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Evaluation of Diagnostic and Therapeutic values of Laparoscopy in Blunt Abdominal Trauma

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Abstract

Trauma is a leading cause of mortality and morbidity among young population nowadays. To assess technical feasibility Successful diagnostic value, therapeutic value and Complications. This prospective randomized controlled study included 40 patients who presented to Kasr Al-ainy emergency department and Maadi military hospital with blunt abdominal trauma during the period from March 2018 to March 2020. Patients were divided into two groups. There was non-significant difference as regards AIS scale, and all therapeutic parameters (the 2 techniques equally effective) ($p > 0.05$). There was highly significant decrease in operative time and blood loss, in Laparoscopy group; compared to Laparotomy group ($p < 0.05$). By using ROC-curve analysis, laparoscopic surgery technique predicted decrease in post-operative pain, with fair (75%) accuracy, sensitivity= 85% and specificity= 65% ($p < 0.01$), decrease in return of bowel habit, with poor (68%) accuracy, sensitivity= 60% and specificity= 70% ($p < 0.05$) and decrease in hospital stay, with fair (74%) accuracy, sensitivity= 80% and specificity= 75% ($p < 0.01$). Laparoscopy was proven to be a good alternative to laparotomy, as it is a reliable and safe method in hemodynamically stable patients with blunt abdominal trauma. It can be used to reduce the rate of laparotomy with lower morbidity and mortality rates, along with reduction of hospital stay and post-operative pain, and improving early return to bowel and daily activities.

Keywords: Diagnostic and therapeutic values, Laparoscopy, Blunt abdominal trauma.

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1. Introduction

Trauma is a leading cause of mortality and morbidity among young population nowadays [1]. Blunt mechanisms account for 78.9 to 95.6% of injuries, with the abdomen being affected in 6.0 to 14.9% of all traumatic injuries [1]. The incidence of blunt abdominal trauma requiring laparotomy is 6% with the most frequently injured organs being spleen (40-55%), liver (35-45%) and retroperitoneum (5%) [2]. Laparoscopy has become cornerstone in general surgical practice, and as technique and instrumentation continue to improve, increasingly complex procedures are being under-taken with this minimally invasive method. The aim is to provide an equal or superior management compared with open procedures but with less patient morbidity [1]. The role of laparoscopy in blunt abdominal trauma is emerging. It can substantially reduce additional surgical aggression. It has both diagnostic and therapeutic potentials and, when negative, may reduce the number of unnecessary laparotomies [3]. Laparoscopic repair of diaphragmatic and small bowel injuries represents the most commonly reported therapeutic uses in blunt abdominal trauma. The aims of this study were primary outcome: Primary outcome: To assess technical feasibility and secondary outcomes: To assess successful diagnostic value, therapeutic value and complications.

2. Patients and methods

This prospective randomized controlled study included 40 patients who presented to Kasr Al-ainy emergency department and Maadi military hospital with blunt abdominal trauma during the period from March 2018 to March 2020.

2.1. Inclusion criteria

All patients sustaining BLUNT abdominal trauma, who were vitally STABLE and NOT indicated for conservative management, Peritonitis, Evidence of diaphragmatic or hollow viscus injury (clinical/ radiological).

It is evidence of moderated to marked intra-abdominal collections without solid organ injury, the unclear abdomen (signs of peritonitis with normal investigations and vice versa), complications after Initial NOM (e.g. retained hemoperitoneum, infective peri-hepatic collections, and treatment of bile peritonitis) and Grade 4 splenic injury in a vitally stable patient.

2.2. Exclusion criteria

Hemodynamically unstable patients (Hemodynamic Instability defined by a systolic BP less than 90mmhg and a Pulse of more than 100bpm despite an initial fluid resuscitation of 2000cc crystalloids), American society of anesthesiology Grade 3 or more. Associated Intracranial injuries, high grade chest trauma, previous abdominal operations and pregnancy.

2.3. Patient's randomization

The method of randomization was through sealed envelope. 40 patients included in this study. They were divided according surgical techniques into 2 groups: Laparoscopy group (20 patients) and Laparotomy group (20 patients).

2.4. Methods

Patients initially assessed according to the ATLS guidelines.

2.4.1. Surgical techniques

The laparoscopic formal exploration performed using general anesthesia. Pneumoperitoneum achieved and maintained during the procedure at pressure 14 mmHg. A camera with 30-degree angle used. The site of the camera port at the umbilicus, and 2 other exploratory ports in both MCL on the same level of the camera port. Additional port sites used according to the intra-abdominal injury especially if therapeutic laparoscopic intervention was planned. Laparoscopic formal exploration started with the patient in the reverse Trendelenburg position. First, the anterior abdominal wall and the diaphragm inspected, then the supra-colic compartment explored by inspection of the liver, gall bladder, hepatic flexure of the colon, the anterior wall of the stomach to the GE junction, the posterior wall of the stomach by dividing the gastro-colic omentum, the spleen and the splenic flexure of the colon inspected next. The infra-colic compartment explored next with the patient in the supine position with tilting of the table left or right accordingly. The pelvis explored in the Trendelenburg position, the small bowel loops are lifted in the abdomen and inspection of the rectum, bladder, and female pelvic organs done. Inspection of the small bowel started at the Ileocecal valve by grasping a segment of small bowel (10 cm segment). The next portion was then grasped with second forceps and "handed off" to the first forceps to elevate and evaluate that segment of bowel. The process repeated until examination of all the small bowel ends. Usage of methylene blue might be required as an adjunct in detecting injuries to the stomach, abdominal part of the esophagus and the intraperitoneal part of the rectum injuries. Therapeutic laparoscopic intervention included repair of diaphragmatic lacerations, gastrointestinal tears repair, management of low-grade liver and splenic lacerations; resection of injured small bowel and colon.

2.4.2. Assessed Parameters

Sensitivity and specificity in detecting intra-abdominal pathology, Conversion rate in the laparoscopic group, Operative time, Postoperative pain: measured during the patient's hospital stay using the numerical pain scale scoring system (NRS), all patients were asked to rate the intensity of their pain on a scale from 0 (no pain) to 10 (worst pain ever). According to this scoring system, mild pain is ranged from 1-3, moderate pain is ranged from 4-6, severe pain is ranged from 7-10, return of bowel habit, length of postoperative hospital stays, wound complications and possible diagnostic and therapeutic values.

2.5. Ethical considerations

The nature of the present study and laboratory or radiological procedures was explained to all participants. Consent was obtained from all participants. At the end of the study, all patients were informed about the results of the examinations performed and received appropriate recommendations, and treatment. The World Health Organization (WHO) and the Declaration of Helsinki recommendations were followed, in terms of protecting the rights and well-being of the studied people [6].

3. Results and discussion

The role of laparoscopy in blunt abdominal trauma is emerging. It can substantially reduce additional surgical aggression. It has both diagnostic and therapeutic potentials and, when negative, may reduce the number of unnecessary laparotomies [7]. Most of the patients in this study were males (70%), in the middle age group (Mean age: 31.5 years). 5% of the patients had DM. Both groups were homogenous from the start regarding age, sex and Co-morbidities as no statistical differences were detected for the abovementioned parameters ($p>0.05$). These results were more or less similar to other studies Abdelshafy et al., and Jangjou & Izadpanah [8-9]. Abdelshafy et al., reported that, the average age of patients was (37) years old, with (66%) of patients were males [8]. Jangjou & Izadpanah also reported that, of the (81) blunt trauma patients who had undergone laparotomy, 66 cases (81.5%) were males, with average age of the patients was 32.03±15.96 years [9]. Regarding Operative diagnostic data mentioned that the average AIS scale was (1.17 ± 0.38), Diaphragm was injured in (12.5%) of patients, (15%) of patients had Mesenteric injury, (2.5%) presented with Esophageal injury, (7.5%) had small bowel and colon injuries, (10%) had Liver injury, and (62.5%) had Spleen injury. On comparing both groups, the comparison reveals non- significant difference as regards diagnostic parameters. This came in agreement with Amutha et al., [10]. Amutha et al., reported that, the most common findings during laparoscopy were injury to the solid organs (both spleen and liver) which occurred in about 14 patients (35.4%). Retroperitoneal hematoma, along with omental bleeding and mesenteric bleeding was found in about 5 patients (16%). Mesenteric vascular injury and small bowel perforation was found each in 2 patients (6.6%) [10]. According to the study we did, the Operative therapeutic data points out that (10%) of patients had Diaphragmatic repair, in (15%) Mesenteric repair was done, (2.5%) had Esophagus and liver repair, and small bowel repair had done in 7.5% of patients, (5%) had Colon repair and (60%) had Spleen repair or splenectomy.

So therapeutic parameters showed us non- significant difference. This came in agreement with Lin et al., [11]. Lin et al., also concluded that, when performed by experienced surgeons, laparoscopy is a feasible and safe tool for the diagnosis and treatment of hemodynamically stable BAT patients for select surgical scenarios. These include suspected hollow viscus injuries, suspected diaphragm injuries, failed NOM for liver or spleen injuries, or patients with isolated intra-abdominal fluid and clinical findings. Laparoscopy can be used to avoid a non-therapeutic laparotomy and to perform therapeutic interventions for these patients [11]. In this study, the average Operative time was (98.5 ± 27.5), and the average Blood loss was (512.5 ± 357.8) ml. and on comparing both groups, highly significant decrease in operative time and blood loss in laparoscopy group was detected. This came in agreement with Abdelshafy et al. [8]. Abdelshafy et al., reported that, the mean operative time in laparoscopy group was 123.28 ± 21.61 min, while in the laparotomy group was 150.84 ± 24.75 min [8]. In this study the average post-operative pain scale was (4.37 ± 1.8). Regarding the average return of bowel habit, it was (1.87 ± 0.93) days, and the average hospital stay was (4.27 ± 1.5) days. On comparison, a highly significant decrease in post-operative pain scale, return of bowel habits and hospital stay days appeared in laparoscopy group.

This came in agreement with Cirocchi et al., and Jangjou & Izadpanah [9,12]. Cirocchi et al., also concluded that, the literature reported an increasing trend of therapeutic laparoscopy, demonstrating that it is safe and effective [12]. Jangjou & Izadpanah reported a much less promising result than ours, and reported that, the average stay time in ICU and in hospital were 7.98±10.08 and 15.2±18.03 days, respectively. This difference in results may be due to different included group of patents [9]. We did Correlation studies between post-operative outcomes; and its relative independent predictors (basic clinical, operative, surgical technique variables) revealed that the usage of Laparotomy technique had an independent effect on increasing the probability of complications occurrence with significant statistical difference (p = 0.029). This came in agreement with Abdelshafy et al., Wafa et al., and Shamim et al., [8,13-14]. Abdelshafy et al., concluded that, laparoscopy can be used to reduce the rate of laparotomy with lower morbidity and mortality rates [8]. Wafa et al., also concluded that, Laparoscopy can be safely performed in haemodynamically stable patients with abdominal trauma for both diagnostic and therapeutic purposes; also, it helps to reduce the number of non-therapeutic laparotomies [13]. Shamim et al., also concluded that, Laparotomy was associated with increased mortality, higher rate of complications, and a longer hospital stay [14].

Table 1: Comparison between the 2 groups as regards socio-demographic data using Mann-Whitney's U and Chi square tests.

Variable		Laparoscopy group (20)	Laparotomy group (20)	Mann-Whitney's U test
		Median (IQR)	Median (IQR)	P value
Age (years)		30 (23 – 35)	33.5 (29 – 35)	= 0.1223
Variable		Laparoscopy group (20)	Laparotomy group (20)	Chi square test
				P value
Gender	Female	5 (25%)	7 (35%)	= 0.4956
	Male	15 (75%)	13 (65%)	
HTN	+ve	0 (0%)	0 (0%)	= 1.000
DM	+ve	1 (5%)	1 (5%)	= 1.000
IHD	+ve	0 (0%)	0 (0%)	= 1.000

IQR: inter-quartile range. * Percentage of Column Total. ## Regarding trauma (inclusion criteria), all cases were positive, so not included in our comparisons.

There was non-significant difference as regards age and sex of the patients (p > 0.05) and non-significant difference as regards co-morbidities (p > 0.05) (Table 1).

Table 2: Comparison between the 2 groups as regards AIS scale using Mann-Whitney's U test.

Variable	Laparoscopy group (20)	Laparotomy group (20)	Mann-Whitney's U test
	Median (IQR)	Median (IQR)	P value
AIS scale	1 (1 – 2)	1 (1 – 1)	= 0.6811

Both groups were homogenous.
There was non-significant difference as regards AIS scale, (the 2 techniques equally effective) ($p > 0.05$) (table 2).

Table 3: Comparison between the 2 groups as regards operative diagnostic data using Chi square test.

Variable		Laparoscopy group (20)	Laparotomy group (20)	Chi square test
				P value
Diaphragmatic injury	+ive	2 (10%)	3 (15%)	= 0.6369
Stomach injury	+ive	0 (0%)	0 (0%)	= 1.0000
Mesenteric injury	+ive	3 (15%)	3 (15%)	= 1.0000
Esophagus injury	+ive	0 (0%)	1 (5%)	= 0.3173
Small bowel injury	+ive	2 (10%)	1 (5%)	= 0.5533
Colon injury	+ive	1 (5%)	2 (10%)	= 0.5533
Rectum injury	+ive	0 (0%)	0 (0%)	= 1.0000
Liver injury	+ive	2 (10%)	2 (10%)	= 1.0000
Spleen injury	+ive	13 (65%)	12 (60%)	= 0.7471

* Percentage of Column Total.
There was non-significant difference as regards and all diagnostic parameters (the 2 techniques equally effective) ($p > 0.05$) (Table 3).

Table 4: Comparison between the 2 groups as regards operative therapeutic data using Chi square test.

Variable		Laparoscopy group (20)	Laparotomy group (20)	Chi square test
				P value
Diaphragmatic repair	Succeeded	1 (5%)	3 (15%)	= 0.2980
Stomach repair	Succeeded	0 (0%)	0 (0%)	= 1.0000
Mesenteric repair	Succeeded	3 (15%)	3 (15%)	= 1.0000
Esophagus repair	Succeeded	0 (0%)	1 (5%)	= 0.3173
Small bowel repair	Succeeded	2 (10%)	1 (5%)	= 0.5533
Colon repair	Succeeded	0 (0%)	2 (10%)	= 0.1519
Rectum repair	Succeeded	0 (0%)	0 (0%)	= 1.0000
Liver repair	Succeeded	1 (5%)	0 (0%)	= 0.3173
Spleen repair or splenectomy	Succeeded	11 (55%)	13 (65%)	= 0.5239

* Percentage of Column Total.

There was non-significant difference as regards AIS scale, and all therapeutic parameters (the 2 techniques equally effective) ($p > 0.05$) (Table 4).

Table 5: Comparison between the 2 groups as regards operative data using Mann-Whitney's U test.

Variable	Laparoscopy group (20)	Laparotomy group (20)	Mann-Whitney's U test
	Median (IQR)	**Median (IQR)**	**P value**
Operative time (min)	90 (60 – 105)	120 (95 – 120)	= 0.017*
Blood loss (ml)	275 (100 – 650)	750 (250 – 1000)	= 0.046*

There was highly significant decrease in operative time and blood loss, in Laparoscopy group; compared to Laparotomy group ($p < 0.05$) (table 5).

Table 1: Roc-curve of laparoscopic surgery to predict efficacy of laparoscopic surgery.

Variable	AUC	SE	Sensitivity (%)	Specificity (%)	P value
Post-operative pain	0.756	0.0772	85	65	0.0009**
Return of bowel habit	0.685	0.0799	60	70	0.02*
Hospital stays	0.742	0.0812	80	75	0.0028**

ROC (Receiver operating characteristic), AUC= Area under curve, SE= Standard Error.

By using ROC-curve analysis, laparoscopic surgery technique predicted decrease in post-operative pain, with fair (75%) accuracy, sensitivity= 85% and specificity= 65% ($p < 0.01$), decrease in return of bowel habit, with poor (68%) accuracy, sensitivity= 60% and specificity= 70% ($p < 0.05$) and decrease in hospital stay, with fair (74%) accuracy, sensitivity= 80% and specificity= 75% ($p < 0.01$). (Table 6)

Table 7: Roc-curve of laparoscopic surgery to predict safety of laparoscopic surgery.

Variable	AUC	SE	Sensitivity (%)	Specificity (%)	P value
Complication's rate	0.675	0.0750	75	60	0.019*
Mortality rate	0.600	0.0459	100	20	0.029*

ROC (Receiver operating characteristic), AUC= Area under curve, SE= Standard Error.
By using ROC-curve analysis, laparoscopic surgery technique predicted decrease in complication's rate, with poor (67%) accuracy, sensitivity= 75% and specificity= 60% ($p < 0.05$) and decrease in mortality rate, with poor (60%) accuracy, sensitivity= 100% and specificity= 20% ($p < 0.05$) (Table 7).

4. Conclusions

Laparoscopy was proven to be a good alternative to laparotomy, as it is a reliable and safe method in hemodynamically stable patients with blunt abdominal trauma. It can be used to reduce the rate of laparotomy with lower morbidity and mortality rates, along with reduction of hospital stay and post-operative pain, and improving early return to bowel and daily activities.

References

[1] T. Ogura, A. T. Lefor, M. Nakano, Y. Izawa, & H. Morita. (2015). Nonoperative management of hemodynamically unstable abdominal trauma patients with angioembolization and resuscitative endovascular balloon occlusion of the aorta. Journal of Trauma and Acute Care Surgery. 78 (1): 132-135.

[2] M. Shahzad, S. M. I. Azeem, & M. Ahmad. (2019). Splenic injury in blunt abdominal trauma. Pakistan Journal of Surgery. [revista en internet]. 35 (1): 8-11.

[3] K. Søreide. (2009). Epidemiology of major trauma. Journal of British Surgery. 96 (7): 697-698.

[4] R. Rubikas. (2001). Diaphragmatic injuries. European journal of cardio-thoracic surgery. 20 (1): 53-57.

[5] S. D. Saverio, A. Birindelli, M. Podda, E. Segalini, A. Piccinini, C. Coniglio, ... & G. Tugnoli. (2019). Trauma laparoscopy and the six w's: Why, where, who, when, what, and how? Journal of Trauma and Acute Care Surgery. 86 (2): 344-367.

[6] M. D. Goodyear, L. A. Eckenwiler, & C. Ells. (2008). Fresh thinking about the Declaration of Helsinki. British medical journal. 337.

[7] V. Justin, A. Fingerhut, & S. Uranues. (2017). Laparoscopy in blunt abdominal trauma: for whom? When? and Why?. Current trauma reports. 3: 43-50.

[8] A. A. Abdelshafy, M. E. Nagy, M. E. Elshinawi, & T. I. Ouf. (2020). Role of laparoscopy in blunt abdominal trauma: a comparative prospective cohort study between laparoscopy and laparotomy in patients with blunt abdominal trauma. The Egyptian Journal of Surgery. 39 (4): 926-931.

[9] A. Jangjou, & P. Izadpanah. (2019). Prediction of the need for laparotomy considering clinical and laboratory findings in abdominal blunt trauma patients referred to Rajaei hospital in year 2017 and 2018. International Journal of Medical Investigation. 8 (2): 6-11.

[10] P. Amutha, P. U. Abinayaa, & S. L. A. Harikumar. (2021). Role of diagnostic laparoscopy in blunt abdominal trauma. International Journal of Surgery Science. 5 (1): 338-342.

[11] H. F. Lin, Y. D. Chen, & S. C. Chen. (2018). Value of diagnostic and therapeutic laparoscopy for patients with blunt abdominal trauma: A 10-year medical center experience. PloS one. 13 (2): e0193379.

[12] R. Cirocchi, A. Birindelli, K. Inaba, M. Mandrioli, A. Piccinini, R. Tabola, ... & S. Di Saverio. (2018). Laparoscopy for trauma and the changes in its use from 1990 to 2016: a current systematic review and meta-analysis. Surgical laparoscopy, endoscopy & percutaneous techniques. 28 (1): 1-12.

[13] A. Wafa, M. Elsagier, R. Friwan, & A. Baio. (2019). Role of laparoscopy in abdominal trauma. International Journal of Surgery Research and Practice. 6: 100.

[14] A. A. Shamim, S. Zeineddin, A. Zeineddin, O. A. Olufajo, G. O. Mathelier, E. E. Cornwell III, ... & D. Tran. (2020). Are we doing too many non-therapeutic laparotomies in trauma? An analysis of the National Trauma Data Bank. Surgical Endoscopy. 34: 4072-4078.