

Laparoscopy a Realistic Diagnostic and Therapeutic Modality for Abdominal Trauma

Our Experience of Laparoscopy in Abdominal Trauma : A Prospective Study

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Abstract:-

➤ Background

Trauma is considered as one of the leading and preventable cause of death in young adults and its incidence is on a steady rise. Laparoscopy as an alternative has been used with great benefits, although the rate of non-therapeutic laparotomy still remains high. The present study was aimed for assessing the efficacy of laparoscopy in the cases of abdominal trauma of any kind and to assess the primary outcome as avoiding unnecessary laparotomy and secondary outcome in the terms of hospital stay and overall prognosis.

➤ Materials and Methods:

This study was conducted as a prospective interventional study on all abdominal trauma patients reporting at Trauma Centre, and Super Specialty Hospital, BHU, Varanasi from July, 2017 through June, 2019. All selected patients underwent the laparoscopic exploration if required then converted to laparotomy.

➤ Result:

Fifty-two patients with abdominal trauma considered and underwent laparoscopic exploration in 25 (48.9%) and converted to laparotomy in 27 (52.1%) patients. This led to a reduction of non-therapeutic laparotomy in patients with abdominal trauma using diagnostic laparoscopy was up to 23%. However, laparotomy was avoided in 48.9% of cases. In our study, laparoscopy was 100% accurate in identifying the site and organ of injuries. The laparotomy group had significantly higher rates of SSI and chest infection (p.01). The mean length of hospital stay in the laparoscopy group was 4.72 days and in the laparotomy group was 9.81 days (p 0.001).

➤ Conclusions:

Laparoscopy seems a useful and safe tool for the management of hemodynamically stable patients with

abdominal trauma of any kind and can reduce the risk of non-therapeutic laparotomy and its associated postoperative complications.

Keywords:- Laparoscopy, Prospective Study, Abdominal Trauma, Uncertain Abdomen.

I. INTRODUCTION

Trauma is becoming a major public health concern worldwide, and the incidence is on constant and steady rise^[1] especially in under the age of 35 years. Despite the advances in diagnostic modalities, abdominal trauma poses a diagnostic challenge at times owing to its varied injury spectrum and mechanism of injury^[2].

Laparoscopy was considered as an alternative diagnostic tool for trauma patients for many decades, and as a therapeutic tool getting more limelight in recent era. Its role in penetrating abdominal trauma (PAT) is established, but blunt abdominal trauma (BAT) can be a matter of debate and challenge. Hence, the use of laparoscopy is relatively limited in BAT as compared to PAT^[2,3].

Acute Care Surgery (ACS) is now becoming widely accepted in acute care surgery (ACS) and is used with significant benefits in centers with experience in laparoscopic skills^[4]. The role of Therapeutic Laparoscopy (TL) is still a controversial concern for the management of multiple bowel injury where as the conversion rate remains too high.

The laparoscopic-assisted procedure (LAP) is helpful and can be used for the management of bowel injuries instead of straightway going for laparotomy. Laparotomy remains the gold standard in hemodynamically unstable patients and in centers where resources are limited^[5].

Recent studies had confirmed the role of diagnostic laparoscopy (DL) has a high yield in both identifying and excluding injury, thereby reducing negative non-therapeutic laparotomy^[6,7]. While it is still debatable in BAT, a prompt adequate resuscitation and an early accurate diagnosis remain critical step for reducing morbidity and mortality.

Here we report our experience of laparoscopy in abdominal trauma (both BAT and PAT) and findings in terms of diagnostic role, missed injuries, need of avoiding negative laparotomy, along with reduced length of hospital stay and overall outcome.

II. MATERIAL AND METHOD

It was prospective interventional study, conducted in the Trauma Centre, Banaras Hindu University, and Varanasi from July 2017 through June 2019, approved by the Institute ethical board (Dean/2017/EC/195). Informed consent was obtained from each case that qualified the inclusion criteria.

The hemodynamically stable patients (SBP 90 mmHg and PR 100 bpm) in the age group of 18–50 years, patients with an "unclear abdomen" with equivocal clinical findings, and those with a high index of suspicion for mechanism of injury and the missile trajectory in PAT were also included.

Hemodynamically unstable (SBP 90 mmHg, PR >100 bpm) even after resuscitation, clear signs of peritonitis and bowel evisceration, and those unfit for general anesthesia, including polytrauma cases with tension pneumothorax and TBI (GCS 8), were excluded from the study.

Laparoscopy was performed under proper general anesthesia and pneumoperitoneum was created using Verres's needle or Hassan's canula and CO₂. Pressure was maintained between 10-12 mmHg. A 10 mm supraumbilical port was placed initially, and additional ports were used based on the intraabdominal findings.

Laparoscopic exploration was done to reveal any peritoneal breach and the whole abdominal cavity was explored to detect any injury in the solid organs, diaphragm, stomach and omentum, followed by the small bowel and large bowel. The procedure was either done laparoscopically or converted to laparotomy. Patients were managed in the surgical ward or ICU postoperatively. All patients were in postoperative care till their discharge from the hospital or declared death in the hospital.

DL was considered as negative in the absence of injury and non-therapeutic when the lesions identified but did not

warrant any surgical intervention. Therapeutic laparoscopy (TL) was defined when the intervention for the identified lesions were managed totally laparoscopic or laparoscopic-assisted (LAA).

III. RESULTS

During this study period, 52 patients with abdominal trauma (AT) were managed laparoscopically (BAT: PAT 3:1). Of those, 46 were male and the rest 6 were female, with a mean age of 33.60 years. (Table 1)

Mechanism of injury Types	Types	
	BAT (39)	PAT (13)
Road Traffic Accident	31	-
Stab Injury	-	7
Fall from Height	6	-
Firearm Injury	-	6
Machine Injury	1	-
Fall of a wall over body	1	-

Laparoscopy alone and laparoscopic-assisted (LAA) procedures were executed in 25 cases, while a conversion to laparotomy was required in 27 cases (BAT = 19; PAT = 8). (Table 2)

Mechanism of injury Types	BAT		PAT	
	Laparoscopy	Laparotomy	Laparoscopy	Laparotomy
Road Traffic Accident	14	17	-	-
Stab Injury	-	-	3	4
Fall from Height	4	2	-	-
Firearm Injury	-	-	2	4
Machine Injury	1	0	-	-
Fall of a wall over body	1	0	-	-
Total	20	19	5	8

Hemoperitoneum was the most common finding in 31 patients (Figure: 1). a total of 28 hollow organ injuries (HOI) were present in 21 patients: 16 with single HOI, 3 with double HOI, and the rest, 2 with triple HOI. Mesenteric and liver injuries were noted in 10 patients each, while splenic and

diaphragmatic injuries were identified in 3 and 1 patient respectively. (Table: 3)

Table 3: Anatomical distribution of Injury & Type of procedure

Organ	No.	DL	TL	LAA	Laparotomy
Hollow Organ Injury					
• Stomach	4	0	0	0	4
• Small Bowel	15	0	0	3	12
• Large Bowel	9	0	0	2	7
Mesenteric injury	10	6	1	0	3
Liver	10	5	0	0	5
Spleen	3	2	0	0	1
Diaphragm	1	0	0	0	1

The laparoscopy was negative in 7 patients and non-therapeutic in 5 patients. Therapeutic laparoscopy was done in 8 patients while Laparoscopic-assisted procedures were done in 5 patients. (Figure:2) Overall, unnecessary laparotomy was avoided in 12 (23%) cases.

In the BAT cohort, 20 patients (51.3%) had multiple injuries: 9 with thoracic trauma, 4 with extremity injuries, 2 with facial trauma and 5 had other injuries including pelvic fractures and TBI (Frontal contusion). In PAT, 2 cases had associated thoracic injuries, amongst which one was a case of firearm injury with right hemothorax with right diaphragm injury along with a Grade 2 liver injury.

Table 4: Operative time and length of hospital stay

	Laparoscopy		Laparotomy	
	Early (n=20) (<72 hrs)	Late(n=6) (>72 hrs)	Early (n=21) (<72 hrs)	Late (n=5) (>72 hrs)
Length of stay (days)	4.15±1.57	6.50±3.39	8.40±2.41	10.13±4.92
Operative time (min)	82.4±48.6	116.2±54.7	167.1±79.5	179.4±58.9

41 cases underwent early DL (≤72 hours of injury) while the rest 11 cases were done after 72 hours of injury. Those cases who underwent early intervention had a shorter hospital stay and shorter operative time in both the laparoscopy and laparotomy group (Table:4). The overall length of hospital stay of the laparoscopic group was significantly shorter than the conversion group (p<0.001). (Table:5)

Table 5: Overall hospital Stay

	Laparoscopy	Laparotomy
Length of stay (days)	4.72±2.301	9.81±4.574

13 patients developed postoperative complications (Table:6) and 3 patients, all from the laparotomy group, needed ICU admission with a median stay of 8.33 days each (range 3-14). Out of 52 patients, there was a single mortality, who was a 41-year-old male with BTA following RTA. On Laparoscopy, a large mesenteric tear was noted with an ischemic ileal segment. Laparotomy followed by resection and anastomosis of the Ileum was done. Postoperatively, patient developed sepsis followed by acute renal failure and respiratory failure and finally succumbed to MODS on postoperative day 14.

Table 6: Postoperative complications

	Laparoscopy(n=25)	Laparotomy(n=27)
SSI	1	7
Chest Infection	1	2
DVT	0	1
Sepsis	0	1
<i>p-value <0.01</i>		

IV. DISCUSSION

Laparoscopy in trauma was first used in 1956 by Lamy. Later Gazzaniga described the importance of laparoscopy and its role in deciding the need of laparotomy in trauma^[8]. Since then, laparoscopy in trauma is continuously evolving. Its role in PAT is well established as a diagnostic and therapeutic tool both. But unlike in PAT, the role in BAT which is a matter of debate and mainly used in scenarios where there are equivocal clinical and imaging findings for suspected intra-abdominal injury^[9].

Nevertheless, the main role of laparoscopy in trauma is to establish the diagnosis of injury which may require an intervention in the form of a laparoscopic-assisted procedure, a Therapeutic Laparoscopy (TL) or a laparotomy. However, therapeutic laparoscopy is a secondary choice, which completely depends on the surgeon’s expertise, the extent of the injury and available resources^[10].

Exploratory laparotomy is a procedure of choice in abdominal trauma. However, unnecessary laparotomy (negative and non-therapeutic), missed injuries or delay in diagnosis increases the morbidity, mortality and at the cost associated with abdominal trauma, which can be minimized by laparoscopic intervention^[2,11].

Our study revealed a similar result with a blunt and penetrating injury ratio of 3:1. Earlier, mandatory laparotomy in PAT resulted in 37-40% unwanted laparotomy with associated complications as high as 22%. Selective management combined with other diagnostic methods has helped reduced the rate of both non-therapeutic and negative laparotomy^[12].

Here we noticed that negative laparotomy was avoided in 25% of cases in this study. Though the incidence of unnecessary laparotomy has decreased due to imaging, there still exist a major bulk of 3.6% negative laparotomy and 6-27% non-therapeutic laparotomy, with complication rates of 14.5% and 12% respectively. Laparoscopy has been used as a diagnostic tool for such patients and under these circumstances; it has contributed in reducing the negative laparotomy rates [4, 6]. Laparoscopy was 100% accurate in diagnosing injury during the study.

Early experiences have reported missed injury rate up to 77% in diagnostic laparoscopy [13]. Later on, missed injuries in AT was around 1.3-4%, with complication rates of 14-27%, bowel injuries being the most common one. Missed injuries are often attributed to false-negative ultrasound and CT study findings. But recent studies are a testimony to improved techniques and experience in Laparoscopy, which has now helped reduced the incidence of missed injury to <1%. As a result, the diagnostic capabilities of laparoscopy in trauma are no longer in doubt [6, 7]. It was proven as no missed injury was encountered during the study which was supported by other similar studies [14, 15, and 16].

Recent literature has reported a varying rate of TL as low as 13.8% to as high as 83%. The variability in these reported rates may be attributed to individual surgeon experience with laparoscopy [11]. In our experience, we witnessed a TL rate of 15.4% while Laparoscopic procedures (DL+TL) were successful in 48.1%.

In a study, Laparoscopy had an accuracy of 100% in identifying injuries and the rate of reduction of non therapeutic laparotomy using DL was 55.4%. The median length of hospital stay in the laparoscopy group was also significantly lower as compared to the laparotomy group ($p \leq 0.001$) [7]. Our study also revealed a 100% diagnostic accuracy while negative laparotomy was avoided in 25% of cases.

A recent study showed that laparoscopy was associated with a reduction in SSI and chest infection ($p < 0.006$), a decreased length of hospital stay ($p < 0.01$) and reduced duration of surgery ($p < 0.008$) [17]. A similar result in terms of reduced in-hospital stay ($p < 0.001$) and reduced complication rates were observed in the study.

In BAT, the number of patients who benefited from laparoscopy was limited, as BAT was often associated with higher grade injury and hemodynamic deterioration owing to major blood loss. Also, most Solid Organ Injury (SOI) do not require surgical intervention and are managed nonoperatively [3, 14]. CT is the gold standard examination for SOI and identifies the source of bleed with an accuracy of >90%. CT also has an essential role in the follow up of these patients [7].

In the first 6 hours following an HOI and mesenteric injury, CT can miss the injury in 5.9-14.8% [19, 20, 21]. Free intraperitoneal fluid without SOI is the most common indirect sign present in more than 90% of bowel injuries (Sensitivity > 90%; Specificity $\leq 33\%$) [7, 19]. HOI and mesenteric avulsion with bowel ischemia, with or without major haemorrhage, are considered as the most severe injury. In this scenario, DL is considered superior to both CT and ultrasound, offering a direct visualization of the injury [10].

In our study, the main indications for DL were: suspected HOI and mesentery injury, with or without diaphragmatic lesion, 'unclear abdomen' or suspicion of ongoing minor bleeding diagnosed on imaging. The majority of patients in our cohort had clinical features of pain (100%), distension (28.2%) and nausea/vomiting (20%).

In 41 patients, DL was performed within 72 hours of injury and it was observed that early intervention was associated with a decreased length of hospital stay and a reduced recovery time.

Patients with localized intraperitoneal fluid collection on imaging with equivocal clinical signs can be monitored and treated expectantly, and on non-improvement or progression of symptoms, patients should be considered for DL at the earliest and evacuation done.

In the study, Hemoperitoneum (59.6%) and perforated hollow organ injury (HOI) (28.8%) were the most frequent findings. It was observed that, in the presence of hemoperitoneum, CT was less contributive to detect the hollow viscous injury leading to peritonitis as the use of CT as a diagnostic tool for bowel injury had a diagnostic accuracy of 63.46% (Sensitivity 33.3%, Specificity 83.9%, PPV 58.33%, and NPV of 65%) in the study. In a similar study for Traumatic Bowel and Mesenteric injuries (TBMI), the overall sensitivity of the CT was 63.6%, specificity: 79.6%, PPV: 53.9% and NPV: 85.5% with an overall accuracy calculated at 75.3% [22].

In our cohort, 51.9% of the cases needed conversion. The main reasons for conversion were: uncontrolled extensive bleeding, complex high-grade injuries, intra abdominal adhesions, poor visibility and intra operative deterioration of patients.

Complications of laparoscopy in abdominal trauma varies between 1 to 12.2% [3, 22]. In our study, the complication rate was 8% (2/25) in the laparoscopy group as compared to 40.7% (11/27) in the laparotomy group. Three patients (5.7%) needed an Intensive care unit (ICU) with a mean ICU stay of 8.33 (3.00-14.00). There was single mortality because of multi-organ failure unrelated to laparoscopy. The mortality rate was 6.1% in a study [3], while no mortality has been reported in other studies [7, 23].

Though it was a small study group, we observe that Laparoscopy is a feasible and safest tool for the diagnostic as well as therapeutic option in selected cases of hemodynamically stable abdominal trauma patient based on our observation. Laparoscopy is an ideal tool to detect injuries of 'unclear abdomen' either in early or delayed intervention and can be helpful in deciding and avoiding a non-therapeutic laparotomy and to perform therapeutic interventions or an assisted procedure as and when required. There is a lack of randomized trial on laparoscopy; hence there is no consensus available for the management of such cases. Most studies are single centre study having a limited number of recruited cases.

Our study has its limitations this was a single centre prospective study, with a limited number of cases. There is a need for prospective multicentre study or RCT for an authentic and robust evaluation of laparoscopy, especially in blunt abdominal trauma.

V. CONCLUSIONS

Laparoscopy in trauma is extremely useful in select patient like blunt abdominal trauma. It is safe, reduces morbidity, shorten hospital stay, and help in making accurate diagnosis and avoiding unnecessary laparotomy.

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Funder: None

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