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Laparoscopic Repair of Perforated Peptic Ulcer: Simple Closure Versus Omentopexy

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ABSTRACT

Background: Laparoscopic repair of perforated peptic ulcer (PPU) has become an accepted way of management. Omentopexy was the main method of repair for decades.

Objective: The goal of the present study was to evaluate whether laparoscopic simple repair of PPU is as safe as omentopexy.

Patients and Methods: This prospective study included 50 patients who were diagnosed with perforated peptic ulcers and underwent laparoscopic repair of perforated peptic ulcers at our institute from September 2019 to September 2020. They were divided into two groups: Omentopexy (group A) (n=20) and repair with simple closure only (group B) (n=30). Patients' age, sex, pulse, blood pressure, respiratory rate, Boey score, perforation size, operation time, leakage, wound infection, and length of hospital stay were evaluated. The data were compared by Mann-Whitney U test and the Pearson's chi-square test.

Results: No patients died nor leaked. After matching, the simple closure and omentopexy groups had similarity in age, gender, pulse rate, respiratory rate, Boey score, perforation size and wound infection. There were statistically significant differences in systolic blood pressure (P = **0.002**), operating time (136.40 ± 10.45 versus 106.83 ± 6.89 minutes; P < 0.0001), and length of hospital stay (7.20 ± 1.32 versus 5.67 ± 0.55; P < 0.0001).

Conclusion: Laparoscopic repair of a perforated peptic ulcer without an omental patch is a safe option and shortens the operating time.

Keywords: Laparoscopic repair, Perforated peptic ulcer, Simple closure, Modified Cellan-Jones omentopexy.

INTRODUCTION

The incidence of perforation in peptic ulcer disease is 2–10% [(1)]. While treatment of gastroduodenal perforations remains surgical. the number of patients presenting with this problem has declined over the past decade due to improved medical management of peptic ulcer disease [(2)]. Closure of a perforated duodenal ulcer using an omental pedicle was first reported by Cellan-Jones in 1929 [(3)]. In 1937, Graham described 51 cases treated with free omental patch closure in essentially the same fashion [(4)]. **Mouret *et al.*** [(5)] first described laparoscopic intervention for perforated duodenal ulcers in 1990. A number of studies have demonstrated that laparoscopic surgery for patients with a perforated peptic ulcer is superior to conventional open repair, and is safe and feasible in terms of early outcomes, including pain and wound infection [(6)]. Patients with risk factors for increased mortality at presentation should not be considered for laparoscopic intervention. These include individuals who present in shock, who have delayed presentation > 24 h and who have a major medical illness, or are > 70 years old [(7)].

A published systematic review of laparoscopic versus open perforated peptic ulcer repair, proposes that laparoscopic approach should be the first treatment of choice. In most institutions, the standard laparoscopic repair for PPU is closure with an omental patch [(8)]. Adding an omental patch requires technical skill and is time consuming. However, is it safe to repair the perforation without an omental patch to shorten the operating time? A review of the literature revealed a few studies that have reported on the safety of simple closure and compared its outcomes versus those of omental patches [(9-11)]. In our study, we aimed to compare the outcomes of laparoscopic repair of perforated peptic ulcers using an omental patch with that of simple closure without an omental patch.

PATIENTS AND METHODS

This was a single-center prospective comparative study. All patients were diagnosed in our tertiary hospital with a perforated peptic ulcer from September 2019 to September 2020, who underwent laparoscopic surgery. For the prevention of selection bias of patients who did or did not undergo the laparoscopic method, patients with shock, generalized peritonitis, previous upper-abdominal surgery, non juxtapyloric gastric ulcers, perforations > 12 mm, and concomitant ulcer bleeding or gastric outlet obstruction were excluded.

Preoperative data like age, sex, and Boey score were recorded. The Boey scoring system is known worldwide for stratification of high-risk patients with perforated peptic ulcers. Thirty patients underwent simple closure whereas the other twenty patients underwent repair using an omental pedicle (omentopexy). Consultant surgeons who are well experienced in advanced laparoscopy did all surgical procedures. Under general anesthesia, patients were placed in a 15- to 20-degree reverse Trendelenburg position. The surgeon and assistant stood at the patient's left side (with an assistant on the other side).

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The laparoscopic approach was standardized with an 11 mm camera port inserted through a periumbilical incision using the open method. Carbon dioxide was then insufflated to produce a pneumoperitoneum with the pressure maintained at 12 mmHg. A 10-mm, 30-degree, laparoscope was used for all the cases. A second 11-mm port was inserted in the left upper quadrant, and another 5 mm port was inserted in the right upper quadrant. The fourth one was variable in position either in the epigastric area or near the third one in the anterior axillary line for liver retraction (according to surgeon preference) (figure 1). Examination of the entire abdomen was performed, and the perforation site was identified (figures 2 & 3). The perforation was closed using a 3-0 polyglactin (Vicryl) or polydioxanone suture (PDS) with or without an omental patch. Of the 30 simple closure patients, the stitch was placed on the point 5-10 mm from both edges of the perforation with intracorporeal knot-tying (figures 4 & 5).

The numbers of stitches were chosen according to perforation size. For perforations closed with an omental patch, the omental patch was applied by mobilizing the greater omentum (figure 6) over the repaired site and fixing the previously retained suture ends in a buttressed manner (figure 7). The peritoneal cavity was irrigated with several liters of warm saline using a pressurized suction irrigation system with special attention paid to the right subphrenic space, Morrison pouch, splenic fossa, and pelvic floor (figures 8 & 9). A pelvic drain was placed (figure10).

Intraoperative findings such as ulcer size and operation time were also recorded. Finally, postoperative data including length of hospital stay and complications such as wound infection, intra-abdominal abscess, bile leakage, and mortality were reviewed.

Figure (1): Position of trocars (3 trocars) in supine position.

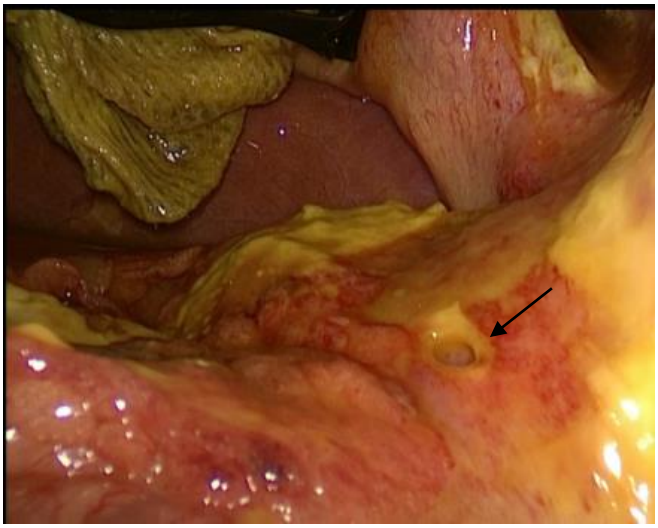

Figure (2): Laparoscopic view of pre-pyloric perforated peptic ulcer (arrow).

Figure (3): Intra-abdominal collection from perforated peptic ulcer.

Figure (4): Simple repair of the perforation with PDS 3-0.

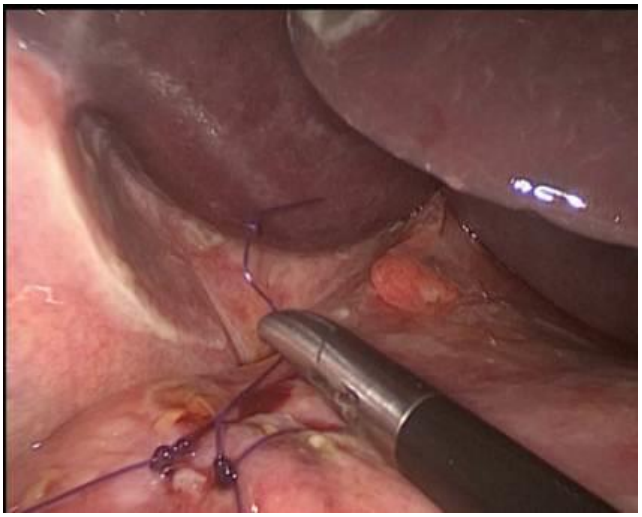

Figure (5): Laparoscopic closure of the perforation with two stitches.

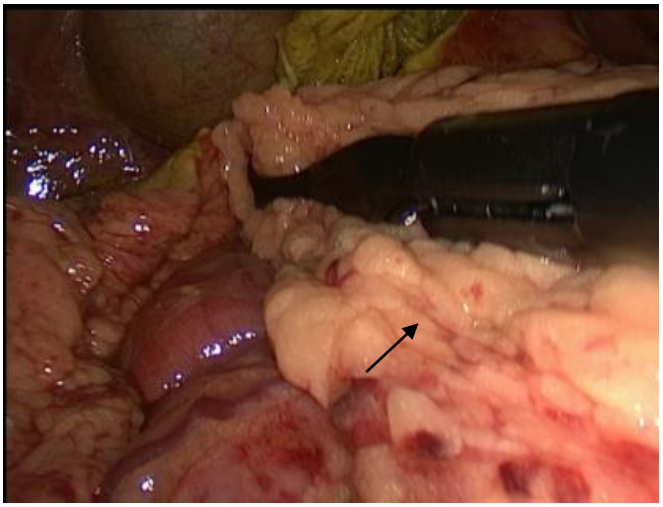

Figure (6): Mobilization of vascularized omental pedicle (arrow) for omentopexy.

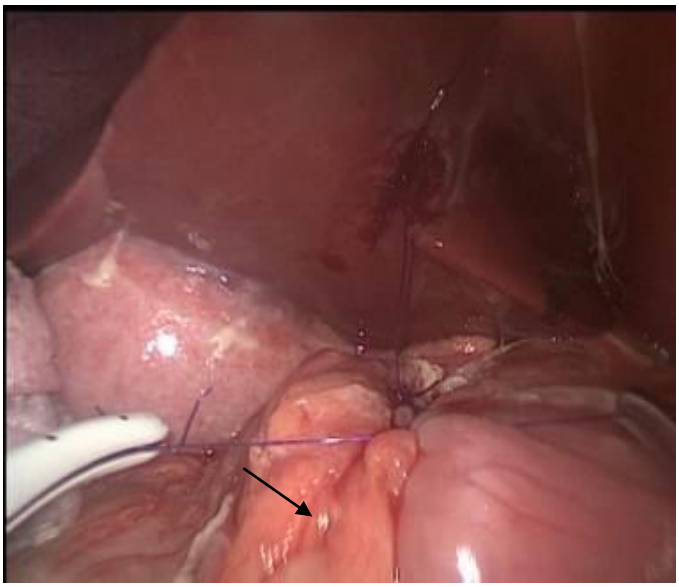

Figure (7): Laparoscopic omentopexy (arrow showing the fixed omental pedicle).

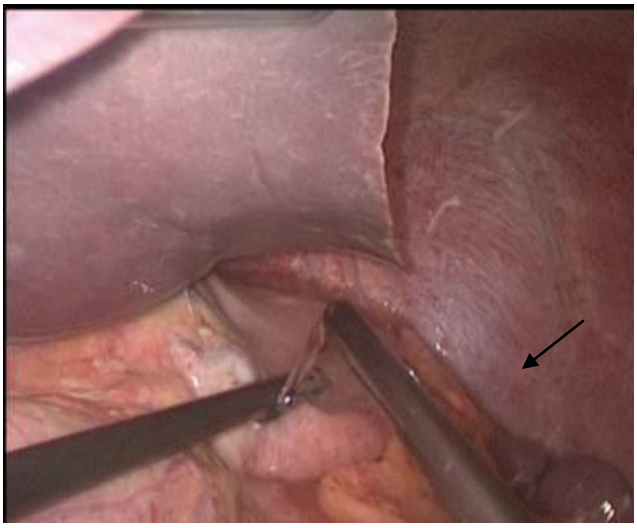

Figure (8): Irrigation with saline at the left subphrenic space.

Figure (9): Irrigation and suction at the right subphrenic and subhepatic spaces.

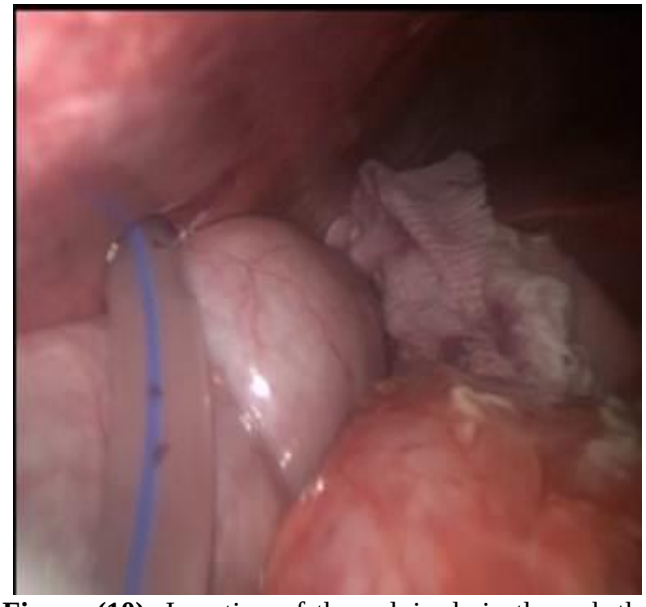

Figure (10): Insertion of the pelvic drain through the right port.

Ethical consent:

An approval of the study was obtained from Sohag University Academic and Ethical Committee.

Every patient signed an informed written consent for acceptance of the operation. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The data in this study were performed using SPSS version 20.0 (IBM Corp, Armonk, NY). For continuous variables, descriptive statistics were calculated and were reported as mean ± SD. Discrete variables were expressed as numbers and percentages. The chi-square test was used to compare categorical variables. The Mann-Whitney U test was used to compares the means of two groups (e.g. age, systolic blood pressure, pulse rate, respiratory rate, operating time, length of hospital stay, and perforation size). Statistical significance was defined as $p \leq 0.05$.

RESULTS

This study included 20 patients in the omentopexy group (group 1) and 30 patients in the simple repair group (group 2).

Table (1) showed the demographic data of the simple closure and omentopexy patients. The two groups were similar in terms of age (P = 0.624), clinical parameters as pulse rate (P = 0.605) and respiratory rate (P = 0.115), and Boey score (P = 0.79). Fortunately, postoperatively no patients developed leakage nor died. There was statistically significant difference in SBP (P = 0.002).

Table (2) showed surgical outcomes of the simple closure and omentopexy patients. There were statistically significant differences in length of hospital stay (LOS) (7.20 ± 1.32 versus 5.67 ± 0.55 days; P < 0.0001), and operating time (136.40 ± 10.45 versus 106.83 ± 6.89 minutes; P < 0.0001). There were no statistically significant differences in perforation size (≤ 5 mm versus > 5 mm; P = 0.2) and wound infection [6 (30%) versus 5 (16.7%); p = 0.311].

Table (1): Preoperative demographic data of the patients.

	Group (1)	Group (2)	P-value
Age (years)	47.65 ± 12.90	45.96 ± 14.47	0.624
Gender Male Female	 16 (80%) 4 (20%)	 18 (60%) 12 (40%)	0.216
Boey score 0 1	 5 (10%) 15 (30%)	 16 (32%) 14 (28%)	0.79
Systolic blood pressure (mmHg)	124.25 ± 11.95	134.17 ± 7.55	**0.002***
Pulse (beat/minute)	98.80 ± 12.78	100.10 ± 9.76	0.605
Respiratory rate (cycle/minute)	18 ± 1.72	18.77 ± 1.43	0.115

Data are represented in mean ± standard deviation or number (and percentage %). *Bald values indicate statistical significance ($p<0.05$).

Table (2): Intra and post-operative data of patients.

	Group (1)	Group (2)	P-value
Perforation size ≤5mm >5mm	 13 (65%) 7 (35%)	 13 (43.3%) 17 (56.7%)	0.2
Operative time (minutes)	136.40 ± 10.45	106.83 ± 6.89	0.000*
Length of hospital stay (days)	7.20 ± 1.32	5.67 ± 0.55	0.000*
Wound infection No Yes	 14 (70%) 6 (30%)	 25(83.3%) 5(16.7%)	0.311
Leakage	0	0	

Values are represented in mean ± standard deviation for numerical data, and number (and percentage) for categorical data. *****Clinically significant values.

DISCUSSION

Laparoscopic surgery is being used increasingly in many aspects of emergency gastrointestinal surgery, including appendectomy and cholecystectomy [12, 13]. The advantages of laparoscopic surgery include decreased overall morbidity, mortality, cost, length of hospital stay and post-operative pain with an earlier return to work and resumption of normal daily activity[14, 15].

The use of laparoscopic surgical techniques in emergency surgery was controversial in the early 1990s due to concerns of risk of bacteremia and endotoxemia in the presence of abdominal sepsis. It was thought that establishing carbon dioxide pneumoperitoneum increased the risk of bacteremia due to the increase in abdominal pressure [15]. After the first study of laparoscopic repair for perforated peptic ulcer at 1990, many studies (meta-analyses of

randomize control trail, prospective, retrospective, observations) were favoring laparoscopic repair opposing the open technique [16]. A systematic review in 2018 demonstrated no significant difference in the incidence of sepsis or intra-abdominal collections between laparoscopic and open repair in perforated peptic ulcer [17]. Another concern for laparoscopic repair in PPU was the higher leakage rate and subsequent formation of intra-abdominal abscess and persistent postoperative sepsis requiring further interventions reported in early studies [8]. In recent studies The rate of leakage was (1.1%) [17] much lower than that reported in earlier studies (3.8 to 6.9%) [18, 19].

A recent metaanalysis demonstrated a steady, ongoing reduction in postoperative morbidity over time for emergency laparoscopic surgery [20]. An early criticism of laparoscopic repair for PPU was the longer average operating time (OT) associated. When the average OT was further subcategorised to before and after 2000, there was a reduction in average OT after 2000 in the LR group (61.4 min) [17].

In the laparoscopic era, there is a debate to use omental patch or not in perforated duodenal ulcers patients [21]. There are studies supporting the omental patch technique; they used it to prevent suture tearing and potential leakage. Yet, laparoscopic omental patch requires technical skill and longer operative time [22]. Few studies have been published to report the safety of the laparoscopic simple closure over omental patch [11]. Older age groups have been noted to be an independent predictor of morbidity and mortality in PUD [23].

In our study, there was no significant difference in patients' age (p = 0.624). This is in agreement with **Abd Ellatif *et al.*** [11] (p=0.8) and **Pan *et al.*** [24] (p=0.857). No patients were above 60 years. **Lo *et al.*** [25] reported Median age is 53.5 years old in simple repair group (1) (range 21–85 years old) and 54.0 years old in patch group (2) (range 19–90 years old). Two patients in group 1 and six patients in group 2 were between 80 and 90 years old. Moreover, they reported non-significant p value (p=0.590). **Lin *et al.*** [22] reported 14 patients aged > 70 years and 1 incurred leakage (7.1%). Comparison between patient aged > 70 years and < 70 years, the leakage rate was not significant (7.1% versus 1.9%, P = 0.318) and concluded that old age does not seem to be an absolute risk factor.

As regards the gender, there was no significant difference (p = 0.216), with male predominance in both groups like that was reported by **Lin *et al.*** [22] (p = 0.683) and **Lo *et al.*** [25] (p = 0.723). As regard **Pan *et al.*** [24]**.** Although the sex distribution ratio was significantly different (p=0.012) between the two groups, a trend for male predominance trend was observed in both groups [26]. Males predominated in our study (68%), which is comparable with other studies in developing countries [27].

The statistically significant difference between both groups as regards systolic blood pressure (p = 0.002) is not reported in many studies as **Abd Ellatif *et al.*** [11] (p = 0.74) and **Lin *et al.*** [22] (p = 0.997). Higher percentage of hypertensive patients within simple repair group seems to be the explanation.

We also reported no significant difference as regards pulse (p = 0.605) and respiratory rate (p = 0.115). This also was reported by **Lin *et al.*** [22] (0.739 and 0.731 respectively) and **Abd Ellatif *et al.*** [11] (p = 0.82 as regard the pulse rate).

As regards Boey score, there was no significant difference between both groups (p = 0.79), like that is reported by **Pan *et al.*** [24] (p = 0.458), **Lin *et al.*** [22] (P = 0.734)**, Lo *et al.*** [25] (P = 0.239) and **Abd Ellatif *et al.*** [11]**.** We only included patients with Boey score zero and one, while others included score two.

Therefore, both groups were almost comparable in terms of preoperative findings to a degree that makes their surgical outcomes comparable. Our mean operating time of simple closure versus omentopexy was 106.83 ± 6.89 versus 136.40 ± 10.45 minutes (P < 0.0001). Thus, simple repair without omental patch significantly shortens the operative time. This significant difference is in agreement with that reported by **Abd Ellatif *et al.*** [11] (73 ± 32 versus 59 ± 19 with p = 0.01), **Lin *et al.*** [22] (139 versus 90 with p = 0.0001) and **Pan *et al.*** [24] (106.65 ± 27.62 versus 84.4 ± 26.78 with p=0.001). The longer operating time in the omentopexy group could be attributed to time spent for mobilization a vascularized omental pedicle and time taken for intracorporeal knot tying of the modified Cellan-Jones omentopexy.

In this study, the perforation size was not statistically significant. Therefore, we cannot attribute this difference in the operating time to the perforation size. We did not include perforation size larger than (1 cm). However, **Lo *et al.*** [25] included size ≥ 1cm and also reported that no difference was noted between both groups for the percentage of patients having small (< 5 mm), medium (5–10 mm), and large perforations (>10 mm). The majority of the ulcer perforations in **Abd Ellatif *et al.*** [11] were small. The mean size of perforation was 6 mm (4-17 mm). There was no difference between both groups regarding the size of perforation (p = 0.08). This is in agreement with **Pan *et al.*** [24] with mean size of perforation was 6.4 mm in group A (simple closure) and 6.57 mm in group B (omentopexy), with no statistically significant difference (p = 0.796). However, **Lin *et al.*** [22] reported that the perforation size was significant (4.0 versus 5.0 mm; P < 0.001). Since operating time and perforation size were significantly different, operating time might be confounded by perforation size and could not really reflect the benefit of simple closure alone. To clarify whether perforation size is confounded by operating time, they chose 4.0 mm (median perforation size of simple closure) as a cutoff point and divided the patients into 2 groups (4.0 mm and 5.0-12 mm) and

analyzed the operating time in the simple closure and omentopexy groups, respectively. They found that the size was associated with a negative effect (3.0 versus 3.0 mm, P = 0.254; and 5.0 versus 6.0 mm, P = 0.118, respectively). Of the 4.0 mm and 5.0-12 mm groups, the median operating time of the simple closure versus omentopexy were 76.0 versus 133.0 minutes (P < 0.0001) and 97.0 versus 139.5 minutes (P = 0.006), respectively.

The higher percentage of older patients in omentopexy group might explain the longer length of hospital stay (P = 0.00). This is in agreement with **Lin BC *et al.*** [22] (p = 0.022). **Lo *et al.*** [25] reported that the median length of hospital stay was marginally longer in group 1 (7 days) than in group 2 (6 days) (p = 0.098). This is in agreement with **Abd Ellatif *et al.*** [11] (p = 0.7) and **Pan *et al.*** [24] (p = 0.699).

None of our patients has developed leakage. The explanation for this low leakage rate may be because most of our patients as candidate for laparoscopy, were early presenters, good general condition and they had low Boey's score of surgical risk. The small sample size should also be taken in consideration. Some small sized studies also have reported no leakage rate [21]. Recent studies have reported low leakage rate as in **Lo *et al.*** [25] that was only 2.7% (2/73). Both these patients were very old (87 and 90 years old, respectively) and had multiple systemic diseases with impaired organ functions before operation, and in **Abd Ellatif *et al.*** [11] it was 3.9%. In **Pan *et al.*** [24] only one patient had bile leakage (1/79); however, the leakage healed spontaneously without intervention. **In Lin *et al.*** [22] three patients incurred leakage (simple closure, n = 1; omentopexy, n = 2) for a rate of 2.5%. The difference in leakage rate of cases treated with simple closure versus omentopexy was not statistically significant (P = 0.545). This non-significance also has been reported by **Abd Ellatif *et al.*** [11] (simple closure, n=3; omentopexy, n=4; p=0.41).

There was no significant difference between groups as regards wound infection (p = 0.31). This is in agreement with **Lo *et al.*** [25] (4 patients in each group) and also with **Pan *et al.*** [24] (one patient in each group). **Abd Ellatif *et al.*** [11] reported zero port site infection.

Ates and Dirican[28] concluded that simple closure of a perforated peptic ulcer without an omental patch is a good option based on the criteria that include: the duration of symptoms, mean Mannheim peritonitis index, American Society of Anesthesiologists score, and size of the perforation. Our study confirms that using these criteria, it is safe to abandon omental patch repair to simplify the procedure and to shorten the operative time.

The limitation of our study was that it was with a small sample size, which may not be able to reveal significant differences. Additionally, the Boey score in our study was less than one point, which means that the overall severity of the disease in our study was not high. The maximum age of our patients was 60 years, so older patients to be included. In addition, the short follow up time to be considered.

CONCLUSION

Under certain selection criteria such as small perforation size (<10 mm) and Boey score ≤ 1, laparoscopic repair of a perforated peptic ulcer using only simple closure is sufficient and does not increase the complication rate. An omental patch is necessary for some patients who do not meet these criteria.

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