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A COMPREHENSIVE STUDY OF PATHOPHYSIOLOGY AND MANAGEMENT OF BLUNT ABDOMINAL TRAUMA

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ABSTRACT: This prospective study based on the analysis of 60 consecutive cases of blunt abdominal trauma admitted to Department of Surgery M.K.C.G. Medical College hospital, Berhampur, Odisha, during the study period of JULY 2012- JULY 2014. Each patient was examined thoroughly, after taking a detailed history and Cases were admitted on emergency basis and possible immediate investigations were done. The diagnosis was made with history, clinical features and X-ray chest PA view and/or X-ray abdomen erect posture with/ without ultrasound abdomen computed tomography of abdomen and pelvis to support the diagnosis. **AIMS AND OBJECTIVES:** To determine the incidence, Patho-Physiology and Management of various abdominal organs injuries caused by blunt force. **RESULTS:** Among 60 cases of blunt abdominal injury, maximum number of cases belongs to the age group 21-30 yrs. Males were the predominant victims with ratio 7.5:1. It was found that road traffic accidents by heavy vehicle like bus; car and truck were responsible for 71.66% of blunt abdominal injuries. Among 60 cases of blunt injury, the incidence of the involvement of jejunum, spleen, liver and stomach were 30%, 25%, 15%, 8.33% cases respectively. Exploratory Laparotomy was done in 48 cases and 12 cases were managed conservatively to change the fate of these patients. The procedures adopted in the management were splenectomy, hepatorrhaphy, omental patch closure (either Grahams or modified Grahams technique according to the surgeon's preference), simple closure, resection anastomosis, ileostomy or colostomy etc according to the surgical pathology and general condition of the patient. Mortality rate in this study is 11.66% (n=7) and immediate cause of death was shock and haemorrhage and in those cases where death was delayed, cause of death was septicaemia. **CONCLUSION:** Road Traffic Accidents is the major cause and small intestine is more frequently involved abdominal organ. Early diagnosis and treatment of blunt abdominal trauma carries better prognosis. The mortality is more in patients with other associated injuries especially head injuries and in patients who were admitted delayed in the hospital. Evaluation of other associated injury should be mandatory in all blunt abdominal trauma cases.

KEYWORDS: Blunt abdominal trauma, pathophysiology and management, exploratory laparotomy, road traffic accidents.

INTRODUCTION: Blunt abdominal trauma (BAT) accounts for the majority (80 percent) of abdominal injuries seen in the Emergency Department^[1] and a leading cause of morbidity and mortality among all age groups. Identification of serious intra-abdominal pathology is often challenging;^[2,3] many injuries may not manifest during the initial assessment and treatment period. Missed intra-abdominal injuries and concealed hemorrhages are frequent causes of increased morbidity and mortality, especially in patients who survive the initial phase after an injury.

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Physical examination findings are notoriously unreliable. One reason is that mechanisms of injury often result in other associated injuries that may divert the physician's attention from potentially life-threatening intra-abdominal Pathology. Other common reasons are an altered mental state and drug and alcohol intoxication.

Blunt abdominal trauma usually results from motor vehicle collisions (MVCs), assaults, recreational accidents, or falls. The most commonly injured organs are the Spleen, Liver, Retro-Peritoneum, Small Bowel, Kidneys, Bladder, Colorectum, Diaphragm, and Pancreas. Men tend to be affected slightly more often than women.

Intra-abdominal injuries secondary to blunt force are attributed to collisions between the injured person and the external environment and to acceleration or deceleration forces acting on the person's internal organs. Blunt force injuries to the abdomen can generally be explained by 3 mechanisms.

1. The first mechanism is deceleration. Rapid deceleration causes differential movement among adjacent structures. As a result, shear forces are created and cause hollow, solid, visceral organs and vascular pedicles to tear, especially at relatively fixed points of attachment.

Classic deceleration injuries include hepatic tear along the ligamentum teres and intimal injuries to the renal arteries. As bowel loops travel from their mesenteric attachments, thrombosis and mesenteric tears, with resultant splanchnic vessel injuries, can result.

2. The second mechanism involves crushing. Intra-abdominal contents are crushed between the anterior abdominal wall and the vertebral column or posterior thoracic cage. This produces a crushing effect, to which solid viscera (eg, Spleen, Liver, Kidneys) are especially vulnerable.
3. The third mechanism is external compression, whether from direct blows or from external compression against a fixed object (eg, lap belt, spinal column). External compressive forces result in a sudden and dramatic rise in intra-abdominal pressure and culminate in rupture of a hollow viscous organ (i. e., in accordance with the principles of Boyle law).

The liver and spleen seem to be the most frequently injured organs, though reports vary. The small and large intestines are the next most frequently injured organs.

The initial clinical assessment of patients with blunt abdominal trauma is often difficult and notably inaccurate. The most reliable signs and symptoms in alert patients are as follows:

- a) Pain.
- b) Tenderness.
- c) Gastrointestinal haemorrhage.
- d) Hypovolemia.
- e) Evidence of peritoneal irritation.

However, large amounts of blood can accumulate in the peritoneal and pelvic cavities without any significant or early changes in the physical examination findings. Bradycardia may indicate the presence of free intra-peritoneal blood.

On physical examination, the following injury patterns predict the potential for intra-abdominal trauma:

1. Lap belt marks: Correlate with small intestine rupture.
2. Steering wheel-shaped contusions.

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3. Ecchymosis involving the flanks (Grey Turner sign) or the umbilicus (Cullen sign): Indicates retroperitoneal haemorrhage, but is usually delayed for several hours to days.
4. Abdominal distension.
5. Auscultation of bowel sounds in the thorax: May indicate a diaphragmatic injury.
6. Abdominal bruit: May indicate underlying vascular disease or traumatic arterio-venous fistula.
7. Local or generalized tenderness, guarding, rigidity, or rebound tenderness: Suggests peritoneal injury.
8. Fullness and doughy consistency on palpation: May indicate intra-abdominal haemorrhage.
9. Crepitations or instability of the lower thoracic cage: Indicates the potential for splenic or hepatic injuries.

Assessment of hemodynamic stability is the most important initial concern in the evaluation of a patient with blunt abdominal trauma.

In the hemodynamically unstable patient, a rapid evaluation for hemoperitoneum can be accomplished by means of diagnostic peritoneal lavage (DPL) or the focused assessment with Sonography for trauma (FAST) or C T Scan.

CT scanning often provides the most detailed images of traumatic pathology and may assist in determination of operative intervention^[4,5,6] Unlike DPL or FAST; CT can determine the source of hemorrhage.

Treatment of blunt abdominal trauma begins at the scene of the injury and is continued upon the patient's arrival at the ED or trauma centre. Management may involve non-operative measures or surgical treatment, as appropriate.

AIMS AND OBJECTIVES: The aim of the study is to evaluate the following aspects of blunt abdominal trauma:

1. The incidence and mode of blunt injury abdomen.
2. Clinical Presentation.
3. Incidence of organ involvement.
4. Method of treatment.
5. Morbidity & Mortality.

MATERIAL AND METHODS:

INCLUSION CRITERIA: This study will be carried out in patients presented to SURGERY OPD of M.K.C.G MEDICAL COLLEGE AND HOSPITAL FROM JULY 2012 TO JULY 2014. The patients are chosen with previously described criteria (signs and symptoms) which belong to this wide spectrum of blunt trauma abdomen.

EXCLUSION CRITERIA: The patients which are not willing to take part in the study or doing investigations or taking treatment or follow up excluded from the study.

DIAGNOSIS: While HISTORY AND DETAILED PHYSICAL EXAMINATION are often insufficient to diagnose majority of blunt trauma abdomen may benefit from adjunctive imaging like: STRAIGHT X-RAY ABDOMEN ERECT POSTURE, USG ABDOMEN AND PELVIS, FOUR QUADRANT ASPIRATION, DIAGNOSTICS PERITONEAL LAVAGE, CT SCAN.

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TREATMENT: Treatment of blunt abdominal trauma begins at the scene of the injury and is continued upon the patient's arrival at the Emergency Department or trauma Centre.

Management may involve non-operative measures or surgical treatment, as appropriate. Indications for laparotomy in a patient with blunt abdominal injury include the following:

1. Signs of peritonitis.
2. Uncontrolled shock or haemorrhage.
3. Clinical deterioration during observation.
4. Haemoperitoneum findings on FAST or DPL.

NON-OPERATIVE MANAGEMENT: In blunt abdominal trauma, including severe solid organ injuries, selective non-operative management has become the standard of care. Non-operative management strategies are based on CT scan diagnosis and the hemodynamic stability of the patient, as follows:

1. For the most part, paediatric patients can be resuscitated and treated non-operatively; some paediatric surgeons often transfuse up to 40 ml/kg of blood products in an effort to stabilize a paediatric patient.
2. Hemodynamically stable adults with solid organ injuries, primarily those to the liver and spleen, may be candidates for non-operative management.
3. Splenic artery embolotherapy, although not standard of care, may be used for adult blunt splenic injury.
4. Non-operative management involves closely monitoring vital signs and frequently repeating the physical Examination.

OBSERVATION: This study was conducted in M.K.C.G. Medical College Hospital, Berhampur and patients admitted with particular criteria fixed during the study period were taken as the universe after cases which refused the advised intervention or got themselves transferred to private set up (5 cases) were removed from the group. Diagnosis was made clinically and confirmed by radiography, four quadrant aspiration, DPL, ultrasound and CT scan.

The total number of patient who had sustained blunt injuries to the abdominal organs were 60. In this study 60 patients 53 cases were male and 7 cases were females. This gives a male to female ratio of 7.5:1. The increase incidence of trauma in males may probably be due to relatively high association of males in acts of violence outdoor activity and vehicular accidents. Majority of patients belonged to 21-30 years followed by 31-40 years age group.

Mode of injury	No. of cases	Percentage (%)
RTA	43	71.66%
Assault	5	8.33%
Fall	12	20.00%
Total	60	100%

Road traffic accidents (RTA) constitute about 71.66% of total blunt abdominal trauma, Followed by fall (20%). The following table shows the incidence of various symptoms and signs with which the 60 patients studied presented with.

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Symptoms and signs	No. of patients	% wrt to studied cases
Abdominal pain	45	75.00%
Vomiting	12	20.00%
Abdominal distension	30	50.00%
Haemetemesis	5	8.33%
Abdominal tenderness	38	63.33%
Guarding and Rigidity	29	48.33%
Pallor	12	20.00%
Pulse rate>90/min	34	56.66%
BP<90mm Hg systolic	30	50.00%
Absent bowel sounds	24	40.00%
Symptoms and signs		

Majority of patients presented with abdominal pain (75%) and abdominal tenderness (63.33%). Most of the patients with blunt abdominal trauma clinically presented within 4 hour (n=28, 46.66%).and mostly associated with chest injury (21.66%) followed by head injury(16.66%).

Plain X-ray abdomen was done in 30 cases. Gas under the diaphragm was found in only about 28 cases of 31 bowel perforation detected at laparotomy. The number of patients who underwent four quadrant aspirations were 11 and positive results found in 8 patients and negative in 3 patients.

Four Quadrant Aspiration	Laparotomy- Organ Injury		Total
	Present	Absent	
Positive	7	1	8
Negative	2	1	3
Total	9	2	11
Four Quadrant Aspiration VS Laparotomy Findings			

Four Quadrant Aspiration had a sensitivity of 77.77% and a specificity of 50%. A total of 40 patients were subjected for ultrasound examination, out of which 36 patients had scan detected organ injuries or hemoperitoneum for which they underwent laparotomy and 4 patients were treated conservatively because they were reported as minor or no organ injury.

CT Scan Abdomen was very useful in managing hemodynamically stable blunt injury abdomen patients. A total of 10 patients underwent CT Scan Abdomen in the study. CT Scan is important to detect injuries in solid organs as well as hollow viscous which undiagnosed by ultrasound, Serial CT Scan was further used to evaluate patients with renal injury, retroperitoneal hematoma and pseudo pancreatic cyst who were treated conservatively.

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Organ injured	No. of patients	Percentage
Spleen	15	25%
Liver	9	15%
Kidney	1	1.66%
Pancreas	1	1.66%
Stomach	5	8.33%
Duodenum	1	1.66%
Jejunum	18	30%
Ileum	4	6.66%
Caecum	1	1.66%
Colon	4	6.66%
Mesentery	3	5%
Retro peritoneum	NIL	NIL
Bladder	NIL	NIL
Organ Wise injury		

In the present series, Jejunum (n=18) (30%) is the most commonly involved organ followed by spleen (25%) and liver (15%). In this series mesenteric injury is associated with other abdominal injury. Negative laparotomy constitutes 0.02% of total laparotomies for blunt abdominal trauma.

OPERATIVE PROCEDURES: Laparotomy was done in 48 cases and 12 cases were managed conservatively. The following table shows the various operative procedure carried out on 48 patients who underwent exploratory laparotomy. Liver injuries were usually of grade 1 & 2. Hepatorrhaphy where suturing with chromic catgut along with Gelfoam packing was done in all cases. Splenic injuries ranged from grade 1 to 5 but all majority of splenic injury patients underwent splenectomy.

Bowel perforations were usually treated by simple suturing in 20 patients with 10 patients requiring resection & anastomosis. Mesenteric injuries were treated by simple suturing and ligating the bleeding points.

Procedure	No. of patients
Splenectomy	11
Hepatorrhaphy	3
Bowel perforation closure	20
Resection & anastomosis	10
Ileostomy/colostomy	5
Gastric perforation repair (simple closure/modified grahams)	5
Repair of mesentery	4

Post-operative complication includes wound infection (n=20), wound dehiscence (n=4), biliary leak (n=2), respiratory complication (n=2), intra-abdominal sepsis (n=2) etc. The mean range of stay of patients in the hospital ranged from 10-19 days and range varied from 5-46 days.

7 patients with blunt injury abdomen died in this present study. 6 patients belonged to operative group and died in the post-operative period. Therefore the mortality rate in the present

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study is 11.66%. Hypovolemic shock is major cause of death in early post op case and in solid organ injuries and sepsis in hollow viscous injuries in late post op cases.

DISCUSSION: The present study included observations made in 60 cases admitted with the history of blunt trauma with abdominal organs injuries. This constitutes 0.058% of total hospital admission from July 2012 to July 2014. Fifteen cases were in the age group of 21-30 years which accounts for 25% of cases. Thirteen cases were under the age of 31-40 years of age and 11 cases were over 11-20 y of years of age. Allen et al^[7] reported in their series 28% of patient in the age group 20-29 years and 68% were in the age range 10 to 39 years. Fitzgerald et al^[8] showed highest incidence (55%) between the ages 21 to 50 years.

Fifty three patients were males accountings for 88.33% and 7 were female's accountings for 11.66%. Allen et al^[7] showed 75.4% male patient, Perry^[9] reported 78% male patients. This shows that persons in the active period of life are more susceptible for accidents and injuries.

In our study the commonest mode of injury was road traffic accidents which occurred in 43 cases accounting for 71.66% followed by injuries due to fall accounting for 20%. The other mode of injuries are due to assault accounts for 8.33%. Allen et al^[7] reported 69.5% incidence of road traffic accidents in blunt abdominal trauma. This may be due to higher vehicular traffic in developed countries. The mode of injuries in road traffic accidents are mostly by direct hit followed by run over accidents.

Solid organs are injured by a direct violence or deceleration injury because of protected position and ligament attachments. Injury to the kidney and Pancreas is usually by direct trauma. In our study direct hit was the commonest mode of injury occurred during road traffic accidents. In our study 28 patients were admitted in this hospital within 4 hours after injury and 14 patients were admitted within 4 to 8 hours. Thirty patients (50%) were hemodynamically unstable and shock was evident on admission.

Preoperative physical examination showed that thirty eight patients had abdominal tenderness and Guarding & Rigidity were present in twenty nine patients accounting for 48.33% %. Bowel sounds were heard in twenty four patients accounting for 40%. Per rectal examination showed collection in the rectovesical pouch in 35 patients accounting for 58.33%. Davis et al^[10] in 1976 reported that abdominal tenderness occurred in 75%, rigidity and guarding in 28 % of patients. In his study 80 % of the patients were undergone exploratory laparotomy and 20% of the patients managed conservatively according to severity of symptoms and signs.

The comparative figure of our study and the studies conducted by Davis et al ^[10] and Siddique et al^[11] are given in Table.

Sl. no	Physical Signs	Over Study		Davis etal ^[10]	Siddique etal ^[11]
		No	%		
1	Abdominal tenderness	38	63.33%	75%	88.88%
2	Rigidity & guarding	29	48.33%	28%	55.55%
3	P R Exam Positive	35	58.33%	3%	0%
4	Bowel sounds absent	24	40.00%	0%	60%

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The commonest associated injury in our study is thoracic injury (21.66%) which accounted for 13 cases followed by head injury (16.66%) and orthopaedic injury and soft tissue injury. But in B.C. Jain et al^[12] study it was orthopedics injury (16%) followed by thoracic injury(11%).

In our study splenic injury is responsible for 15 cases accounting for 25%. The incidence is slightly higher when compared to study conducted by Allen et al^[7] which constitute about 23.33%.

There were totally 9 cases of liver injury which constitutes an incidence of 15 % which correlates well with Feliciano DV et al^[13] study who has reported an incidence of 15 to 20 %. Hepatorrhaphy as a technique for management of liver injury was adopted in 33.33% of liver injuries patients. Feliciano et al^[13] in his study adopted hepatorrhaphy as a method of treating liver injury in 64% of patients. Mortality rate in our study due to liver injury was 16.66% which correlates with that of study conducted by Moore EE et al^[14] who had reported mortality rate of 10 %.

There was only 5 case with stomach injury with incidence of 0.83% in our study but in Tejerina Alvarez et al^[15] study it was 0.5%.

There were totally 22 cases of small bowel injuries which constitute about 38.36%. This is in variance with the findings of Dauterive AH et al^[16] and Divincenti et al^[17] who have reported the incidence of 5% to 15%. In our study small intestine was the most common organ involved and spleen was second ranked. However the finding does correlate with that of Root HD et al^[18] who have ranked small bowel injury in the list after liver & spleen. Road traffic accidents is the major cause for small bowel trauma. Mortality due to small bowel injury was 0%. But Mukhopadhyay M et al^[19] mortality was 6.38%. In this study, there was 1 case of negative laparotomy.

Goldman et al^[20] in their study of 146 cases showed wound infection in 6 cases, wound dehiscence 17 cases, Atelectasis in 4 cases. But in our study of 50 cases showed wound infection in 20 cases, wound dehiscence 4 cases, Atelectasis in 2 cases and sepsis in 2 cases. Agent of injury and brief time interval prior to surgery were the factors for lower incidence of sepsis.

These were totally 7 deaths in this study of 60 cases constituting a mortality rate of 11.66% (4 death due to severe liver laceration and 3 due to small and large bowel injury). But in Siddique MAB et al^[11] study mortality rate was 6%.

CONCLUSION: Blunt trauma accounts for large majority of civilian trauma. Prompt evaluation of the abdomen is necessary to minimize preventable morbidity and mortality. Unstable patients with evidence of intra-abdominal hemorrhages (by US or grossly positive DPL) should undergo laparotomy immediately.

Of the multiple modalities available for evaluating stable patients, contrast enhanced CT provides the most useful information for deciding which patient needs operative therapy, observation in the intensive care unit or hospital, or can be safely discharged from the emergency department.

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