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Clinical Study Of Penetrating Abdominal Injury And Its Management

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Abstract
Introduction*: Abdomen being the third most commonly injured organ, represents 20% of the injuries requiring operative intervention. Despite being frequent, the recognition and treatment of life threatening intra-abdominal injuries remains a challenge, and 10% of all traumatic deaths are the direct consequence of abdominal injuries. There is very little room for error and well co-ordination of surgical, laboratory and radiological skill is the key to manage the patients with penetrating abdominal trauma.*
Materials and Methods*: A study of various types of penetrating injuries of abdomen was carried out in during the period from 1st June, 2019 to 31st May 2020 in Guwahati Medical College and Hospital. The study was carried out in the patients of males and females of more than 12 years of age. The patients were personally studied from time of admission to the time of discharge or death in the hospital and followed up in their subsequent visits. During this period, a total number of 50 cases of penetrating abdominal injuries were attended in the hospital. A detailed history of each patient was taken and was managed conservatively or by operative treatement and follow-up is done*
Results and Observations*: Total 60 cases of penetrating abdominal injury admitted in Gauhati Medical College and Hospital were selected for the study. The incidence of penetrating abdominal injury following stabbing and gunshot injury are increasing and incidence was found to be 2.36% of the total admissions in the department of surgery and 6.41% out of all trauma patients admitted in the department of surgery, Gauhati Medical College and Hospital.A great number of patients were young adult males with an age group of 20 to 30 years and homicidal stabbing is the commonest cause of penetrating abdominal injury. The physical findings are the most common indicator for abdominal exploration whereas the use of imaging techniques is also very important. Most commonly small bowel is affected in this form of abdominal injury followed by colon mesentery liver in decreasing order of frequency of injury. All patients (100%) required exploration. Most of the patients can be saved except two who were beyond the aid of any recovery.*
Conclusion*: The improvement in the communication and transportation, better monitoring systems and resuscitative measures, improvised diagnostic methods, better availability of blood and timely as well as more skillful surgical techniques has resulted in decrease in the mortality and morbidity from penetrating abdominal trauma.*

Keywords: *Penetrating abdominal trauma, Exploratory laparotomy, Bowel perforation*

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I. Introduction

Trauma, or injury is defined as cellular disruption caused by an exchange with environmental energy that is beyond body's resilience which is compounded by cell death due to ischemia/reperfusion. Trauma remains the most common cause of death for all individuals between ages of 1 and 44 years and is the third most common cause of death regardless of age(1). Abdomen being the third most commonly injured organ, represents 20% of the injuries requiring operative intervention. The large size and the lack of protection of the abdomen may contribute to the increased incidence of abdominal injury compared to the other parts of the body. Despite being frequent, the recognition and treatment of life threatening intra-abdominal injuries remains a challenge, and 10% of all traumatic deaths are the direct consequence of abdominal injuries (2)(3)(4). In this age of speed, civil violence, armed conflicts, crimes of passion and traffic accidents, the incidence of penetrating injuries to abdomen have been on the increase. The common availability of fire arms, the lack of proper law and governing personnel, the incidence of such injuries are on the rise.As like the gunshot wounds, stabs injuries are particularly rising owing to the interpersonal conflict and civil violence. Other causes of penetrating injury being fall from a height on sharp object, industrial accidents, bull gore injury, impalement injuries, bullet injuries, etc.

In the present year, due to overall improvement in the communication and transportation, better monitoring systems and resuscitative measures, improvised diagnostic methods, better availability of blood and

blood products, better medications and more skillful surgical techniques, the outcomes of these injuries are improving. The rapid development of ultrasonography as an early and non-invasive tool for diagnosing intraperitoneal injury has made it easier to select the patients who need laparotomy. The introduction of CT scan in the year 1980 and diagnostic laparoscopy in the year 1990 has aided in the diagnostic workup.In the appropriate environment, selective non-operative management of penetrating abdominal solid organ has a high success rate and a low complication rate. Formal wound exploration, peritoneal tap, peritoneal lavage, ultrasonography, CT scan and laparoscopy have been recommended by a number of authors. And still in most of the time it is the clinical judgment and experience which helps in deciding the management protocol. Mandatory exploratory laparotomy is still thought to be the safest means of evaluation and managing the penetrating trauma victims especially in centers where advanced investigating techniques are not available.

This present study of different types of penetrating abdominal injuries was carried out in Guwahati Medical College and Hospital to find out the incidence of the penetrating abdominal injuries, their causative factors, age, sex, presenting symptoms and signs, different organs injured, associated extra-abdominal injuries with special emphasize to their management, complications and mortality. There is very little room for error and well co-ordination of surgical, laboratory and radiological skill is the key to manage the patients with penetrating abdominal trauma.

II. Aims And Objectives

- To study its incidence, age and sex distribution,
- To study the various types and mechanism of injury.
- To study its clinical presentations and patterns of abdominal injuries and associated extra abdominal injuries.
- To study the different recent diagnostic modalities and Treatment options.
- To identify the risk organs so as to facilitate early diagnosis of trauma victims.
- To study the outcome of treatment and complications if any
- To study the mean hospital stay of the patients
- To study mortality and
- Follow up of patients

III. Materials And Methods

A study of various types of penetrating injuries of abdomen was carried out in during the period from 1st June, 2019 to 31st May 2020 in Guwahati Medical College and Hospital. The study was carried out in the patients of males and females of more than 12 years of age. The patients were personally studied from time of admission to the time of discharge or death in the hospital and followed up in their subsequent visits. During this period, a total number of 50 cases of penetrating abdominal injuries were attended in the hospital. A detailed history of each patient was taken and was managed by exploratory laparotomy and follow-up is done

Patient Selection: All cases of penetrating abdominal injuries above 12 years of age, admitted and treated in Guwahati Medical College Hospital from 1st June, 2019 to 31st May 2020 were taken up for this study.

Inclusion Criteria: Patients above 12 years of age with history of penetrating injury to the abdomen attending Gauhati Medical College and Hospital and underwent laparotomy

Exclusion Criteria:

- Patients below 12 years of age
- Patients diagnosed during examination or laparotomy with no breach of peritoneum
- Patients that died before any surgical intervention could be carried upon
- Patients that left the institution against medical advice

IV. Results And Observation

Incidence Of Penetrating Abdominal Injury:

During this period of study 5,329 patients were admitted in the Department of Surgery, of which 1965 patients were for trauma. Among these patients 396 sustained abdominal injuries, of which 270 patients had blunt trauma and 126 patients suffered penetrating injuries of Abdomen.. 60 patients were selected for the present study. Patients that died before any surgical intervention could be carried upon and those that left the institution against medical advice were not included in the study. Thus the incidence of penetrating abdominal trauma was found to be 2.36% of the total admissions in the department of surgery and 6.41% out of all trauma patients admitted in the department of surgery, Gauhati Medical College and Hospital. Relative percentages of penetrating and blunt trauma were 31.82% and 68.18% respectively.

Causes Of Penetrating Abdominal Trauma

The most common cause of penetrating abdominal injury found in this study is stab injury by sharp objects which is followed by gunshot injury.

The different causes of penetrating abdominal injuries of this series are mentioned in the table below:

Mode Of Injury	No. Of Cases	Percentage
Stab Injury	31	51.67%
Gunshot Injury	12	20.00%
Splinters	2	3.33%
Fall On Sharp Object	9	15.00%
Others	6	10.00%
Total	60	

Sex Incidence:

In this study we found a male preponderance in cases of penetrating injury to the abdomen. This may be because males are more commonly involved in the criminal activities and inter-personal conflict. Out of 60 cases, we found 50 cases to be male and the rest 10 to be female. Hence the m ale female ratio in the present study comes out to be 5:1.

Sex	No of cases	Percentage
M	50	83.33%
F	10	16.67%

Age Distribution:

In this present study, the age of the patients ranged from 13 years to 68 years. The commonest age group was 20 to 30 years which comprises about 36.67%. Next most common age group was 4th decade (25%). The mean age came out to be 32.88 years.

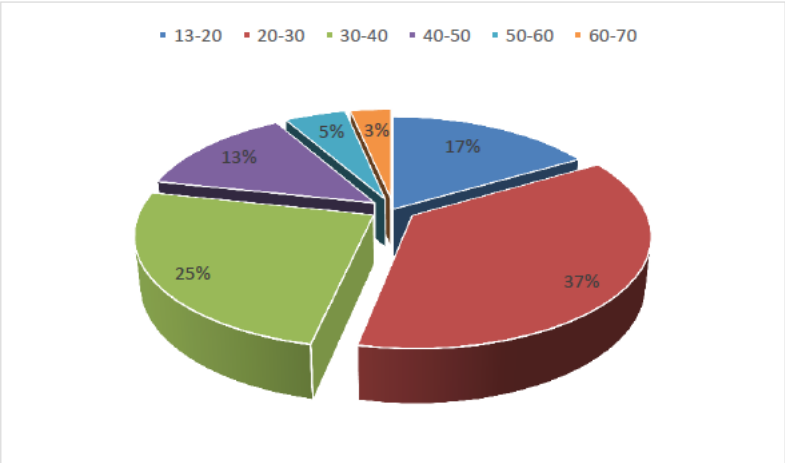

Fig 29: Pie diagram showing the different age distribution in penetrating abdominal injuries.

Associated Injuries:

It is found in this series that a total of 29 cases (48.33%) out of 60 cases had one or more associated injuries along with abdominal injuries. It is seen that mode of injury carries an association with the presence or absence of associated injuries. The victims of stab injury show infrequent number of associated injuries in comparison to gunshot injury and road traffic and accidental fall injuries. The various associated injuries in patients with penetrating abdominal trauma are shown in the table below:

Mode of injury	No of associated injury	Percentage of associated injury
Stab injury	6	10.00%
Gunshot injury	8	13.33%

Splinters	2	3.33%
Fall on sharp object	5	8.33%
Others	8	13.33%

Table 4: Table showing the relation of associated injuries to the mode of injury

Associated injuries	No of cases	Percentage%
Soft tissue injury	17	28.33%
Chest injury	3	5.00%
Skeletal injury	9	15.00%
Total associated injuries	29	48.33%

Table 5: Table showing associated injuries with penetrating abdominal injuries

Criminal Status Of Injury:

It is found that most commonly the penetrating abdominal injuries are due to homicidal stab or gunshot injury followed by accidental injuries. The criminal status is as follows: Homicide 45 cases (75%), Accidental 12 cases (20%) and Suicidal 3 cases (5%).

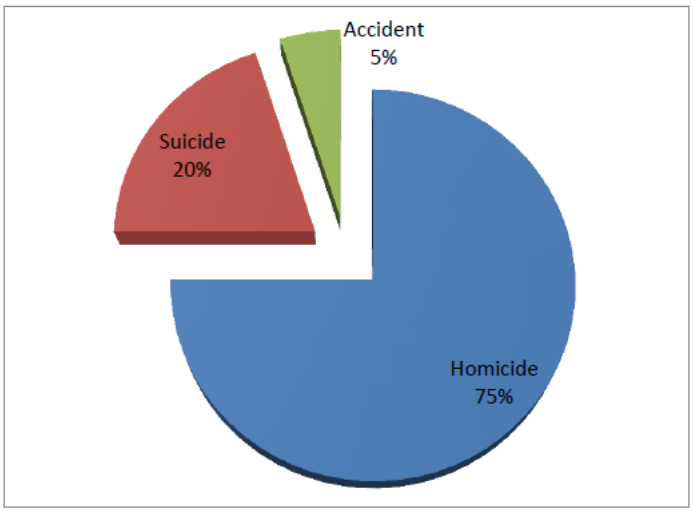

Fig 32: Pie diagram showing the criminal status of the injuries

Time Interval Between Injury And Admission:

It is very crucial to know the time interval between the injury and admission as it directly affects the outcome of the patient. In the present study most of the patients were found to attend the medical facility as early as within 6 hours.

Time interval	No of cases	Percentage
0 to 6 hrs	44	73.33%
6 to 12 hrs	7	11.67%
12 to 24 hrs	2	3.33%
24 to 48 hrs	5	8.33%
More than 48 hrs	2	3.33%

Mode Of Presentation:

The patients with penetrating abdominal injury presented with various symptoms. However moderate to severe pain were observed in 96.6%cases. The pain was continuous in nature in all the cases. There was abdominal distension as presenting symptoms in 55% cases and vomiting in 40% cases. 16.67% cases had bleeding from the wound as presentation. The following table shows modes of presentation found in the present study.

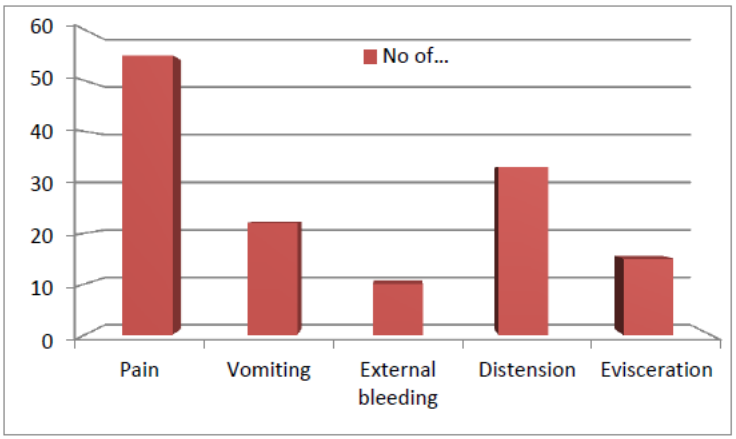

Fig 34: Bar diagram showing the different presentations of penetrating abdominal injury

Physical Findings (Signs):

In the present study, the various physical findings found, in order of frequency, other than injuries are tenderness, rigidity, and obliteration of liver dullness, absence of bowel sounds, pallor and shifting dullness and shock .91.67% cases presented with abdominal tenderness,55% cases presented with distension of abdomen,50% cases presented with absence of bowel sound and 10% cases presented in shock The following table shows the different physical findings.

Serial No	Signs	No of cases	Percentage
1	Tenderness	55	91.67%
2	Rigidity	21	35.00%
3	Distension	33	55.00%
4	Absent bowel sound	30	50.00%
5	Pallor	12	20.00%
6	Shock	6	10.00%

Investigations:

1. Blood:

Haemoglobin estimation, Total leucocyte count, Random blood sugar and Serum creatinine were done in almost all cases. Most of the cases presented with moderate to severe degree of anaemia, (which may be due to blood loss or due to preexisting anaemia).

Those patients who presented late (beyond 6 hrs), presented with raised leucocyte counts. Among 60 cases, 12 cases (20%) presented with raise leucocyte counts .

Random sugar was raised in one patient who was known diabetic and his blood sugar level was corrected before operation.

Serum creatinine level was raised in those patients who presented lately (due to dehydration), as they received less Intravenous fluid due to dehydration.

2. Urine:

In all cases, urine examination was found to be normal

3. Radiological investigations:

All the patients of penetrating abdominal injury after initial resuscitative measures were taken through radiological investigations like Plain x-ray of the chest and abdomen and ultrasonography of the abdomen. No CT scan was done in this series. The following are the different results of investigations found in the present study.

a. Plain x-ray: The most common finding in the plain x-ray was free gas under the diaphragm which was found in cases. The other findings were generalised haziness, dilated bowel loops and obliterated psoas shadow in decreasing order.

Serial No	X-ray findings	No of cases	Percentage
1	Normal	29	48.33
2	Free gas under diaphragm	24	40.00
3	Dilated bowel loops	10	16.67
4	Generalized haziness	11	18.33
5	Obliterated psoas shadow	3	5.00

b. Ultrasonography: Focused assessment with sonography for trauma (FAST) was used for almost all the cases on arrival in the casualty department . FAST was found to be very effective in diagnosing the solid organ injury whereas it effectiveness in detecting hollow viscus injury was found doubtful especially in cases presenting early. FAST showed some of the positive findings in 43 (71.67%).

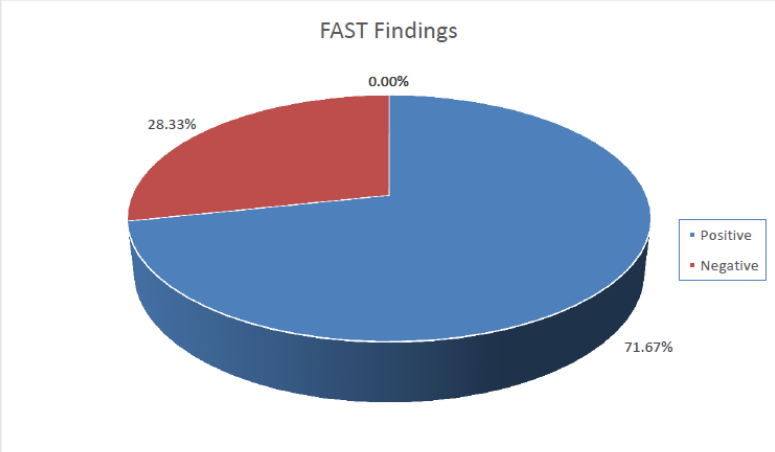

Fig 37: Bar diagram comparing the ultrasound findings with operative findings

c. Diagnostic peritoneal tapping: Diagnostic peritoneal tapping was performed in 37 cases with inconclusive findings. But the positive results were of definite help in making the diagnosis. A tapping of non-clotting blood, bile stained fluid, fluid stained with fecal matter were considered as positive tapping

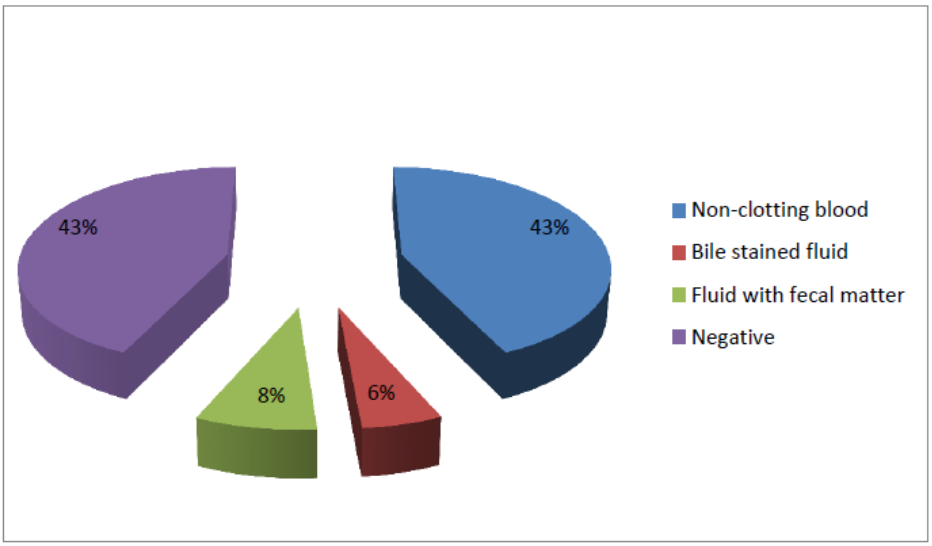

Fig 38: pie diagram showing findings of abdominal tapping

Management:

The selective approach for the management of penetrating trauma had been used. However all of the patients with penetrating abdominal trauma underwent some kind of surgical intervention (100%), All laparotomies were performed through midline incision except in three cases where right paramedian incision was used as the suspected injury was more towards the right side and hence to allow more accessibility. The midline incision was extended laterally in left side as 'T' in one patient with penetrating splenic injuries.

A. Indication for laparotomy:

For determining the factors that can predict the need for laparotomy, five factors were compared and their positive values are shown below.

Positive finding	No. of cases	Percentage
Peritonitis	21	35.00%
Absent B. Sound	30	50%
USG	43	71.67%
Pneumoperitoneum	24	40%
Positive paracentesis	21	35.00%
Shock	6	10.00%
Evisceration	10	16.67%

B. Time interval from admission to laparotomy:

The time is very important in the management of penetrating abdominal trauma and the shorter the time taken for intervention, the better is the prognosis of the patient. In this series the time interval from admission to surgery is 30 minutes to 63 hours and the maximum number of surgeries was done within 6 hours from the time of admission. The following table show the different time interval take from admission to surgery in this series.

Hours	No. of cases	Percentage
0 to 6 hours	49	81.66%
6 to 12 hours	6	10.00%
12 to 24 hours	3	5.00%
24 to 48 hours	2	3.33%

C. Conservative or operative management:

Out of 60 cases in this series all cases were managed operatively.(100%)

D. Incidence of prolapsed abdominal viscera:

It is found that in 10 cases out of 60 cases (16.67%) prolapse of abdominal viscera is seen. The following table shows the frequency of prolapse of abdominal viscera.

Viscera involved	No of cases	Percentage
Omentum alone	7	11.67%
Intestine alone	2	3.33%
Omentum and intestine	1	1.67%

E. Operative findings:

On laparotomy of the 60 cases, blood in the peritoneal cavity was observed in almost all the cases with or without the admixture of intestinal contents. Peritoneal fluid with intestinal contents only was found id 3 cases whereas bile stained fluid was found in 3 patients. However there was no findings and no visceral injury in 3 cases in this study.

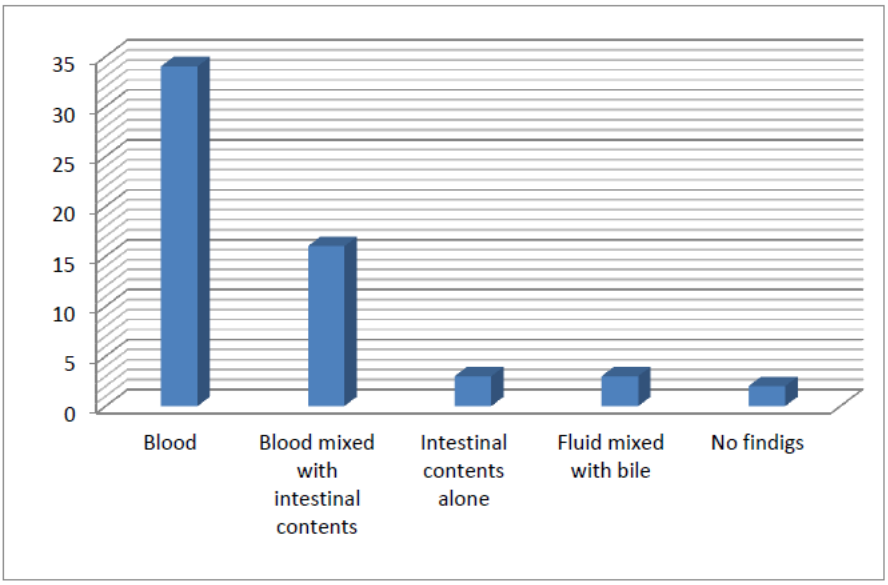

Fig 42: Bar diagram showing operative findings

F. Frequency of organs involved:

Penetrating injury may involve any viscera in the abdomen to varying extent. In this series, it is found that the small intestine is the most commonly involved viscera followed by colon, omentum and mesentery and liver in decreasing order. The following diagram shows the frequency of organ involvement.

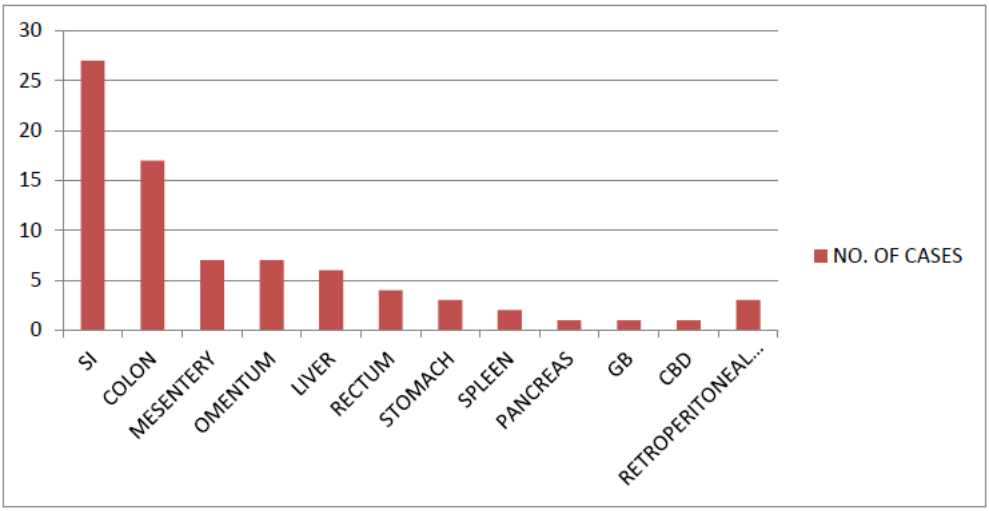

Fig 43: Bar diagram showing frequency of organs involved

G. Operations performed:

1. Small intestine: Small bowel injuries were the most frequently encountered in this series. A total number of 27 small bowel injuries were found. A total of 21Small intestinal perforations were treated by primary repair in two layers, the first layer with 2-0/3-0 round body vicryl/chromic catgut with an atraumatic round bodied needle through all layers and a second layer of seromuscular inverting suture of 2-0/3-0 atraumatic silk with round body needle. Perforations were repaired in transverse direction. 7 cases required resection and end-to-end anastomosis because of multiple injuries and/ or devitalised bowel. It is also done in two layers with similar

suture material as repairing a perforation. The following table shows the number and pattern of small intestinal repair.

Parts of small intestine	Number of cases	
	Primary repair	Resection and reanastomosis
Duodenum	3	0
Jejunum	7	2
Ileum	11	5

2. Colon and rectum:. 17 cases of colonic injuries and 4 cases of rectal injuries are found in this series. The colonic injuries were repaired in either interrupted single layer or two layers with or without colostomy. The sutures used are vicryl 2-0/3 -0, silk 2-0/3-0 with round body needle. In one case resection and reanastomosis is done along with colostomy. Following table shows the management pattern of colorectal injuries

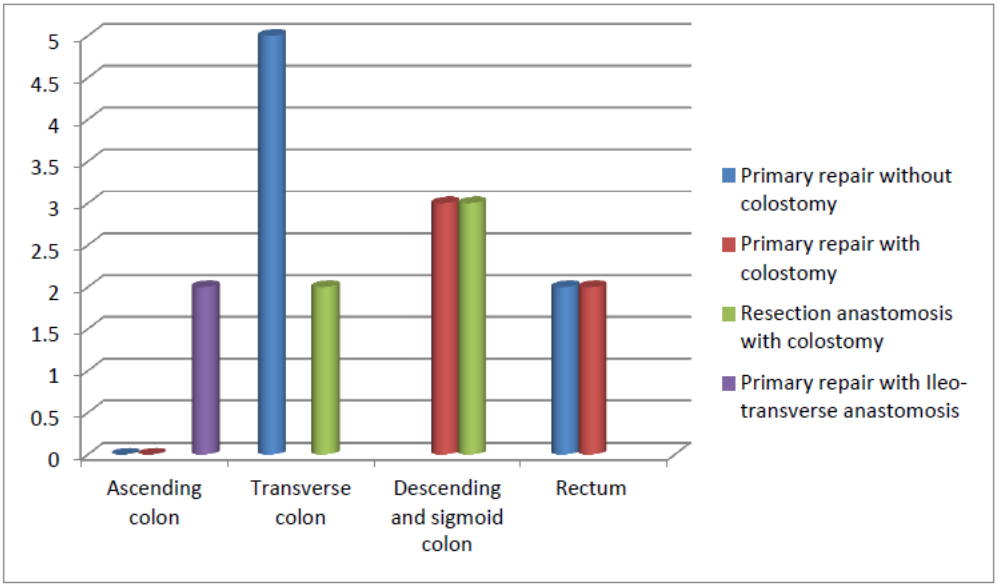

Fig 45: Bar diagram showing procedures performed for colonic injuries

3. Mesenteric injuries: There are 7 mesenteric injuries in this study. Tear of the mesentery was repaired with 2-0 round body silk sutures. Bleeding points were secured and ligated with silk. When the tear is more than 5cm in transverse direction, resection of bowel segment was required. The hematomas associated with mesenteric injuries were evacuated and bleeding was controlled by under running silk sutures.
4. Omental injuries: 7 cases have been identified to have omental injuries and all these were managed by ligating and dividing the injured omentum after proper hemostasis.
5. Eviscerated organs: In this series, there are 10 patients with eviscerated viscera. Those with evisceration of bowel loops, after an exploratory laparotomy, the bowels were washed and examined carefully and repositioned into the peritoneal cavity. Omental eviscerations were treated in a similar fashion but except in one case, in all the 9 cases, the protruding omentum is excised after proper ligation.
6. Liver injuries: there were 6 liver injury cases which were managed by simple primary repair with interrupted 1-0 chromic catgut sutures and drainage. Packing and resection were not used.
7. Retro-peritoneal hematoma: All of the 3 retroperitoneal hematomas were in zone II and were not explored.
8. Stomach injuries: All 3 stomach injuries were treated with primary repair with application of Graham's patch over the defect.
9. Splenic injury: Splenectomy was done as a treatment for penetrating splenic trauma.
10. Pancreatic injury:1 cases of pancreatic injury were found which were of grade I and hence only drainage was used for their management.
11. Common bile duct injury: A single case of laceration of the supraduodenal portion of the common bile duct is found in this series. The laceration measuring 2 cm in vertical direction was repaired with 3-0 vicryl with the

placement of T-tube in the CBD. The t-tube was removed after 2weeks after a t-tube cholangiogram.
12. Gallbladder injury: In one patient the gallbladder was transected in the fundus as a result of penetrating trauma. Cholecystectomy was done in that patient.
13. Any bleeding vessels encountered was secured and ligated.

V. Complications

1. Wound infection: Wound infection was found in 17 cases varying from minor stitch infection to wound gapping. They were grouped as –minor stitch infection, wound infection and wound gapping. These patients responded to antibiotic and regular dressing with antibiotic ointment. Wound gapping required secondary suture and results were satisfactory.
2. Intra-abdominal abscess: It developed in 2 cases and they responded to conservative management, none of them required drainage.
3. Anastomotic leak: not developed in any case.
4. Chest complication like basal atelectasis, exacerbation of COPD and Respiratory tract infection developed in 4 patients post-operatively. Out of them 3 responded well with antibiotics, Oxygen inhalation, Nebulization and Chest physiotheraphy and the rest one expired.
5. Shock: Postoperative shock developed in 3 patients. Out of which 2 patients recovered with adequate resuscitation while the other died.

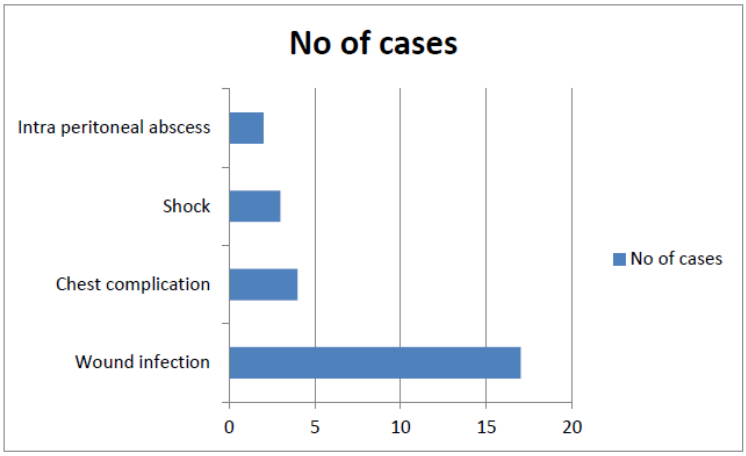

Fig 46: Bar diagram showing post- operative complications

Mortality:

There were 2 mortalities in this study of 60 patients with penetrating abdominal trauma making the mortality rate of 3.33%. Mortality depends directly in the diagnosis and treatment, as well as the severity of injury.

Mortality rate of this present study is shown below:

Treatment	Number of cases	Deaths
Operative	60	2
Conservative	none	None

Follow Up:

Out of the 60 cases in this series, 45 patients came for follow up within 2 weeks. All the patients were doing well with some having the complaints mentioned in the table below

Complaint	No of patient
No complaints	32
Scar hypertrophy	5
Scar tenderness	6
Wound infection	2

VI. Discussion

The penetrating abdominal injuries are on the rise because of the increase in the urban violence and now it is encountered as the common injuries all around the world. As a rule, the number of penetrating injury is also on the rise in this part of the country and admissions for such kind of injury are also increasing day by day in the Gauhati Medical College and Hospital.

During this one year period from 1st June 2019 to 31st may 2020, a total of 60 cases of penetrating abdominal injuries have been identified for this study on the basis of the inclusion and exclusion criteria mentioned as earlier. A clinical study was done during hospital stay, taking careful history of the injury, the clinical presentation, the investigations and in particular the management of the patient including the complications (if any) and the result of follow up were noted and the outcomes of treatment whether conservative or operative were evaluated.

Thus the incidence of penetrating abdominal trauma was found to be 2.36% of the total admissions in the department of surgery and 6.41% out of all trauma patients admitted in the department of surgery, Gauhati Medical College and Hospital. Relative percentages of penetrating and blunt trauma were 31.82% and 68.18% respectively. The following table shows the incidences of different authors in different studies in different time period.

Author	Incidence out of all abdominal injury cases
Nance et al (1974)	68%
Rastogi et al (2014)	31%
G Rajendran et al(2018)	30.53%
Olagun et al(2019)	47.9%
Present study	31.82%

In this present study, the age ranged from 13 years to 70 years and the commonest age group was 20 to 30 years which was comparable to the previous studies. The next common age group was 30 to 40 years followed by 13 to 20 years. The mean age found in the current series was 32.88 years which tally with the results found by various authors. The following table shows the different age groups found by different authors in comparison to the present study.

Table comparing the mean age found by different author at different times:

Author	Mean age
Demetriades et al (1991)	28 years
Clarke et al (2008)	30.5 years
Schmelzer et al (2008)	32 years
G Rajendran et al(2018)	35.5 years
Present study	32.88 years

In this study males were found to be much more commonly involved than females. 83.33% of the cases were found to be males. In the previous study by different authors, it was found that males always outnumbered females in penetrating abdominal injuries, the reports of some of the studies are shown in the table below.

Name of the Author	Male (%)	Female (%)
D J J Muckart (1990)	93.7	6.3
D Demetriades (1991)	97	3
Clarke (2008)	92	8
Mohammad A Gad (2012)	87.1	12.9
Present study	83.33%	16.67%

It is very crucial to know the time interval between the injury and admission as it directly affects the outcome of the patient. In the present study most of the patients were found to attend the medical facility as early as within 6 hours (73.33%).

The presence or absence of associated extra-abdominal injury plays a vital role in the prognosis of the patient. It is found that the mode of injury carries an association with the presence or absence of associated injuries. The victims of stab injury show infrequent number of associated injuries in comparison to gunshot injury and road traffic and accidental fall injuries. In this series 29 cases (48.33%) were found to have associated injury with abdominal injury. The following table shows the occurrence of associated injury with penetrating abdominal trauma in different studies.

Author	Associated injuries
Mohammad A Gad et al (2012)	42.1%

G Rajendran et al(2018)	60%
Sharma et al(2019)	56%
Present study	48.33%

In the present study plain x-ray of the abdomen was used to evaluate the patients and the x-ray finding was positive in 29 cases (48.33%). Free gas under diaphragm, dilated bowel loops; generalized haziness and obliterated psoas shadow were amongst the positive findings in the x-ray. However, Aho et al (1980) found only 5.5%(30). Demetriades (1991) used free gas under the diaphragm as an indication for surgery and Muckart et al (1990) used x-ray to document and locate the foreign body if any.

The common positive findings in ultrasonography in this series were lacerations or contusions of solid organ, abdominal free fluid, and free gas in the peritoneum and in some cases dilated bowel loops. FAST showed some of the positive findings in 43 (71.67%). The sensitivity of ultrasonography for abdominal trauma according to Udobi et al (2001), Boulengar et al (2001), Tayal et al (2004) and Smith et al (2006) was 60%, 67%, 100% and 71.4% respectively.

Paracentesis was done in 37 cases with inconclusive findings. But the positive results were of definite help in making the diagnosis. A tapping of non-clotting blood, bile stained fluid, fluid stained with fecal matter were considered as positive tapping. Out of these 37 cases, paracentesis was positive in 56.76% cases. Ergene et al (2002) found surgically confirmed hemoperitoneum in 6 out 0f 7 cases of paracentesis positive patients(84). Gao et al (2003) found 58.82% paracentesis positive cases in their study.

The indications for operation in this present series were identified as

- Signs of peritonitis,
- A positive paracentesis,
- Persistent hypovolemic shock,
- Absent bowel sounds,
- Pneumoperitoneum in x-ray and
- Positive ultrasound findings and organ evisceration.

The time is very important in the management of penetrating abdominal trauma and the shorter the time taken for intervention, the better is the prognosis of the patient. In this series the time interval from admission to surgery is 30 minutes to 60 hours and the maximum number of surgeries was done within 6 hours from the time of admission (80%). The treatment delays found by different authors are listed below.

Author	Treatment delay
Nassoura et al (1991)	94.67% within 6 hours
Narshimha et al(2017)	87% within 6 hrs
G Rajendran et al(2018)	80% within 6hrs
Present study	80% within 6 hours

Table showing the time interval between admission to operation in different studies

In this series all the 6 liver injuries were managed with primary repair by simple suture with chromic catgut. The primary repair of liver injuries were advocated by authors like Asensio et al(2000)(139). However complex liver injuries might require hepatic resection (Polanco P. et al 2008) or packing to temporarily control the bleeding (Asensio et al 2000).

Rodney Durham (1990), D.S Morris et al (1991) suggested repair of stomach injuries in two layers(46, 75). All 2 stomach injuries in this series were treated in this fashion with additional Graham's patch application.

One case of common bile duct injury was found and was about 1/3rd of the circumference of the common bile duct. It was repaired with a T-tube in situ. Kitahama et al (1982), Feliciano et al (1986), P G Bade et al (1989) also advised repair in similar fashion.

Single case of gallbladder injury underwent cholecystectomy which is at par with the management followed by Kitahama et al (1982), Feliciano et al (1986), P G Bade et al (1989).

In this series, a single case of grade I pancreatic injury was found, which was managed only with drainage. Most of the authors advocated drainage for pancreatic injuries up to grade III. A Loppaniomi et al (1988) stated that pancreatic injuries occur in 0.2 to 6% of cases of abdominal trauma he said that drainage, suture, Roux-en-y anastomosis, distal resection and Pancreatico-duodenectomy give good results.

There were 3 retroperitoneal hematomas in this series, all were in the zone II and they were managed by observation. Costa and Robs in 1985 classified the retroperitoneal hematomas and suggested expectant management for zone II hematoma. Later D.V Feliciano (1990) and Manzini et al (2013) came out with the same results.

Out of all the penetrating abdominal injuries in this series, only 2 patients died and thus the mortality

comes out to be 3.33 %. The mortality rates found by various authors in different times are shown in the table below.

Author	Mortality (percentage)
Arikan et al (2005)	0%
Lipsky(2006)	3%
Schmelzer (2008)	2%
Letton (2010)	1.2%
Burlew (2011)	1.5%
Present study	3.33%

From the reports of the various authors it is seen that mortality is decreased due to overall improvement in the communication and transportation, better monitoring systems and resuscitative measures, improvised diagnostic methods, better availability of blood and blood products, better medications and more skillful surgical techniques.

VII. Conclusion

This present study was done in Gauhati Medical College and Hospital with an aim to find out the overall incidence, age and sex incidence, the cause, the nature of injury, the organs involved, and the management of the cases. Total 60 cases of penetrating abdominal injury admitted in Gauhati Medical College and Hospital from 1st june 2019 to 31st may 2020 were selected for the study.

The incidence of penetrating abdominal injury following stabbing and gunshot injury are increasing and incidence was found to be 2.36% of the total admissions in the department of surgery and 6.41% out of all trauma patients admitted in the department of surgery, Gauhati Medical College and Hospital.A great number of patients were young adult males with an age group of 20 to 30 years and homicidal stabbing is the commonest cause of penetrating abdominal injury.

The physical findings are the most common indicator for abdominal exploration whereas the use of imaging techniques is also very important. Most commonly small bowel is affected in this form of abdominal injury followed by colon mesentery liver in decreasing order of frequency of injury. All patients (100%) required exploration. Most of the patients can be saved except two who were beyond the aid of any recovery. The improvement in the communication and transportation, better monitoring systems and resuscitative measures, improvised diagnostic methods, better availability of blood and timely as well as more skillful surgical techniques has esulted in decrease in the mortality and morbidity from penetrating abdominal trauma

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