

Comparison of laparoscopic surgery versus traditional laparotomy for the treatment of emergency patients

Journal of International Medical Research

48(3) 1–8

© The Author(s) 2019

Article reuse guidelines:

sagepub.com/journals-permissions

DOI: 10.1177/0300060519889191

journals.sagepub.com/home/imr



Ning Cui, Jun Liu and Haiyan Tan 

Abstract

Objective: To investigate the clinical efficacy of laparoscopic gastrointestinal emergency surgery and postoperative complications.

Methods: Data for 604 patients undergoing emergency gastrointestinal surgery between January 2013 and December 2018 were analyzed retrospectively. Treatment efficacy and postoperative complications were compared between 300 patients (control group) undergoing traditional laparotomy and 304 patients (observation group) undergoing laparoscopic surgery.

Results: Clinical features were significantly better in the observation group than in the control group, including duration of surgery (59.12 ± 10.31 minutes vs. 70.34 ± 12.83 minutes), intraoperative blood loss (41.21 ± 10.45 mL vs. 61.38 ± 9.97 mL), postoperative pain score (1.25 ± 0.25 points vs. 5.13 ± 0.43 points), length of hospital stay (5.13 ± 0.24 days vs. 7.05 ± 0.13 days), and time to free activity (13 ± 2.96 hours vs. 22 ± 3.02 hours). The total complication incidence in the observation group was 3.9%, compared with 16% in the control group (16%). No significant differences in direct medical costs were recorded between the observation and control groups.

Conclusions: For patients undergoing emergency gastrointestinal surgery, laparoscopic surgery resulted in better clinical outcomes than traditional laparotomy without incurring additional costs. The potential clinical benefits of emergency laparoscopic gastrointestinal surgery warrant further study.

Keywords

Laparoscopy, gastrointestinal surgery, emergency laparotomy, emergency surgery, postoperative complications, medical costs

Date received: 29 March 2019; accepted: 23 October 2019

Renmin Hospital of Wuhan University, Wuhan, Hubei, P. R. China

Corresponding author:

Haiyan Tan, Renmin Hospital of Wuhan University, Wuhan, Hubei, P. R. China.

Email: 2009283020197@whu.edu.cn



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

Introduction

Acute appendicitis, peptic ulcer perforation, intestinal obstruction, colorectal rupture, and acute gastrointestinal hemorrhage are all commonly treated by emergency gastrointestinal surgery. These illnesses share clinical characteristics including acute onset, severe abdominal pain, and symptoms of diarrhea, nausea, and vomiting.¹ Cases can become life-threatening in the absence of immediate proper treatment, which generally entails traditional laparotomy. However, such treatment is inevitably associated with significant disadvantages including a large wound and prolonged post-operative recovery time. Rapid developments in laparoscopic surgery have recently revealed its potential for improving the efficacy and clinical outcomes of emergency gastrointestinal surgery. These include a smaller wound, shorter recovery time, enhanced safety, and surgical accuracy. With these apparent advantages, laparoscopic surgery could become the method of choice for performing emergency gastrointestinal surgery.²⁻⁴

Materials and methods

Study groups

In total, the outcomes of 604 patients undergoing emergency gastrointestinal surgery between January 2013 and December 2018 were analyzed retrospectively. All cases in the study period were included. The control group underwent traditional laparotomy, and the observation group received laparoscopic surgery. For all patients, diagnosis was confirmed on the basis of appropriate disease-specific criteria. Patients were all admitted without severe cardiovascular or brain disease. Data were compared between the groups to retrospectively evaluate the features of surgery and post-operative outcomes including the

duration of surgery, intraoperative blood loss, post-operation pain score, duration of hospital stay, and incidence of complications. Comorbidities were also calculated. All details of ethical approval and human rights of this study were approved by the Institutional Patient Care and Data Use Committee of Wuhan University. Our findings revealed the clinically significant advantages of laparoscopic surgery and provide reference values for future research and clinical practice.

Surgical procedures

Patients in the control group underwent traditional laparotomy under general anesthesia for diagnosis and treatment. Those in the observation group underwent laparoscopic surgery under general anesthesia. The surgeons were all senior professors (male; 45–55 years old) in the GI Surgery Department with more than 15 years of experience. Drainage tube placement was based on the individual patient condition.⁵ All surgical procedures conformed to clinical guidelines appropriate for specific gastrointestinal disease treatment including selection of the incision site and avoidance of intestinal adhesions.^{6,7}

Clinical indices

The surgery-associated features analyzed and compared in this study were as follows: duration of surgery, intraoperative blood loss, post-operation pain score, duration of hospital stay, and incidence of complications. The pain score was determined 24 hours after surgery based on a visual analog scale and scored as follows: painless, 0 to 2; mild pain, 3 to 5; moderate pain, 6 to 8; and severe pain, 9 to 10. Complications were recorded during a 3-month postoperative follow-up period.

Cost analysis

Direct medical costs (admission fees, procedure fees, consumable fees, medication fees, and nursing fees) spanning from the time of patient admission to discharge were tabulated using hospital charge lists.

Statistical analysis

Statistical analysis was performed using SPSS 19.0 software (SPSS Inc, Chicago, IL, USA). Data were presented as the mean \pm SD. Student's *t*-test was used for comparison between groups. The χ^2 test was used for enumeration data. $P < 0.05$ was considered significant.

Results

Patient profiles

Patient ages ranged from 17 to 79 years (mean, 40.1 ± 10.5 years). The 604 study patients comprised 240, 136, 128, and 100 cases of peptic ulcer perforation, acute appendicitis, colorectal rupture, and intestinal obstruction, respectively. The control group ($n = 300$; 160 men and 140 women; mean age, 39.2 ± 11.5 years) was treated via traditional laparotomy. The observation group ($n = 304$; 166 men and 136 women; mean age, 36.1 ± 10.2 years) was treated by laparoscopic surgery. According to the calculation and analysis of comorbidities, the two groups were comparable in terms of the severity of cases. There were no significant differences in patient profiles (as shown in Table 1) and case severity (as shown in Table 2) between the two groups ($P > 0.05$).

Comparative surgical and postoperative indices

The mean duration of laparoscopic surgery was 59.12 ± 10.31 minutes in the observation group, which was significantly shorter than

the mean surgical duration of 70.34 ± 12.83 minutes in the control group ($P < 0.05$). The results for other indices all indicated significantly improved outcomes ($P < 0.05$) for patients receiving laparoscopic surgery compared with traditional laparotomy as follows: intraoperative blood loss, 41.21 ± 10.45 mL vs. 61.38 ± 9.97 mL; postoperative pain score, 1.25 ± 0.25 points vs. 5.13 ± 0.43 points; duration of hospital stay, 5.13 ± 0.24 days vs. 7.05 ± 0.13 days; and time to free activity, 13 ± 2.96 hours vs. 22 ± 3.02 hours. These results are presented in Table 3.

Postoperative complications

As shown in Table 4, the incidence of postoperative complications was significantly lower for patients receiving laparoscopic surgery than in those undergoing traditional laparotomy. After 3 months of follow-up, the total complication incidence in the observation group was 3.9%, compared with 16% in the control group ($P < 0.05$). Laparoscopic surgery was not associated with any incidence of postoperative abdominal infection or septicemia, compared with rates of 4% and 1.3%, respectively, in the control group. All other examined complications were less frequent in the observation group than in the control group, including wound infection (0.7% vs. 2.7%), vomiting (1.3% vs. 4%), and nausea (2% vs. 4%). Disease subgroups were also analyzed. The results revealed remarkable advantages for laparoscopic surgery in all subgroup diseases, as shown in Table 5.

Cost comparison

Costs were separated into several fee categories including hospitalization, laboratory, radiology, nursing, medication, anesthesia, consumables, and surgery. More specific itemized cost analysis requiring access to

Table 1. Patient profiles.

Features	Observation group	Control group	Total
Number	304 (50.3%)	300 (49.7%)	604
Age, years (range)	40.1 ± 10.5 (17–79)	39.2 ± 11.5	
Gender			
Male	166 (50.9%)	160 (49.1%)	326
Female	136 (49.3%)	140 (50.7%)	276
Diseases			
Peptic ulcer perforation	136 (56.7%)	104 (43.3%)	240
Acute appendicitis	87 (64.0%)	49 (36.0%)	136
Colorectal rupture	65 (50.8%)	63 (49.2%)	128
Oncological reasons	16 (45.7%)	19 (54.3%)	35
Non-oncological	49 (52.7%)	44 (47.3%)	93
Intestinal obstruction	64 (64.0%)	36 (36.0%)	100
Oncological reasons	20 (64.5%)	11 (35.5%)	31
Non-oncological	44, 63.7	25, 36.3	69
Treatment	Laparoscopic surgery	Traditional laparotomy	

Unless otherwise indicated, data are presented as n (%).

Table 2. Comorbidities.

Comorbidity Classification (n, %)	Observation group	Control group	Total
Total cases	304 (50.3%)	300 (49.7%)	604
Cardiovascular system	91	84	175
Hypertension	41 (50.0%)	41 (50.0%)	82
Coronary heart disease	26 (53.0%)	23 (47.0%)	49
Arrhythmia	24 (54.5%)	20 (45.5%)	44
Nervous system	44	36	80
Cerebral infarction	31 (53.4%)	27 (46.6%)	58
Epilepsy	13 (59.0%)	9 (41.0%)	22
Endocrine system	82	70	152
Diabetes	46 (51.7%)	43 (48.3%)	89
Hyperthyroidism	20 (50.0%)	20 (50.0%)	40
Hyperuricemia	16 (69.5%)	7 (30.5%)	23
Others	63	64	127
Abnormal liver function	40 (47.6%)	44 (52.4%)	84
Kidney stone	23 (53.5%)	20 (46.5%)	43
Operation history	22	25	47
Gynecological	8 (57.1%)	6 (42.9%)	14
Orthopedic	5 (38.5%)	8 (61.5%)	13
General surgery	9 (45.0%)	11 (55.0%)	20

Unless otherwise indicated, data are presented as n (%).

hospital financial system records was not possible this study. Total costs were divided into National Health Insurance (NHI) covered fees and uncovered fees (paid by

patients). As shown in Table 6, no significant overall cost difference was observed between the control and observation groups ($P > 0.05$).

Table 3. Comparative surgical and postoperative indices.

Group	Case (n)	Operation time (minutes)	Intraoperative blood loss (mL)	Post-operation pain score	Length of hospital stay (days)	Time to free activity (h)
Control	300	70.34 ± 12.83	61.38 ± 9.97	5.13 ± 0.43	7.05 ± 0.13	22 ± 3.02
Observation	304	59.12 ± 10.31	41.21 ± 10.45	1.25 ± 0.25	5.13 ± 0.24	13 ± 2.96
t value		14.9	15.9	20.7	10.2	21.3
P		0.00030	0.00015	0.00002	0.00071	0.00098
		<0.001	<0.001	<0.001	<0.001	<0.001

Table 4. Comparative postoperative complications during 3 months of follow-up.

Group	Case (n)	Wound infection	Abdominal infection	Septicemia	Vomiting	Nausea	Incidence
Control	300	8	12	4	12	12	48 (16%)
Observation	304	2	0	0	4	6	12 (3.9%)
χ^2							12.26
P value							0.00075
							<0.001

Discussion

It is important to quickly and efficiently diagnose and treat cases of acute appendicitis, peptic ulcer perforation, intestinal obstruction, colorectal rupture, and acute gastrointestinal hemorrhage. Such cases can rapidly progress, and patients can experience severe symptoms and signs, including continuous and serious abdominal pain, board-like rigidity, signs of peritoneal irritation, and unstable vital signs. However, traditional laparotomy in the treatment of acute appendicitis and peptic ulcer perforation is usually associated with postoperative complications such as wound infection. The incidence of complications decreases sharply when laparoscopic surgery is employed. The feasibility of replacing laparotomy with laparoscopic surgery can be enhanced through more extensive clinical research and practice, leading to lower rates of misdiagnosis and post-operative complications.⁸⁻¹⁰ Moreover, research has revealed that establishing pneumoperitoneum for

intestinal decompression in patients with intestinal obstruction improved treatment efficacy and led to better clinical outcomes including shorter durations of surgery, less intraoperative blood loss, lower postoperative pain scores, and shorter lengths of hospital stay.¹¹⁻¹³

Minimally invasive laparoscopic surgery has been performed for 30 years, and continuous improvements in techniques and equipment have produced a reliable clinical procedure for emergency gastrointestinal surgery.¹⁴ Compared with traditional laparotomy, laparoscopic surgery is more generally accepted, and it is associated with the relative advantages of smaller wounds, reduced pain, shorter operation time, less intraoperative blood loss, shorter length of hospital stay, and fewer complications.¹⁵⁻¹⁷ Additionally, it is possible through enlarged, multi-dimension viewing at higher definition and greater illumination to perform laparoscopic surgery without opening the abdominal or exposing organs to the

Table 5. Comparative clinical indices of all subgroups.

Subgroup/analysis	Observation Peptic ulcer perforation	Control Peptic ulcer perforation	Observation Acute appendicitis	Control Acute appendicitis	Observation Colorectal rupture	Control Colorectal rupture	Observation Intestinal obstruction	Control Intestinal obstruction
Case (n)	133	104	87	49	65	63	64	36
Operation time (minutes)	46.57 ± 9.62	66.43 ± 10.75	50.35 ± 11.81	68.44 ± 12.49	57.31 ± 14.16	82.58 ± 18.26	58.04 ± 14.76	79.33 ± 17.56
Intraoperative blood loss (mL)	29.73 ± 5.14	43.27 ± 6.25	37.75 ± 6.84	52.36 ± 8.55	50.21 ± 10.28	72.38 ± 11.14	48.82 ± 10.36	67.26 ± 10.46
Post-operative pain score	0.76 ± 0.13	3.92 ± 0.55	1.06 ± 0.72	3.80 ± 0.58	1.48 ± 0.36	5.60 ± 0.88	1.34 ± 0.46	5.72 ± 1.24
Length of hospital stay (days)	3.04 ± 0.58	5.22 ± 0.85	4.25 ± 0.79	6.37 ± 0.98	6.04 ± 1.16	9.96 ± 1.84	5.72 ± 0.90	8.92 ± 1.48
Time to free activity (h)	8 ± 1.22	14 ± 2.24	9 ± 1.86	15 ± 3.46	15 ± 3.25	26 ± 5.56	13 ± 3.78	23 ± 4.26
Wound infection (n)	0	2	0	0	1	4	1	2
Abdominal infection (n)	0	3	0	2	0	5	0	2
Septicemia (n)	0	1	0	0	0	2	0	1
Vomiting (n)	1	3	2	4	0	2	1	3
Nausea (n)	3	5	1	2	1	2	1	3
Total (n)	4	14	3	8	2	15	3	11
P	<0.01		<0.01		<0.01		<0.01	

Table 6. Comparison of medical costs (Chinese Yuan, RMB) between the observation and control groups.

Category	Observation group	Control group
Hospitalization	180	169
Laboratory	1495	1531
Radiology	750	762
Nursing	314	332
Medication	6673	7045
Anesthesia	1348	1492
Consumables	7234	6433
Surgery	1909	1747
Covered by NHI	10,015	10,340
Paid by patient	9888	9170
Total	19,903	19,511

environment. This can lead to a lower incidence and severity of postoperative gastrointestinal irritation and adhesion. However, the technical demands of laparoscopic surgery require the availability of a highly skilled and qualified surgeon for preoperative assessment and emergency treatment.¹⁸ Furthermore, there are several contraindications for laparoscopic surgery including severe cardiopulmonary dysfunction, coagulation disorders, and pregnancy.

The present study confirmed the aforementioned significant advantages of laparoscopic surgery compared with laparotomy for use in emergency gastrointestinal surgery. Laparoscopic surgery yielded significantly better outcomes than laparotomy in terms of the duration of surgery, intraoperative blood loss, postoperative pain score, length of hospital stay, and time to free activity. The same improved outcomes were observed for postoperative complications including wound infection, vomiting, nausea, abdominal infection, and septicemia. These clinical improvements were obtained in the absence of increased medical costs.

In conclusion, based on superior clinical outcomes and similar costs, the present study results demonstrate the clear value of laparoscopic surgery as a general approach for emergency gastrointestinal surgery.

Limitation

Because of the retrospective approach, our study had some limitations. This was not a randomized study. Data were collected only from one research center. It was difficult to quantify and standardize the ability and judgment of all surgeons. The comparison of all operative techniques was not as detailed as possible. The follow-up period for these two groups was only 3 months. Thus, randomized controlled trials should be conducted in the future to further clarify the relative merits of these two operations.

Acknowledgement

Ning Cui performed data collection and analysis. Ning Cui and Jun Liu wrote the manuscript. Haiyan Tan conceived this study. All authors declare there was no conflict of interest with any other third party.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Ethics Statement

We have checked approval with our review board and received their exemption. We have de-identified the details such that the identity of the patients may not be ascertained in any way.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ORCID iD

Haiyan Tan  <https://orcid.org/0000-0002-2409-8976>

References

1. Jimenez Rodriguez RM, Segura-Sampedro JJ, Flores-Cortés M, et al. Laparoscopic approach in gastrointestinal emergencies. *World J Gastroenterol* 2016; 22: 2701–2710.
2. Schreinemacher MH, ten Broek RP, Bakkum EA, et al. Adhesion awareness: a national survey of surgeons. *World J Surg* 2010; 34: 2805–2812.
3. Diamond MP, Wexner SD, diZereg GS, et al. Adhesion prevention and reduction: current status and future recommendations of a multinational interdisciplinary consensus conference. *Surg Innov* 2010; 17: 183–188.
4. Peters MJ, Mukhtar A, Yunus RM, et al. Meta-analysis of randomized clinical trials comparing open and laparoscopic anti-reflux surgery. *Am J Gastroenterol* 2009; 104: 1548–1561.
5. Wei B, Qi CL, Chen TF, et al. Laparoscopic versus open appendectomy for acute appendicitis: a metaanalysis. *Surg Endosc* 2011; 25: 1199–1208.
6. Johns A. Evidence-based prevention of post-operative adhesions. *Hum Reprod Update* 2001; 7: 577–579.
7. Pados G, Venetis CA, Almaloglou K, et al. Prevention of intra-peritoneal adhesions in gynaecological surgery: theory and evidence. *Reprod Biomed Online* 2010; 21: 290–303.
8. Jacobi CA, Sterzel A, Braumann C, et al. The impact of conventional and laparoscopic colon resection (CO₂ or helium) on intra-peritoneal adhesion formation in a rat peritonitis model. *Surg Endosc* 2001; 15: 380–386.
9. Koninckx PR, Corona R, Timmerman D, et al. Peritoneal full-conditioning reduces postoperative adhesions and pain: a randomised controlled trial in deep endometriosis surgery. *Ovarian Res* 2013; 6: 90.
10. Teoh AYB, Chiu PWY, Kok ASY et al. The selective use of laparoscopic repair is safe in high-risk patients suffering from perforated peptic ulcer. *World J Surg* 2015; 39: 740–745.
11. Wilhelmsen M, Møller MH and Rosenstock S. Surgical complications after open and laparoscopic surgery for perforated peptic ulcer in a nationwide cohort. *Br J Surg* 2015; 102: 382–387.
12. Lee DJK, Ye M, Sun KH, et al. Laparoscopic versus open omental patch repair for early presentation of perforated peptic ulcer: matched retrospective cohort study. *Surg Res Pract* 2016; 9: 1–8.
13. Byrge N, Barton RG, Ennis TM, et al. Laparoscopic versus open repair of perforated gastroduodenal ulcer: a National Surgical Quality Improvement Program analysis. *Am J Surg* 2013; 206: 957–962.
14. Zhou C, Wang W, Wang J, et al. An updated meta-analysis of laparoscopic versus open repair for perforated peptic ulcer. *Sci Rep* 2015; 5: 13976.
15. Ge B, Wu M, Chen Q, et al. A prospective randomized controlled trial of laparoscopic repair versus open repair for perforated peptic ulcers. *Surgery* 2016; 159 : 451–458.
16. Schietroma M, Piccione F, Carlei F, et al. Peritonitis from perforated peptic ulcer and immune response. *Invest Surg* 2013; 26: 294–304.
17. Kong SH and Yang HK. Surgical treatment of gastric gastrointestinal stromal tumor analysis of 92 operated patients. *Digest Surg* 2008; 25: 208–212.
18. Jaschinski T, Mosch C, Eikermann M, et al. Laparoscopic versus open appendectomy in patients with suspected appendicitis: a systematic review of meta-analyses of randomized controlled trials. *BMC Gastroenterol* 2015; 15: 1–10.