International Surgery Journal
Sengar S et al. Int Surg J. 2016 Nov;3(4):2135-2140
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20163587

Original Research Article

Recognition and management of small bowel and mesenteric injuries in blunt abdominal trauma

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Received: 23 July 2016
Accepted: 28 August 2016

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ABSTRACT

Background: The small intestine is the third most commonly injured organ in blunt abdominal trauma (BAT) following liver and spleen. As the non-operative management of BAT becomes increasingly accepted by surgeons the concern arises whether small bowel and mesenteric injuries are being missed or recognized after a delay. In patients sustaining BAT the role of clinical assessment or imaging is being continually evaluated. Objective of the study was to evaluate the role of clinical assessment, imaging in establishing the diagnosis of small bowel / mesenteric injuries in BAT and outcome of patients
Methods: The study was conducted at tertiary care center over a period of 2 years. It was planned as a retrospective observational study which looked at patients with BAT who underwent laparotomy and were found to have small bowel/mesenteric injuries. The case records were reviewed with a view to analyze what prompted the decision to operate and the time to laparotomy.
Results: Out of 74 patients operated for BAT 29 had small bowel and mesenteric injuries. Amongst these 29 patients the decision of laparotomy was taken primarily on clinical assessment in 11 patients and in the other 18 patients imaging helped in identifying the injury. 25 perforations of small bowel and 5 mesenteric injuries with small bowel ischemia were noted. 2 patients died despite surgical intervention.
Conclusions: Patients with BAT can be recognized based on clinical assessment and selective imaging.

Keywords: Blunt abdominal trauma, Mesenteric injury, Small bowel injury

INTRODUCTION

Intestinal injuries constitute the third most commonly injured organ in blunt trauma.[1] Missed injuries were implicated as the major contributing factor in mortality for HVI (73%).[2]

Mesenteric injury occurs in 18 percent of patients with penetrating abdominal injury and occur in 5 per cent of those with BAT and BAT is a difficulty entity to manage specially so because nowadays there is an increasing trend towards non operative management.[3] The key indication for non-operative management is hemodynamically stable patients in whom HVI has been confidently ruled out. Ultrasound (US) has been described as a potentially useful diagnostic tool and is being used with increasing frequency.[4] In present scenario, much emphasis is given to CT scan findings associated with bowel and mesenteric injury due to blunt trauma.

In this study all patients with proven small bowel and mesenteric injuries as diagnosed at laparotomy will be reviewed in order to better understand the presentation and diagnosis of such injuries in the patient with BAT.

METHODS

During the study period of two year from August 2013 to August 2015 there were 74 patients of BAT operated at this centre. 29 patients were identified with isolated mesenteric, mesenteric with small bowel and isolated small bowel injuries. An observational study was done during the study period and the patients were analyzed with respect to age, sex, etiology of trauma, clinical presentation, location of injury, associated injuries, treatment, mortality and morbidity. Injuries were classified as 1) isolated small bowel perforation 2) small bowel perforation with insignificant mesenteric injuries 3) significant mesenteric injuries (gangrenous bowel) with small bowel perforation 4) isolated mesenteric injuries with bowel gangrene. All patients (adult / pediatric) admitted in the hospital with blunt trauma abdomen with the diagnosis of small bowel and mesentery injuries as confirmed on operation were assessed. Patients with penetrating abdominal trauma and duodenal injury were not included in the study. The outcomes were analyzed by assessing the mortality/morbidity within 30 days period of the patient.

RESULTS

During the two year period, 74 patients of BAT were operated at this center. Out of this group 29 patients had small bowel and mesenteric injuries. In these 29 patients there were 35 injuries to small intestine (25 perforations and 10 serosal tears) and 14 injuries to the mesentery (5 mesenteric lacerations were associated with gangrene of corresponding small bowel). The small bowel and mesenteric injuries identified on laparotomy are summarized in Figure 1. Amongst the mesenteric injuries nine were located in jejunal mesentery and five were located in ileal mesentery. The prevalence of small bowel perforations in patients with BAT requiring laparotomy was 33% (25/74) and the prevalence of mesenteric injury with gangrene of corresponding bowel segment was found to be 7% (5/74).

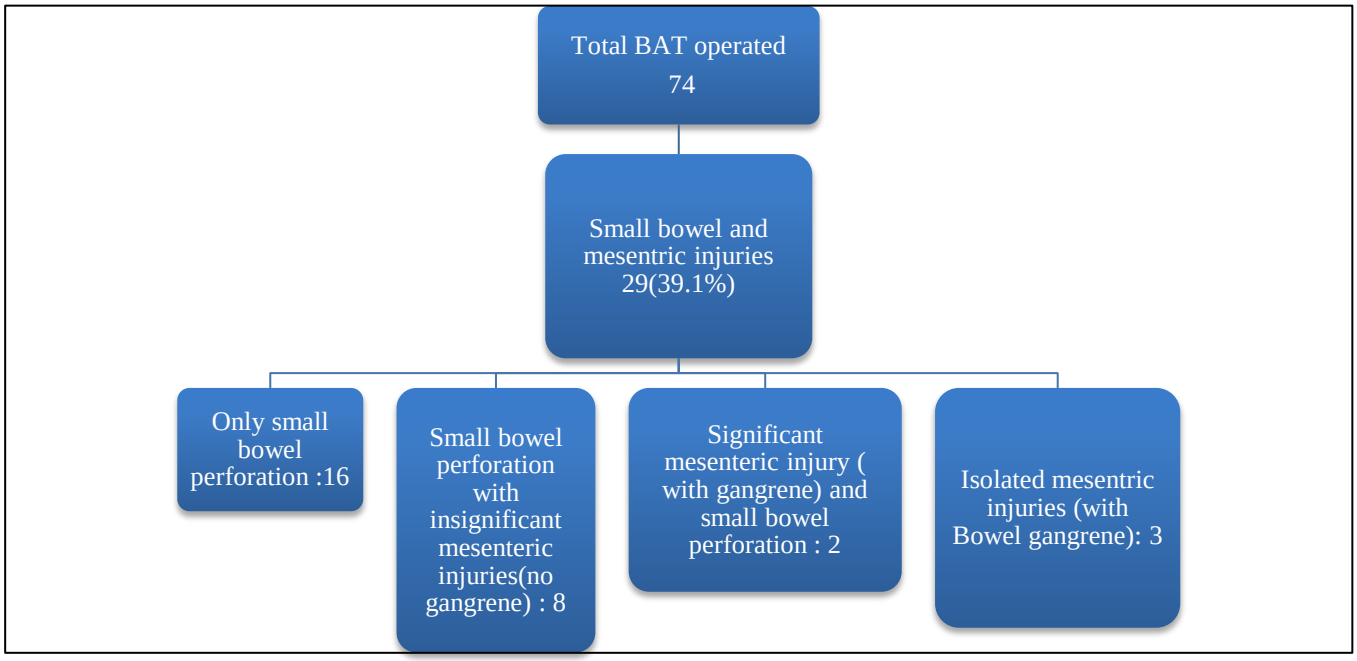

Figure 1: Prevalence of significant small bowel/mesenteric injury in blunt trauma abdomen requiring laparotomy.

There were 3 cases that would fall under the category of missed injuries. 2 cases were undergoing treatment elsewhere and their bowel injury was missed, however they were fortunate enough to survive and reached Himalayan hospital after 10 and 17 days of sustaining injuries in a moribund condition. Both these patients had ileal perforation that had led to formation of dense adhesion and multiple pus pockets. 1 case of duodenal perforation was missed on initial exploration and led to on early relaparotomy. There was no major difference in number of morbidities among patients who reached early (<12 hours) or late (>12 hours). There was mortality among patients who reached to hospital early. There was mortality in patients who reached hospital late as given in Table 1.

A total of 18 patients were found to have associated injuries. In rest 11 patients there were no associated injuries apart from small bowel/mesenteric injuries. The injuries of liver and spleen were such that by themselves they would not have merited exploration as in Table 2. In this series of 29 patients none required to be shifted to operating room immediately upon arrival to emergency.

All patients responded to initial resuscitation and were subjected to imaging.

Table 1: Morbidity and mortality with respect to delay in reaching hospital.

Time elapse	No. of patients	Morbidity	Mortality
1-12 hours	16	Anastomotic leak (2) Respiratory (2) Surgical site infection (3)	1
12-24 hours	6	Surgical site infection (2) Respiratory (2) Pancreatic fistula(1) Billiary leak	
>24 hours	7	Surgical site infection (3) Empyema thoracis (1) Diaphragmatic hernia (1)	1

Table 2: Additional intervention required for associated injuries (n = 29).

Site	No. of patients	Intervention
Liver	4	Repair of liver laceration
Spleen	2	Splenorraphy(1)
Pancreas	1	Repair of pancreatic injury
Colon	2	Hartmann procedure
Chest	2	Intercostal drainage and thoracotomy
Vascular	1	Reverse saphenous vein graft for brachial artery injury
Skeletal	6	POP slab, k wire fixation
Total	18	

An X ray of chest was undertaken in all patients however only nine were found to have gas under diaphragm and they were taken for laparotomy, thus the sensitivity of x-ray in diagnosing small bowel perforations due to BAT was 31%. An important finding noted was the presence of gas under diaphragm in 2 out of 3 cases of isolated mesenteric injuries with gangrene of corresponding bowel segment. Nine patients were hemodynamically stable with equivocal abdominal examination and were taken for surgery on the basis of their CT scan reporting.

Six patients were found to have positive finding on USG with features of peritonitis.

These six patients include those in whom x-ray show no gas, no CT scan was done. Rest five patients (x-ray suggest no gas, USG and CT was not done) were taken to operating room on clinical grounds. Patients having isolated mesenteric injury with gangrenous bowel were 3 in number. Amongst these, 2 patients were diagnosed by their clinical presentation and their x-ray findings while 1 patient was diagnosed by clinical abdominal findings where x-ray chest did not show gas under diaphragm as seen in Table 3. CT scan was evaluated in terms of hemoperitoneum and pneumoperitoneum. Of all 9 patients with CT scan done, hemoperitoneum was found in 6 patients and rest 3 patients had hemoperitoneum and pneumoperitoneum.

Most of the patients (18) were having jejunal injuries approximately 2-4 ft from DJ and mesenteric injuries leading to gangrenous bowel segment were approximately 2-4 ft from DJ and 1.5 ft from IC jx (Figure 3). There were total 25 perforation, of all these, single perforations were treated by primary closure. Multiple perforation (7), completely transected bowel loops (5), gangrenous bowel segments (4) were treated by resection and anastomosis/stoma formation. All anastomosis were hand sewn, no stapler used in trauma setting as shown in Table 4.

Table 3: Indication of surgery in blunt abdominal trauma with small bowel /mesenteric injuries.

Indication	No. of patients
X-Ray of pneumoperitoneum	9
CT Scan findings Hemoperitoneum / Pneumoperitoneum	9
Peritonism+ presence of free fluid on USG	6
Clinical peritonitis	5

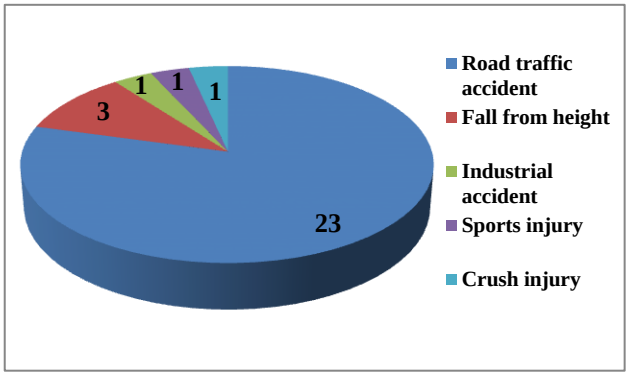

Figure 2: Mode of injury in patients with small bowel perforation/mesenteric injuries due to blunt trauma abdomen.

Table 4: Surgical procedure done at laparotomy for small bowel/mesenteric injuries.

Number of small bowel and mesenteric injuries	No. of mesenteric Repairs done	No. of resection Anastomosis	No. of resection + stoma done	No. of primary repair of perforation done
39	10	9	7	12

Table 5: Complication following laparotomy in blunt abdominal trauma with small bowel/mesenteric injuries (n = 29).

Complications	No. of patients	Outcome
Gastrointestinal (enetrocutaneous fistulae and missed duodenal injury)	2	Survived
Respiratory	10	2 Expired
Surgical site infection	8	Survived
Total	**20**	

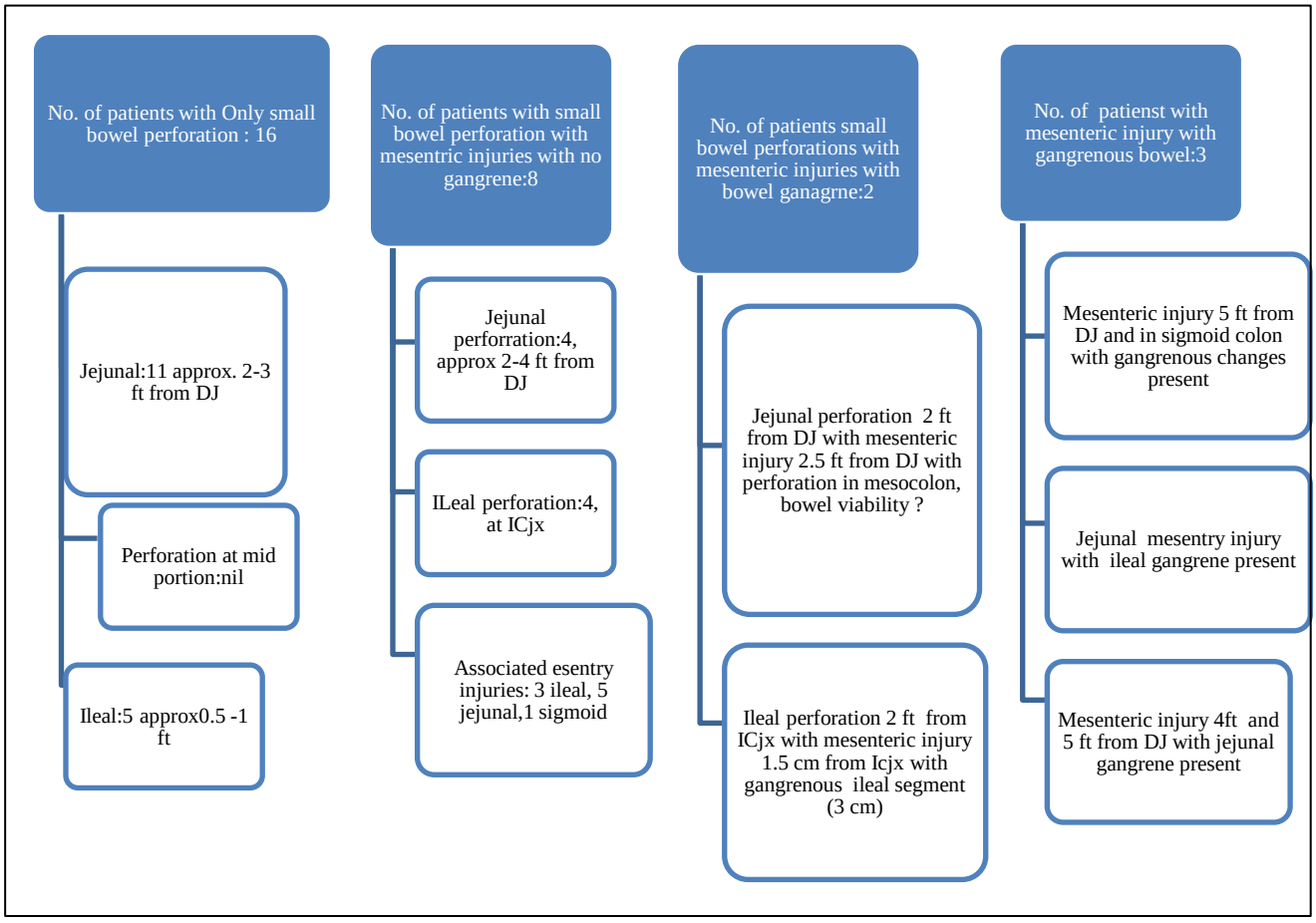

Figure 3: Location of perforations and mesenteric injuries.

In this study, complications were noted in twenty patients. Respiratory complications and surgical site infections accounted for the majority of morbidities. Re-exploration was needed in two patients (one for missed injury in duodenum and other due to enterocutaneous fistula). There were 2 deaths among 29 patients. Both these patients had no other significant associated injuries. One died on third post-operative day due to septic shock and other died within a month due to sepsis and multiorgan failure as given in Table 5.

DISCUSSION

The prevalence of small bowel injuries (33%) and of mesenteric injury with gangrenous bowel 7% is consistent with the figure 56% (47 patients of small bowel injury out of 83 patients) suggested by

Madhumita.[1] However Dauterive et al (1978) found in study that only 60 (6.9 %) patients suffered small bowel injuries out of 870 patients underwent laparotomy for BAT.[2] The reason behind such a large difference in small bowel injuries is that in earlier times approximately all patients of BAT used to get operated and there was no concept of conservative treatment of solid organ injury but in present time large number of BAT patients were managed conservatively.

In this series 16 (55%) patients were identified having only small bowel perforation out of 29 cases operated for BAT. This is in accordance with the study by James et al,[5] which showed 30 patients (42%) out of 70 cases having isolated small bowel injuries only on exploration, whereas the rest 40 patients had other associated intra-abdominal injuries.

In this study of 29 patients of BAT with bowel / mesenteric injury 23 patients were of less than forty years of age. The most common age group was 20-30 years. The same been observed by Dauterive et al that these injuries were seen more in the younger age group i.e. less than forty years of age.[2,6] This is because of the fact that young people are more frequently involved in outdoor activities and hence are more susceptible to trauma.

RTA were the most common mode of blunt trauma to abdomen resulting in bowel /mesenteric injury. Accidents involving motorcycle were the most common source of injury (34%). This is contrary to the observation by Dauterive et al.[2] They found auto accidents (77%) more common than motorcycle (27%). Yehia et al also reported RTA most common causes of BAT followed by pedestrian accidents, fall from heights and abdominal blows.[7] In this series only one patient had blunt injury due to restraint by seat belt that led to perforation. However incidence of seat belt injury resulting in bowel perforation was higher in other studies mainly by Chandler et al who reported 6% incidence of bowel perforation among patients restraint by seat belt in a car accidents.[8] In the present study overall number of abdominal injury due to motorcar is less (2/29).

3 (10%) patients out of 29 had missed injuries. An associated duodenal injury was missed intra-operatively, while in two patient who received treatment elsewhere the bowel injury was missed and they presented late with features of severe abdominal sepsis. All these were found to have longer hospital stay and severe postoperative complication but there was no mortality. Allen et al reported 10 cases of missed injuries in a cohort of 139 patients of BAT with hollow viscous injury.[9] Ekeh et al demonstrated that despite the use of CT technology 11 patients out of 82 (13%) patients had delayed recognition of bowel /mesenteric injury.[10] Associated extra abdominal injuries were noted in 18 patients (62%). The most common associated injury was skeletal injuries. In the abdomen, the associated injuries were noted in liver and spleen. However, they were not clinically significant and would not have resulted in exploration by themselves. Other significant intra-abdominal injuries were mainly to colon and pancreas and the most common extra-abdominal injuries were skeletal. According to Yehia et al most of the associated intra-abdominal injuries were in liver followed by spleen.[1,7,11]

26 patients were operated within 12 hours of reaching hospital and 3 patients were operated after 12 hours. The morbidities and mortalities were similar in both these groups. Davis et al also suggest that there was no significant difference in mortality or morbidity in the group of patients whose operation was delayed.[12] Thus delay in diagnosis is not related to increased mortality and morbidity in patients receiving extensive supportive care. If the supportive care is suboptimal then patient with delay in definitive management have a worse outcome and may succumb because of peritonitis and sepsis. This has been supported by Fang et al who reviewed 111 patients of BAT with bowel injuries and noticed that delay in surgery does not affect the mortality.

Associated extra abdominal injuries were noted in 18 patients (62%). The most common associated injury was skeletal injuries. In the abdomen, associated injuries were noted in liver and spleen. However, they were not clinically significant and would not have resulted in exploration by themselves. Madhumita reported associated injuries in 13 out of 47 patients (13%) and the most common extra-abdominal injuries were skeletal.[1,7,11]

Nine patients were taken for surgery on x-ray findings alone, nine patients operated on the basis of CT scan, USG with features of pertonism was seen in six patients and five patients were diagnosed clinically as having peritonitis. The presence of free fluid without solid organ injury on CT scan in patients with BAT is an indication of surgery. Brasel et al suggested that the presence of more than trace amount of free fluid in BAT patients be considered as an indication for exploratory laparotomy.[13] Cunningham et al also found isolated intra-peritoneal fluid in 29 patients out of 126 patients operated for BAT.[14]

In this study, most of the patient had small bowel injuries (25 injuries) in proximity to the DJ and IC jx however this assertion is counter by Dauterive et al, their study suggest that 28 injuries out of 37 small bowel injuries occurred between ligament of Treitz and the ileocecal junction without preference for any specific location (83 Patients were identified having isolated mesenteric injuries with gangrenous bowel segment. 2 patients were diagnosed by the x-ray findings showing pneumo-peritoneum and 1 patient was diagnosed by the features of clinical peritonitis. Mesenteric injuries cause necrosis of bowel wall with time thus resulting in gas under diaphragm on x- ray. Wang et al also suggested that patients with mesenteric injuries have slow oozing from mesenteric vessels resulting in hematoma, which may remain undetected for days, until bowel necrosis occurs

leading to peritonitis. Regarding treatment of bowel / mesenteric injuries results are in accordance with the study by Madhumita in which single bowel perforation were treated by primary repair and multiple perforation required resection and anastomosis.[1]

Only few patients were treated by stoma formation i.e ileostomy. In this series 24% (7 out of 29) patients were treated by stoma formation. Jha NK et al also reported 22.4% patient had stoma formation.[15] In our study mortality rate was 6.8% which is similar to that quoted by Madhumita as 6.38%.[1] Mortality rate quoted by Dauterive et al range from 10-30%.[2] Mortality rates were low in our study, most probably due to the low rates of associated injuries. Reports have shown that mortality increases with the number of associated injuries.[16]

CONCLUSION

The HVI are more frequently then mesenteric injury, RTA being the commonest mode of trauma, motor cycles are mostly involved vehicle. Younger age group male were more than female. Hemodynamically unstable patient should be resuscitated before shifting to O.T. X-ray chest is must in all trauma patients, in hemodynamically stable patient CT scan is better investigation, in hemodynamically unstable patient, USG whole abdomen is the prime investigation. Skeletal injury are mostly extra abdominal associated injury, liver is the most common associated organ involved intraabdominally. All small bowel injury lies near to fixed points intrabadominally. Primary repair and resection with anastomosis with stoma are the mostly done surgery

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Sengar S, Rehmani B, Kumar N. Recognition and management of small bowel and mesenteric injuries in blunt abdominal trauma. Int Surg J 2016;3:2135-40.