

Retrospective Observational Study of the Role of Laparoscopy in Lower Gastrointestinal Surgical Emergencies in Adults

Mohamed Elnemr, Tamer A.A.M. Habeeb, Ibrahim A. Heggy, Tamer Wasefy

Department of General Surgery, Faculty of Medicine, Zagazig University, Egypt

***Corresponding author:**

Tamer A.A.M. Habeeb, M.D.
Assistant professor of General Surgery
Department of General Surgery
Faculty of Medicine, Zagazig University
Egypt
Tel: +0201225040432
E-mail: tameralnaimy@hotmail.com

ABSTRACT

Introduction: Lower abdominal pain is caused by various gastrointestinal tract (GIT) emergencies, including acute appendicitis, intestinal obstruction, acute perforated diverticulitis, obstructed hernia, and iatrogenic colon perforation. Therefore, laparoscopy may be of diagnostic and therapeutic value.

Methods: Between April 2017 and April 2020, 793 patients with lower GIT emergencies, including acute appendicitis, acute intestinal obstruction, complicated colonic diverticulum, complicated hernias, and iatrogenic colonic perforations, were included.

Results: The most common age was under 40 (63%), with a male predominance (75%). Acute appendicitis (77%), intestinal obstruction (8%), acute perforated diverticulitis (4%), obstructed hernia (9%), and iatrogenic colonic perforation (2%) were the main causes of lower GIT emergencies. Inferior epigastric artery injury (0.3%), urinary bladder injury (0.4%), appendicular artery bleeding (0.9%), omental hemorrhage (0.6%), intestinal injury (0.9%), splenic injury (0.3%), and duodenal injury (0.1%) were the most prevalent intraoperative complications. The conversion rate was 48 (6%), with 37 patients converted due to difficult dissection or obstructed anatomy, particularly during IO surgery, followed by appendicular surgery. In 206 (26%) of the cases, postoperative complications occurred. Pneumonia (n=55), wound infections (n=35), and ileus (n=22) were the most common postoperative complications. Re-intervention occurred in 53 cases (53/793, 6.7%), with causes including appendicular surgery (13 cases), IO surgery (12 patients), diverticulitis surgery (12 patients), and hernia surgery (12 patients), and iatrogenic perforation surgery (4 patients). The death rate was 3%.

Conclusion: In cases of acute appendicitis and obstructed hernia, as well as in the hands of skilled surgeons, the laparoscopic method is considered possible and safe; however, in other cases, such as IO, perforated diverticular disease, and iatrogenic colonic perforation, it is not.

Key words: emergency laparoscopy, lower GIT emergencies, acute appendicitis

INTRODUCTION

Acute lower abdomen is typically caused by peritoneal irritation due to inflammation, rupture, or hollow organ obstruction. Patients with severe acute lower abdominal pain either proceed to the operating room or undergo additional investigations or diagnostic laparoscopy (DL). Laparoscopy should not

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be used routinely in cases of acute lower abdomen due to anesthetic risks and morbidity (1).

Most hospitals perform emergency abdominal surgeries, and laparotomy in these procedures is associated with high mortality rates (14 to 20%) (2-3). Laparoscopic surgery has become a standard diagnostic and therapeutic tool in abdominal emergencies. It has been employed in some situations of lower abdominal crises in recent years (4).

General surgeons frequently face diagnostic challenges in cases of emergency abdominal conditions. Diagnosis is crucial for planning an appropriate abdominal incision and for avoiding unnecessary surgery. Non--invasive diagnostic approaches, such as radiological examinations, are not always conclusive. Furthermore, they are costly and cannot be performed 24 h a day in all hospital circumstances (5). This retrospective observational study was designed to analyze the intraoperative and postoperative outcomes of the laparoscopic technique in emergent lower GIT surgeries.

MATERIAL AND METHODS

Design of the study and participants

Between April 2017 and April 2020, 793 patients experienced lower GIT emergencies, including acute appendicitis, acute intestinal obstruction, complicated colonic diverticulum, complicated hernias, and iatrogenic colonic perforations. To be eligible for the study, patients must meet all of the following criteria: >18 years of age, both sexes, and have undergone laparoscopic surgery for acute lower GIT emergencies,, such as acute appendicitis, acute intestinal obstruction, complicated colonic diverticulum, complicated hernias, and iatrogenic colonic perforations. The exclusion criteria were age < 18 years and a history of open surgery. The STROBE criteria were followed for reporting work and registration in a clinical trial.

Types of outcomes (clinical endpoints)

Intraoperative complications were the primary outcome. Postoperative complications were the secondary outcome.

Method

Perioperative evaluation and approach

Plain radiography, abdominal ultrasonography, and computed tomography (CT) were performed to confirm the diagnosis (CT). For three years, all surgeries were

performed in a single location. The procedures were performed as instructed (6-10). All the patients were tracked for 24 months after discharge from the hospital. Patients were approached by phone, outpatient clinic visits, or e-mails. Comprehensive history review, clinical examination, USS, and CT were performed during the follow-up period. None of the patients was lost to follow-up.

Statistical analysis

The mean SD was used for normally distributed continuous variables, and the median was used for non-normally distributed continuous variables. Percentages were used to represent categorical variables. The test results were examined to determine whether they were within the normal range. SPSS version 20 (SPSS, Chicago, IL, USA) was used for all the statistical analyses.

RESULTS

Preoperative and demographic characteristics of the study participants are shown in *table 1*. The most common age was under 40 (63%), with a male predominance (75%). Acute appendicitis (77%), intestinal obstruction (8%), acute perforated diverticulitis (4%), obstructed hernia (9%), and iatrogenic colonic perforation (2%) were the main causes of lower GIT emergencies. Diabetes mellitus was the most prevalent comorbidity (27%), whereas ASA I was the most common (57%). In 11% of individuals, previous lower abdominal operations were present.

Table 2 displays intraoperative findings. In 49% of cases, the operation took more than an hour. Inferior epigastric artery injury (0.3%), urinary bladder injury (0.4%), appendicular artery bleeding (0.9%), omental hemorrhage (0.6%), intestinal injury (0.9%), splenic injury (0.3%), and duodenal injury (0.1%) were the most prevalent intraoperative problems. The conversion rate was 48 (6%), with 37 patients converted due to difficult dissection or obstructed anatomy, particularly during IO surgery, followed by appendicular surgery.

Postoperative data are shown in *table 3*. Most patients required more than one day in the hospital, with 16% requiring ICU admission. In 206 (26%) of the cases, postoperative complications occurred. Pneumonia (n=55), wound infections (n=35), and ileus (n=22) were the most common postoperative complications. Re-intervention occurred in 53 cases (53/793, 6.7%), with causes including appendicular surgery (13 cases), IO surgery (12 patients), diverticulitis surgery (12 patients), and hernia surgery (12 patients), and

Table 1 - Demographic and preoperative data of patients (793 patients)

Data	N (%)
Age (years)	
<40	500 (63%)
>40	293 (37%)
Sex	
Male	595 (75%)
Female	198 (25%)
Causes of surgical lower GIT emergencies	
Acute appendicitis	610 (77%)
• Intraoperative macroscopically normal appendix	20
• Non complicated appendicitis	530
• Complicated appendicitis	30
• Interval appendectomy	30
Intestinal obstruction	63 (8%)
• Adhesive IO	47
• Intussusception	2
• Acute mesenteric ischemia	3
• Cancers	11
1. obstructed small intestine cancer	1
2. obstructed right colon cancer	2
3. obstructed left colon cancer	2
4. obstructed transverse colon cancer	1
5. obstructed sigmoid cancer	4
6. obstructed rectal cancer	1
Perforated acute diverticulitis	31 (4%)
• Hinchey I	14
• Hinchey II	8
• Hinchey III	6
• Hinchey IV	3
Obstructed hernia	72 (9%)
• Inguinal	47
• PUH	23
• Femoral hernia	1
• Internal hernia	1
Iatrogenic colonic perforation	17 (2%)
Co-morbidities	
• Diabetes Mellitus	214 (27%)
• Hypertension	119 (15%)
• Respiratory problems	79 (10%)
• Cardiac and valvular problems	63 (8%)
Initial Body mass index	31.5±2.41
American Society of Anesthesiology	
I	452 (57%)
II	151 (19%)
III	151 (19%)
IV	24 (3%)
V	15 (2%)
Previous lower abdominal surgery	87 (11%)

iatrogenic perforation surgery (4 patients). The death rate was 3% (table 4).

DISCUSSION

Role of laparoscopic approach in acute appendicitis

Laparoscopy is safe for the diagnosis and treatment of acute appendicitis (11). Laparoscopic appendectomy

Table 2 - Intraoperative data (793 patients)

Operative time	
< 60 min	404 (51%)
> 60 min	389 (49%)
Intraoperative complications	26 (3%)
Inferior epigastric artery injury	2 (0.3%)
Urinary bladder injury	3 (0.4%)
Appendicular artery bleeding	7 (0.9%)
Omental bleeding	4 (0.6%)
Intestinal injury	7 (0.9%)
Splenic injury	2 (0.3%)
Duodenal injury	1 (0.1%)
Conversion to open	48 (6%)
Causes of conversion	
Obstructed anatomy or difficult dissection	37
• During appendicular surgery	10
• During IO surgery	17
• During diverticulitis surgery	4
• During hernia surgery	4
• During colonic perforation surgery	1
Uncontrolled bleeding	7
• Bleeding appendicular artery - controlled by ileocolic ligation	5
• Omental bleeding during transverse colectomy - controlled by suture ligation	1
• Spleen injury during left colectomy - splenectomy	1
Intestinal injury	3
• Injury to caecum during appendectomy - RT hemicolectomy	1
• Injury to intestine during IO surgery - primary repair	2
Duodenal injury	1
• During RT hemicolectomy - repair with gastrojejunostomy	1

has many benefits, including lower abdominal wall morbidity, especially in obese patients; better assessment of the extent of sepsis (subphrenic collection, generalized peritonitis); less postoperative pain; faster recovery; earlier return to normal activity; better cosmetic results; easier localization and removal of an ectopic appendix; decreased abdominal wall morbidity; and complete evaluation of the abdominal cavity in cases of diagnostic doubt (12). While Li et al. found a low wound infection rate (3.81%) following a laparoscopic appendectomy, they also found a slightly higher incidence of intraoperative bleeding, postoperative abdominal abscess, and urinary tract infection. 9.51% of patients were converted from laparoscopy to open appendectomy (13). These benefits are particularly significant in obese patients (14).

In cases of complicated appendicitis, a previous study recommended laparoscopic appendectomy for severe appendicitis because of the low rate of surgical intra-abdominal abscess, quick recovery time, rapid return to oral intake, and brief hospital stay (15). During the Covid-19 era, there was a higher incidence of complicated appendicitis after abscess drainage, such as appendicular abscesses and recurrent appendicitis. There has been debate about the use of laparoscopy or

Table 3 - Postoperative data (793 patients)

Data	N (%)
Hospital stay	
1 day	254 (32%)
>1 day	539 (68%)
Time of analgesic intake	
< 2 days	214 (27%)
> 2 days	579 (73%)
Intensive care unit admission	127 (16%)
Time return to work	
Within 1 week	206 (26%)
>1 week	587 (74%)
Drain removal	
Within 6 days	555 (70%)
> 6 days	238 (30%)
Clavien-dindo classification	
0	397 (50%)
I	285 (36%)
II	79 (10%)
III	32 (4%)
Causes of early and late postoperative complications	206 (26%)
Seroma	14
Hematoma	12
Wound infection	35
Abscess formation	17
Ileus	22
Pneumonia	55
Port site bleeding	12
Omental bleeding	9
Port site hernia	16
Adhesive intestinal obstruction	14
Re-intervention	53 (6.6%)
Following appendicitis surgery	13
Appendicular artery bleeding	3
Appendicular stump leakage	2
Intestinal injury	1
Adhesive IO	4
Port site incisional hernia	2
Direct inguinal hernia	1
Following intestinal obstruction surgery	12
Missed Intestinal injury	2
Adhesive intestinal obstruction	3
Port site incisional hernia	5
Omental bleeding	2
Following diverticulitis surgery	12
Missed Intestinal injury	2
Adhesive intestinal obstruction	4
Port site incisional hernia	4
Omental bleeding	2
Following complicated hernia surgery	12
Missed intestinal injury	2
Omental bleeding	2
Adhesive IO	2
Port site incisional hernia	3
Recurrent hernia	3
Postoperative meralgia parathetica	0
Following iatrogenic perforation surgery	4
Omental bleeding	1
Port site incisional hernia	2
Adhesive IO	1
Mortality	24(3%)

an open approach after appendicular abscess drainage to contain virus spread (16-17).

In our analysis, The most common emergencies

performed at our facility were acute appendicitis (610, 77%), predominantly non-complicated appendicitis (530/610). The number of laparoscopic appendectomies performed in our facility decreased during the COVID-19 pandemic. The most common intraoperative problems we encountered were appendicular artery hemorrhage in 7 patients (0.9%) that slipped during dissection and were treated in 2 patients, while five patients required open conversion to control the bleeding via ileocolic artery ligation. Postoperative complications occurred in 28 patients, including port-site wound infections (n = 6), ileus (n = 5), and pneumonia (n = 3). Reintervention was required in 13 patients after appendectomy due to appendicular artery bleeding (3 patients), appendicular stump leakage (2 patients), intestinal damage (1 patient), adhesive IO (4 patients), incisional hernia (2 patients), and direct inguinal hernia (1 patient). We conclude that laparoscopic repair of acute appendicitis is safe and feasible, with few intraoperative and postoperative complications. The lower incidence and safety of laparoscopy in the treatment of acute appendicitis have been accepted in previous studies (18-20). The increased rate of postoperative wound infection is attributable to the large number of patients who undergo laparoscopic appendectomy. Furthermore, we did not employ a retrieval bag to remove the inflamed appendix as in other studies (21).

We encountered a normal intraoperative appendix. Our center's procedure involved the removal of apparently normal appendices for microscopic early mucosal inflammation, and the risk of recurrent appendicitis was significant. According to a previous study, 10% to 15% of appendectomies are carried out for a healthy appendix (22). This concept was agreed upon in another study (23). However, other studies did not advocate appendectomy in the normal macroscopic appendix owing to the low incidence of recurrent appendicitis (1).

Laparoscopic approach in intestinal obstruction

Adhesions, tumors, strangulated hernias, intussusception, and paralytic ileus can cause intestinal obstructions. Electrolyte and fluid imbalances, intestinal ischemia and stasis, microbial proliferation in the intestinal lumen, and bacterial translocation through the intestinal wall are consequences of this condition. (24). Laparoscopic management of acute IO is challenging because of the restricted working space produced by the ileus, fragility of dilated intestinal

Table 4 - Detailed analysis of post-operative complications

Complications	Total number	Appendix	IO	Diverticulitis	Hernia	Perforation
seroma	8	3	2	2		1
hematoma	6	2	1	1	1	1
Wound infection	20	6	4	3	5	2
Intra-abdominal abscess	9	3	2	2	1	1
ileus	12	5	5	2		
pneumonia	20	3	8	3	3	3
Port site bleeding	7	2	2	1	1	1
Omental bleeding	6	1	2	1	1	1
Port site incisional hernia	9	1	2	2	2	2
Adhesive IO	7	2	1	1	2	1
	104	28	29	18	16	13

loops, and difficulty in determining the cause of obstruction in some patients. As intestinal injuries are potentially lethal, bowel manipulation requires utmost care. The laparoscopic method's conversion rates can range from 0% to 52%, depending on surgeon's experience and patient choice (25-26). In contrast, earlier studies have found that laparoscopy is safe and feasible for emergency colorectal obstruction, with good outcomes in terms of hospital stay and mortality reduction (4).

Intestinal obstruction occurred in 63 patients (8%) in our study, with adhesive IO being the most common cause (47/63). The most common cause of malignant obstruction is sigmoid colon obstruction. Intraoperative complications necessitated conversion in 21 patients (21/63, 33%). One patient underwent splenectomy due to splenic injury during the left hemicolectomy, one patient underwent exploration due to intestinal injury with primary resection and anastomosis, and one patient underwent exploration due to duodenal injury during the right hemicolectomy, and the tear was repaired. Pneumonia, ileus, and wound infections were the most prevalent postoperative complications. Postoperative problems necessitated reintervention in 12 patients (12/63, 19%), including missed intestinal injuries in two patients, adhesive IO in three, port site incisional hernia in five, and omental hemorrhage in two. Laborious dissection with a limited working area was the cause of the increased intraoperative and postoperative difficulties. No intraoperative enterotomy was performed. We conclude that Laparoscopy in IO is difficult and dangerous, with significant intraoperative and postoperative complications. These findings are consistent with previous studies (27). However, Li et al. (28) reported low overall complication rates, and that the laparoscopic method was safer than open treat-

ment when performed by skilled surgeons in carefully selected patients.

Role of laparoscopy in obstructed hernia

Laparoscopic hernia repair, including TAPP repair, is a viable option for treating incarcerated inguinal hernias, provided that sufficient anatomical knowledge and expertise are available to dissect and decrease the sac with favorable outcomes (4,9). Research has also shown that emergency surgery has the same rates of intra- and postoperative problems and recurrences as elective surgery (4). Therefore, patients who meet these requirements may undergo laparoscopic treatment of incarcerated ventral hernias. Adhesiolysis must be performed appropriately; atraumatic graspers must be used; and the contents of the defect must be thoroughly inspected for blood supply, motility, and integrity.

In our study, laparoscopy was performed in 72 patients (9%), with TAPP for inguinal hernia being the most common surgery. As previously documented, we employed a percutaneous transabdominal external needle to close the hernial defect (29) and used a tacker or histoacryl to secure the mesh (9,30). Intraoperative complications necessitated open conversion in four patients (4/72, 5.5%), with wound infection and pneumonia being the most prevalent postoperative sequelae. Owing to proper sac dissection with nerve sparing, no patients experienced postoperative meralgia parathetica, a finding comparable to that of a prior study examining the value of laparoscopic hernia surgery (31). Reintervention was performed in 12 patients (12/72, 16.6%) due to missed intestinal damage (n=2), omental hemorrhage (n=2), adhesive IO (n=2), port site incisional hernia (n=3), and recurring

hernia (n=3). We discovered that laparoscopic repair of an obstructed hernia is safe and possible, with few intraoperative and postoperative complications. In our investigation, the incidence of wound infection was lower than that reported in earlier studies (32) and was most likely related to differences in the approach and method.

Role of laparoscopy in acute perforated diverticulitis

Treatment of acute diverticulitis with laparoscopy is feasible and safe, with complication rates ranging from zero to 54 percent. Previous studies have described using laparoscopic surgery to treat diverticulitis, reporting positive outcomes, such as low complication rates, no deaths, and gastrointestinal (GI) healing rates of up to 90%. However, to date, only a few cases have been reported (33). A systematic review of laparoscopic peritoneal lavage for perforated diverticular diseases included 231 patients from two prospective cohort studies and nine retrospective case series. The mortality rate was 1.7%, with a morbidity rate of 10.4%. Abdominal and systemic infections were successfully treated in 95.7% of patients, with only 37.7% requiring subsequent resection (34).

Thirty-one patients with perforated colonic diverticulum underwent laparoscopic surgery. Due to obstructed anatomy or difficult dissection, conversion occurred in four patients (4/31, 13%). As previously stated, we performed intraoperative colonic lavage and resection with end-to-end or side-to-end colorectal anastomoses (35). Pneumonia and wound infections were the most prevalent postoperative consequences. Due to missed intestinal injury (2), adhesive IO (4), port site incisional hernia (4), and omental bleeding (2), 12 patients (12/31, 39%) required re-intervention. The feasibility and safety of the laparoscopic approach for perforated diverticulitis are questionable, owing to the high morbidity and re-intervention rates.

Role of laparoscopy in iatrogenic colonic perforation

Iatrogenic colonic perforation is the most serious risk associated with diagnostic and therapeutic colonoscopy. If the bacterial load in the colon spreads to the peritoneal cavity, peritoneal contamination, peritonitis, and systemic sepsis can develop rapidly, dramatically increasing the risk of morbidity and fatality. Colonic perforation rates have increased over the past decade owing to the increasing use of colonoscopy for diagnostic and therapeutic purposes (36-40).

Iatrogenic perforation is a rare, but serious complication of several surgical procedures. The Literature reports a risk of up to 0.66% during diagnostic colonoscopy and up to 2.14% during therapeutic procedures (10,37,38,41), with mortality risk up to 25.6%.(37). Although this is a relatively rare complication, advances in treatment over the past decade have made it more manageable and have opened up new options for surgeons and endoscopists.

If the patient's colon has already been prepped, they have the option of primary repair or non-operative treatment. Preparing the colon reduces the number of bacteria present within the colon and the risk of peritoneal contamination. For perforations < 1 cm in size, endoscopists are advised to perform endoscopic clipping to close the perforation promptly. (42-43).

Few studies have investigated the use of laparoscopic access for managing iatrogenic colonic perforation, despite recent suggestions that laparoscopic procedures may be safe and successful in this setting (44-46). Previous studies have reported no morbidity or mortality rates (47-50).

We included 17 patients who underwent laparoscopic treatment for iatrogenic colonic perforations. One patient (1/17,6%) required conversion to open surgery because of difficult dissection and the failure to locate perforations. Most patients who experienced postoperative complications developed pneumonia (3/17, or 17.6%). Four patients (23.5%) required additional surgery after the first procedure failed. Wounds can be repaired with simple colonorrhaphy (1 or 2-layer stitches) or tangential resection. Primary colonic repairs are more likely to be successful and can be accomplished as soon as possible after diagnosis; therefore, timely diagnosis and surgery are essential. When stitched, there were two layers. Laparoscopic resection or colonic diversion, such as the Hartmann operation (Patient 2), can be performed effectively if a primary colonic suture is not possible, owing to the state of the colon and peritoneal contamination. Bowel resection, ileostomy, or colonic diversion may be necessary because of high levels of peritoneal contamination and colon anomalies. If the perforation is in the retroperitoneum, it is critical to wash the abdomen thoroughly (we used to perform lavage with 6 to 8 L of saline solution) and observe the precise location of the perforation with broad mobilization of the colon. The actual non-invasive treatment is conservative therapy, which some authors recommend for particular patients (51). On the other hand, it is not completely risk free.

Owing to the increased risk of peritoneal infection, poor outcome, significant morbidity, and death from sepsis, more extensive surgical operations may be required if conservative treatment fails or the surgical approach is delayed (42). Laparoscopic surgery is not recommended for the treatment of colonic perforations.

CONCLUSION

In cases of acute appendicitis and obstructed hernia, as well as in the hands of skilled surgeons, the laparoscopic method is considered possible and safe. However, this is not the case in other cases, such as IO, perforated diverticular disease, and iatrogenic colonic perforation.

Strength and limitations

The retrospective nature and limited scope of the study due to being conducted at a single center are two significant limitations. We ensured that the information was accurate, and reduced the possibility of bias.

Registration Criteria for registering on the quality control review protocol on clinicaltrials.gov protocol.

Conflict of interest

All author declare that they have no conflict of interest.

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Ethical statement

The Faculty of Medical Ethics Committee of Zagazig University provided ethical consent. All participants provided written informed consent for publication. All authors contributed to the conception and design of the study, acquisition of data, analysis, interpretation of data, drafting of the article, critical revision for important intellectual content, and final approval of the version to be submitted.

This study was conducted in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki).

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