Original Paper

Role of Laparoscope in Abdominal Trauma

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Abstract

Background: Use of laparoscopy in trauma is in general limited for diagnostic purposes; we aim to evaluate the therapeutic role of laparoscopic surgery in trauma patients. Laparoscope could be safe and effective in the treatment of patients with abdominal trauma.

Aims of the Study: To identify the following:

1. Benefits of Laparoscope in Abdominal Trauma.
2. Contraindications for Laparoscope in Trauma Patients.
3. Indications for conversion (from laparoscopic to open approach).

Patient and methods: Forty patients with abdominal trauma, whether penetrating or blunt who was admitted to the casualty unit in Imam Hussein Medical City in The Holy Karbala City from Jan 2016 to June 2016 and were diagnosed as cases of acute abdomen by clinical examination base some were in shock state and unstable, admitted immediately to theatre, laparotomy was done to them. Other cases in shock, but corrected undergone surgery for different causes, some of them undergone purely laparoscopic interference by laparoscopic device under the name (KARL STORZ—ENDOSKOPE), other patients undergone conversion for different causes.

Results: Forty were included in a prospective study who were undergone surgical intervention either in the form of traditional laparotomy or diagnostic laparoscopy eight (20%) of them undergone exclusive laparoscopic interference while nine (22.5%) undergone conversion, other twenty- three (57.5%) undergone open approach.

Conclusions: From our study, we concluded that:

1. A laparoscope is an important tool in the management of blunt abdominal trauma.
2. A laparoscope is a good preventive measure of nontherapeutic laparotomies.
3. It's an important measure in diagnosing and even treating diaphragmatic injuries.
4. Traumatic bowel injuries can be diagnosed and even treated by the laparoscope
5. The presence of profuse hemorrhage make continue on the laparoscopic approach is non judges.

Keywords: laparoscope, abdominal trauma, laparotomy, conversion.

Introduction

Trauma is the leading cause of death between 1 and 44 years. The evaluation and treatment of abdominal injuries are critical components in the management of severely injured trauma patients, the laparoscope was first used for a trauma patient in 1956 by Lamy, who observed two cases of splenic injury. Since then, Gazzaniga noted that laparoscope is useful for determining the need for laparotomy. In 1991, Berci reported that he had reduced the number of negative laparotomies performed for hemoperitoneum by 25 percent through the use of laparoscopy in 150 patients with blunt abdominal trauma[(1)], exploratory laparotomies in trauma patients with suspected intra-abdominal injuries are associated with a high negative laparotomy

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rate and significant procedure related morbidity. The Laparoscope has been proposed for trauma patients to prevent unnecessary exploratory laparotomies with their associated higher morbidity and cost [2].The necessity of urgent explorative laparotomy as a standard procedure in the treatment of abdominal penetrating wounds is controversial. Mandatory surgical intervention for penetrating abdominal trauma yields a high rate of negative laparotomies in the absence of visceral injuries. The Laparoscope is an alternative diagnostic procedure inspecting the peritoneum for signs of perforation and excluding significant intra-abdominal injuries [3].

Debate remains regarding the optimum role of laparoscopy in the setting of trauma, although it can offer advantages over traditional exploratory laparotomy, laparoscopy can be a screening, diagnostic or therapeutic tool in trauma [4]. Laparoscopic surgery has greatly improved surgical outcome in many areas of abdominal surgery. But many surgeons concern about its safety have limited its application in abdominal trauma. Laparoscope could be safe and efficacious in the treatment of patients with abdominal trauma and reduce the laparotomy related complications (pain, long hospital stay and wound complications) as avoiding unnecessary laparotomy[5].The main goal of a laparoscope is to use the least invasive method to identify or exclude organs and visceral injuries and, if possible, reach a diagnosis. Therefore, with evolving techniques and improved practice, laparoscope may potentially be a therapeutic option for patients with selected traumatic injuries[6] ,the last update of guidelines for diagnostic laparoscope by Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) on Apr. 2010 has been proposed for trauma patients to prevent unnecessary exploratory laparotomies with their associated higher morbidity and cost. A Laparoscope is technically feasible and can be applied safely in appropriately selected trauma patients (moderate recommendation). The procedure has been effectively decreased the rate of negative laparotomies and minimize patient morbidity. It should be considered in hemodynamically stable blunt trauma patients with suspected intra-abdominal injury and equivocal findings on imaging studies or even in patients with negative studies, but a high clinical likelihood of intra-abdominal injury (strong recommendation). It may be particularly useful and should be considered in patients with penetrating trauma of the abdomen with documented or equivocal penetration of the anterior fascia (strong recommendation). It should be used in patients with suspected diaphragmatic injury, as imaging occult injury rates are significant and laparoscope offers the best diagnostic accuracy (strong recommendation). Patients should be followed cautiously postoperatively for the early identification of missed injuries. Therapeutic intervention can be provided safely when laparoscopic expertise is available (strong recommendation). To optimize results, the procedure should be incorporated in institutional diagnostic and treatment algorithms for trauma patients [2].

The high rate of missed occult small bowel injuries associated with a laparoscope with trauma is a major reason why some surgeons still preclude laparoscope in trauma today. No standardized laparoscopic examination for evaluation of the peritoneal cavity is described for trauma [7]. The ability to exclude internal organ injury non-operatively avoids the potential complications of unnecessary laparotomy. Development of new concepts and advancing technologies induced an evolution of diagnostic and operative techniques in intra-abdominal and diaphragm injuries in the last decades [8].

Although laparoscope is the gold standard for diaphragmatic examination in patients with penetrating left thoraco abdominal stab wounds, multi slice computed tomography is also valuable for detecting

diaphragmatic injury [9]. The Laparoscope can be used as a safe and feasible procedure in the repair of diaphragm wounds. It may be an alternative method in the diagnosis and treatment of these patients. In most institutions, evidence of penetration requires a laparotomy to evaluate organ injury, as it is difficult to exclude all intra-abdominal injuries laparoscopically [8]. The Laparoscope is not a substitute for open laparotomy, especially in the presence of haemoperitoneum or contamination [9].

Patients and methods

Inclusion criteria; all patients subjected to abdominal trauma and diagnosed as acute abdomen proposed for surgery were included.

Exclusion criteria; any abdominal trauma patient not proposed for surgery was excluded from the study.

This is a prospective study conducted at Imam Hussein Medical City in Karbala Governorate during the period from January 2016 to June 2016. Forty patients included in the study were admitted to the casualty unit as a trauma patient, these forty patients who were exposed to abdominal trauma some of them associated with extra-abdominal trauma (head and neck ,chest, and limbs) others only abdominal trauma , all of these patients undergone intervention for different causes, these forty patients divided to blunt trauma (either road traffic accident or falling from height), and penetrating injury (either stab injuries or bullet injuries).

Data collected from patients admitted to casualty after resuscitation, some of them were vitally unstable so deep intravenous lines, fluids administration, and some patients examined by Focused Abdominal Sonography for Trauma (FAST) which revealed intra-abdominal free fluid, were admitted immediately to the theatre, others after resuscitation and stabilization, abdominal U/S and abdominal spiral computed tomography (CT) scan were done which revealed visceral injuries or presence of haemoperitoneum.

A questionnaire built up for them and vital signs with clinical examination and related important blood test in form of complete blood count, blood group, Rh, and other important relevant investigations like abdominal U/S or abdominal spiral computed tomography (CT) scan whether native or with intravenous contrast media study were done according to the patient's status and a copy of the report were kept for this study analysis.

Exploration was done in the casualty theatre by laparoscopic approach or open approach according to the situation at that time. In our Imam Hussein Medical City casualty theatre, we used laparoscopic device (KARL STORZ—ENDOSKOPE) serial # (07-101446), model # (SC-X15-A1203), part # (90X0374-C).

Laparoscopic technique

Under general anesthesia with endo-tracheal tube supine position after full abdominal exposure, draping of the abdomen and after preparation of the whole laparoscopic instruments in addition to laparotomy set as at any time conversion might be decided, 1 cm infraumbilical slit incision were done, entrance to abdominal cavity done by 10-mm port by open method to avoid blind entrance, then introduce pneumoperitoneum directly (without veress needle), check the abdominal cavity for presence of hemoperitoneum [Fig 1], bile or intestinal contents, then two additional 5mm laparoscopic ports were also placed under direct vision at right iliac fossa and at right upper quadrant then other two 5-mm ports can be used on the left side as needed as shown in [Fig. 2],the upper part of the abdominal cavity is explored mainly spleen and liver, diaphragm, stomach and then small and large bowel and mesentery examined and then pelvic cavity was examined, and finally the retro peritoneum was assessed for any hematoma or visible renal or pancreatic injuries.

Figure 1. Heamoperitoneum in Abdominal Trauma Patient undergone Laparoscopic Surgery

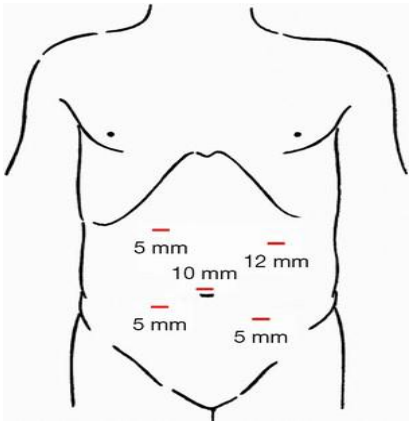

Figure 2. Ports Sites during the Laparoscopic Surgery

Results

Totally forty cases who exposed to abdominal trauma and undergone surgical intervention were grouped into those who exposed to blunt abdominal trauma who were twenty five (62.5%), while another group was penetrating abdominal trauma were fifteen (37.5%), there were nine cases (60%) of this group exposed to bullet injury, which regarded by some authors as a contraindication for laparoscopic interference, while the remaining six cases (40%) were stab injuries we considered it as an indication for laparoscopic interference unless the victim was vitally unstable and this is what we found in our study that from these six patients four of them were approached laparoscopically unfortunately two of them were converted to open laparotomy for causes that we going to discuss it later in the discussion, while the remaining two were approached laparoscopically, the remaining two cases were treated through opened laparotomy from the start. In the blunt trauma group nineteen patients (76%) are road traffic accident victims and six patients (24%) falling from height

Regarding gender distribution our study revealed that ten (25%) of them were females eight of them (80%) approached laparoscopically whether exclusively or converted while only two (20%) were approached by open while male gender were thirty (75%) from them nine (30%) approached by laparoscopy and twenty-one (70%) were open. the male to female ratio was 3:1 with (p-value <0.001) which is statistically significant.

Regarding age group we found that in (18-30) age group we had five cases (12.5%) were females while the male in this age group were twelve (30%) this is followed by pediatric age group below eighteen years old was nine (22.5%)[table 2]

Regarding cases that are started with laparoscope then converted to open approach in our study we got nine cases (22.5%) were converted to open laparotomy, from these cases we had six cases (66.6%) where profuse haemoperitoneum from which four of them were mesenteric injuries while other two, one of them liver injury and other was splenic injury, the other two bowel injuries one of them was small bowel injury and other was large bowel injury, only one (11.1%) was urinary bladder injury[table 3]

Regarding the period of hospitalization, the eight cases managed laparoscopically, six of them (15%) kept in hospital from one-three days postoperatively while the other two cases which approached by laparoscope were hospitalized more than seven days because they had extra-abdominal injuries one of them extremity injury who required two orthopedic surgeries, the other case had head injury and required close monitoring in the intensive care unit (ICU), while regarding open approach only six (15%) were one-three days and the other were 12(30%) for four-seven and more than seven days[table 4].

About the duration of the operation we found that duration of the laparoscopic procedures (diagnostic or therapeutic) were shorter and we found that the duration of operation were significantly short when compare open and conversion groups [table 5].

Table 1. Mechanism of Trauma in Patient Undergoing Surgical Intervention

Mechanism of Abdominal Trauma	Laparoscopically Treated	Open surgery	Total
Blunt trauma	**13(76.4%)**	**12(52.1%)**	**25(62.5%)**
RTA	7(41.1%)	12(52.1%)	19(76%)
FFH	6(35.2%)	-(0.0%)	6(24%)
Penetrating	**4(23.5%)**	**11(47.8%)**	**15(37.5%)**
Stab	4(23.5%)	2(8.6%)	6(40%)
Bullet	-(0.0%)	9(39.1%)	9(60%)
Total	**17(42.5%)**	**23(57.5%)**	**40**

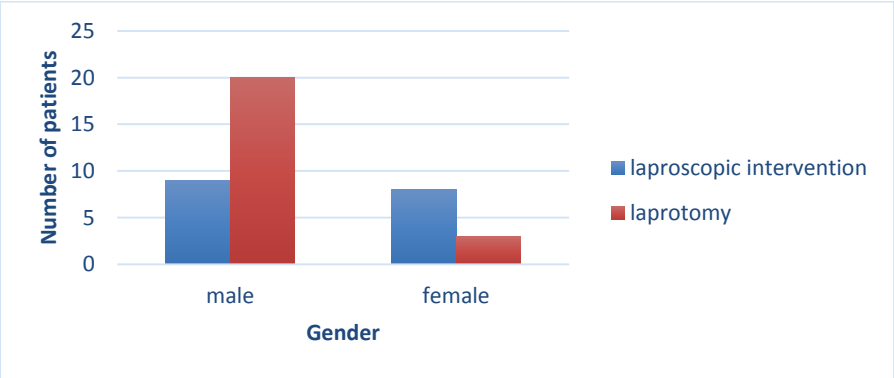

Figure 3. Gender Distribution According to Type of Intervention.

Regarding open operative procedures, there were eighteen cases of bleeding control, which involve liver and splenic injuries, mesenteric injuries , while nine cases were bowel injuries with resection and anastomosis while in laparoscopic procedure we had one case of liver injury with bleeding controlled with cauterization and tube drain placed ,one case with intra-abdominal ruptured hydatid cyst which treated by excision (deroofing), we had one case stomach injury which was sutured laparoscopically, two cases no findings identified and two cases simple haemoperitoneum found but no interference needed and one case splenic sub capsular hematoma identified kept in place [table 6].

Eight patients with extra-abdominal injuries who managed laparoscopically we found four cases had head and neck injuries, one with chest injury and five with limbs injuries [table 7].

Discussion

Trauma is still one of the major cause of death and disability, and in the case of young people under 40 it is the most significant cause of mortality [3]. Immediate management of abdominal injuries consists of resuscitation and evaluation. Patients in shock require resuscitations with crystalloid solutions and blood products, as well as a rapid assessment for the sources of bleeding, according to ATLS protocol [13].

Nowadays the surgical practice is directed toward the minimally invasive intervention, the laparoscope can play an important role in the diagnosis and treatment of blunt and penetrating trauma in hemodynamically stable patients [3, 11].

Table 2. Age Distribution Regarding Gender

Age(years)	<18	18-30	31-40	41-50	51-60	>60	Total
Males	**6**(15%)	**12**(30%)	**7**(17.5%)	**2**(5%)	**1**(2.5%)	**2**(5%)	**30**(75%)
Females	**3**(7.5%)	**5**(12.5%)	**-**(0.0%)	**1**(2.5%)	**1**(2.5%)	**-**(0.0%)	**10**(25%)
Total	**9** 22.5%	**17**42.5%	**7**(17.5%)	**3**(7.5%)	**2**(5%)	**2**(5%)	**40**(100%)

Table 3. Reasons for Converting to Open Laparotmy

Reasons for Conversion	No. of patients
Profuse Heamoperitoneum	**6** (66.6%)
Bowel Injuries	**2** (22.2%)
Urinary Bladder Injury	**1** (11.1%)
Total	**9 (22.5)**

Table 4. Period of Hospitalization

Days	No. of patients	
	Lap.	Open
1-3	**6(15%)**	**6(15%)**
4-7	**-**	**12(30%)**
>7	**2(5%)**	**12(30%)**
		2 died in ICU
Total	**8**	**32**

Table 5. Duration of Operation

Time(hours)	< 1	1-2	2 >
Laparoscope	5(12.5%)	3(7.5%)	-
Conversion		6	3
Open	1(2.5%)	16(55%)	6(22.5%)
Total	6(15%)	25(62.5%)	9(22.5%)

Table 6. Operative Procedure in Patient Undergoing Surgery

Operative Procedure	No. of Patient
ExclusivelyLaparoscope	
Liver injury suturing	**1**
No positive finding	**2**
Ruptured hydatid cyst	**1**
Stomach injury suturing	**1**
Small bowel inj. suturing	**1**
Positive Finding Without Interferance	**2**
Open Laparotomy	
Bleeding control	**18**
Segmental Resection of SmallBowel	**9**
Loop Colostomy	**3**
Diaphragm Injury Repair	**4**
Stomach Injury Suturing	**2**

Table 7. Extra-Abdominal Associated Injuries

Type of Injury	No. of Patient	
	Lap.	Open
Head and Neck	4	5
Chest	1	6
Limbs	5	12
Total	10	23

It's considered as an additional tool that has been used more recently, mainly to establish or exclude the presence of peritoneal penetration, but others mentioned that diagnostic laparoscopy remains fairly well accepted that it's in most hands not sufficient to explore the entire abdomen (there will be missed injury) but it can be used to identify violation of the parietal peritoneum, which can then prompt laparotomy to address injuries [13,15] we found that in trauma patient whether blunt or penetrating (except in case of bullet injury) laparoscope is highly beneficial in evaluation of intra-abdominal organs injuries and this will reduce the negative laparotomy (supposing that patient is vitally stable) and this is agreed by Heng-Fu Lin, et al. who published a study and concluded that Laparoscope is feasible and safe for hemodynamically stable patients with blunt hollow viscus and mesenteric injuries and also this proved by Selman Uranus et al. who concluded that laparoscope can be used effectively and safely in stable trauma patients and this greatly reduced the number of negative laparotomy, morbidity, hospital stay, and cost effectiveness[14,15].in addition to these conclusions there is wider uses of laparoscope in trauma patients like a study by Sosa who reported 121 consecutive abdominal gunshot wounds managed with laparoscope. Seventy-nine (65%) had negative laparoscopy, and these patients were managed without laparotomy, another 7.2 % avoided non-interventional laparotomy [1]. So most of authors and in our practice in hemodynamically unstable trauma patient whether blunt or penetrating injury there is no role to start with laparoscopy but can be assessed by other examinations like FAST or depend on clinical findings and shift patient to laparotomy.

Diaphragmatic injuries if not diagnosed and treated promptly then it will end with diaphragmatic hernia and will be difficult to be repaired later on. On the other hand, presence of diaphragmatic injury can be risky to patient to undergo laparoscopic interference as it may lead to tension pneumothorax unless it treated promptly by chest tube at side of diaphragmatic tear [10], then laparoscopy can be used for both diagnostic and therapeutic purposes.

In our study we had nine cases converted from laparoscopic approach to open laparotomy mainly because of profuse haemoperitoneum resulted from splenic or liver injuries which obscured the visualization that necessitate conversion and this matter can be avoided (avoidable causes of conversion) by improving the level of skills for the surgeon and for the assistant staff, and by improving the advanced instrumentations like suction system, monitor HD and so on.

On the other hand, another cause of the conversion we faced was the presence of small bowel injuries, again this is another avoidable cause of conversion and this is by improving skills and provision of laparoscopic staplers which encourage the therapeutic laparoscopy. This is proved by the study done by Matsevych OY *et al*. where he had small bowel repair, resection and anastomosis of the most cases in his study, the rate of therapeutic laparoscope was 73% [(17)]

Improvement of laparoscopic interference in the casualty will improve skills and be beneficial to trauma patient to reduce conversion rate as we had one case in our study with urinary bladder injury which is can be dealt laparoscopically with the availability of skilled well trained personnel.

We found that therapeutic laparoscope beneficial even with unordinary emergency cases in trauma that we had cases of post-trauma intra-abdominal ruptured hydatid cyst which treated laparoscopically by suction of the contents and excision of the cyst and wash of the abdominal cavity with normal saline and surgery outcome was encouraging .

About the period of hospitalization it's much shorter with laparoscopy even it was therapeutic laparoscopy and this agreed with what Zafar SN *et al*. reported in his retrospective study that patient undergone laparoscopic approach had significantly lower hospital stay as compared with those undergone open approach [(18)].

Regarding complications of laparoscopic surgery ….

- First of all, were complications of general anesthesia and this matter is specifically important in our study because we were dealing with trauma patient who had a significant insult to the normal physiology of the body although some reported cases done under spinal anesthesia and even under local anesthesia, and there is report about bed side laparoscope.
- Second one, is missed injuries in laparoscopy that include bowel, vascular, bladder injuries and so on. that's we didn't record any case of missed injury but Tammy Kindel et al. in his study recorded significant missed injuries [(20)]
- Other less common events are trauma induced by laparoscopy this trauma occurs even in most skilled surgeons one of it is off-screen injuries, heat transmission by using electro cauterization and else.

Conclusions

From our study we concluded that:

1. A Laparoscope is an important tool in the management of blunt abdominal trauma.
2. A Laparoscope is a good preventive measure of negative laparotomies.
3. It's important measure in diagnosing and even treating diaphragmatic injuries.
4. Traumatic bowel injuries can be diagnosed and even treated by laparoscopic approach.
5. The presence of profuse hemorrhage make continue on laparoscopic approach is non judges.

Recommendations

a. We highly recommend use of laparoscope as a tool in the management of trauma patients.
b. Encouragement and improvement of emergency theatre teams with proper instrumentations and advanced skills of laparoscopic procedures to increase the percent of laparoscopic therapeutic interventions.

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