

Diagnostic and therapeutic role of laparoscopy in penetrating abdominal trauma in hemodynamically stable patients: a prospective study

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Introduction

In young patients, penetrating abdominal trauma is associated with serious morbidity leading to mortality. The frequency of penetrating trauma varies greatly throughout the world. In the same way, the global experience of laparoscopy in trauma patients differs. Many recent studies have concluded that the laparoscopy has a viable role in such individuals. This work was conducted to assess the diagnostic and therapeutic role of laparoscopy in penetrating abdominal wall trauma.

Patients and methods

The study enrolled 33 patients with penetrating abdominal trauma. The mean age of those patients was 33.45 years. Majority (84.4%) of patients were male. All those patients were subjected to diagnostic (\pm therapeutic as needed) laparoscopy. The study was conducted from January 2018 to January 2021.

Results

Twenty (59.6%) patients had different organ injuries. The most frequent affected organs were small intestine (15.2%) and mesentery (12.1%). Fourteen (42.2%) patients had a therapeutic procedure, while 13 (39.4%) patients had only a diagnostic procedure. In only six (18.2%) patients, conversion to open laparotomy was done. Only three patients developed wound infection

Conclusion

Laparoscopy is a safe and practical option for hemodynamically stable individuals with penetrating abdominal injuries. It provides for a full and thorough assessment of intra-abdominal viscera. Also, it reduces the frequency of nontherapeutic laparotomy, and allows for therapeutic intervention. However, it necessitates proper surgeon training and expertise in complex surgical techniques.

Keywords:

abdominal trauma, laparoscopy, penetrating, therapeutic

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Introduction

It is debatable how to manage hemodynamically stable individuals with penetrating abdominal trauma (PAT). Minimally invasive methods such as laparoscopy and nonsurgical treatment have reduced the number of nontherapeutic laparotomies that result in needless morbidity. However, avoiding surgical investigation in individuals with this kind of trauma is linked with a higher risk of delayed diagnosis and complications [1].

In recent years, the indications for laparoscopic operations have been steadily expanding. However, the diagnostic and therapeutic value of laparoscopy in the therapy of blunt and penetrating abdominal injuries is still debatable [2].

Diagnostic laparoscopy is regarded as a reliable technique for assessing peritoneal penetration, with a negative predictive value of 100% and a sensitivity of

100% [3]. Diagnostic laparoscopy must be followed by a laparotomy in patients with peritoneal penetration to examine possible intra-abdominal injuries [4].

Aim

The current study aimed to evaluate the diagnostic and therapeutic role of laparoscopy in stable patients with PAT.

Patients and methods

Approvals and consents

This work was conducted in accordance with the Code of Good Practice and the guidelines of Declaration of Helsinki, 7th revision, 2013 and after being approved

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by the Local Medical Ethics Committee of the Faculty of Medicine. Also, a written informed consent was obtained from all participants before being enrolled into the study.

Study setting and design

A prospective cross-sectional study was conducted at the Department of General Surgery from 2018 to 2021.

Participants

The study recruited 33 hemodynamically stable patients with PAT. Exclusion criteria included hemodynamically unstable patients, clinical peritonitis, and/or associated serious injuries as brain or spinal cord injuries.

Methodology

All patients were subjected to thorough history taking and full physical examination. Baseline laboratory data as complete blood count and international randomized ratio were ordered. All patients were evaluated hemodynamically before the procedure.

Under general anesthesia in a supine position, the procedure was done. A 0° angle, 10-mm laparoscope was inserted via infraumbilical incision for abdominal exploration. Two additional 5-mm laparoscopic ports were inserted under direct view at right iliac fossa and right upper quadrant (paramedian area) in case of left-sided trauma, while the opposite was done in the case of right-sided trauma. Following the insertion of the laparoscope, a search for blood, bile, or intestinal content was performed.

Standard examination included inspection of the diaphragm and parietal peritoneum for penetration and spleen and liver for bleeding. This is followed by examining from the stomach to rectum and assessment of small bowel from Treitz's ligament to the ileocecal valve. Small bowel and mesentery were elevated and evaluated in segments. By crossing the graspers, the reverse sides were similarly viewable. This approach was repeated until reaching the ileocecal valve, at which point colon was inspected from cecum to rectum.

Ultimately, the lesser sac was pierced, allowing visualization of the posterior gastric wall and most of the pancreas (body and tail) if there is suspected injury at this area. At the end we closes the port sites after insertion of tubal drain in the pelvis when need.

These steps were done in all patients. If there are no detectable intra-abdominal injuries, no more intervention was needed while the others show intra-abdominal injuries that need further

management, which was completed by laparoscopy in some patients and by conversion to open laparotomy.

Operative intervention was done based on findings. Cases with small bowel perforation detected were simply sutured by 3-0 Vicryl, after irrigation and drainage of the intraperitoneal collection (Fig. 1). Also, cases with bleeding from torn mesentery were controlled by suture ligation and cauterization. In cases of prolapsed omentum through the site of wound entry, reduction of the omentum and repair of the wound was done (Fig. 2).

In cases of diaphragmatic injury, a subxiphoid trocar was placed and repair was done with silk sutures, and ipsilateral chest tube was inserted.

Cases with small mesenteric hematoma with no affection on bowel vascularity were left undisturbed, while in large-volume hematomas (mostly clots), evacuation (irrigation and drainage) was achieved by direct insertion of a plastic tube through a 12-mm port.

Conversion to open laparotomy was done in six cases secondary to uncontrolled bleeding during the procedure:

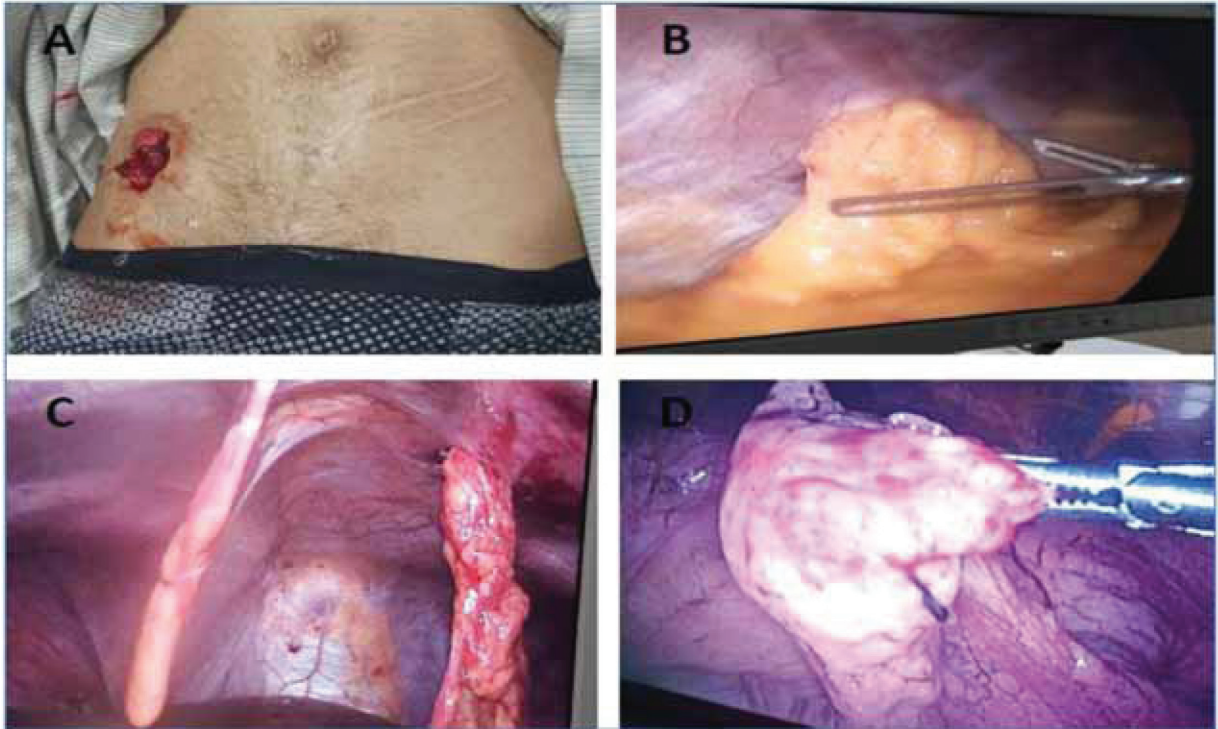
- (1) Two cases had hepatic injury where repair was done with control of bleeding.
- (2) Another two cases had splenic injury and were managed with bleeding control and splenectomy was done.
- (3) One case had inferior epigastric artery injury with huge abdominal wall hematoma where bleeding control was done after conversion to laparotomy. The last patient had colonic injury but had active bleeding from the mesenteric tear. Control of bleeding was achieved by sutures plus exteriorization colostomy for the perforated segment was done and closure of the abdomen with single pelvic drain.

Those patients were postoperatively followed up hemodynamically and assessed for any possible complications. The following data were assessed as the type of procedure, operative time, blood loss, hospital stay, and any possible complications.

Statistical analysis

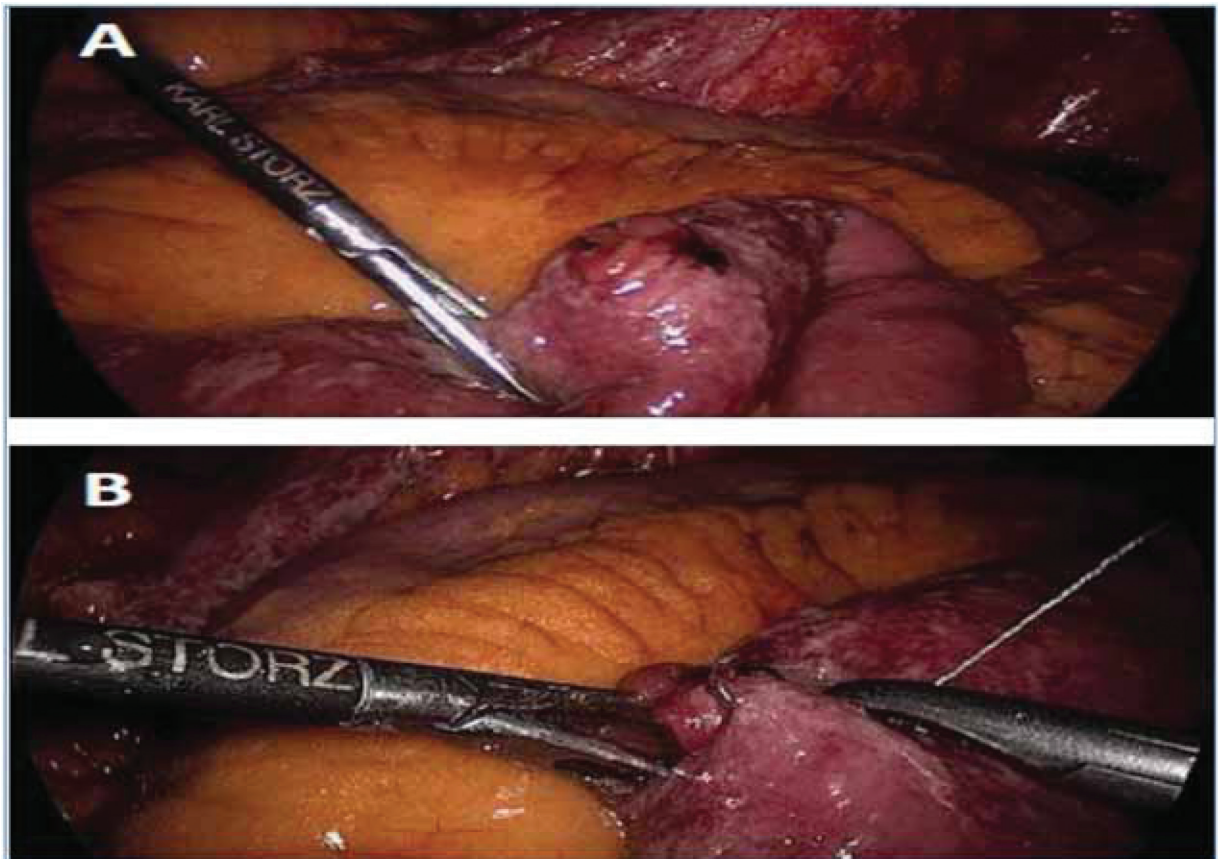
All the data were collected, correlated to each other, and analyzed using the Statistical Package for the Social Science (SPSS, SPSS Inc®, Chicago, IL, USA), version 20. The quantitative data were presented in the form of mean and SD. The qualitative data were

Figure 1



(a) Prolapsed omentum through RIF stab wound, (b, c) prolapsed omentum, (d) reduction of the omentum and repair of the wound.

Figure 2



(a) Small bowel perforation and (b) small bowel repair.

presented in the form of number and percentage and compared with χ^2 test. *P* value was considered statistically significant when *P* value less than 0.05.

Results

Baseline data of enrolled patients

Mean age of the studied patients was 33.45 ± 10.89 years in the range between 16 and 62 years. Of these patients, 28 (84.4%) were males. Majority (93.9%) of the patients had stab wound injury. Data about the site of lesions are summarized in Table 1.

Operative data among the studied patients

Mean operative time was 79.8 ± 20.98 min. It was found that 13 (39.4%) patients had no organ injury and 20 (59.6%) patients had different organ injuries. The most frequent observed injuries were to small bowel (15.2%), mesentery (12.1%), and diaphragm (9.1%). Each of liver, spleen, and omentum injury was detected in two patients. One patient had colonic injury and other patient had injury to inferior epigastric artery (Table 2).

As regards the type of procedure, it was only diagnostic laparoscopy in 13 (39.4%) patients, diagnostic and therapeutic laparoscopy in 14 (42.2%) patients, and in six (18.2%) patients the procedure was converted to open laparotomy.

Hospital stay and complications among the studied patients

Majority (91%) of the patients had no complications. Only three patients developed wound infection at port site, which responded well to local antibiotics and

Table 1 Baseline data of studied patients

	N=33
Age (years)	33.45 ± 10.89
Sex	
Male	28 (84.8)
Female	5 (15.2)
Type of trauma	
Stab wound	31 (93.9)
Gun shots	2 (6.1)
Number of wounds	
Single	27 (81.8)
Multiple	6 (18.2)
Site of the wound	
Right iliac fossa	10 (30.4)
Right lumbar	8 (24.3)
Left lumbar	7 (21.2)
left hypochondrium	5 (15.2)
Epigastrium	5 (15.2)
Right hypochondrium	2 (6.1)
Left iliac fossa	2 (6.1)

Data expressed as *n* (%) and mean (SD).

frequent dressings. Hospital stay was less than 2 days in 18 (54.5%) patients and exceeded 2 days in 15 (45.5%) patients (Table 3).

Hospital stay based on the type of procedure

It was found that hospital stay was greatly affected by the type of procedure, where all those patients who underwent conversion to open laparotomy had a hospital stay that exceeded 2 days and those who underwent diagnostic procedure had a stay of less than 2 days (Table 4).

Hospital stay based on the presence of organ injury

Hospital stay was prolonged based on the presence of organ injury, where 14 patients with organ injury had a hospital stay that exceeded 2 days while all patients with no organ injury, with the exception of one patient, had a hospital stay of less than 2 days (Table 5).

Discussion

Several researches have looked at various elements of its use on trauma patients. Despite being used for both

Table 2 Operative data and definitive management among the studied patients

	N=33
Operative time (minute)	79.8 ± 20.98
Range	45–130
Operative findings	
No organ injury	13 (39.4)
Organ injury	20 (59.6)
Small bowel	5 (15.2)
Mesentery	4 (12.1)
Diaphragm	3 (9.1)
Liver	2 (6.1)
Spleen	2 (6.1)
Omentum	2 (6.1)
Colon	1 (3)
Inferior epigastric artery	1 (3)
procedure	
Diagnostic only	13 (39.4)
Diagnostic and therapeutic	14 (42.4)
Conversion to open laparotomy	6 (18.2)

Data expressed as *n* (%).

Table 3 Hospital stay and complications among the studied patients

	N=33
Complications	
None	30 (91)
Wound infection	3 (9)
Hospital stay	
≤2 days	18 (54.5)
>2 days	15 (45.5)

Data expressed as *n* (%).

Table 4 Hospital stay based on the type of procedure

	Hospital stay		P value
	≤2 days (N=18)	> 2 days (N=15)	
Type of procedure			
Diagnostic only	13 (72.7)	0	<0.001
Diagnostic and therapeutic	5 (27.8)	9 (60)	
Conversion to open laparotomy	0	6 (40)	

Data expressed as *n* (%). *P* value was significant if less than 0.05.

Table 5 Hospital stay based on the presence of organ injury

	Hospital stay		P value
	≤2 days (N=18)	> 2 days (N=15)	
Organ injury			
Yes	6 (33.3)	14 (93.3)	<0.001
No	12 (66.7)	1 (6.7)	

Data expressed as *n* (%). *P* value was significant if less than 0.05.

blunt and penetrating injuries, laparoscopy has received the most general support as a valuable technique in the care of patients with PAT. It has been demonstrated that it can properly detect anterior peritoneal penetration from knife and gunshot wounds [3].

In the current study, 33 hemodynamically stable patients with PAT were studied. The study aimed to evaluate the diagnostic and therapeutic role of laparoscopy in such patients. The mean age of those patients was 33.45±10.89 years and the majority of them (84.8%) was males. Stab wound was the most common cause of trauma, while gun shots injuries were present in only two patients.

Bain *et al.* [5] used laparoscopy to evaluate 56 individuals with PAT. They discovered that the average age of their patients was 40 years, ranging from 16 to 66 years. Stab wounds to the abdomen were responsible for 48 (85.7%) patients. The remaining eight (14.3%) patients were all victims of gunshot wounds to the abdomen. Furthermore, the vast majority of the patients were men.

We found that 13 (39.4%) patients had no organ injury and 20 (59.6%) patients had different organ injuries. The most frequently observed injuries were to small bowel (15.2%), mesentery (12.1%), and the diaphragm (9.1%). Simple repair and closure was the most frequent definitive management that was used in 12 (36.4%) patients.

A previous published systemic review of 51 studies recruited 2563 patients who were subject to laparoscopy for PAT. The organs most commonly requiring repair were the diaphragm (54%), omentum/mesentery (13%), and the liver (13%), followed by stomach (7%) and small bowel (5%) [6].

In the current study, as regards the type of procedure, it was only diagnostic laparoscopy in 13 (39.4%) patients, diagnostic and therapeutic laparoscopy in 14 (42.2%) patients, and in six (18.2%) patients the procedure was converted to open laparotomy. So, a nontherapeutic laparotomy was avoided in 39.4% of our patients.

Conversion rate to laparotomy was 17.9% according to Bain *et al.* [5], who enrolled 56 patients who underwent laparoscopy. Of the 46 patients who did not require conversion, 33 (71.7%) patients underwent diagnostic laparoscopy. Therapeutic laparoscopy was performed in 13 (28.3%) patients. A nontherapeutic laparotomy was avoided in 58.9% of their patients.

According to O'Malley *et al.* [6], the major advantage of laparoscopy is the avoidance of unneeded laparotomies. Overall, laparoscopy was shown to be extremely sensitive in detecting peritoneal penetration. The authors reported a 24.29% rate of therapeutic laparoscopy.

In our results, six (18.2%) patients required conversion to open laparotomy. This correlates with the rates documented in previous literature, which ranges from 7 to 37%. The main causes of conversion included complex injuries, poor visibility, and failure of equipment [7]. The current study found that the majority (91%) of patients had no complications. Only three patients developed wound infection that respond well to local antibiotics and frequent dressings. Hospital stay was less than 2 days in 18 (54.5%) patients and exceeded 2 days in 15 (45.5%) patients. Mean hospital stay was 3.06±2.10 day. Patients who underwent laparotomy had significantly longer hospital stay.

Bain *et al.* [5] reported that there were no mortalities in any of their patients. Three patients suffered from postoperative complications. One patient developed a postoperative ileus, another patient developed hospital-acquired pneumonia requiring prolonged intravenous antibiotic therapy, and the last one patient developed a postoperative intra-abdominal abscess.

Zafar *et al.* [8] reported that 69% of those patients had a penetrating injury, and therapeutic laparoscopy was performed in 19.3% of patients. The most commonly performed laparoscopic therapeutic procedure was diaphragmatic repair (19.2%). The rate of missed injury in this study (injuries that had not been detected during the initial diagnostic laparoscopy) was 0.5%.

Conclusion

Laparoscopy in PAT may have an important role in a selected subgroup of patients, with surgeon expertise being an important factor. Laparoscopy has screening, diagnostic, and therapeutic roles, particularly where diaphragm injury is suspected.

The development of specific guidelines or protocols may increase the value of laparoscopy in trauma but this would require more evidence of a higher quality. Low rate of missed injury rates, reduced duration of hospital stay, faster recovery, and reduced cost make it an attractive and

safe alternative to classical trauma laparotomy. But, it has a limited role in retroperitoneal organ injuries.

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Nil.

Conflicts of interest

The authors declared no conflict of interest.

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