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Original Research Article

A prospective observational study of gastrointestinal perforations following blunt trauma abdomen

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ABSTRACT

Background: Blunt trauma abdomen often presents late leading to increased morbidity and mortality, therefore the challenges in management of such patients warrant a study in this area for early diagnosis and better outcomes.
Methods: A prospective observational study was carried out at a government institute in Central India. All patients having blunt trauma abdomen with GI perforations were observed over 2 years wherein clinical presentation, time of presentation, diagnostic methods and the outcomes were the parameters studied.
Results: Young men (21-30 yrs) were found to be the commonly injured group. Road traffic accidents were the most common cause of blunt trauma abdomen. We found that mechanism of injury is related to the outcome and high energy transfer injuries (76%) led to high morbidity and mortality. Abdominal pain with abdominal tenderness and guarding was the most common presentation. Chest X-ray showed free gas under diaphragm in 58%patients who underwent xray. Other modalities used were FAST (focussed abdominal scan for trauma) scan which showed hemoperitoneum. CT scan had 97% sensitivity in diagnosis. Jejunum was the most common site of perforation. Simple closure of perforation with peritoneal lavage was the most commonly performed operative procedure. Overall, 35 patients developed complications in the postoperative period, wound infection being the most common. Mortality in this study was 26%.
Conclusions: Young men are the most commonly injured in road traffic accidents with jejunum being the commonest organ injured. High velocity trauma, late presentation, multi- organ injury worsens the prognosis hence early diagnosis becomes imperative for better outcome.

Keywords: Blunt trauma, Gastrointestinal perforations, Peritonitis, Hollow viscous injury, Diagnostic delay

INTRODUCTION

Traumatic injuries from violence, self-harm, and unintentional events are a major global public health problem. Accounting for more than 5 million deaths every year, the mortality burden of trauma accounts for 1.7 times more than deaths from HIV/AIDS, malaria, and tuberculosis combined.[1] Traumatic injuries have been one of the causes of substantial morbidity and mortality all over the world.[2,3]Blunt trauma abdomen is one of the leading causes of death among all age groups. Thus, being an important topic of discussion and research.[4] The most common cause of blunt trauma abdomen is road traffic accidents. Other causes being fall from height, assault, and animal attack.[5,6] There is increase in number of patients with blunt trauma abdomen due to developments in industrialisation, various transport systems and violence.[7,8] The diagnosis of gastrointestinal

perforation in case of blunt trauma abdomen is infrequent as the injury needs to be very severe to cause perforation. A hollow viscus injury is not usually suspected unless the clinical condition is highly suggestive.[2,6]

The most important problem associated with gastrointestinal tract lesions following blunt abdominal trauma is that they frequently remain undetected or are diagnosed too late despite advances in medical imaging with techniques such as focussed abdominal sonography for trauma (FAST), computerised tomography scan, and magnetic resonance imaging.[9,10] A delay in diagnosis and treatment of the hollow viscus injury results in early peritonitis, hemodynamic instability leading to increased mortality and morbidity.[2,5,8]

A high degree of suspicion of intra-abdominal injuries, even in cases following minor trauma will prevent the diagnostic errors. Early diagnosis and effective management of gastrointestinal perforations following blunt trauma to abdomen helps in decreasing overall morbidity and mortality among these patients. These patients pose a real challenge to the surgeons with respect to diagnosis as well as treatment thereby representing importance of this study.

Objectives taken into consideration were to study the demographics of the population involved, the mechanisms of injury leading to blunt abdominal trauma, clinical features of patients presenting with such history, investigation procedures for the diagnosis, operative intervention and complications of the injury.

METHODS

Our study was conducted in a tertiary care hospital (Government Medical College and Hospital, Nagpur) with Trauma care centre facility in Central India. All patients presenting with history, signs, symptoms and/ or radiological investigations suggesting gastrointestinal perforations following blunt trauma abdomen were included in the study. Data for the study was collected from hospital records.

Study design, subjects and duration

This is a prospective observational study. Patients admitted to Trauma care centre, General Surgery Ward and Casualty with history and symptoms suggesting Gastrointestinal perforations following blunt trauma abdomen. Study was conducted from June 2019 to November 2021.

Inclusion criteria

All patients presenting with history, signs, symptoms and/ or radiological investigations suggesting gastrointestinal perforations following blunt trauma abdomen were included.

Exclusion criteria

Patients with known psychiatric illness, patients with penetrating trauma to abdomen, pregnancy patients not consenting for study were excluded.

Sample size

Sample size was calculated considering the most common site of injury with blunt trauma abdomen being Ileum as reported in article by Jha et al with following assumptions; Proportion of patient with most common site of injury with Blunt Abdominal Trauma=46.2%, Absolute precision =10, Desired confidence level=95%. Thus, sample size was calculated to be 95.

RESULTS

In all 95 patients with gastrointestinal perforations following blunt trauma abdomen were included. Most patients were young and middle aged with maximum numbers in 21-30 yrs (N=26) followed by 31-40 yrs and 41 -50 yrs each having 22 patients (Table 1).

Table 1: Age and sex distribution of study population (n=95).

Age group (years)	N	Male	Female	%
0-10	2	1	1	2.10
11-20	9	8	1	9.47
21-30	26	23	3	27.36
31-40	22	20	2	23.15
41-50	22	20	2	23.15
51-60	8	6	2	8.42
61-70	5	4	1	5.26
71-80	1	1	0	1.05
More than 80	0	0	0	0
Total	95	83	12	100

Table 2: Modes of injury (n=95).

Mode of injury	N	%
Road traffic accidents	70	73.6
Fall from height	12	12.6
Assault	6	6.3
Animal attack	5	5.2
Fall while playing	2	2.1

Number of men affected were 83 and women were 12 (Table 1). With regards to mode of injury, road traffic accidents was the most common cause (N=70) followed by fall from a height (N=12) (Table 2). With respect to time of presentation to the hospital, 55 patients presented within 24 hrs of the injury and 40 presented late (more than 24hrs post trauma) (Table 3). Most patients presented with pain in abdomen (N=48) as their only chief complaint. Others had pain in abdomen with other symptoms like vomiting breathlessness and other symptoms in relation to polytrauma (Table 4).

Radiological investigations were done which included X-ray of the chest and abdomen, FAST scan and Plain CT scan of abdomen (Table 5).

Table 3: Time of presentation (n=95).

Presentation	Total	Mortality	%
Acute (admission within 24 hours)	55	11	20
Delayed presentation (admission after 24 hours)	40	12	30
Total	95	23	100

Table 4: Presenting complaints.

Complaints	N	%
Pain in abdomen isolated	46	48
Pain in abdomen and vomiting	5	5.2
Vomiting only	7	7.3
Vomiting and breathlessness	2	2.1
Constipation and vomiting	1	1.05
Pain in lower back	1	1.05
Pain in abdomen and urinary complaints	3	3.15
Pain in abdomen and lower back	4	4.21
Pain in abdomen and any extremity	3	3.15
Pain in abdomen and breathlessness	6	6.31
Pain in abdomen with other complaints	12	12.63
Altered consciousness	6	6.31

Table 5: Radiological Evaluation (n=95).

Investigation performed (Total/n)	Positive findings-Present	Positive findings-Absent	Sensitivity (%)
Ct-scan (72/95)	71	1	98
X-ray (93/95)	58	35	59
FAST-scan (95/95)	42	53	44.21

Positive findings

CT scan-extraluminal air and intraabdominal collection, Chest X-ray-free air under diaphragm, FAST scan-free fluid, hemoperitoneum with or without solid organ injuries. We detected perforation by presence of free gas under diaphragm in chest X-ray in 57 patients. Perforation was detected using CT scan without contrast in 71 out of 73 patients who underwent the scan. FAST scan done in 42 patients detected features suggestive of perforation which included fluid in peritoneal cavity, no solid organ injury, and dilated fluid filled loops of bowel not exhibiting peristalsis. There were 29 patients with associated injuries with maximum having bony injuries (13) followed by chest trauma (5) (Table 6). Thirteen out of 29 patients died, maximum ratio being that of splenic injuries i.e. 2 out of 3, followed by bony injuries found in 8 out of 13 patients (Table 7).

Table 6: Gastrointestinal perforations with associated injuries and death correlation.

No. of cases with GI perforationsand Associated injury		Mortality	%
Bone	13	8	61
Head	4	1	25
Spleen	3	2	66.66
Liver	4	1	25
Chest	5	1	20
Total	29	13	100

Table 7: Correlation between death in cases of isolated blunt trauma abdomen and patients injuries including blunt trauma abdomen.

Parameters	Mortality	N	%
Isolated blunt trauma abdomen	12	66	18
Blunt trauma abdomen with associated injuries	13	29	44

Table 8: Intraoperative management.

Surgical procedure	N	Mortality
Primary repair	61	10
Resection and anastomoses	8	1
Gastric perforation repair with omentopexy	4	1
Primary repair with proximal stoma	6	5
Resection with stoma	8	2
Resection and anastomoses with proximal stoma	1	0
Hartman's procedure	1	1
Duodenostomy with feeding jejunostomy	1	1
Primary closure with feeding jejunostomy	4	4
Total	95	25

Among all 95 patients with gastrointestinal perforations, the most common site of injury was jejunum 42 (47.36%) patients (Table 10). Next most injured site was ileum 27 (28.42%) patients. Duodenum was injured in 5 patients, stomach and colon having 4 patients each, rectal perforation in 2 patients and one isolated oesophageal perforation. There were 10 patients who had more than one site of injury (multiple perforations). Among the procedures performed, primary repair of perforation with peritoneal lavage was the most performed procedure in 62 patients (65.26%) (Table 8). Resection anastomosis was done 8 cases, while primary repair with stoma was fashioned in 6 patients, resection with stoma in 8. One

patient underwent resection and anastomoses with proximal ileostomy. Gastric perforation repair with omentopexy done in 4 of the stomach perforations. One Hartmans procedure and one duodenostomy with feeding jejunostomy was also done. Primary closure with Feeding jejunostomy was done in all 4 cases of duodenal perforations. The development of complications was noted in postoperative period till the time of discharge, and, after that, the patients were called for follow-up every week up to 3 months. Complications were seen in 42 patients with wound infection being the most common which was seen in 12 out of 42 patients (Table 9).

Table 9: Post operative complications (n=95).

Parameters	N	%	Mortality
Wound infection	12	12.63	03
Wound dehiscense	09	9.47	03
Anastomotic leak	01	1.05	0
Anastomotic leak with re operation	01	1.05	0
Duodenal leak	02	2.10	02
Biliary peritonitis	01	1.05	01
Chest infection	10	10.5	06
Enterocutaneous fistula	01	1.05	0
Laparostomy	01	1.05	01
Septicemia	04	4.21	04
Total	42	44	20

Ten patients had wound dehiscence out of which one was managed with Bagota bag technique. Chest infection was seen in 10 patients out of which 6 succumbed to death.2 cases had anastomotic leak, one of them underwent re-operation and only one patient developed enterocutaneous fistula, managed conservatively. Out of 25 deaths that occurred, significant deaths occurred in patients with high energy transfer injuries as compared to low energy transfer injuries (Table 10).

DISCUSSION

The most injured organs in case of blunt abdominal trauma are solid organs. Yet gastrointestinal perforations following blunt trauma abdomen accounts for significant number of cases in the emergency department.

Age group

The age group most commonly involved was 21-30 years closely followed by 31-40 and 41-50 years age groups, which signifies the working population of the country taking transportation facilities, exposed to injuries due to work place like construction sites (fall from height) and young subjects taking part in the violent activities to settle down scores.[7,8] Similarly study carried out by Sule et al in 2007 with a total of 23 patients mean age of patients was 28.5 years with most patients in the age group 21-30 years.[9-11] Bajiya et al in 2016 also had similar findings i.e. most of the subject were in age group 21-30 years. Another study consistent with our study was Goel et al in 2018 with maximum patients in age group 21-30 years. A study by Mukhopadhyay et al in 2009 had a slightly higher range of 31-40 years with mean age 34.98 years. Similar findings of a slightly higher range of age group was found in Kurane et al in 2017 and Wakodkar et al in 2019.[6-13]

Table 10: Site of injury, mechanism of injury, and mortality correlation (n=95).

Site of GIinjury	High energy transfer injuries (n=74)			Low energy transfer injuries (n=21)			Total		
	N	Mortality	%	N	Mortality	%	N	Mortality	%
Oesophagus	1	0	0	0	0	0	1	0	0
Stomach	2	1	1.3	2	0	0	4	1	1.3
Duodenum	5	4	5.4	0	0	0	5	4	5.4
Jejunum	35	6	14.28	7	1	1.3	42	6	15.5
Ileum	20	6	6.7	7	1	1.3	27	6	8
Colon	2	1	1.3	2	1	1.3	4	2	2.6
Rectum	2	2	2.6	0	0	0	2	2	2.6
Multiple	7	2	2.6	3	0	0	10	2	2.6
Total	74	22	88	21	3	12	95	25	26

Sex distribution

Men were affected the most (87%) and very few women (13%) were affected. This finding was consistent with almost all the other relevant studies.

Mode of injury

Our study showed that the most common mode of injury was road traffic accident consistent with the other studies. Sule et al also had a similar finding, with road traffic accident accounting for 73.9% injuries. Mukhopadhyay et al reported road traffic accident to be the most common mode with 55.32% patients being in that category.[11,12] Kurane et al did a similar study and reported 72% as the number of patients in road traffic accidents in their study. Goel et al had 56% patients being victims of road trauma accidents and Wakodkar et al reported 62% patients falling in road trauma injuries category.[6-13] Study done by Jha et al also reported road traffic accidents as the most

commonly encountered cause of blunt trauma abdomen in 57% patients, fall from height in 36% and assault in 6% cases.[2]

Symptoms

Like the previous studies most of the patients in our study presented with the chief complaints of abdominal pain as the only complaint. Vomiting as an isolated complex in 7%, pain in abdomen with vomiting in 5%, pain in abdomen with urinary complaints in 3%. This was similar to other studies. Wakodkar et al reported abdominal pain in all patients and few patients with distension and vomiting. Mukhopadhyay et al also reported similar presenting complaints in patients. Goel et al study showed most patients presented with abdominal pain and distension.[10-13]

Time of presentation since injury

Nearly 58% patients presented within the first 24hrs of injury and the remaining 42% presented 1-6 days later. These findings differ from previous studies. In Goel et al study, 26 (81.2%) patients reported to hospital within 24 hours of injury. The average time to hospital was 19 hours. Most of the patients (76%) presented to hospital within 24 hours, but few delayed beyond 24 hours in a study presented by Kurane et al.[6,10] In a study reported by Bajiya et al there were 66% patients presenting within 8 hrs and 83% within 48 hrs. Remaining patients presented late within 5 days. The reason for such delay is thought to be as follows -a relatively feeble initial peritoneal irritation induced by the nearly neutral intestinal content in a normal disease free trauma abdomen, particularly those with perforation between the duodeno-jejunal flexure and the ileocecal junction; also in relatively small perforations, the mucosa may prolapse through the perforation and partly seal it making early signs misleading, and occurrence of a delayed perforation by an evolving injury where an initial contused bowel wall at the time of trauma ultimately ruptures after a variable period with resultant peritonitis.[9,10] The reason that probably could be thought of was ours being the tertiary care centre and higher centre in the district for reference ,patients were referred from places not connected well with the city. Also the lack of transportation and socioeconomic conditions added to it. Also, the diagnosis of blunt trauma abdomen needs high index of suspicion and experience in such cases which may be lacking in lower-level centres.

Investigation

In our study gas under diaphragm was seen in 58 out of 93 patients who underwent X-ray examination showing lesser sensitivity of X-ray. The sensitivity of plain CT scan to detect perforation was 98%. FAST scan revealed hemoperitoneum and free fluid in the abdomen. In our study, patients with free fluid in abdomen with diagnostic tap suggestive of hemoperitoneum without solid organ injury or pyoperitoneum were considered for exploration, which was present in 7 patients.

Associated injuries

There were 29 patients with associated injuries with maximum patients having bony injuries followed by chest trauma. Patient with isolated blunt trauma abdomen had significantly lower mortality than those having blunt abdominal trauma with associated injuries.

Mechanism of injury involving blunt trauma abdomen

Blunt abdominal trauma can be divided according to the transfer of energy involved in the event leading to injury. We broadly classify injuries into caused by high energy transfer such as auto-pedestrian accidents, road traffic accidents in which the car's change of velocity (ΔV) is more than 20 mph or in which the traveller has been thrown out, 2-wheeler accidents, and falls from heights >20 ft and those caused by low energy transfer such as being hit by slow speed vehicles or falling from a bicycle, usually does not result in widely distributed injuries, falling from lesser heights <20ft.[14] We observed that the outcome of injuries related to high energy transfer involved: the patients presenting early, the number of associated injuries was more with high energy transfer injuries, more morbidity and mortality. In low energy transfer injuries, we observed lesser mortality and morbidity, late presentation since patient suffered from lesser devastating injuries.

Site of perforation

Jejunum was found to be the most common site of perforation in the study subjects followed by ileum, which was consistent with previous studies. We also had one oesophageal injury not seen in previous comparable studies. Multiple perforations were found in 10% patients, also a finding not common with previous studies except few studies. Sule et al found most commonly injured organs as both jejunum and ileum. Mukhopadhyay et al reported Jejunum as most commonly injured part of the gastrointestinal tract.[11,12] Bajiya et al also reported jejunum as the most frequently injured segment and Wakodkar et al proved the same. Kurane et al found ileum to be most commonly injured organ amongst gastrointestinal injuries. In the study by Jha et al ileum was the most common site of injury recorded in 80 (46.2%) patients followed by jejunum in 77 (44.5%).[2,6,9,13] There were 5 gastric perforations, duodenal, 2 colonic, 2 sigmoidal and 2 rectal injuries. One caecal injury was also seen.

Surgical management

According to the intra-op findings, decisions were made, primary closure of perforation with peritoneal lavage was the most commonly performed procedure

in 61 cases. Resection anastomosis was done in 8 cases, while stoma was made in 8patients, other procedures were done as per organ involved i.e. stomach was repaired using omentopexy in 4 gastric perforations, for rectal perforation Hartmans procedure was done, and duodenal perforation was repaired with duodenostomy and a feeding jejunostomy. Amongst all procedures done, duodenostomy with feeding jejunostomy had worst results. Resection and anastomoses was well tolerated except for one mortality. In the study by Wakodkar et al there were 42 patients, one duodenal perforation was found in first part of duodenum which was closed primarily with live omentopexy.[13] In perforations near Duodenojejunal junction there were 2 patients with circumferential disruption which was repaired by end-to-end anastomosis with placement of naso-jejunal tube across the anastomosis. All the multiple perforations were managed by resection and anastomosis. Perforations of transverse colon, sigmoid colon and 3 patients of terminal ileal injury required covering stoma which was closed later. In the study by Mukhopadhyay et al there were 32 patients with small bowel injury and one duodenal injury.[12] The duodenal perforation was managed by repair of the perforation, gastrojejunostomy and a feeding jejunostomy. All their multiple perforations and 3 isolated perforations underwent resection and anastomosis. The rest of the patients were treated by primary closure. The major seromuscular injuries of the small bowel in their study required resection and anastomosis. In the colon, the 2 perforations needed primary repair. In the ascending colon, the seromuscular injuries required resection and anastomosis, in the transverse colon, resection and stoma were performed and those in the sigmoid colon underwent resection and anastomosis with a protective colostomy. They treated mesenteric injuries with resection and anastomosis. While Bajiya et al also had similar management guidelines in their study.[9] Single perforation was managed by simple closure. This was the most commonly performed procedure in the study consistent with all other studies, since it is a well-established procedure with minimal complications. For multiple perforations in a small segment, resection and anastomosis was their procedure of choice. In cases of mesenteric injury causing ischemia of the bowel, resection is the treatment of choice as stated by them. For colonic and rectal perforations, the decision of closure with or without colostomy requires proper consideration. Stoma surgery was done in their study in cases of rectal perforations and colonic perforation, which were either multiple or presented late. In a study done by Kurane et al all the patients underwent exploratory laparotomy with drainage of collection, peritoneal lavage and repair.[6] For hollow viscus perforation the procedure of choice was simple closure. It was the most commonly performed repair in their study. In case of multiple perforation or segmental avulsion of bowel, resection and anastomosis was done. And for colonic perforation primary closure with covering proximal colostomy was considered. In another study by Jha et al gastric and duodenal injuries were closed primarily.[2] Most of the small intestinal perforations were managed by primary closure, resection and anastomosis while few needed ileostomies. One caecal injury was managed by primary closure while two colonic injuries required diversion ileostomy. All four rectosigmoidal perforations were treated by diversion colostomy followed by stoma closure at 3 months.

Complications

Forty-two patients developed complications in the postoperative period with wound infection being the most common. All other complications encountered were lesser in comparison to previous studies. Most of the complications were managed conservatively except one patient who required re-operation with laparostomy but eventually succumbed on day 2 of reoperation due to respiratory failure. Certain complications lead to more deaths such as chest infections (6 deaths). It was noted that patients with duodenal injuries had the maximum mortality which can be attributed to the fact that duodenum being the retro peritoneal organ the signs of peritonitis appeared late, and the referred patients presented late. In other studies like Jha et al complications were encountered in 22.00% patients.[2] 11 of them had anastomosis leak, while 27 had burst abdomen. Study by Sule et al reported wound infection in 26% patients and enterocutaneous fistula in 8.7% cases. Study by Mukhopadhyay et al showed anastomotic leak occurring in 10.6% cases.[12] Bajiya et al had 35.9% patients in the category of chest infections, wound infections in 21.8% cases and intraabdominal abscess in 10.3%.[9] Goel et al found chest infections as most common complication in 16% patients.[10] Wakodkar et al study revealed anastomotic leak in 7.14% cases and 4.7% patients developed wound dehiscence and intra-abdominal abscess.[13]

Limitations

The non-inclusions of detailed analysis of the factors associated with mortality is a limitation of the study. The sample size being small makes comparison of similarities and differences of similar study with larger sample size difficult.

CONCLUSION

Young men are the most commonly affected in cases of blunt trauma to abdomen. Road traffic accidents is the most commonly encountered cause. Others being fall from height, assault and animal attack. Most common complaint of clinical presentation is pain in abdomen. The patients presenting to the hospital within 24 hours have a better outcome. Jejunum is the most common site of perforation followed by ileum. Primary closure of

perforation with peritoneal lavage is most commonly performed procedure. Other procedures performed are resection and anastomoses with or without proximal stoma. Most commonly encountered complication is wound infection followed by chest infection and wound dehiscence. Mortality is higher in case of patients presenting late, in patients with high energy transfer injuries and in patients with associated injuries along with blunt trauma abdomen. To conclude, gastrointestinal perforation in a blunt trauma abdomen is a diagnostic challenge to the trauma surgeon. With high level suspicion, backed by knowledge and experience one can reach to the diagnosis and provide timely care. Early diagnosis with prompt surgical intervention can reduce morbidity and mortality to great extent. Set algorithms for initial assessment and management can improve outcome.

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REFERENCES

1. Bocage C, Mashalla Y, Motshome P. Applying the Haddon matrix conceptual model to guide motor vehicle crash injury research and prevention in Botswana. Afr J Emerg Med. 2020;10:S38-43.
2. Jha KN, Kumar YS, Sharma R. Characteristics of Hollow Viscus Injury Following Blunt Abdominal Trauma; a Single Centre Experience from Eastern India. Beat J. 2014;2:12-8.
3. Jain S, Maske D, Songra MC. Clinical study of hollow viscus injury in abdominal trauma. Int Surg J. 2017;5(1):39.
4. Dauterive AH, Flancbaum L, Cox EF. Blunt Intestinal Trauma A Modern-day Review. Ann Surg J. 1985;201(02):198-203.
5. Hughes TMD, Elton C. The Pathophysiology and Management of Bowel and Mesenteric Injuries Due to Blunt Trauma. Ann Surg J. 2002;33:120-8.
6. Kurane SB, Ugane SP. A clinical study of hollow viscus injury due to blunt trauma abdomen. Int J Res Med Sci. 2017;5(11):5017.
7. Badrinath T, Sreelaxmi T. Abdominal trauma-A clinical study. IAIM. 2018;5(2):116-23.
8. Kulkarni SH. A study of traumatic perforation peritonitis in a rural medical college hospital with identification of risk factors. Int J Healthcare Biomed Res. 2014;3(2):12-9.
9. Bajiya P, Jain S, Meena L. Gastrointestinal perforation following blunt trauma abdomen: a study of 78 cases. Int J Med Sci Public Health. 2016;5(6):1225.
10. Goel A, Bansal A, Gogia B. Outcome of gastrointestinal perforations due to blunt abdominal trauma. Int Surg J. 2018;5(8):2836.
11. Sule AZ. Gastrointestinal perforation. East Afr Med J. 2007;84(9):429-40.
12. Mukhopadhyay M. Intestinal injury from blunt abdominal trauma: A study of 47 cases. Oman Med J. 2009;24(4):256-9.
13. Wakodkar AA, Singh AD, Meshram HM. Descriptive study of isolated bowel injury following blunt trauma abdomen. Indian J Appl Res. 2019;9(9):32-9.
14. Charles B. Trauma. In: Schwartz's Principles of Surgery. 10th ed. USA: McGraw Hill Publisher; 2015: 174-175.

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