

Evaluation of the Role of Laparoscopy in Emergency Abdominal Surgery: Outcomes of 1740 Patients

Ahmed Elnabil-Mortada, MRCS, MD, FACS; Sherif Albalkiny, MRCS, MD; Mohamed Elnagar, MRCS, FRCS; Mohamed Elsayed Seifalyazal, MD

Department of General Surgery, Faculty of Medicine, Ain Shams University, Egypt

Background: Emergency Surgery is growing nowadays as separate subspeciality from general surgery in many countries. Minimally invasive approach is currently utilized routinely in most of the elective abdominal surgeries due to its better outcomes to the open approach but is not widely used as the same in setting of major abdominal emergencies. We aimed in our study to evaluate the role of laparoscopy in management of major abdominal emergencies in our busy tertiary university hospital.

Patients and methods: A retrospective cohort analysis of total 1740 eligible patients' records who underwent emergency major abdominal surgery for abdominal trauma, generalised peritonitis, and bowel obstruction. Cohort were divided into three groups; those who underwent emergency laparotomy (OP), completed laparoscopic surgery (LA) and laparoscopy converted to open (LAC). Demographic data, operations type, causes of conversion, perioperative outcomes, and hospital stay of the groups were compared and statistically analysed.

Results: Total number of 1322 (79%) patients in (OP) group, and 418 (31%) had attempted diagnostic laparoscopy and proceed (DLP), with 157 out of total 418 (37.5%) patients were converted to open (LAC) mainly for inadequate exposure (36.3%). Laparoscopic surgery was completed in only 15% of the total patients in our study (261/1740) and was mainly for management of peritonitis (90%). LA group had significantly lower rate of surgical site infection (SSI), respiratory complications, shorter ileus time, hospital and ICU stay, with lower hospital mortalities.

Conclusion: Utilization of laparoscopy is still less favourable in emergency surgery, but it is feasible and effective approach by experienced surgeons in selected patients with significant quicker recovery, shorter hospital stay and lower rate of surgical site and respiratory complications.

Key words: Emergency Laparotomy, Diagnostic laparoscopy, Peritonitis, Abdominal Trauma, Bowel obstruction, Perforated Viscous.

Introduction

Emergency Surgery is growing nowadays as separate subspeciality from general surgery in many countries. The role of Laparoscopy in abdominal emergencies became more and more popular than before.¹

Laparoscopic approach has multiple advantages for patients; including faster recovery, better cosmetic outcomes, it can provide the diagnosis and avoid a large abdominal incision when exact diagnosis often is in doubt.²

World society of emergency surgery (WSES) suggests the laparoscopic approach as treatment of choice for patients with complicated perforated appendicitis with abscess and perforated peptic ulcer in stable patients where advanced laparoscopic expertise is available, with a low threshold for conversion.^{3,4}

While performing laparoscopic peritoneal lavage and drainage with generalized peritonitis due to perforated colonic diverticulitis, and laparoscopy for adhesive small bowel obstruction (ASBO) are still recommended only in very selected patients.^{5,6}

There is still no consensus regarding the role of laparoscopy in trauma cases. The decision to perform

laparoscopy should be based on the experience of the surgeon and the resources available.⁷

We aimed in our study to evaluate the utilization of laparoscopy in management of major abdominal emergencies in our busy tertiary university hospital.

Materials and methods

This study was conducted in accordance with The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement.⁸ Population, intervention, comparator, outcomes, and study design (PICOS) approach were used to plan our study.

Population

A total of 1740 eligible patients' records who underwent emergency major abdominal surgery between 2016 and 2020 before covid pandemic for abdominal trauma, generalised peritonitis, and bowel obstruction were reviewed and statistically analysed.

Intervention & surgical technique

Emergency laparotomy and emergency laparoscopy.

Comparators

Cohort were divided into three groups; those who

underwent emergency laparotomy (OP), completed laparoscopic surgery (LA) and laparoscopy converted to open (LAC).

Outcomes

Demographic data, ASA grade, intensive care unit (ICU) admission, hospital stay, operations type, causes of conversion, hospital mortalities, intraoperative contamination & bleeding, and postoperative complications of the groups were compared and statistically analysed.

Study design

Retrospective cohort study. The approval of the Ethics Committee in our hospital was obtained before the start of the study.

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (SPSS 25). Data was presented and suitable analysis was done according to the type of data obtained for each parameter.

For descriptive statistics: mean, standard deviation (± SD) and range for parametric numerical data, while Median and Interquartile range (IQR) for non-parametric numerical data. Frequency and percentage of non-numerical data.

For analytical statistics: Chi-Square test was used to examine the relationship between two qualitative variables. Fisher’s exact test was used to examine the relationship between two qualitative variables when the expected count is less than 5 in more than 20% of cells.

P- value was considered significant if P< 0.05.

Results

Total number of 1322 (79%) patients in OP group, and 418 (31%) had attempted diagnostic laparoscopy and proceed (DLP), with 157 out of total 418 (37.5%) patients were converted to open (LAC).

Demographic characteristics of patients

Tables 1,2 show that significant difference in gender distribution and ASA grade between the groups. OP group has higher ASA grade than LA

and LAC.

Operations name

Table 3 shows different kind of operations which were done. Colectomies were the most common procedure in OP (25.491%) and LAC (24.840%), followed by small bowel resection (16.868%), and (15.286%) respectively. The main procedure in LA was washout with appendectomy in (34.482%), washout for other causes (30%) as perforated diverticulitis, postoperative complications followed by laparoscopic repair of perforated peptic ulcer in 13.7%.

ICU Admission and hospital stay

Table 4 shows that both ICU and hospital stay days were significantly lower in laparoscopic group (LA).

In hospital mortalities

Mortality rate was significantly higher (10.96%) in OP group compared with other groups; LA group (2.29%) and (5.09%) patients in LAC as shown in **(Table 5)**.

Intraoperative contamination and bleeding

Table 6 shows that the rate of faecal contamination in OP and LAC groups was significantly higher than LA group, but the no significant regarding the pus contamination between the groups. Table 7 shows the differences in the blood loss between the groups which was highly significant in group OP.

Postoperative complications

Overall complications rate was significantly lower (17.6%) in group LA as compared with (47.2 %) in OP group and (33.1) % in LAC. Surgical site infection, respiratory complications and ileus were more significant in OP in comparison to other groups. but there was no statical difference for the remaining list of complications as shown in **(Table 8)**.

Causes of conversion

The rate of conversion from LA to LAC in our study was 37.55% and it was mainly due to inadequate exposure (36.3%) and need for resection (19.7%) as shown in **(Table 9)**.

Table 1: Demographics

Demographics	Study Groups			Chi-Square test			
	OP (1322) N (%)	LA (261) N (%)	LAC (157) N (%)	Value	p-Value	Sig.	
Sex	Male	714 (54%) ^a	115 (44.06%) ^b	82 (52.22%) ^{a,b}	x ² =8.648	0.013	S
	Female	608 (46%) ^a	146 (55.93%) ^b	75 (47.77%) ^{a,b}			

* Each subscript letter denotes a subset of Group categories whose column proportions do not differ significantly from each other at the .05 level.

Table 2: ASA grade

ASA	Study Groups			Chi-Square test		
	OP (1322)	LA (261)	LAC (157)	X ²	p-Value	Sig.
	N (%)	N (%)	N (%)			
I-II	621 (46.974%) ^a	177 (67.8%) ^b	102 (64.968%) ^b	50.04	<0.001	S
>III	701 (53.025%) ^a	84 (32.2%) ^b	55 (35.031%) ^b			

* Each subscript letter denotes a subset of Group categories whose column proportions do not differ significantly from each other at the .05 level.

Table 3: Operations name

Operations name	OP (1322)	LA (261)	LAC (157)
Colectomy including Hartman's	337 (25.491%)	10 (3.831%)	39 (24.840%)
Small bowel resection	223 (16.868%)	7 (2.681%)	24 (15.286%)
Bleeding control including splenectomy	145 (10.968%)	4 (1.532%)	12 (7.643%)
Repair of perforated ulcer	124 (9.379%)	36 (13.793%)	16 (10.191%)
Washout +appendectomy	160 (12.102%)	90 (34.482%)	6 (3.821%)
Defunction or bypass	88 (6.656%)	6 (2.298%)	17 (10.828%)
Adhenolysis	101 (7.639%)	10 (3.831%)	30 (19.108%)
Wash out	52 (3.933%)	79 (30.268%)	12 (7.643%)
Step down (Open & Close)	32 (2.4%)	10 (3.831%)	1 (0.636%)
Negative	60 (4.53%)	9 (3.448%)	0 (0%)

Table 4: ICU admission and hospital stay

Days	OP	LA	LAC	p-Value	
ICU admissions days (median)	1 (1-4)	0 (0-1)	0 (0-3)	0.023	S
Hospital stay days (median)	12 (7-22)	6 (4-11)	9 (5- 15)	<0.001	S

Table 5: Hospital mortalities

Hospital mortalities	Study Groups			Chi-Square test		
	OP (1322)	LA (261)	LAC (157)	X ²	p-Value	Sig.
	N (%)	N (%)	N (%)			
Yes	145 (10.96%) ^a	6 (2.29%) ^b	8 (5.09%) ^b	23.127	<0.001	S
No	1177 (89.03%) ^a	255 (97.7%) ^b	149 (94.9%) ^b			

* Each subscript letter denotes a subset of Group categories whose column proportions do not differ significantly from each other at the .05 level.

Table 6: Rate of contamination

Contamination	Study Groups			Chi-Square test		
	OP (1322)	LA (261)	LAC (157)	X ²	p-Value	Sig.
	N (%)	N (%)	N (%)			
None	795 (60.1%) ^a	180 (69%) ^b	78 (49.7%) ^c	46.108	<0.001	S
Free pus	368 (27.8%) ^a	81 (31%) ^a	50 (31.8%) ^a			
Faecal	159 (12.1%) ^a	0 (0%) ^b	29 (18.5%) ^c			

* Each subscript letter denotes a subset of Group categories whose column proportions do not differ significantly from each other at the .05 level.

Table 7: Intraoperative bleeding

Blood loss	Study Groups			Chi-Square test		
	OP (1322)	LA (261)	LAC (157)	X ²	p-Value	Sig.
	N (%)	N (%)	N (%)			
<100	528 (39.9%) ^a	221 (84.7%) ^b	109 (69.4%) ^c	248.344	<0.001	S
100-500	688 (52.0%) ^a	39 (14.9%) ^b	20 (12.7%) ^b			
501-1000	80 (6.1%) ^a	1 (0.4%) ^b	22 (14.0%) ^c			
>1000	26 (2.0%) ^a	0 (0%) ^b	6 (3.8%) ^a			

* Each subscript letter denotes a subset of Group categories whose column proportions do not differ significantly from each other at the .05 level.

Table 8: Postoperative Complications

Post-operative complications	Study Groups			Test of significance		
	OP (1322)	LA (261)	LAC (157)	Value	p-Value	Sig.
	N (%)	N (%)	N (%)			
Surgical site infection	146 (11.0%) ^a	5 (1.9%) ^b	13 (8.3%) ^a	X ² = 21.539	<0.001	S
Wound dehiscence or incisional hernia	74 (5.6%)	3 (1.14%)	5 (3.2%)	X ² = 2.24	0.326	NS
Reopening	63 (4.8%)	5 (1.9%)	4 (2.5%)	X ² = 5.563	0.062	NS
Bowel leak	43 (3.3%)	4 (1.53%)	3 (1.9%)	X ² = 4.04	0.133	NS
Intra-abdominal collection	11 (0.8%)	10 (3.83%)	1 (0.6%)	Fisher's Exact test	1.00	NS
Ileus	155 (11.7%)	13(4.9%)	14 (9.0%)	X ² = 8.55	0.014	S
Respiratory complications	132 (10%)	6 (2.3%)	12 (7.6%)	X ² = 1.489	0.475	S

*Chi-Square test of significance (X²).

* Each subscript letter denotes a subset of Group categories whose column proportions do not differ significantly from each other at the .05 level.

Table 9: Causes of conversion

Causes of conversion (N= 157)	N	%
Inadequate exposure	57	36.3%
Need for resection	31	19.7%
Dense adhesions	30	19.1%
Respiratory problems due to pneumoperitoneum	14	8.9%
Iatrogenic injury	13	8.3%
Bleeding	12	7.6%

Discussion

With the advance in radiological diagnostic modalities, taking the proper decision in acute surgical patient is much improved, which leads to better outcomes and lower rate of negative laparotomies. In late 20th century, diagnostic laparoscopy become more popular before formal laparotomy then later it became alternative for open surgery in many cases for emergency surgical patients.⁹

We succeeded to retrieve retrospectively and statistically analysed 1740 medical records to evaluate the utilization of laparoscopy in our hospital

in the settings of major emergency abdominal surgery.

Total number of 1322 (79%) patients underwent emergency laparotomies, and 418 (31%) had attempted diagnostic laparoscopy and proceed (DLP), with 157 out of total 418 (37.5%) patients were converted to open (LAC). Laparoscopic surgery (LA) was completed in only 15% of the total patients in our study (261/1740).

Patients who underwent emergency laparotomy had significant higher ASA grade than patients underwent laparoscopic surgery, with longer ICU and hospital

stay days. Mortality rate was significantly higher in OP group (10.96 %) compared with other groups; LA group (2.29 %) and (5.09 %) patients in LAC.

The most common procedures in OP group were colectomy and small bowel resection 25.491% & 16.868% respectively. The main procedure in LA was laparoscopic washout either combined with appendectomy (34.482%), or for other causes (30.268%) as perforated diverticulitis, postoperative complications followed by laparoscopic repair of perforated peptic ulcer in 13.7%. Inadequate exposure (36.3%) and need for resection (19.7%) were the main causes of conversion (37.55%) from laparoscopy to open (LAC group).

One large population-level study in UK retrospectively reviewed 116 920 patients' NELA data (National database of emergency laparotomy for England and Wales) over 5-year duration showed that laparoscopy was attempted only in 14.6%, with conversion rate of 46.4 %. Only 7.8% (9125/116920) of the procedures were completed laparoscopically. Laparoscopically attempted surgery was associated with lower mortality, blood loss, and duration of hospital stay.¹⁰

Nielsen L et al, found that 18% of the patients in the laparoscopic group were admitted to an ICU, compared with 40% in open group. Overall mortality rates were 8.5%, 18.4%, and 22.4% after a laparoscopic, converted, and open procedures respectively.¹¹

Our study showed that the rate of faecal contamination in OP and LAC groups was significantly higher than LA group, which may be contributed to significantly higher overall complications rates in OP group (47.2 %) and LAC (33.1%) compared to LA group (17.6%) which had significant lower SSI, respiratory complications, and shorter ileus time. The highest rate of complications in OP group were ileus (11.7%), SSI (11%), and respiratory complications (10%). Pucher et al found that major complications occurred after 49.5%, 46.4%, and 31.6% of open, converted, and laparoscopic surgery respectively.⁹

We found that the rate of conversion in our hospital was 37.55%. Inadequate exposure was the most common reason to convert to open surgery after laparoscopy (36.3%) followed by need for resection (19.7%). The conversion rate in other studies of laparoscopic abdominal emergency surgery varied from 0.16% to 55%, that was affected by inclusion criteria of the study. Studies including only perforated peptic ulcer or SBO and excluded cholecystectomies and appendectomies have higher rate than the studies which included them.^{11,12}

Although the advance in radiological diagnostic methods, we had 4.35% (69/1583) overall negative laparotomies/laparoscopy rate in our study with

4.53%, 3.44% in OP and LA groups respectively. Those in OP group with negative laparotomies would have avoided the potential complications of big wounds if they had attempted laparoscopy and the same 2.4% of the patients who had (Open & close) in OP group.

Surgery remains a multidisciplinary endeavour. In particular, the importance of a quality radiology service cannot be overstated. Expert radiologists will not only diagnose intra-abdominal pathology more accurately; they may be able to advise on the urgency of surgery, the degree of contamination, the presence of intra-abdominal adhesions and even the optimum laparoscopic port positions.^{13,10}

Laparoscopy in our study was utilised by consultants with advanced laparoscopic skills mainly for young patients with lower ASA grade to manage peritonitis due to perforated/complicated appendicitis, repair of perforated duodenal ulcer, washout for perforated diverticulitis, and postoperative complications. While the cases presented with abdominal trauma, bowel obstruction were managed mainly by traditional emergency laparotomy to control intraabdominal bleeding, and bowel resection.

Laparoscopic approach is recommended by WSES as primary choice for management complicated perforated appendicitis with abscess and perforated peptic ulcer in stable patients where advanced laparoscopic expertise is available, with a low threshold for conversion.^{3,4}

Recent evidence from the literature,¹⁴⁻¹⁶ had concluded that laparoscopic lavage in Hinchey III acute diverticulitis shows a comparable mortality but is associated with a failure rate with a significantly augmented need for reoperation due to the failure of the treatment and to intra-abdominal abscess formation. Long-term results were similar, with no difference in morbidity and mortality. Several controversies remain about laparoscopic lavage and drainage. It may be an acceptable alternative in selected young patients without visible perforations.¹⁴

Laparoscopy in an abdomen with very distended loops of bowel and multiple complex adhesions is associated with the risk of enterotomies and delayed diagnosis of perforations in 6.3 to 26.9% of patients treated with laparoscopic adhesiolysis for ASBO.¹⁷⁻¹⁹

Less than 2 laparotomies in history, appendectomy as the operation in history, no previous median laparotomy incision, and a single adhesive band were described as the predictors for successful laparoscopic approach for ASBO.²⁰

Recently published Meta-analysis with a total of 5,517 patients from 23 eligible studies found that there is no significant difference in the incidence

of missed injury and mortality between abdominal trauma patients receiving laparoscopy and those receiving laparotomy, in addition laparoscopic approach was associated with similar risk of intra-abdominal abscesses, thromboembolism, and ileus, and lower incidence of wound infection, pneumonia, shorter hospitalization times. They concluded that laparoscopic surgery is a practical alternative to laparotomy for appropriate patients with abdominal trauma. The decision to perform laparoscopy should be based on the experience of the surgeon and the resources available.⁷

Our study has some limitations and strengths. First is limited by the retrospective analysis with potential selection bias which doesn't reflect actual feasibility of usage of laparoscopy especially in absence of expert surgeon or availability of the laparoscopy in addition of recall bias for accurate data collection. The second limitation is that we lumped OP group together including laparotomies for abdominal trauma and bowel obstruction which most of the surgeons aren't in favour of using laparoscopy. The strength in our study is that it is one of few in the literature evaluating large population in single centre for emergency laparoscopic surgery.

Conclusion

Utilization of laparoscopy is still less favourable in emergency surgery, but it is feasible and effective approach by experienced surgeons in selected patients with significant lower rate of complications, hospital stay and quicker recovery.

Compliance with ethical standards

Conflict of interest: Drs Ahmed Elnabil-Mortada Sherif Albalkiny, and Mohamed Elnagar, declare that they have no conflict of interest.

Informed Consent not applicable.

Ethics approval: The approval of the Ethics Committee in our hospital was obtained before the start of the study.

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