Laparoscopic repair of early versus delayed presented perforated peptic ulcer: a prospective comparative study

Mohamed Abdelshafy, Mohamed Yousef, Asmaa Gaber, Mohamed Omar, Mohamed Mubark, Mahmoud A. Mahmoud

Department of General Surgery, Qena Faulty of Medicine, South Valley University, Qena, Egypt

Correspondence to Mahmoud A. Mahmoud. Department of General Surgery, Qena Faulty of Medicine, South Valley University, Qena 83523, Egypt. Tel: +0965337573 (off)/+01019848899 (mob); fax: +096-5337571; e-mail: mahmoud_abdelhameid@yahoo.com

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Background
Perforated peptic ulcer is one of the common surgical emergencies. Laparoscopic repair has been used to treat perforated peptic ulcers since 1990 and is gaining acceptance. The main concerns are postoperative intra-abdominal collections and performing laparoscopy in the presence of peritonitis. Studies that evaluate the role of laparoscopy in early and delayed presentation are deficient.
Aim
To compare laparoscopic repair in early versus delayed presentation of perforated peptic ulcer in terms of operative time, conversion rate, postoperative pain, postoperative complications, hospital stay, and conversion rate.
Patients and methods
This nonrandomized interventional study recruited 140 patients with perforated peptic ulcer who underwent laparoscopic repair and were admitted at the General Surgery Department (Emergency Unit) during the period between May 2019 and June 2021. This study was conducted at the main tertiary referral institution that covers the population in Upper Egypt. Only experienced laparoscopic surgeons participated in this study.
Results
A total of 140 patients were included in this study; 75 patients underwent laparoscopic repair during the early presentation period (within 24 h), and their mean age was 42 ± 12.4 years, whereas 65 patients underwent laparoscopic repair during the late presentation period (>24 h), and their mean age was 45 ± 9.8 years. Operative time was significantly longer in the late laparoscopic group (120 ± 14.6 min) in comparison with the early group (80 ± 10.6 min). Moreover, the conversion rate was significantly higher in the late group. The postoperative complications were higher in the late group than the early group.
Conclusions
Laparoscopic repair of perforated peptic ulcer is safe and reliable even in delayed presentations with peritonitis. It has an acceptable morbidity and all the advantages of a minimally invasive surgical approach.

Keywords:
delayed, early, laparoscopic repair, late presentation, perforated peptic ulcer

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Introduction

Peptic ulcer disease affects four million individuals worldwide per year, of which 10–20% of these patients develop life-threatening complications including bleeding, perforation, penetration, and obstruction. Perforation is the second most common complication after bleeding [1,2]. Perforated peptic ulcers affect 2–14% of these patients [3].

Although the incidence of peptic ulcer decreased owing to advancement in proton-pump inhibitors (PPIs), antiulcer medication, and *Helicobacter pylori* eradication [4], the incidence of complications such as perforated peptic ulcer is still rising, and this may be owing to the increased use of NSAIDs and the aging population [4–6].

Peptic ulcer perforation is one of the common surgical emergencies that need immediate surgical intervention [7] and is associated with high morbidity and mortality, and outcomes are worse in the elderly and when the diagnosis is delayed for more than 12 h after the onset of symptoms [8].The mortality rate ranges from 8 to 25% in published studies [5,9,10]. Presence of comorbidities, diagnostic and treatment delay, and perioperative shock are factors associated with poor outcomes [11–13].

Early recognition, prompt diagnosis, resuscitation, and early surgical intervention keep the morbidity and mortality low.

Delay in diagnosis and management of perforated PUD has clearly been shown to be associated with high morbidity and mortality [14]. Delays of more than 24 h increase surgical mortality seven- to eightfold, complication rate threefold, and length of hospital stay two-fold in the Western world [15].

Boey's score [16] is used to predict mortality and morbidity and is based on the presence of (I) severe medical illness; (II) preoperative shock, and (III) duration of perforation more than 24. The score ranges from 0 to 3 (each factor scores 1 point if positive). Patients with none, one, two, or all three variables have hospital mortality rates of 0, 10, 45.5, and 100%, respectively [16,17].

Upper laparotomy has been the routine treatment of perforated peptic ulcer for many years [11]. Surgery is still the mainstay of treatment for peptic ulcer perforation. Many perforations are repaired using an omental patch, a technique that was first described by Cellan-Jones [18] and later was modified by Graham [19].

Laparoscopy has gained wide acceptance by surgeons for elective cases, as well as for emergency situations, such as acute cholecystitis and appendicitis. Laparoscopic repair for perforated peptic ulcer was first described in 1990 [20]. Laparoscopic repair of perforated peptic ulcer represents an attractive option and has many advantages as it allows identification of the site of perforation with less postoperative pain, less pulmonary infection, shorter hospital stay, and earlier return to normal activities [21]. Many studies have confirmed the safety and efficacy of minimally invasive laparoscopic surgery in the management of perforated peptic ulcer [22], without the disadvantage of large abdominal incisions [23].

Laparoscopic repair of perforated peptic ulcer in patients with peritonitis or delayed presentation or in critically ill patients remains controversial regarding its safety and feasibility [24]. Laparoscopic experience is a very important factor in improving the surgical outcome of laparoscopic perforated peptic ulcers. Many authors have reported that a learning period is necessary to improve the surgical outcomes of this type of surgery; therefore, only experienced laparoscopic surgeons participated in this study to resolve this problem.

The aim of this study was to evaluate the feasibility, safety, and efficacy of laparoscopic repairs of perforated peptic ulcers in the presence of peritonitis and compare the outcomes of laparoscopy in early and delayed presented perforated peptic ulcers.

Patients and methods

This prospective nonrandomized interventional study recruited 140 patients with perforated peptic ulcers, who underwent laparoscopic repair and were admitted at General Surgery Department (Emergency Unit) of Qena University Hospital, South Valley University, in the period from May 2019 to June 2021.

This study was conducted at the main tertiary referral institution that covers the population in Upper Egypt.

Inclusion criteria

The following were the inclusion criteria:

(1) Patients older than 16 years with a perforated peptic ulcer.
(2) Hemodynamically stable patients.
(3) Size of ulcer less than 2 cm.

Exclusion criteria

The following were the exclusion criteria:

(1) Hemodynamic instability despite hydration.
(2) Septic shock.
(3) Malignant stomach ulcer.
(4) Patients with gastric outlet obstruction.
(5) Bleeding peptic ulcer.
(6) Previous upper abdominal surgeries.
(7) Patients who refused laparoscopic repair.

Conversion criteria

The following were the conversion criteria:

(1) Patients with perforation of more than 2 cm.
(2) Difficult laparoscopic identification of the perforation.
(3) Extensive adhesion prevented through abdominal toilet.
(4) Cardiovascular instability during the operation.
(5) Iatrogenic injury that could not be managed laparoscopically.

Patients were randomly classified into two groups:

(1) Group A: early laparoscopic group.
(2) Group B: delayed laparoscopic group.

Ethical approval: the study was approved by the Institutional Ethics Committee.

All of these patients were consented (oral and signed written informed consent) and subjected to the following:

(1) Complete clinical assessment including the following:
   (a) Full history taking.
   (b) Complete clinical examination.
(2) Full routine investigations including the following:
   (a) Complete blood count, blood sugar, serum creatinine, prothrombin time and concentration, and serum electrolyte level.
   (b) Screening for HIV, HCV, and HBV.
   (c) ECG.
(3) Abdominal ultrasonography:
   It was done for evaluation of presence of intra-peritoneal fluid collection.
(4) Plain radiograph abdomen erect position:

It was used for the detection of free air under diaphragm (Fig. 1).

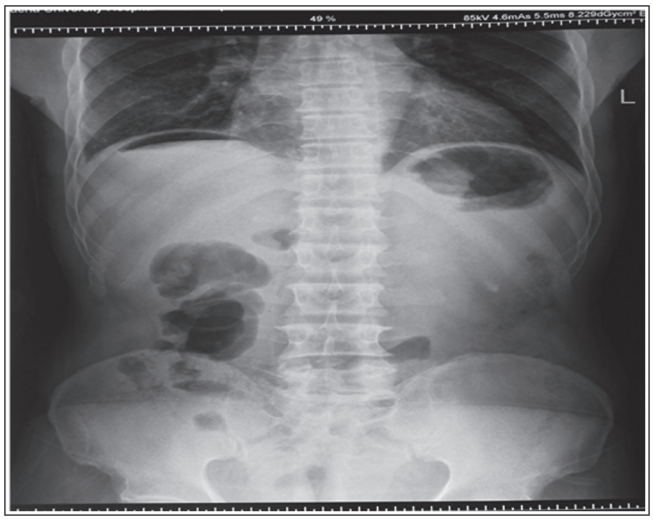
Abdominal computed tomography: it may be required for doubtful cases.

Preoperative and postoperative management

Both groups were subjected to laparoscopic repair

Patients received appropriate management of their septic condition, including resuscitative measures for patients with shock. Patients with severe abdominal pain of more than 24 h before admission were defined as having a delayed presentation. All patients had preoperative and postoperative antibiotics in the form of third-generation cephalosporin and metronidazole for at least 3 days. Postoperative analgesia requirement was recorded.

Figure 1



Plain radiograph abdomen shows air under diaphragm.

All patients received intravenous pethidine as required. All patients received intravenous PPIs during their admission period in the hospital, which was converted to oral PPI once they started oral feeding and continued until they had endoscopic evaluation. They also had eradication therapy for *H. pylori* if proved to be positive. Liquid diet was started when bowel sounds were present, and patients were discharged home when they tolerated an oral diet, no leukocytosis, and no fever. Patients who presented with shock on admission despite hydration were excluded from laparoscopic surgery from start.

A comparison between the two groups was made regarding operative time, number of analgesics required after surgery, time to return to normal diet, length of hospital stay, time to return to work, and complication rate.

The data were computed and analyzed by using SPSS (Statistical Package for the Social Sciences, version 24). *P* value was significant at value less than 0.05.

Operative technique

Laparoscopic approach

Positioning: the patient was placed in the supine position with straight legs, as done for other upper abdominal procedures, and secured to the bed to enable placement in reverse Trendelenburg position. Then, a nasogastric tube and urinary catheter were inserted.

Monitors and equipment

(1) The surgeon stood to the left side of the patient.
(2) The first assistant, whose main task was to position the video camera, sat on the patient's left side.
(3) The instrument trolley was placed on the patient's left side allowing the scrub nurse to assist with placing the appropriate instruments in the operating ports.
(4) Television monitors were positioned on either side of the top end of the operating table at a suitable height for surgeon, anesthetist, and assistant to see the procedure.

Anesthesia: all laparoscopic procedures were performed with the patients under general endotracheal anesthesia.

Procedure: scrubbing of the patient between the nipple down to the mid-thigh and laterally till the posterior axillary lines was done.

Laparoscopic approach: the pneumo-peritoneum was established using Veress needle insufflations or Hasson technique. Pressure was maintained below 14 mmHg to minimize the risk of transperitoneal translocation of bacteria and endotoxemia. The first trocar was introduced into the abdomen under direct vision.

Trocars sites: a 12-mm trocar was used for camera with a 30° view angle through the umbilicus and another two 5-mm ports were inserted into the right and left hypochondrium. The fourth 5-mm port was placed in the epigastrium just to the right of the falciform ligament for irrigation, suction, and retraction of the left lobe of the liver (Fig. 2).

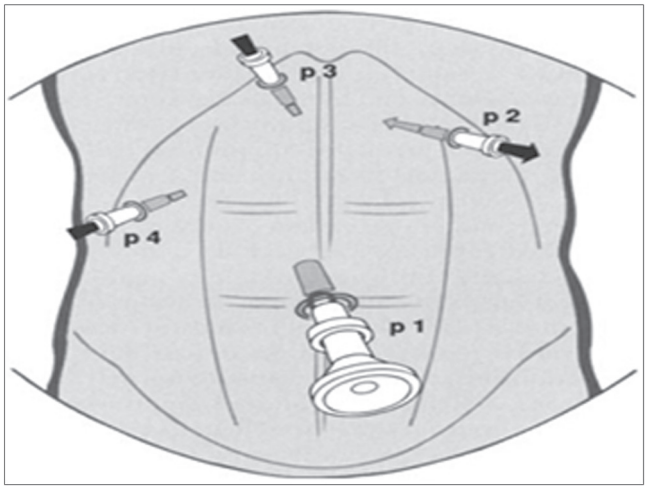
Localization of the perforation

The gallbladder, which usually adheres to the perforation, was retracted by the surgeon's left hand and moved upward. The gallbladder was passed to the assistant using the subxiphoid port, which was placed to the right of the falciform ligament (Figs 3–5). The exposed area was checked, and the perforation was identified as a pinpoint hole on the anterior aspect of the stomach, duodenum. If the omentum was attached to the suspected perforation site, the omentum was gently pulled away with forceps to assess the underlying pathology. Instrumental compression of the antrum of the stomach and the first part of the duodenum facilitated identification by inducing escape of fluid and bubbles from the perforations. The size of ulcer perforation was measured with reference to the size of the jaws of a laparoscopic grasper (Babcock grasper fenestrated double action jaw from Karl Storz), which was ~2 cm in length. Ulcer less than 2 cm were included in this study.

Closure of the perforation

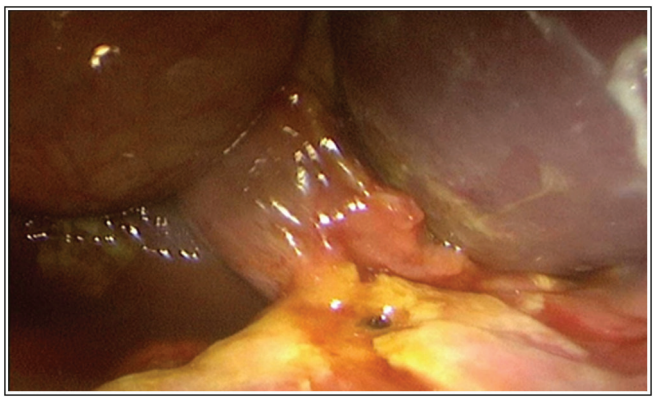
Using an omental (Cellan-Jones) patch, a flap piece of omentum was taken, and the assistant held the omentum patch just over the perforation using an atraumatic instrument (Figs 6 and 7). Intracorporeal knot together with omental patch was applied to seal the perforation. The perforation was closed by intracorporeal stitches (simple closure using 2/0 vicryl on 26 mm rounded body needle, two to three stitches) and re-enforced by a pedicle omental graft. Stitches were placed in a transverse manner over the perforation. This was followed by a complete lavage of the peritoneal cavity using about 6 l of warm physiological saline. A drain

Figure 2



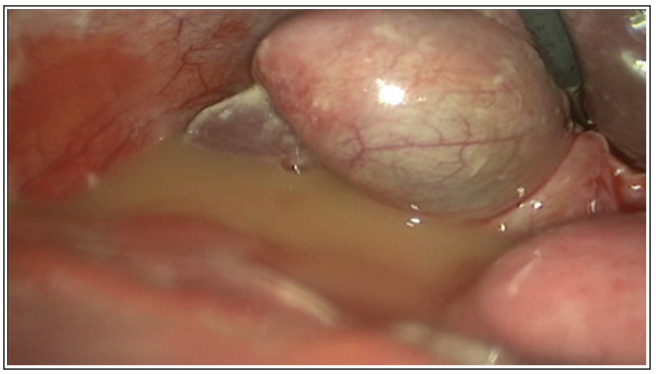
Trocar sites in perforated peptic ulcer.

Figure 3



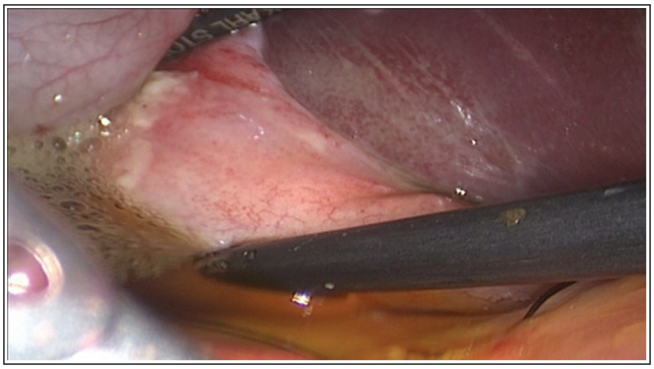
Laparoscopic photograph showing the site of perforation.

Figure 4



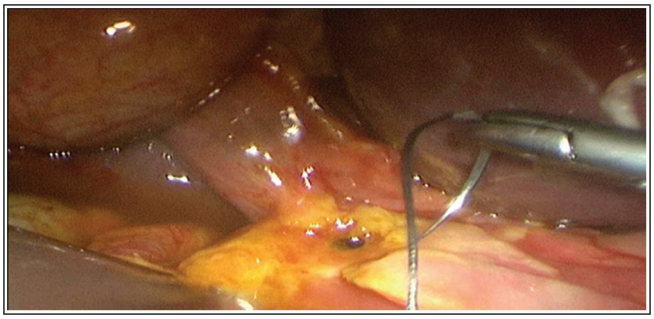
Laparoscopic photograph of turbid fluid collection.

Figure 5



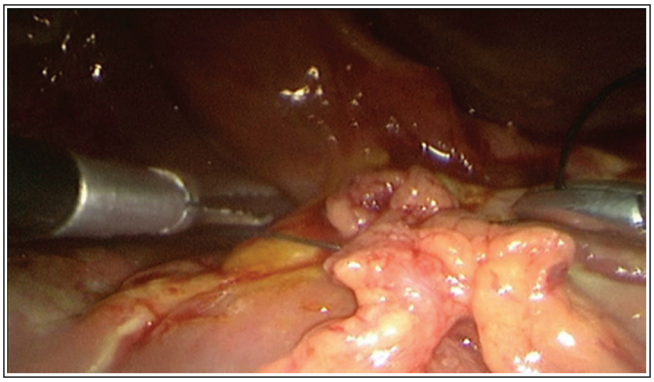
Laparoscopic photograph showing peritoneal lavage of collection.

Figure 6



Laparoscopic photograph of intracorporeal suturing of perforated peptic ulcer (prepyloric).

Figure 7



Laparoscopic photograph showing repair of perforated PPU with omental patch.

was put in the Morrison's pouch through a right-side working port after thorough lavage and suction of the peritoneal cavity. Another drain was put through the left-side working port in the pelvic cavity.

At the end of the procedure, an abdomen examination for any possible bowel injury or hemorrhage was done. The instruments and then the ports were removed. Telescope was removed, leaving gas valve of the umbilical port open to let out all of the gas. Closure of the wound was done with suture: Vicryl for muscle layer and a nonabsorbable or stapler for skin. Adhesive sterile dressing over the wound was applied.

All the patients were assessed postoperatively for the following:

Pain severity score: it was determined according to the mean visual analog score (VAS).

Interpretation of VAS can be done as follows:	
→ [0–0.4] →	no pain
→ [0.5–4.4] →	mild pain
→ [4.5–7.4] →	moderate pain
→ [7.5–10] →	severe pain.

Operative time (min): from insertion of the Veress needle in laparoscopic group and hospital stay.

We noted all operative and postoperative complications. Wound infection was defined as the presence of pus discharge at the surgical site.

Postoperative care

It included the following:

(1) Nothing by mouth, intravenous fluids, broad-spectrum antibiotic, proton-pump inhibitor, opioid analgesic, and thromboprophylaxis were followed.
(2) After return of intestinal motility, usually by the third or fourth day, Ryle is removed with gradually starting oral fluids followed by solid dietary meals. Triple therapy for *H. pylori* was added. Patients were discharged on a combination of antibacterial and anti-secretory therapy for 6 weeks postoperatively.

Follow up

Follow-up of patients was done in the outpatient clinic at second, third, and fourth week, and then on second month and after 4 months.

Endoscopy for confirmation of both ulcer healing and eradication of *H. pylori* was performed in all patients after 6 months.

Results

A total of 140 patients were admitted to the Emergency Department of Qena University Hospital, South Valley University, with perforated peptic ulcer between May 2019 and June 2021 and were included in our study. Overall, 75 patients underwent laparoscopic repair in the early presentation period (within 24 h) and their mean age was 42 ± 12.4 years, whereas those with laparoscopic repair after delayed presentation more than 24 h were 65 patients, and their mean age was 45 ± 9.8 years. In the early laparoscopic group, there were 68 males and seven females, whereas in the delayed group, there were 55 males and 10 females. There was no significant difference in the sex distribution (Tables 1 and 2).

A total of 85 patients had a history of NSAIDs intake: 45 patients of the early laparoscopic group and 40 patients of the delayed group. There was a history of peptic ulcer disease in 20 patients of the early laparoscopic group and in 15 of the delayed group (Tables 3 and 4).

Operative data

Operative time was significantly increased in delayed laparoscopic group (120 ± 14.6 min) compared with the

early group (80 ± 10.6 min), and also the conversion rate was significantly increased in the delayed group (Table 5).

There were operative difficulties such as friable perforation edge, sealed minute perforations, difficulty to localize perforation, and severe adhesions, and these were more pronounced in the delayed group than the early group.

Postoperative follow-up

The number of narcotic injection used/day was not significant in the early laparoscopic group compared with the delayed laparoscopic group (1.564 ± 0.432 vs. 1.9 ± 0.175 doses; *P*=0.147).

Mean VAS of pain at the first day postoperatively was relatively equal in both (3 ± 1 vs. 4± *P*=0.0923).

The length of hospital stay was significantly less in the early group in comparison with the delayed group (*P*=0.018).

Postoperative complications

Postoperative complications were higher in the delayed group than the early group, and there was a statistically significant difference between early and delayed groups (Table 6).

Table 1 Ages of patients

Criteria	Group A: early laparoscopic repair (*N*=75)	Group B: delayed laparoscopic repair (*N*=65)	*P* value early vs. delayed
Age (mean±SD) (years)	42 ± 12.8	45 ± 11.4	0.54 (NS)

Table 2 Sex of patients

Sex	Group A: early laparoscopic repair (*N*=75)	Group B: delayed laparoscopic repair (*N*=65)	Overall number	*P* value early vs. delayed
Male	68	55	140	0.439 (NS)
Female	7	10		

Table 3 Characteristics of patient regarding risk factor for ulceration and perforation and preoperative risk factors

Criteria	Group A: early laparoscopic (*N*=75)	Group B: late laparoscopic (*N*=65)	Overall number (*N*=140)	*P* value
Patients with history of NSAID intake	45	40	85	0.034 (S)
Patient with history of PU	20	15	35	0.84 (NS)
Patient with *Helicobacter pylori* infection	66	50	116	0.76 (NS)

Table 4 Mean duration of symptoms

Criteria	Group A: early laparoscopic	Group B: delayed laparoscopic	*P* value
Duration of symptom (h)	14 ± 0.65	30 ± 20	0.57 (NS)
Delayed (h)			
<24	75	0	
42–48	0	35	
>48	0	30	
Boey's score			
0	60	19	
1	15	31	
2	0	15	
3	0	0	

Table 5 Comparison between group A and group B regarding operative time, postoperative pain, patients' recovery, cosmetic result, and conversion rate

Criteria	Group A: early laparoscopic (*N*=75)	Group B: delayed laparoscopic (*N*=65)	*P* value
Conversion rate %	0.26 (2 patients)	0.15 (10 patients)	0001 (S)
Operative time (mean±SD) (min)	80 ± 10.6	120 ± 14.6	0.03228 (S)
Pain score first day by VAS (mean±SD)	3 ± 1	4 ± 1	0.0923 (NS)
Number of narcotic injection used	1.6 ± 0.432	1.9 ± 0.175	0.147 (NS)
Days to resume oral feeding	2.1±.52	2.9 ± 0.576	0.370 (NS)
Hospital stay (in days)	4 ± 1.54	8 ± 1.6	0.018 (S)
Time to return to normal activity (in days)	12 ± 2.9	16 ± 3.4	0.125 (NS)

VAS, visual analog score.

Table 6 Comparison between group A and group B regarding postoperative complications

Criteria	Group A: early laparoscopic (*N*=75) [*n* (%)]	Group B: delayed laparoscopic (*N*=65) [*n* (%)]	*P* value
Prolonged ileus	2 (2.67)	12 (21.81)	0.0164 (S)
Patients with leak	3	3	0.53 (NS)
Port site infection	2 (2.67)	5 (9.09)	0.365 (NS)
Chest infection	3 (4)	12 (21.81)	0.02 37(S)
Postoperative intra-abdominal abscess	2 (2.67)	4 (7.72)	0.78 (NS)
Cosmetic results			
Good	70	50	
Accepted	5	5	0.154 (NS)
Unaccepted	0	0	

Two (2.67%) patients developed wound infection in the early laparoscopic group in comparison with five (9.09%) patients in the delayed group (*P*=0.0003). The incidence of chest infection and pneumonia was more in the delayed group, and it was statistically significant (*P*=0.0237).

Discussion

Laparoscopic surgical management of peptic ulcer, when compared with the classic open surgery, is an attractive option because it has a lower morbidity rate, better visualization of perforation, visualization of spaces that require lavage, better postoperative outcomes, lesser postoperative analgesic requirement, decreased hospital stay, and lower incidence of surgical site infection, with an acceptable wound scar, in comparison with open conventional repair [11,25].

Laparoscopic repair in presence of peritonitis was a matter of controversy. Two experimental studies that were performed in a rat model showed that CO_2 insufflations of the peritoneal cavity in the presence of peritonitis may cause an increase in bacterial translocation from the peritoneal cavity to the bloodstream [26,27]. On the contrary, many studies have documented that laparoscopic surgery was safe even in the presence of peritonitis [28].

Our demographic data (age and sex) and risk factors (NSAIDs, duration of history of peptic ulcer, and *H. pylori*) were similar to the data collected by Bertleff and Lange [3] obtained from 29 studies that were carried out on 2784 patients.

As regard operative time, in our study, it was longer in delayed presented perforated peptic ulcer group than in the early group, and this difference in time was attributed to the fact that thorough toilet washing of abdominal cavities took longer time than in delayed group and also owing to the technical difficulty to close the friable edges of the perforation and fixating of the friable omentum.

The conversion rate was much lower in the early group than in the delayed group; this may be explained by the extensive adhesion in delayed group and in some cases owing to difficulty in identification of perforation and hemodynamic instability. In our study, two cases in the early group were converted into open surgery: one case owing to hemodynamic instability intraoperatively and the other owing to failure to visualize perforation owing to marked adhesions. Among the delayed group, there were 10 cases of conversion – eight owing to extensive adhesion, making identification of perforation very difficult, and other two cases owing to hemodynamic instability in old aged patients. Boey's score (delayed treatment >24 h, shock at admission, and concomitant diseases) may predict the rate of conversion as the rate of morbidity and mortality [16]. There were no deaths during the management period in our study (this may be explained by that we operated on selected patients without any comorbidities or risk factors). A study by Vaidya *et al.* [29] performed laparoscopic repairs in patients with symptoms of PPU for more than 24 h and concluded that it was safe even in patients with prolonged peritonitis, and this is also confirmed in many studies, such as in the studies by Lagoo *et al.* [30] and Robertson *et al.* [28].

In our study, we can conclude that laparoscopic repair can be performed with ease in patients presented within the first 24 h of manifestations, and also laparoscopic repair may be performed in patients presented after that but with an increasing difficulty, a higher conversion rate, a longer operative time, and a higher incidence of postoperative abscess and port site infection.

Conclusion

Laparoscopic treatment of perforated peptic ulcer is safe and feasible in patients presented early within the first 24 h, and in selected cases, it could also be performed in patients with delayed presentation but with an increased conversion rate and longer operative time. More studies are required to consider more than one variable to compare at the same time such as early presentation versus late presentation, small perforation versus large perforation, and types of repairs either simple suture versus omentopexy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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