

Diagnostic and Therapeutic Laparoscopy in Various Blunt Abdomen Trauma

¹VD Gohil, ²HD Palekar, ³M Ghoghari

¹Assistant Professor, Department of Surgery, Government Medical College and Sir Takhtasinhaji Hospital, Bhavnagar Gujarat, India

²Associate Professor, Department of Surgery, Government Medical College and Sir Takhtasinhaji Hospital, Bhavnagar Gujarat, India

³Resident, Department of Surgery, Government Medical College and Sir Takhtasinhaji Hospital, Bhavnagar, Gujarat, India

Correspondence: VD Gohil, Assistant Professor, Department of Surgery, Government Medical College and Sir Takhtasinhaji Hospital, C/173, Gayatrikrupa, Kalvibid, Ramnagar, Bhavnagar, Gujarat, India, Mob: 9825607560
E-mail: drvijayrajgohil@gmail.com

Abstract

The abdomen is the “Black box” i.e., it is impossible to know what specific injuries have occurred at initial evaluation. The key to saving lives in abdominal trauma is NOT to make an accurate diagnosis, but rather to recognize that there is an abdominal injury. Minimal-access surgery is an integral component of the alternative surgery management paradigm. The addition of videoscopic technology to intracavitary endoscopy has led to a tremendous expansion of indications for minimal-access procedures in all fields of surgery. The use of laparoscopy to assess the peritoneal cavity for injury is not a new concept. Reports by Tostivint et al, Gazzaniga et al, and Carnevale et al discussed the possibilities of using this minimally invasive approach to evaluate the peritoneal cavity for injuries. Laparoscopy has become an important diagnostic and therapeutic tool in the treatment of both blunt and penetrating traumatic injuries. Laparoscopy has been shown to be valuable in detecting occult diaphragmatic injuries in locations where computed tomography (CT) scanning and diagnostic peritoneal lavage have recognized limitations. Notably, laparoscopy can also provide therapeutic interventions in certain circumstances as well. Simultaneous gastric and diaphragmatic injuries have been repaired using this approach. Laparoscopy has been used to repair blunt traumatic solid organ injuries, including a subcapsular splenic hematoma. Blunt hepatic injuries have been successfully treated laparoscopically with the instillation of fibrin glue. A duodenal hematoma has been decompressed laparoscopically. Importantly, in trauma patients with potential intracranial injuries, laparoscopy should be used cautiously because of the risk of increased intracranial pressure. Laparoscopy is also potentially hazardous in patients with acute respiratory distress syndrome, because lung compliance and effective gas exchange may be further decreased by the pneumoperitoneum. Laparoscopy can be performed safely and effectively in stable patients with abdominal trauma. The most important advantages are reduction of morbidity, shortening of hospitalization and cost effectiveness. In the future, new development in laparoscopy equipment and the introduction of computer technology and robotic devices can be expected to have a decisive influence on the treatment of trauma patients.

Keywords: Diagnostic and therapeutic laparoscopy, blunt abdomen trauma, minimal access surgery, exploratory laparotomy.

INTRODUCTION

In the environment that human being has created exposes him to variety of injuries caused by numerous forces like vehicular accident, social conflict, crimes, terrorism, wars, industrial accident, fall from height. In this situation the incidents of blunt abdominal injuries has also been increasing with other injuries of the body part being injured. Road traffic accidents (RTA) are a major cause of blunt abdominal injuries nowadays responsible for 45 to 50% of BATs.¹ Assaults, falls, automobile–pedestrian accidents and work-related injuries are also common.² Abdominal injuries in blunt trauma result from compression, crushing, shearing, or deceleration mechanisms. Fortunately, the incidence of BAT requiring laparotomy is only 6%. The most frequently injured organs are the spleen (40 to 55%), the liver (35 to 45%), and the retroperitoneum (15%).³

Management of blunt trauma abdomen (BTA) requires an art of resuscitation early diagnosis and initial evaluation and management then lastly the perfect surgical skill. In blunt trauma abdomen most commonly injured organs are liver, spleen, kidney, intestines, pancreas, stomach, urinary bladder and vessels accordingly.^{1,3} Previously all BTA ended up in laparotomy and managed according to organ injury, however in such cases chances of negative laparotomy were high but, due to research and advances in diagnostic field like USG, DPL, CT-scan abdomen the chances of negative laparotomy significantly reduced and sometimes managed conservatively.¹⁶

With advent and development of new technology, laparoscopy-minimally access surgery (MAS) has diagnostic as well as definitive therapeutic role in blunt trauma abdomen (BTA).⁴ In the past it was limited only as diagnostic procedure

because of time consumption, need for specialized instruments and need of general anesthesia (GA). As there is availability of sophisticated equipments, instruments and easy availability of anesthetists, laparoscopy is being used more and more for diagnosis as well as therapeutic measure in BTA.⁴

Laparoscopy was first used for a trauma patient in 1956 by Lamy, who observed two cases of splenic injury. Since then, Gazzaniga et al.⁵ noted that laparoscopy is useful for determining the need for laparotomy. In 1991, Berci et al.⁶ reported that he had reduced the number of nontherapeutic laparotomy performed for hemoperitoneum by 25% through the use of laparoscopy in 150 patients with blunt abdominal trauma. Chol et al reported reduced negative and nontherapeutic laparotomy rates in this identified population.⁷ Hemoperitoneum associated with stable vitals with liver injury, splenic injury, bowel injury, mesenteric injury, or bladder injury can be managed very well by means of laparoscopy. Advanced laparoscopic technique including bowel resection and anastomosis, ligation of blood vessels can be utilized in BTA, as good as in elective open surgery.⁸⁻¹¹ One can visualize peritoneal cavity and act expeditiously if needed (i.e. laparotomy, laparoscopic assisted intervention or only observation) at time of laparoscopy.¹² Laparoscopy is cost effective, reduces the rate of negative laparotomy, reduces the patient's stay in hospital and mortality and allows early mobilization and resumption of work.

However with advancement in techniques and equipments, it 'MAY' happen so that laparoscopy may replace laparotomy in near coming future.

AIMS AND OBJECTIVES

1. To know the mode of injury and incidence of organ involvement in blunt trauma abdomen in developing country.
2. To study the management of blunt trauma abdomen in tertiary center in developing countries like India.
3. To find out the role of laparoscopy (diagnostic as well as therapeutic) in management of blunt trauma abdomen (BTA).
4. To reduce the incidence of negative laparotomy.
5. To find out the limitation of laparoscopy in blunt trauma abdomen.
6. To review the method of patient selection, operative technique, operating time, intraoperative and postoperative complications.
7. To find out the impact of laparoscopy on patient with blunt trauma abdomen in terms of early rehabilitation, cost effectiveness and decreased hospital stay and lastly cosmesis.

MATERIAL AND METHODS

To know the role of laparoscopy in the blunt abdominal injury, we have carried out a prospective study among the patients of surgical wards of Sir T hospital, Bhavnagar, Gujarat, India. All

the patients of blunt abdominal injury with hemoperitoneum who were relatively stable hemodynamically after adequate resuscitation taken into study and treated as per the standard protocol of laparoscopic management after investigated thoroughly.

CONTRAINDICATION TO LAPAROSCOPY IN PATIENT WITH BTA¹³

1. BTA with associated head injury with EDH/SDH (GC scale <13-15)
2. BTA with polytrauma (compound fracture, spine fracture, severe chest injury with SPO₂ < 90%)
3. BTA with hemodynamic instability
4. BTA with difficulty in endotracheal intubation.
5. Pregnancy

Patients were given general anesthesia and supine position. First trocar inserted at supraumbilical ridge with open Hassan's method with pneumoperitoneum with pressure of 12-15 mm Hg. Other port site created under direct vision from within. The standard three main ports are (a) umbilical port (10 mm) (b) right sided port (5 mm /10 mm) (c) Left sided port (5 mm/10 mm) (d) others: Extra port made according to organ injury and difficulty in its management usually, subxiphoid 5 mm in epigastrium and in lower abdomen in case of pelvic organ injury.

Diagnostic laparoscopy was done through out the all quadrant from splenic fossa to liver as clock wise. All small bowel and large bowel are thoroughly checked by walk over. Lesser sac and duodenum are checked and lastly retroperitoneum was explored. Blood was aspirated and suction and irrigation done.

In our prospective study, we have done therapeutic laparoscopy by laparoscopic primary closure of the jejunal perforation, primary repair of bladder rupture in two layer, and electro cauterization and hemolock solution spraying locally at liver or splenic injury (either contusion, laceration or tear) with no active bleeding without disturbing the preformed hematoma. All patients were kept under observation in CCU and then after shift to the ward as they were stabilized postoperatively. Due postoperative care given and good follow-up done for every patients. Our results are as below.

OBSERVATION AND DISCUSSION

In present series total 25 cases of blunt abdominal trauma were studied. All have gone through the emergency exploratory laparoscopy, out of which 24 cases (96%) managed laparoscopically and only 1 case (4%) converted into open exploratory laparotomy.

i. Indication for laparoscopy.^{13,17}

- Hemodynamically stable.
- Some abdominal injury.
- DPA (Diagnostic peritoneal aspiration) positive.
- USG/FAST-positive.

ii. *Sex distribution ratio (Table 1):*^{14,15}

Thus in our study male patients are more than female patients who are comparable to others study. This may be due to involvement of male mainly into traveling, alcohol abuse, earning.

Table 1: Sex distribution ratio

Sr. no.	Series	No. of cases (% of total cases)		Total
		Male	Female	
1	Timothy-C Fabian et al(1992) ¹⁵	149 (82%)	33 (18%)	182 (100%)
2	YB Chol et al(2002) ¹⁴	49 (63%)	29 (37%)	78 (100%)
3	Present study(2006)	19 (76%)	06 (24%)	25 (100%)

iii. *Age distribution (Table 2):*^{14,15}

In our study the most common age group involved is 11-20 years and 21-30 years age group. The median age group in our study is 23 years. The median age group in YB Chol et al series¹⁴ is 40.9 years and in Timothy C Fabian et al series¹⁵ is 32 years. This higher incidence in this particular young age group is mainly because of economic status, high mobility and increased in utilization of vehicles by this young age groups and exposure to bad environment and alcohol abuse and early involvement in earning, etc particularly in India.

Table 2: Age distribution

Sr. no.	Age (yrs)	No. of patients	Total
1	0-10 years	03	12%
2	11-20 years	08	32%
3	21-30 years	09	36%
4	31-40 years	05	20%

iv. *Mode of injury (Table 3):*

In present study it shows that the blunt trauma abdomen is mainly due to road traffic accidents (68%) nearer to 2/3 of total cases which is same as in Jason Smith et al series.¹⁸ This may be due to increased transportation and mobilization of people from here to there mainly through the vehicles

Table 3: Mode of injury resulting in blunt trauma abdomen

Sr. no.	Series	No. of cases (% of total case)				Total
		RTA	Fall from height	Assaulted injury	Others	
1	Jason Smith et al ¹⁸	591(61%)	67(7%)	232(24%)	79(8%)	969(100%)
2	Present study	17(68%)	07(28%)	01(04%)	00(0%)	25(100%)

which make them susceptible to road traffic accident. Blunt abdominal injury due to fall down is second leading cause.

v. *Incidence and pattern of organ injury (Table 4):* Liver injury is most commonly seen injury in BTA in this present series followed by spleen. In Nance and Cohn's series and in Town send and colleagues series²² spleen is commonly involved. Pattern of organ injury and no. of patients are different due to different countries, different mode of injuries in India as compared to western countries.**Table 4:** Incidence and pattern of organ injury

Sr.no.	Organ injured in BTA	Michael lenience series (%)	Town send and colleagues series (%)	Present series (%)
1	Liver	15(15%)	8(47%)	14(56%)
2	Spleen	27(27%)	7(41%)	06(24%)
3	Kidney	27 (27%)	0	0
4	Small bowel	06	2(2%)	02(8%)
5	Stomach	01	0	0
6	Colon	02	0	0
7	Pancreas/duodenum	05	0	0
8	Others (e.g. retro-peritoneal bladder injury, no injury)	17	0	03(12%)

vi. *Mode of management (Table 5):*^{19,20} In this present series a laparoscopy used as a diagnostics well as therapeutic tool for patients with blunt trauma abdominal (BTA). Here 25 cases studied out of which only 1 converted to exploratory laparotomy.**Table 5:** Mode of management

Sr. no.	Series	Laparoscopy			Laparo- Total tomy
		Non-operative	Operative	Total	
1	Pascal Fabian et al (2002)	06	20	26	6(19%) 32
2	Sarmiento et al (2003)	20	03	23	2(34%) 35
3	Present study	22	02	24	1(4%) 25

- All patients were undergone emergency diagnostic laparoscopy, out of which 22 had either liver or splenic injury in the form of contusion, laceration or tear with no active bleeding from the sight of injury with non expanding hematoma in surrounding. All these cases

managed conservatively by draining the hemoperitoneum with spraying of the hemolock solution (ferricrylum) at injury site which lead to foam formation locally and promotes hemostasis and stops minute oozing.

- There were two cases found with only retroperitoneum hematoma with 100-150 cc of hemoperitoneum, but no active bleeders found.
- On laparoscopy 3 patients have major injuries, one has Jejunal perforation (single, small, traumatic with size of 1 cm with healthy margin which get closed primarily in two layers with mersilk (2-0) by simple interpreted suture.
- One patient with intraperitoneal bladder rupture with spillage of urine and contrast dye into the abdominal cavity with hemoperitoneum treated laparoscopically by primary closure of bladder tear in two layers with vicryl (2-0) simple interpreted suture.
- Another case with large single traumatic perforation in ileum with large mesenteric hematoma found with moderate fecal contamination which had immediately converted into the exploratory laparotomy by small mid-midline scar through the supraumbilical port site.
- The ileum was delivered out through small incision and that necrosed segment with perforation with mesenteric hematoma gets resected and end to end ileo ileal anastomosis done with thorough peritoneal lavage. Almost all patients were given peritoneum lavage with normal saline and drainage of peritoneal cavity done according to injury site.
- Hence in our study emergency laparoscopy has very good diagnostic and therapeutic role in management of patients with blunt abdominal injury in 96% of total number. of cases. Only 4% of chances of open laparotomy in our study. There were No Missed Injury and all treated patients made uneventful recovery.
- Finding of our present study are correlating with the another study carried out by Pascal Fabian et al in year 2000 with 81% of total patients managed by means of laparoscopy and only 19% had conversion to open laparotomy with no any missed injury and all patients had uneventful recovery.

vii. *Incidence of negative laparoscopy (8%):*¹⁹ In our present series there are two cases in which no any visible injury found in abdominal organ, but only the retroperitoneal nonexpanding hematoma which left undisturbed. Only 100-200 cc of hemoperitoneum was present which get drained. In Pascal Fabian et al series incidence of negative laparoscopy was 6(18.8%) cases.¹⁹

viii. *Diagnostic accuracy of laparoscopy:* Diagnostic accuracy in our study is of 92% which is correlating with the other series (89 to 97%) (Table 6). Hence laparoscopic has got tremendous role in diagnosis of blunt trauma abdomen.

Table 6: Diagnostic accuracy of laparoscopy

Name	Series	No. of cases	Diagnostic Accuracy
1. Gustavo Kuster	General	140	97.9%
2. Hamish Foster ²⁵	General	227	89.0%
3. Present series(2008)	General	25	92%

ix. *Decreased incidence of negative laparotomy:* In Present study and study of Meyer et al²³ the incidence of negative laparotomy is almost nil (Table 7). The other above mention study also had average 8 to 10% of negative laparotomy, which are quite less as compared to open laparotomy study.

Table 7: Incidence of negative laparotomy

Sr. no.	Name	Year	No. of patients	Laparo- scopy	Lapa- rotomy	No. of negative laparotomy
1	Cuschieri et al ²⁴	1985	29	16	13	3 (10.3%)
2	Townsend et al ²²	1990	15	8	07	01 (6.6%)
3	Gruppel et al	1995	118	52	45	04 (8.8%)
4	Meyer et al ²³	2002	20	19	01	0%
5	Present series	2008	25	24	01	0%

x. *No of port's used:*¹⁴ In present study we had used 3-4 ports. Most commonly 3 in number out of which 2 are of 10 mm 1 is of 5 mm which is common in all cases. Umbilical port is usually of 10 mm. 4th trocar usually needed in complex injuries to left lobe of liver, posterior pole of spleen or for diaphragmatic or stomach injuries for better visualization. It is usually taken in subxiphoid/eipgastic region. YB Chol et al series number of port used were three-umbilical port (10 mm), right and left port-5 mm ,10 mm and 12 mm.¹⁴

xi. *Total duration of surgery:* Average duration of surgery is in minutes, approximately 45 to 50 minutes which is quite less than for standard laparotomy which required minimum of at least 1 hour. Hence patient had less surgical stress and less postanesthetic complication. In YB Chol et al series average duration of surgery is 142 minute.¹⁴

xii. *No of blood transfusions:* On an average amount of blood required for any laparoscopic surgery in present study is approximately 2.5 unit (1 unit = 350 cc) of whole blood on an average is required in each patients who is hemodynamically found to be stable. Another study carried out by Nasr and Cynthia et al 1995 on average blood requirement is 2 units in each patient who is stable.

xiii. *Failure of laparoscopy and conversion to laparotomy:* In our present study only in one case laparoscopy fail to manage injury to ileum with large traumatic perforation with mesenteric hematoma, which was managed by open mini laparotomy with resection and anastomosis. Here only small strategic incision taken through umbilical port (vertical midline incision) and traumatized part delivered out and

treated accordingly as mentioned above. Hence the rate of failure of laparoscopy and conversion to open laparotomy in our study is 4%. In Pascal *et al* study rate of conversion to open laparotomy was 18.8%.¹⁹

xiv. *Postoperative management :*

- Most of the patients¹⁸ kept NBM for only day 1 and started liquids orally on 2 days. Only 4 patients kept NBM (2 for 3rd POD and 2 for 4th POD) and made oral on 4th and 5th POD respectively. Almost 80% of patients²⁰ made mobile on 3rd POD with or without drain *in situ* which helpful in early recovery which is main advantage of patients treated laparoscopically. In study by Pascal Fabian *et al*¹⁹ patients made mobile on average 4th + 1 POD. Drain removal done approximately in 50% cases on 3rd POD, 36% cases on 4th POD. Most of the patients were discharge between 4th to 8th days. Mostly are on 7th day. Stitches are removed in 80% of patients²⁰ in 7th POD while in others stitches removed in follow up. Other study like YB Chol *et al*¹⁴ mentioned mean hospital stay of 9.8 days while Pascal-Fabian *et al* has mentioned 4 days of hospital stay.¹⁹

xv. *Complication:* Apparently there is no any complication found related to laparoscopic procedure in present series. There was a one patient having persistent low SPO₂ level even with continuous O₂ inhalation (6 to 8 lit. per minute) which was postanesthetic complication hence not calculated in present study. Patients referred to higher center for further management. In YB Chol *et al* series the complication had occurred only in three cases (Wound infection -1, Paralytic ileus-1, Atelectasis -1).¹⁴

xvi. *Mortality and missed injury:* In present study as such there is no any morbidity and mortality. There is no any missed injury also found. This all findings are comparable to other two studies (YB Chol *et al* and Timothy C Fabian *et al*). So laparoscopy is quite safe and effective method.^{14,15}

The role of laparoscopy in diagnosis and management of BTA is a topic of much debate. In this present series we have reported 25 cases of BTA in which laparoscopy were used as a therapeutic tool in the management of BTA with hemoperitoneum. In patient with spleen or liver injury, though we have CT scan or USG report, we are more comfortable only after seeing the organ injury by naked eye and knowing the amount of hemoperitoneum. The other main advantage of laparoscopy is significantly reduced hospital stay. Patients with laparoscopy have very small incision with less surgical manipulation with early mobilization from very 3rd day in out study. Allow the patient to sent at home early as compared to patients who had undergone laparotomy, Hence it is helpful in terms cost effectiveness and early resumption of work. Laparoscopy provide patient early mobilization, oral intake hence patient had good nutrition with less chance of complication to develop because of prolonged bedridden condition in patient of laparotomy who need at least 5 day's

NBM and bed rest to recover from stress of abdominal open surgery.

As in trauma surgery more effects toward organ preservation should also be made in elective/emergency laparoscopy in patient with BTA. It is found that laparoscopic partial Splenectomy or same for liver lobectomy or segmentectomy is a safe method and readily mastered. If the blood vessels are dissected carefully and in accordance with anatomical principle, hemisplenectomy or liver resection can be done very quickly and with less blood loss than with open surgery.^{21,9}

With the improvement of laparoscopic techniques and instrumentation more blunt injuries can probably be managed laparoscopically with all the benefits observed with the shift from open to laparoscopic procedure, and it is likely that laparoscopy will find its place as an integral part of evaluating and treating patients with blunt abdominal injury.

CONCLUSION

1. Blunt injuries becoming more common than before with RTA are highest, Over all liver and spleen are commonly injured solid organ, Solid organs and hollow viscera at points of fixation are more injured in blunt abdominal injuries. Serious intra-abdominal injuries can occur from minor trauma.
2. Highest incidence is seen in males in 2nd and 3rd decade of life.
3. Associated injury delay and mask the symptoms of blunt abdominal trauma.
4. Ultrasound examination plays a key role in diagnostic armamentarium in our institute. Diagnostic Peritoneal aspiration is used less in our institute. CT scan is optional at secondary center, in developing country like India, CT scan facility is available near by trauma center. When CT scan is out side the hospital premises say in tertiary center of the developing county like India, It is dangerous to shift the patient having blunt abdominal injuries with hemoperitoneum for CT scan Abdomen. In developing country the portable ultrasonography machine play a major role in management of BTA.
5. Conservative line of management for visceral trauma is to be considered whenever possible.
6. Laparoscopy is newly emerging diagnostic as well as therapeutic modality in management of blunt abdominal injury which is getting acceptance world wide, subjective to availability of equipments and skilled team.
7. Laparoscopy provides early oral intake and early mobilization of the patient which help in fast recovery and early resumption of work.
8. Laparoscopy significantly reduces the number of negative laparotomies. Practically zero percent chances of negative laparotomy when patient subjected to laparoscopy.
9. In selected cases laparoscopic repair (e.g. Bowel perforation, Bladder rupture) can also avoid laparotomy.

10. Laparoscopically treated patient has reduced postoperative analgesia requirement, shorten duration of hospital stay with early discharge with fast recovery with early resumption of routine work as compared to those who are treated by laparotomy.
11. Laparoscopy is associated with less/or no complication as compared with open laparotomy.
12. The ultimate outcome the laparoscopy is very much satisfactory and cost effective to the patient.
13. A combined effort of efficient trauma surgeon, orthopedic surgeon, critical care specialist and skilled nursing and paramedical staff is the key to successful laparoscopic management of patients with blunt abdominal trauma.
14. Limitations of laparoscopy are that it can not be performed in patients who are hemodynamically unstable. Patient who is hemodynamically stable with or without resuscitation can under go laparoscopy. Another limitation is, it is difficult to visualize second part of duodenum, pancreas, posterior wall of stomach, posterior pole of spleen and retro-peritoneum, hence chances Missed Injuries are more, if this organ gets injured in blunt abdominal injury.

The question addressed by this article is whether the introduction of an aggressive laparoscopy program would find acceptance and will make a difference or not. Our data clearly show that this indeed will do occur, however it requires further prolonged prospective study for having an even more conclusion and interpretation. With the advancement in equipment and more and more people get trained and doctors are being able to perform more and more technically difficult maneuvers laparoscopically, it appear that laparoscopy is now nearer to take the place of laparotomy in forthcoming future in management of blunt abdominal injury. In the future, new development in laparoscopy equipment and the introduction of computer technology and robotic devices can be expected to have a decisive influence on the therapeutic laparoscopic management of abdominal trauma patients.

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