 2002
19. Kurtzman RS, radiology of blunt trauma abdomen, journal of interventional radiology, 2000
20. Moore EE, Mithkan JS, Moore GE, small intestinal injuries, 2002
21. Poer DH, Woluer, intestinal and mesenteric injuries in blunt trauma, 2001
22. Peter Muche, Richard C et al. selective conservatism in abdominal injuries, European journal of surgery, 1999
23. Thal et al, morbidity of colostomy in colonic injuries, 1998
24. Scot CM, Greaslaeger RC, intraabdominal sepsis after hepatic injuries, principles of abdominal surgery, 2000
25. Vijay Malhotra, dept of sugery, Ajmer medical college, study on urban Indian road traffic accidents, 1996
26. Straub, university of Pittsburgh, splenic injuries, 2000
27. Bell C, broke army medical center, texas, dpl and ct scan in abdominal trauma, 2002
28. Shanmughanathan K, department of diagnostic radiology, Maryland medical center, journal of radiology, 2001
29. Sabistan DC, textbook of surgery, 16th edition, 2002
30. Sagalowsky AI, McConnell MN, renal and genitourinary trauma, journal of trauma, 1998

31. Axel Blumsworth, pancreatic injuries in blunt injury abdomen, 2000
32. Sergeant JC, retroperitoneal injuries, journal of major trauma, 1998
33. Rothenberger DA, Quattlebaum FW, blunt material trauma, American college of surgeon virginal paper, 2000
34. Olsen WR, Redman HC, Hildereth MV, abdominal four-quadrant tap, journal of trauma, 2002
35. Traub C, Perry JF, injuries associated with splenic trauma, 21:840, 2000
36. Vandamme JPJ, Bonte J, anatomy of blunt injuries, 1997
37. Pickhardt B, Moore, et al operative splenic salvage, journal of trauma, 1999
38. Williams's RD, Sergeant FT, mechanism of intestinal injuries in trauma, bmj, 2000
39. WoodburneRVT : essentials of anatomy, oxford university press, 2000
40. Wesson DE, Filler BN, Ein SH, et al, ruptured spleen, mesh repair, 2003.