The Egyptian Journal of Hospital Medicine (October 2020) Vol. 81 (6), Page 2173-2178

Laparoscopy Versus Laparotomy in The Surgical Treatment of Perforated Duodenal Ulcers

Mohamed Tag El-Din
General Surgery Department, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

ABSTRACT

Background: There is no clear consensus about whether laparoscopy or laparotomy is more beneficial in managing perforations of duodenal ulcers.

Objective: The study was performed to compare between laparotomy and laparoscopic approaches in managing perforations of duodenal ulcers regarding operative time and early operative outcomes.

Patient and methods: This randomized comparative prospective study included 84 cases diagnosed with perforated duodenal ulcer, they were divided into two equal groups: laparotomy and laparoscopic groups (42 cases for each). All cases were clinically and radiologically assessed. Operative time was our primary outcome, while secondary outcomes included post-operative pain, analgesic consumption, hospitalization time, and complications of both techniques.

Results: No significance in differences were reported between the two groups regarding patient demography. Both smoking history and analgesic use were reported by most cases in both groups. The operative time ($p = 0.082$) was not significantly different between the two groups. The laparoscopic group showed less pain scores, less morphine needs, earlier oral fluid intake, and short hospitalization time in comparison to the laparotomy group. Also, the wound infection incidence was significantly higher in the laparotomy group.

Conclusion: The laparoscopic approach appears to be more safe and efficacious in the surgical treatment of perforations of duodenal ulcers, as it is associated with less peri-operative complications and shorter hospitalization time with a comparable operation time in comparison to laparotomy.

Keywords: Perforated duodenal ulcer; Laparoscopy, Laparotomy.

INTRODUCTION

Although the modern development in the medications for peptic ulcer disease have resulted in a great decrease in the number of elective surgeries for such cases [1], the number of cases requiring urgent surgery for peptic ulcer complications including perforation and obstruction remains relatively unchanged [2]. These emergency operations have a mortality risk ranging between 6 and 30% [3].

Perforation can complicate up to 2 – 10% of cases with peptic ulcer disease [4]. It should be suspected in cases with sudden onset of severe diffuse abdominal pain. Duodenal ulcer perforation is characterized by a classic triad consisting of sudden abdominal pain, tachycardia, and abdominal rigidity [5]. Multiple options are existing for the management of perforated duodenal ulcer including repair by interrupted sutures only, interrupted sutures followed by a pedicled omentum coverage (Cellan-Jones repair), or perforation plugging with an omental patch (Graham patch) [5].

Laparoscopy has been introduced in treating peptic ulcer disease since 1990 [1]. The application of laparoscopy is associated with documented benefits including smaller incisions, less post-operative pain, better cosmesis, and better post-operative recovery compared to the laparotomy approach [4]. However, other authors have denied the superiority of laparoscopy over laparotomy in managing such cases. in addition, they reported that laparoscopy was associated with worse outcomes and prolonged operative time [6, 7]. Despite the previously mentioned advantages, laparoscopy should not be used on the expense of morbidity and mortality. Hence, this study was conducted to compare between laparotomy and laparoscopic approaches in the treatment of perforations of duodenal ulcers regarding operative time and early operative outcomes.

PATIENTS AND METHODS

This is a randomized comparative prospective study that was completed during the period of three years, from July 2017 till July 2020. The study included cases diagnosed with perforated duodenal ulcers who were admitted and operated during that period in three hospitals; Al-Hussein University Hospital, Al-Rahma, and Dar Al-Hekma Private Hospitals.

Sample size was calculated using the IBM[a] SPSS[a] SamplePower[a] version 3.0.1 (IBM[a] Corp., Armonk, NY, USA). According to the literature review, the mean operative time in the laparoscopic group reported by Lunevicius and Morkevicius [8] was 76.2 min. (S.D 35.5) versus 57.3 min. (S.D. 26.1) in the laparotomy group. The difference between these two groups was used to calculate the sample size. At 95% level of significance and power of 80%, the sample size calculated was 42 in each group.

Received:22 /7 /2020
Accepted:21 /9 /2020

Cases who were initially diagnosed with perforated duodenal ulcer were included in the study whatever age or gender. Conversely, history of upper abdominal surgery, bleeding ulcer, malignancy, delayed presentation (> 48 hours), or the presence of contraindication to laparoscopy were causes of exclusion.

84 cases were included in the current study, and they were randomly allocated into two groups using the closed envelope method. Laparotomy group included 42 cases and the Laparoscopic group included the remaining 42 cases.

All cases were subjected to complete history taking (especially smoking and NSAID use), general examination, local abdominal examination, and routine laboratory investigations. in addition, an erect abdominal X ray along with pelviabdominal ultrasonography were ordered for all the included cases. Triphasic pelviabdominal computerized tomography was only ordered in some cases whose diagnosis was doubtful.

The ethical approval: the study was approved by the local ethical committee of the Faculty of medicine, Al-Azhar University.

A written informed consent was obtained from all cases before operation after explanation of the benefits versus drawbacks of each approach.

Before operation, the included cases had the appropriate resuscitation by intravenous infusion of saline 0.9 and Ringer lactate solutions, and intravenous broad spectrum was given (Ceftriaxone 2 gm). Also, a urinary catheter was inserted to monitor urine output, and nasogastric tube was introduced to decrease abdominal distension.

All cases were subjected to general anesthesia, when the patient was in supine position. In the laparotomy group, abdominal exploration was performed via an upper midline incision. The abdominal cavity was explored after suction of the abdominal free fluid. After identification of the perforation site, it was repaired by interrupted vicryl or PDS sutures (3 – 4 sutures). After defect closure, a patch of greater omentum was fixed over the suture line. Peritoneal toilet with warm saline (about 5 – 7 liters) was performed, and abdominal drains were inserted at the Morrison pouch, at pelvis, and lastly at the perisplenic area. Finally, the incision was closed over a subcutaneous suction drain.

In the laparoscopic group, after abdominal insufflation, a port for the camera was inserted just above the umbilicus, while the two ports for working instruments were inserted at right and left midclavicular lines at the midway between umbilicus and costal margin. An additional assistant port was inserted in the epigastric region for liver retraction. After suction of infected abdominal contents and identification of the perforation site, it was repaired by 3 – 4 intracorporeal sutures. The following steps including peritoneal toilet and drainage were similar to the laparotomy approach. For both techniques, care was taken to have large bites from both ulcer edges before suturing (about 1 cm), and if opposition of the two edges was found difficult, direct closure was avoided, and only omental patch was used.

After operation, all cases were commenced on intravenous fluids, intravenous antibiotics, and proton pump inhibitor (pantoprazole 40 mg). Post-operative pain was managed by intravenous paracetamol or NSAID. If there was no response, opioid analgesic was ordered. Assessment of pain was done by the visual analogue score (VAS) with 0 for no pain, and 10 for the worst pain ever [9].

After having intestinal sounds or passing flatus, patients were allowed to start oral fluid intake following NGT removal, and patients were discharged after achieving adequate oral intake and drain removal. Post-operative complications like surgical site infection, ileus, and mortality were recorded. Patients were commenced on oral PPI therapy for at least 2 months after operation.

Our primary outcome was the operative time between the two approaches, whereas secondary outcomes included post-operative pain, analgesic consumption, hospital stay, and post-operative complications.

Statistical analysis

Data were entered, tubulated and analyzed using SPSS software version 26 for Windows. Patient characteristics were presented as mean values and standard deviations (SD), median and range, or frequencies and percentages (%). In addition, Fisher's exact test (or Chi-Square test) was used to compare qualitative data of two independent groups, while quantitative data of the two groups were compared via independent-Samples t-test and Mann-Whitney U tests (for parametric and non-parametric data respectively). For all tests, P values$\leq$ 0.05 was considered significant.

RESULTS

The mean age of the included cases was 42.23 and 40.15 years in the laparotomy and laparoscopic groups respectively. Males represented 95.24 and 100% of cases in both groups respectively. Most of the included cases were smokers (90.48 and 95.24% in both groups respectively), while nonsteroidal anti-inflammatory drugs (NSAID) intake was reported in 88.09 and 83.33% of cases in the two groups respectively. Together with systemic comorbidities, all of the previous variables significantly showed no difference between both groups ($p > 0.05$).

Shock was diagnosed in 7.14 and 4.76% of cases in the two groups respectively ($p = 0.482$). Also, both groups did not differs significantly between the study groups as regard pre-operative leucocytic count ($p = 0.240$). These data are illustrated in table (1).

Table (1): Pre-operative data.

Variable	Laparotomy group (n = 42)	Laparoscopic group (n = 42)	P value
Age	42.23 ± 4.26	40.15 ± 3.29	0.216 ¶
Gender			
-Male	40 (95.24%)	42 (100%)	0.146 *
-Female	2 (4.76%)	0 (0%)	
Smoking	38 (90.48%)	40 (95.24%)	0.134 *
NSAID intake	37 (88.09%)	35 (83.33%)	0.169 *
Comorbidities			
-Diabetes mellitus	7 (16.67%)	8 (19.05%)	
-Hypertension	4 (9.52%)	3 (7.14%)	0.304*
-Ischemic heart disease	3 (7.14%)	1 (2.38%)	
Shock on admission	3 (7.14%)	2 (4.76%)	0.482*
WBCs count (x10^9)	18.41 ± 2.03	18.94 ± 2.41	0.240 ¶
Independent samples t-test			
Chi square/Fischer's exact test			

NSAID: Nonsteroidal anti-inflammatory drugs, WBCs: White cell count.

When it comes to the operative data, no significant difference was noted between both groups as regard the operative time (75.29 vs. 80.46 in laparotomy and laparoscopic groups respectively - p = 0.082). The size of perforation had mean value of 5.23 and 5.42 mm in the study groups respectively. In the current study, no conversion to the laparotomy approach was done in the laparoscopic group (Table 2).

Table (2): Operative data.

Variable	aparotomy group (n = 42)	ıparoscopic group (n = 42)	P value
Operative time (min)	75.29 ± 14.08	80.46 ± 11.95	0.082 ¶
Perforation size (mm)	5.23 ± 0.94	5.42 ± 0.86	0.156 ¶
Conversion to laparotomy	-----	0 (0%)	
¶: Independent Samples t-test			

VAS score values were lower significantly in the laparoscopic group (2 vs. 5 in the laparotomy group p = 0.005), in addition, the time needed for first rescue analgesia was longer significantly in the laparoscopic group (11.27 vs. 5.81 hours in the laparotomy group (p = 0.001).

Consequently, the morphine dose was decreased significantly in the laparoscopic group (1.54 vs. 4.81 mg- p = 0.001). The time needed to start oral fluids was significantly prolonged in the laparotomy group versus that needed in the laparoscopic group (4 vs. 3 days– p = 0.015).

As regard the post-operative complications, ileus was present in 16.67 and 7.14% of cases in the laparotomy and laparoscopic groups respectively (p = 0.092).

Surgical site infection was diagnosed in 23.81 and 4.76% of cases in the laparotomy and laparoscopic groups respectively (p = 0.001). No leakage or mortality were encountered in the current study. The duration of hospitalization was significantly prolonged in the laparotomy group (5 vs. 4 days in the laparoscopic group p = 0.009). These data are summarized in table (3).

Table (3): Post-operative data.

Variable	Laparotomy group (n = 42)	Laparoscopic group (n = 42)	P value
VAS	5 (4 – 6)	2 (2 – 4)	0.005 ¶¶
Time to first request for rescue analgesia (hours)	5.81 ± 1.07	11.27 ± 2.86	0.001 ¶
Morphine (mg) in the first day	4.81 ± 1. 23	1.54 ± 0.47	0.001 ¶
Post-operative ileus	7 (16.67%)	3 (7.14%)	0.092 *
Time to start oral	4 (3 – 5)	3 (2 – 3)	0.015 ¶¶
Leakage	0 (0%)	0 (0%)	1 *
Mortality	0 (0%)	0 (0%)	1 *
Hospital stay (days) median	5 (5 – 6)	3 (3 – 4)	0.009*
Surgical site infection	10 (23.81%)	2 (4.76%)	0.001 *

¶: Independent samples t-test
¶¶: Mann-Whitney u-test
***: Chi square/Fischer's exact test**

VAS: Visual analogue scale.

DISCUSSION

This study was conducted to compare between laparotomy and laparoscopic approaches in the surgical treatment of perforations of duodenal ulcers. No difference was noted significantly between the two groups regarding age (p = 0.216), that had mean values of 42.23 and 40.15 years in the two groups respectively. In line with our findings, another Egyptian study has reported a mean age near to ours. The mean age of the included cases was 42 and 40 years in the laparotomy and laparoscopic groups respectively (p = 0.55) [10].

In the current study, males represented 95.24 and 100% of cases in the laparotomy and laparoscopic groups respectively. **Lee and his associates** [(11)] reported the higher predominance of such complication in males, as males represented 89.8 and 87.5% of cases in the laparotomy and laparoscopic groups respectively (p = 0.92).

In the current study, most of the included cases were smokers (90.48 and 95.24% in the laparotomy and laparoscopic groups respectively). **Alnaimy *et al.*** [(1)] reported high prevalence of smoking in the included cases with duodenal ulcer perforation. Smoking was reported by 87.5 and 78.1% of cases in the laparoscopic and laparotomy groups respectively. Smoking is a documented risk factor for duodenal ulcer disease, as it leads to a decrease in pancreatic bicarbonate secretion leading to increased duodenal acidity [5, 12].

In the current study, chronic NSAID intake was reported by 88.09 and 83.33% of cases in the laparotomy and laparoscopic groups respectively. It was previously reported that the magnitude of the risk for peptic ulcer disease complications was associated with NSAID intake depends on the specific drug and the prescribed dose [13]. Another Egyptian study conducted by **Alnaimy *et al.*** [1]has reported the higher prevalence of NSAID intake in both laparoscopic and laparotomy groups like our study (87.5 and 75% of cases in both groups respectively – p = 0.2).

In the current study, shock was diagnosed in 7.14 and 4.76% of cases in the laparotomy and laparoscopic groups respectively (p = 0.482). Of course, these cases were properly resuscitated before transfer to the operative theater. In another study, **Zedan *et al.*** [(10)] has reported that shock was present in 12.5 and 9.5% of cases in the laparotomy and laparoscopic groups respectively, without any significant difference between the study groups (p =- 0.75).

As regard the operative time in the current study (the primary outcome), no significant difference was detected between the two groups regarding operative time (75.29 vs. 80.46) in laparotomy and laparoscopic groups respectively (p = 0.082). This could be explained by the high surgical expertise of the operators. In addition, the time consumed for laparotomy and closure of the abdominal wound in the laparotomy group was saved with the use of laparoscopy.

The latter explanation would compensate the more time needed in laparoscopy for intracorporeal suturing and peritoneal cavity irrigation. Besides, the perforation size did not significantly differ from one group to the other, and that reflects the non-significant difference in the number of sutures taken to close the defect. All of these factors could lead to the comparative results between the two approaches regarding operative time. Furthermore, from our point of view, Suction and irrigation of the abdominal cavity by laparoscopy is easier compared to the laparotomy approach, as

surgeon can approach any site in the abdomen with changing patient position to perform suction and aspiration, with good visualization.

On the contrary, suction of the pelvic infected fluid would be more problematic using the upper midline incision performed in the laparotomy approach. In agreement with our findings, a previous study conducted in 2018 did not report any significant difference between the two approaches regarding operative time (p = 0.693). Operative time ranged between 60 and 90 minutes in 31 and 44% of cases in laparoscopic and laparotomy groups respectively, while the remaining cases had operative time longer than 90 minutes [1].

On the contrary, **Zedan and his colleagues** [10] reported that the duration of operation was significantly shorter in the laparotomy group (110 vs. 145 minutes in the laparoscopic group – p = 0.0001). Moreover, a previous meta-analysis confirmed the prolonged operative time in laparotomy group versus laparoscopic one (94 vs. 135 minutes – p < 0.05) [14]. In addition, **So *et al.*** [15] reported the same finding as the median value was 65 and 80 minutes in both groups respectively. On the contrary, **Siu *et al.*** [2] reported that the duration of operation significantly decreased in the laparoscopic group compared to the laparotomy one (42 vs. 52.3 minutes respectively, p = 0.025). Apparently, there is heterogenicity of reports handling operative time between the two approaches, and that necessitates conduction of more studies regarding that perspective from different surgical centers.

We did not need conversion into the laparotomy approach in any of our cases. In a previous meta-analysis, **lau *et al*.** [16] reported that conversion rates in perforated duodenal ulcer operations ranged between 0 and 29.1%. This percent varied according to perforation size, operative difficulties, and surgeon experience.

In the current study, VAS score had a significant lower values in the laparoscopic group (2 vs. 5 in the laparotomy group, p = 0.005), and consequently, the morphine dose in the 1st post-operative day was decreased significantly in the laparoscopic group (1.54 vs. 4.81 mg, p = 0.001).

Similarly, another study confirmed our findings regarding decreased pain scores in the laparoscopic approach group (4.4 vs. 7 in the laparotomy group, p = 0.0001). As a result, opioid consumption was significantly decreased in the laparoscopic group (p < 0.001) [10]. in addition, **Lau *et al.*** [16] in their meta-analysis reported significant decrease in opioid analgesic requirement in 8 of the included studies. Furthermore, **Robertson and his associates (17)** reported that morphine consumption had mean value of 100 mg. and 15 mg in the laparotomy and laparoscopic groups respectively.

In the current study, time needed to start oral fluids was significantly prolonged in the laparotomy group (4 vs. 3 days in the laparoscopic group, p = 0.015). **Katkhouda *et al.*** [18] showed significant earlier resumption of the oral fluids after laparoscopic repair compared to the laparotomy approach which agrees with our findings. However, **Siu and his colleagues** [19] reported similar results between the two groups regarding oral intake, as it was allowed on the day 4 post-operatively.

As regards post-operative ileus in our study, it was present in 16.67 and 7.14% of cases in the laparotomy and laparoscopic groups respectively, without any significant difference between the study groups (p = 0.092). Likewise, another study reported no significant difference between the two groups as regard the incidence of post-operative ileus (1.8 and 5% of cases in the laparotomy and laparoscopic groups respectively – p = 0.63) [11].

Our findings showed that surgical site infection occurred less frequently in 23.81 and 4.76% of cases in the laparotomy and laparoscopic groups respectively (p = 0.001). **Siu *et al.*** [19] reported significant lower rates of surgical site infection in the laparoscopic versus laparotomy approach group (3 vs. 12% respectively, p < 0.05). Another study reported a significant increase in wound infection rates after the laparotomy approach compared to the laparoscopic one (29.2 vs. 4.8% respectively, p = 0.033) [10].

On the other hand, other authors reported comparable results between the laparotomy and laparoscopic groups regarding wound complications (p > 0.05). However, the surgical wound infection incidence was higher in the laparotomy group (5.6 and 0% respectively) [11].

Post-operative leakage was not encountered in the current study. **Lee and his associates** [11] also reported that leakage was rarely encountered in their study. Leakage was not encountered in the laparoscopic group, while it was only present in only one case in the laparotomy group (0.9%).

In the current study, the duration of hospitalization showed significant prolongation in the laparotomy group (5 vs. 4 days in the laparoscopic group, p = 0.009). In agreement with our results, **Zedan *et al.*** [10] reported that the mean duration of hospitalization had significant short time with laparoscopy (6.9 vs. 8.9 days in the laparotomy group, p = 0.022). **Lee and his associates** [11] reported also the same findings (5 vs. 4 days in laparotomy and laparoscopic groups respectively, p < 0.01).

The main limitation encountered in the current study is the relatively small sample size. Hence, more studies including more cases should be conducted in the near future.

CONCLUSION

Based on our findings, the laparoscopic approach appears to be more safe and efficacious in the surgical treatment of perforated duodenal ulcers, as it is

associated with less peri-operative complications and short duration of hospitalization with a comparable operation duration time when compared to the laparotomy approach.

Conflict of interest

The authors have no particular conflict of interest.

REFERENCES

1. **Alnaimy T, Elalfy T, Elkilany M (2018):** A Comparison of Laparoscopic and Open Repair of Perforated Duodenal Ulcer Using Omental Patch: A Prospective Randomized Controlled Trial. Kasr El Aini Journal of Surgery, 19 (1): 1.
2. **Siu W, Leong H, Law B *et al.* (2002):** Laparoscopic repair for perforated peptic ulcer: a randomized controlled trial. Annals of surgery, 235 (3): 313.
3. **Svanes C, Lie R, Svanes K, Lie S, Søreide O (1994):** Adverse effects of delayed treatment for perforated peptic ulcer. Annals of surgery, 220 (2): 168.
4. **Smith R, Sundaramurthy S, Croagh D (2019):** Laparoscopic versus open repair of perforated peptic ulcer: A retrospective cohort study. Asian Journal of Endoscopic Surgery, 12 (2): 139-44.
5. **Chung K, Shelat V (2017):** Perforated peptic ulcer-an update. World journal of gastrointestinal surgery, 9 (1): 1.
6. **Lau W, Leung K, Kwong K *et al.* (1996):** A randomized study comparing laparoscopic versus open repair of perforated peptic ulcer using suture or sutureless technique. Annals of Surgery, 224 (2): 131.
7. **Bertleff M, Halm J, Bemelman W *et al.* (2009):** Randomized clinical trial of laparoscopic versus open repair of the perforated peptic ulcer: the LAMA Trial. World journal of surgery, 33 (7): 1368-73.
8. **Lunevicius R, Morkevicius M (2005):** Comparison of laparoscopic versus open repair for perforated duodenal ulcers. Surgical Endoscopy and Other Interventional Techniques, 19 (12): 1565-71.
9. **Heller G, Manuguerra M, Chow R (2016):** How to analyze the visual analogue scale: myths, truths and clinical relevance. Scandinavian Journal of Pain, 13: 67-75.
10. **Zedan A, Lolah M, Badr M, Ammar M (2015):** Laparoscopic versus open repair of perforated duodenal peptic ulcer: a randomized controlled trial. Menoufia Medical Journal, 28 (1): 62.
11. **Lee D, Ye M, Sun K, Shelat V, Koura A (2016):** Laparoscopic versus open omental patch repair for early presentation of perforated peptic ulcer: matched retrospective cohort study. Surgery Research and Practice, 2016: 1-7.
12. **Hernández-Díaz S, Rodríguez L (2000):** Association between nonsteroidal anti-inflammatory drugs and upper gastrointestinal tract bleeding/perforation: an overview of epidemiologic studies published in the 1990s. Archives of internal medicine, 160(14):2093-9.
13. **Lau J, Sung J, Hill C *et al.*(2011):** Systematic review of the epidemiology of complicated peptic ulcer disease: incidence, recurrence, risk factors and mortality. Digestion, 84 (2): 102-13.
14. **Matsuda M, Nishiyama M, Hanai T, Saeki S, Watanabe T (1995):** Laparoscopic omental patch repair for perforated peptic ulcer. Annals of surgery, 221 (3): 236.
15. **Sø J, Kum C, Fernandes M, Goh P (1996):** Comparison between laparoscopic and conventional omental patch repair for perforated duodenal ulcer. Surgical endoscopy, 10 (11): 1060-3.
16. **Lau H (2004):** Laparoscopic repair of perforated peptic ulcer: a meta-analysis. Surgical Endoscopy and Other Interventional Techniques, 18 (7): 1013-21.
17. **Robertson G, Wemyss-Holden S, Maddern G (2000):** Laparoscopic repair of perforated peptic ulcers. The role of laparoscopy in generalised peritonitis. Annals of the Royal College of Surgeons of England, 82 (1): 6.
18. **Katkhouda N, Mavor E, Mason R *et al.* (1999):** Laparoscopic repair of perforated duodenal ulcers: outcome and efficacy in 30 consecutive patients. Archives of Surgery, 134 (8): 845-50.
19. **Siu W, Chau C, Law B, Tang C, Ha P, Li M (2004):** Routine use of laparoscopic repair for perforated peptic ulcer. British journal of surgery, 91 (4): 481-4.