**Clinical Efficacy of Laparoscopic Surgery in Abdominal Trauma: A Prospective Study**

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**Abstract:**

**Introduction:** Laparoscopic surgery has greatly improved surgical outcome in many areas of abdominal surgery. But many concerns of safety have limited its application in abdominal trauma. With the developments in the medical innovation and increased surgical experience, advanced laparoscopic surgical procedures are performed successfully. The purpose of our study was to explore the diagnostic and therapeutic significance of Laparoscopic surgery in Abdominal Trauma patients.

**Method:** We retrospectively reviewed 65 abdominal trauma patients, diagnosed and treated with laparoscopic surgery. Laparoscopic surgery was performed after diagnostic laparoscopy in 60 cases of abdominal trauma. However, 5 of them were converted to laparotomy. The Surgery was performed from January 2010 to May 2015 at Taishan Medical College Lagging Affiliated Hospital.

**Result:** 65 cases were diagnosed through diagnostic laparoscopy. 5(7.69%) cases, laparotomy performed because clear diagnosis was not achieved during laparoscopy. Amongst these, 23 (35.38%) cases didn’t require any intervention, 27(41.53%) cases received laparoscopic surgery (The hand assisted laparoscopic surgery). 10 (15.38%) cases were converted to open surgery. Post operative wound infection occurred in 2(3.07%) cases (Surgical site infection occurred in 1 case after operation and 1 case developed subphrenic abscess). Results of 65 patients with Laparoscopy exploration after operation were analyzed at 2 to 48 months with a median of 10(20.83%) months follow up. All patients discharged successfully. During follow up period, no complications arise and re-operation was not needed.

**Conclusions:** In patient with abdominal trauma who is hemodynamically stable, laparoscopy is less invasive, safe, effective, feasible and reliable technique. Negative laparotomy has the advantage of high rate of diagnosis and effectiveness. Laparoscopy can be done in mild to moderate abdominal trauma cases. In hemodynamically unstable patient with intraperitoneal extensive hemorrhage early laparotomy should be performed to implement deterministic operation.

**Keywords:** Laparoscopy, Therapeutic laparoscopy, abdominal trauma and Laparotomy

**Introduction:**

Trauma is one of the major cause of death in young people mainly occur under the age of 40 years [1]. Subsequently, Laparoscopy has also greatly improved surgical outcomes in many areas of possible abdominal surgery [2]. There are many conventional diagnostic methods for abdominal trauma. But, they are limited by effective imaging, hemorrhage, hemodynamical unstability and solid organ injury evaluation [3, 4]. The laparoscopic technique is recognized as a new method for treatment of abdominal trauma with high efficacy [4, 5]. It is the most acceptable technique with greater frequency all over the world for the management of abdominal traumatic Injuries[6]. Only a few studies regarding Clinical Efficacy of abdominal Laparoscopic Surgery were done in the Shanghai, China. The study was carried out with the aim to explore the diagnostic and therapeutic significance of Laparoscopic surgery in Abdominal Trauma patients in Taishan Medical College Lagging Affiliated Hospital shanghai, china. Our argument was that laparoscopy could be safe and efficacious in both diagnosis and treatment of patients with abdominal trauma, eliminating unnecessary risk.

**Materials and Methods:**

### General Information

**Design**

The present hospital-based a Prospective study was performed from January 2010 to May 2015 at Taishan Medical College Lagging Affiliated Hospital.

**Age distribution, Clinical presentation and investigation of patients**

Among 65 cases of abdominal trauma patients, 44 (67.7%) males, 21(32.3%) females, age ranges from 15 to 66 years old, Average age is 41.8 years old. On admission, 60(92.3%) cases were hemodynamically stable and 5(7.7%) cases were hemodynamically unstable. After resuscitation in emergency room with isotonic fluid, hemodynamic stability was achieved easily, all patients underwent diagnostic laparoscopy and according to result theraputic laparoscopy or laparotomy [execute](http://www.thesaurus.com/browse/execute)d.

### Procedure for operational Method

The patient kept in supine position under general anesthesia. 10 mm subumbilical incision was made, skin and subcutaneous tissue incised, veress needle inserted inside the peritoneal cavity, checked with the saline drop test, pneumoperitoneum created with CO2 insufflator, pressure maintained at 13-15 mmHg[1mmHg=0.1.33Kpa], 10mm trocar with cannula inserted through the wound, 30 degree laparoscopic camera were inserted through the subumbilcal port and laparoscopic evaluation done. Estimated blood loss and bleeding site was confirmed, Bleeding from the posterior surface of liver, spleen, mesenteric blood vessel rupture and other parenchymal structures were controlled by hook electrocautery or by applying titanium clip in the mesentery. In case of bleeding from major vessels endoscopic suture ligation were also performed to achieve hemostasis. For gastrointestinal perforation, direct suture repair were done in laparoscopy. If surgeon saw intra-operative visceral hollow organ injury associated with bile duct injury, pancreatic injury, persistent bleeding with severe injury, which could not be treated by laparoscopic surgery, laprotomy was performed.

**Statistical Analysis**

Data entry, data checking, compiling and editing was done manually .Data analysis was done in Statistical Package for Social Science (SPSS) software version 18.0 software. The results are projected as proportions and percentages.

**Results**

In a 5-year period, 65 cases were diagnosed through diagnostic laparoscopy. 5(7.69%) cases, laparotomy performed because clear diagnosis was not achieved during laparoscopy. Among these, 23 (35.38%) cases didn’t require any intervention, 27(41.53%) cases received laparoscopic surgery (The hand assisted laparoscopic surgery). 10 (15.38%) cases were open surgery was performed. Post operative wound infection occurred in 2(3.07%) cases (Surgical site infection occurred in 1 case after operation and 1 case developed subphrenic abscess).

**Causes of abdominal injury**

Among 65 cases, 10(15.4%) cases were of open injury, the remaining 55(84.6%) cases were of closed injury, and 45 (69.2%) cases of traffic accidents, 9 (13.8%) cases fell from heights, 8 (12.3%) cases from sharp injury, blunt injury in 3 (4.6%) cases.

**Figure 1: Causes of abdominal trauma in patients undergoing surgical intervention**



There were 45(69.2%) cases of hemoperitoneum and out of that 25(38.4%) cases were having blood coagulopathy. Bed side ultrasound were done in 60 cases, 35 (58.3%) cases showed accumulation of fluid in the pelvic cavity along with 20 (33.3%) patients with liver, spleen and renal injury. CT scan were done on 55 cases, 35 (63.6%) cases were having peritoneal fluid collection.

**Injured organs**

60 cases of abdominal trauma underwent laparoscopic exploration instantly after making diagnosis. 5 cases of liver injury, 6 cases of splenic injury, 6 cases of the stomach along with small intestine and mesenteric injury, 5 case of gastric perforation, 7 cases of small intestinal Injury, 4 cases of colonic injury,4 cases were injured over anterior abdominal wall with peritoneal breach and 23 cases had no obvious injury. In 5 patients after laparoscopic exploration with hemoperitoneum, the bleeding site was not identified, unable to confirm diagnosis and the case were converted to laparotomy.During exploratory laparotomy, 2 cases were identified as splenic diaphragm laceration, In 1 case there was laceration on initial part of jejunal mesentery, In 1 case there was laceration of right posterior lobe of the liver and 1 case of ascending colon extra -peritoneal injury.

**Table 1: Injured organs stratified by injury type**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | | **Injured organs** | **Laparoscopic examination (N=60)** | | Liver injury | **5 (8.3%)** | | splenic injury | **6 (10%)** | | Stomach along with small intestine and Mesenteric injury | **6 (10%)** | | Gastric perforation | **5 (8.3%)** | | Small intestinal Injury | **7 (11.6%)** | | Colonic injury | **4 (6.6%)** | | Injury over anterior abdominal wall with Peritoneal breach | **4 (6.6%)** | | No obvious injury | **23 (38.3%)** | |

**Methods of operation**

Out of 60 cases, 23 cases with laparoscopic exploration had no obvious injury and bleeding, requiring no therapeutic treatment, 27 cases were treated by laparoscopic surgery and 10 cases were converted to laparotomy.

**Table 2: Operative procedures in patients undergoing surgery**

|  |  |  |
| --- | --- | --- |
| **Various procedures performed.** | **Frequency (N=60)** | |
| Laparoscopic exploration had no obvious injury and bleeding, requiring no therapeutic treatment | | **23 (38.33%)** |
| Laparoscopic surgery | **27 (45%)** | |
| Laparotomy | **10 (16.66%)** | |
|  |  | |

**Operative procedures in organ injury patients**

Among 37 case having injured organ was treated by various methods. In 5 cases of liver injury, 2 cases were treated with electric coagulation hemostasis and 3 cases were repaired with suture laparoscopically. In 6 cases of spleen injury; 2 cases of mild laceration were treated with electric coagulation hemostasis, 1 case having mild bleeding was treated using titanium clip hemostasias and 3 cases were treated with laparoscopic splectomy Including hand-assisted laparoscopic surgery. 4 cases of gastric injury were treated by direct suture repair. 1 case involving serious injury of stomach wall was transferred to laparotomy and repair was done. 4 cases of greater omentum and mesentery injury were treated with titanium clip hemostasis. 2 cases of greater omentum and mesentery injury patients were transferred to laparotomy to stop bleeding .In 7 cases of small intestinal injuries; 4 cases under went laparoscopic repair, 3 cases due to serious injury along with contamination were transferred to laparotomy. 4 cases of colon perforation resulting from abdominal contamination were converted to laparotomy surgery. 4 cases of abdominal and peritoneal injury were treated by electric coagulation hemostasis.

**Table 3: Operative procedures in organ injury patients**

|  |  |
| --- | --- |
| **Organ injury patients (Treatment )** | **Frequency(N=37)** |
| **Liver injury** |  |
| Electric coagulation hemostasis | **2 (5.4%)** |
| Suture laparoscopically | **3 (8.1%)** |
| **Spleen injury** |  |
| Electric coagulation hemostasis | **2 (5.4%)** |
| Titanium clip hemostasias | **1 (2.7%)** |
| Laparoscopic splectomy | **3 (8.1%)** |
| Stomach along with small intestine and mesenteric injury |  |
| Clip hemostasis | **4 (10.8%)** |
| Transferred to laparotomy to stop bleeding | **2 (5.4%)** |
| **Gastric perforation** |  |
| Direct suture repair | **4 (10.8%)** |
| Transferred to laparotomy | **1 (2.7%)** |
| **Small intestinal injury** |  |
| Laparotomy repair | **4 (10.8%)** |
| Transferred to laparotomy | **3 (8.1%)** |
| **colonic injury** |  |
| Laparotomy surgery | **4 (10.8%)** |
| **Injury over anterior abdominal wall with peritoneal breach** |  |
| Electric coagulation hemostasis | **4 (10.8%)** |

**Laparoscopic exploration**

In 23 patients who underwent laparoscopic exploration, operative duration was for 20-55 minutes, average time of 30 minutes. Hospital stay 3-6 days; average of 4-5days .The operation duration of 27 cases with laparoscopic operation was 60-170 minutes , average time of 130 minutes, hospital stay of 4-15days, average was 6 days. In 15 patients who underwent laparotomy for 90-210 minutes, average time of 130 minutes, the length of hospital stay was 8-22 days, average of 11 days. 1 patient had superficial Surgical site infection 4 days after surgery , the wound healed after continuous dressing for few days . 1 Patient developed postoperative diaphragmatic abscess 5 days after surgery, and underwent ultrasound guided drainage tube placement for drainage of abscess. patient improved symptomatically 7 days after insertion of drainage tube with complete resolution of abscess loculi. The remaining patients without any complication were discharged. Postoperative follow up of 65 patients treated with laparoscopic exploration were followed up for 2-48 months, median of 10 months. All patients recovered and were discharged, no obvious complication was found during the follow up period and no reoperation was required.

**Table 4: laparoscopic exploration**

|  |  |
| --- | --- |
| **Laparoscopic exploration (23 cases)** | **Duration** |
| Operative duration | **20-55 minutes** |
| Average time | **30 minutes** |
| Hospital stay | **3-6 days** |
| Average | **4-5days** |
| **Laparoscopic surgery (27 cases)** |  |
| Laparoscopic operation | **60-170 minutes** |
| Average time | **130 minutes** |
| Hospital stay | **4-15 days** |
| Average | **6 days** |
| **laparotomy (15 cases)** |  |
| Laparotomy duration | **90-210 minutes** |
| Average time | **130 minutes** |
| Hospital stay | **8-22 days** |
| Average | **11 days** |

**Discussion**

Abdominal trauma is a clinically common acute abdominal disease and because of the different injury mechanism, there is a significant difference in the clinical manifestation. The site of injury and the degree of blood loss are more difficult to determine whether there is an active bleeding. Early diagnosis and treatment is keystone to reduce the mortality of abdominal trauma [1]. At present, although ultrasound, CT examination of abdominal trauma have a certain sensitivity and accuracy, FAST (Focused Assessment with Sonography for trauma) are not reliable for the detection of hollow visceral and retroperitoneal injuries [7, 8]. CT Imaging are also inaccurate to determine visceral hollow injuries. But in suspected cases direct peritoneal lavage (DPL) is useful [5]. However, in the abdominal visceral organs, mechanism of injury is more complex for hemodynamically stable patients. In patients who have minor injury, it is relatively difficult to try and clear a preoperative intra-abdominal organ injury. Acute abdomen applied laparoscopic technique is a very safe and effective method with integration of diagnosis and treatment. It has greater advantage than open laparotomy in that with small incision, quicker recovery, cost effectiveness, low post operative complication, shorter hospitalization time as well as reduction of morbidity and other advantages [4]. The application of laparoscopic techniques is significantly used in improving the early diagnosis and cure rate of acute abdominal pain, if reduces the rate of negative laparotomy and to reduce the blindness and risk of the surgery. Compared with the traditional laparotomy surgery, laparoscopy exploration views the field of vision more clearly. Hence most of the patients benefit from having this therapeutic laparoscopy [9, 10]. The patient’s diagnosis on early stage after minor injury, the abdominal paracentesis and peritoneal lavage can be done, which has obvious advantage. In Berci et.al reported 150 cases of blunt abdominal trauma which were treated with laparoscopy, 56% of patients with exploration was negative, 19% patients underwent laparoscopic exploration and surgical treatment, and 25% of patients with mild to moderate abdominal intraperitoneal hemorrhage were under close observation and conservative treatment. In addition,in 1 case patient required surgery to avoid unnecessary exploration [11]. There are some scholars who reported that laparoscopic technique has certain limitation[12]. In laparoscopy there is lack of effective cleaning of intraperitoneal hemorrhage and ability of blood clot for rapid bleeding with severe abdominal visceral injury or greater vessel rupture. Laparoscopic surgery versus laparotomy is not same as hemostasis. so, it is difficult to quickly stop bleeding and cannot complete hemostasis occasionally [10, 13, 14]. Reported that among 109 patients, 45 had missed injuries, which was 41% missed injury rate per patients. The recent study shows the significant decline of missed injury, reported is less than 1% by changing position in laparoscopic surgery, careful systemically inspection, improved equipment and video imaging[15]. In addition, due to limitation of equipments, its operation have certain degree of difficulty, the operation speed is limited or restricted. However, laparoscopic exploration comparable with the conventional Laparotomy surgery when there is abdominal injury combine with multiple Injuries in the time to make correct diagnosis and definitive treatment, improve the rescue efficiency, accelerating the rehabilitation of patients[16, 17].

The cases of this group were diagnosed with traditional clinical diagnosis and indicated for exploratory laparotomy. 60 cases were diagnosed immediately after laparoscopic exploration, In 5 cases the cause of bleeding was not found in laparoscopy and was converted to laparotomy. On 60 cases after laparoscopic diagnosis, 23 cases were treated with laparoscopic exploration which had no obvious injury performed without therapeutic treatment, 27 cases underwent laparoscopic surgical repair to stop bleeding or internal organs repair(Including 3 hand –assisted laparoscopic surgery). 10 cases due to rupture of hollow viscera organs were contaminated and converted to laparotomy. The results suggest that laparoscopy, in the diagnosis and treatment of abdominal trauma has great significance, it can provide the basis for the choice of subsequent treatment follow-up measures to avoid unnecessary laparotomy. However due to small number of cases in this group, its definitive conclusion needs further large sample studies. But still significantly reduces the rate of negative laparotomy.

**Conclusion:**

This study had many limitations caused by selection bias and retrospective study; laparoscopy gradually has being accepted as a treatment modality for penetrating abdominal injuries in patients that are hemodynamically stable. At present study for abdominal trauma patients with stable vital signs, Laparoscopic application is preferred. Laparoscopic therapeutic evaluation in abdominal trauma patients results are successful and provide better outcome to the patients. Early abdominal injury has more precise positioning for diagnosis and trauma assessments. Taken timely appropriate treatment or carry out the laparoscopic exploration, making a diagnosis and giving treatment on laparoscopic exploration provide sequence before preparing for operation. Along with the improvement of laparoscopic equipment, minimally invasive technique in the diagnosis and treatment of abdominal trauma will have more standard therapeutic intervention along with broad bright prospects in the future.

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**Author contribution**

CGT and RG designed research; HP and RG collect data; RG, CG, HP, SK, PJ, RB and CGT analyzed data; RB, CGT and RG wrote the paper.

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