

Laparoscopic repair of perforated peptic ulcer: A prospective study

Tamer A ElBakary, MD

Department of General Surgery, Tanta University Hospital, Tanta, Egypt.

Abstract

Background: Perforated peptic ulcer is a common surgical emergency. Its classic treatment is the mid-line laparotomy. However, laparoscopic treatment has been shown to be reliable. Few studies have evaluated its overall utility. The aim of this study is to assess the efficacy of laparoscopy in perforated peptic ulcer repair.

Patients and methods: The study included 18 patients presented by perforated peptic ulcer between July 2009 and December 2011. They were submitted to laparoscopic omental patch repair with thorough peritoneal wash. Patients' demographics, diagnostic techniques, management, and outcome were evaluated.

Results: The mean age was 35.6 years. Male to female ratio was 14:4. The mean duration of symptoms was 18 hours. The perforation was diagnosed by plain X-ray of the abdomen in erect position in 15 patients and by abdominal CT scan in 3 patients. The laparoscopic repair of the perforation was successful in 16 patients while in 2 patients mid-line laparotomy was needed for proper control of the severe intra-abdominal sepsis. The mean operative time was 90 minutes. Post-operatively, the VAS score ranged between 3 and 6 with a mean of 3.5 in the first post-operative day. Narcotics were needed for a mean of 1.5 days. All the patients tolerated soft diet on the 3rd post-operative day and full diet on the 4th post-operative day. The mean duration of hospital stay was 4.5 days. One patient developed post-operative intra-abdominal collection that was treated by ultrasound guided drainage. One patient developed umbilical port site wound infection. No chest infection, prolonged ileus, leakage, or mortality was encountered in the study.

Conclusion: Laparoscopic repair of perforated peptic ulcer is a safe and reliable technique with accepted morbidity and mortality rates and all the advantages of the minimally invasive surgery.

Key words: Laparoscopy, perforation, peptic ulcer, omental patch.

Introduction:

Peptic ulcer perforation is a common surgical emergency. The mortality rate of patients with perforation ranges from 10% to 40%. So, immediate surgery is the treatment of choice.¹ As the efficacy of gastric anti-secretory medication and eradication of *Helicobacter pylori* has improved, the preferred surgical technique for perforated duodenal ulcer treatment has been shifted from definitive ulcer surgery to primary repair of the perforation.² In 1989, Mouret et al³ performed the first laparoscopic perforated peptic ulcer

closure using fibrin glue and omental patch. Then, Nathanson et al in 1990⁴ described the first laparoscopic suture repair of perforated peptic ulcer. Since that time, laparoscopic repair of perforated peptic ulcer has gained more acceptance because it does not only allow to identify the site and pathology of perforation, but it also allows closure of the perforation and peritoneal lavage just like in the open repair but without the large upper abdominal incision and with less post-operative pain, faster recovery, and shorter hospital stay.^{5,6} Despite many trials, the upper laparotomy still

seems to be the routine treatment of perforated peptic ulcer. So, we conducted this study to assess the efficacy of laparoscopic approach in perforated peptic ulcer repair.

Patients and methods:

Between July 2009 and December 2011, 18 patients diagnosed with perforated peptic ulcer were consented for laparoscopic repair of the perforation. All the patients were submitted to full history taking, laboratory investigations (complete blood count, liver & kidney function tests, and serum electrolytes level), and plain X-ray of the abdomen in an erect position. If no free air under the diaphragm was found in the plain X-ray, the patient was submitted to CT abdomen and pelvis. All patients were initially treated by intra-venous fluid resuscitation, naso-gastric tube insertion for gastric decompression, parenteral analgesics, I.V. ranitidine 50 mg every 12 hours, and I.V. antibiotics in the form of cefotaxime sodium 1 gm every 12 hours and metronidazole 500 mg every 8 hours. Informed consent was taken from all patients for diagnostic laparoscopy and laparoscopic perforated peptic ulcer repair with possibility of conversion to open laparotomy.

Exclusion criteria in this study included patients presented with septic shock and hemodynamic instability, gastric ulcer

perforation, history of upper abdominal surgeries, and patients with symptoms duration more than 24 hours.

Once the patient was stabilized, surgery was done. Under general anesthesia with muscle relaxation, the patient was placed in Lloyd-Davis' (French) position with reverse Trendelenberg tilt and the operating surgeon stood between the patient's thighs. Ten mm port was introduced through a longitudinal supra-umbilical incision using the open technique. A 30 degrees scope was introduced through this port for abdominal exploration and confirmation of the duodenal ulcer perforation. Then, two 5-mm working ports were introduced on the right and left mid-clavicular lines just above the level of the umbilicus.

The first step was to do laparoscopic exploration to confirm the diagnosis and to assess the degree of the peritoneal soiling. The pre-pyloric and the duodenal regions were carefully inspected to localize the perforation, if omental reaction was found, the omentum was gently pulled away from the site of the perforation. Then, the perforation was repaired using intra-corporeal 3/0 polyglactin stitches **Figure(1)** that were tied over a pedicled omental patch **Figure(2,3)**. The number of stitches depended on the size of the perforation.

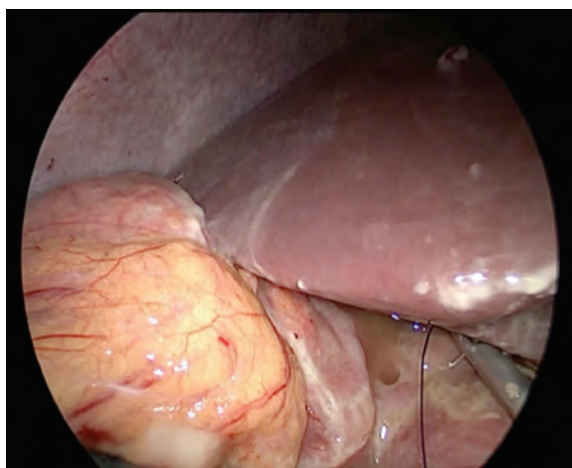


Figure (1): Taking the stitch through the edges of the perforated duodenal ulcer.

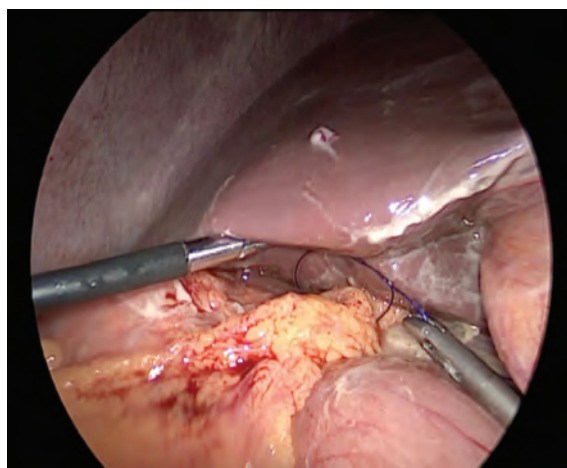


Figure (2): Intra-corporeal knotting of the stitch over a pedicled omental flap.

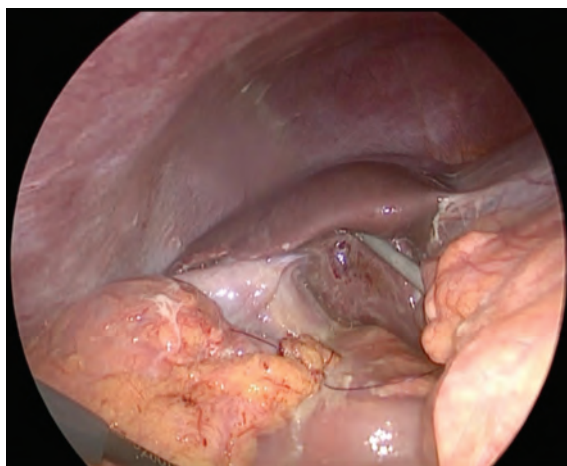


Figure (3): The final appearance of the repair.

Then, thorough peritoneal irrigation and suction of different abdominal compartments was done with special attention paid to sub-phrenic, sub-hepatic and pelvic regions

Figure(4,5) and with obtaining samples of the intra-peritoneal fluid for cultures. An average of 6-8 liters of saline was needed to accomplish this irrigation.

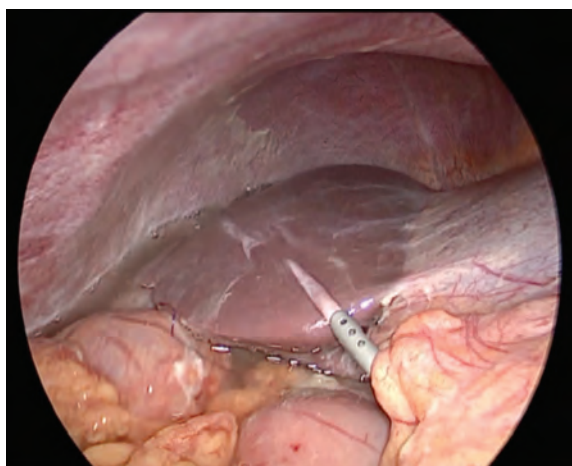


Figure (4): Irrigation and suction of the sub-phrenic and sub-hepatic spaces.

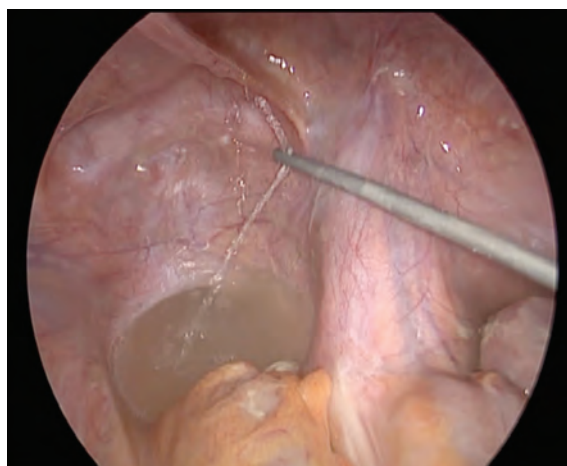


Figure (5): Irrigation and suction of the pelvis.

At the end of the procedure, insufflation of the stomach with 250ml of air was done to rule out any leak from the repair. Then, the incisions were closed. Duration of surgery was recorded from the time of skin incision to the time of skin closure.

Post-operatively, the patients were kept on parenteral narcotics (pethidine 50 mg IM every 12 hours) for pain relief. Intravenous antibiotics and ranitidine were continued for 5 days. We recorded the degree of post-operative pain by the Visual Analogue Scale (VAS) ranging from 0 (no pain) to 10 (severest pain) and by the number of days during which the patient was

in need for narcotics. The naso-gastric tube was removed on the second post-operative day and the oral feeding was started once the post-operative ileus resolved.

Post-operative complications were recorded in the form of prolonged ileus, wound infection, chest infection, intra-abdominal collections, leakage from the site of repair, and death. The patient was discharged once he tolerated oral diet, afebrile, and ambulant. Duration of hospital stay was calculated.

The patients were reviewed in the out-patient clinic at 2 weeks, 3 and 6 months post-operatively.

All patients were advised to use proton pump inhibitors for 3 months with proper diet control and avoidance of smoking, NSAIDs, and alcohol.

Results:

This study was conducted on 18 patients who presented by perforated duodenal ulcer and they were treated by laparoscopic repair of the perforation. Patients' demographics are shown in **Table(1)**.

Table (1): Patients demographics.

criteria	Number of patients (n.=18)
Mean age	35.6
Male: female ratio	14:4
Known history of peptic ulcer	3
Smoking	9
NSAID use	5

The age of the patients ranged between 19 and 46 years with a mean of 35.6 years. There were 14 males (77.8%) and 4 females (22.2%). Three patients (16.7%) gave history of symptoms suggestive of peptic ulcer disease. Nine patients (50%) were cigarette smokers and 5 patients (27.8%) were using NSAID for more than 2 weeks prior to the perforation. The duration of symptoms ranged between 4 and 24 hours with a mean duration of 18 hours. In all the patients, plain X-ray of the abdomen in erect position was done. It showed free air under the diaphragm in 15 patients (83.3%). In the other 3 patients (16.7%), no free air under the diaphragm was seen in the plain X-ray. So, CT scan of the abdomen was done and it showed free intra- peritoneal air.

Intra-operatively, all the patients showed intra-abdominal free fluid that ranged between greenish bilious fluid to purulent fluid with pyogenic membranes covering the bowel and the intra-abdominal viscera according to the duration of the perforation.

Meticulous irrigation and suction was done for all the intra-abdominal compartments and between the bowel loops. Major part of the operative time was spent for this peritoneal wash. In 2 patients, there was marked technical difficulty to control the intra-abdominal soiling with food particles and bowel adhesions. So, laparoscopic peritoneal toilet was inadequate. Midline laparotomy was done for proper control of the intra-abdominal soiling in these 2 patients

with closure of the perforation over an omental patch. So, laparoscopic repair of the perforation was successful in 16 patients (88.9%). The perforation was closed by 1 stitch in 11 patients (61.1%), by 2 stitches in 4 patients (22.2%), and by 3 stitches in 3 patients (16.7%).

The operative time ranged between 75 minutes and 110 minutes with a mean of 90 minutes. Most of this time was consumed for peritoneal lavage especially in patients with bowel adhesions and inter-loop collections. In the 2 patients converted to laparotomy, the operative time ranged between 100 minutes and 115 minutes.

Post-operatively, VAS pain score ranged between 3 and 6 with a mean of 3.5 in the first post-operative day. It ranged between 2 and 4 in the second post-operative day with a mean of 2.4. The patients needed post-operative parenteral narcotics for a period ranging between 1 and 2 days with a mean of 1.5 days.

All the patients started on clear fluids on the 2nd post-operative day, and were allowed soft diet on the 3rd post-operative day, then full diet on the 4th post-operative day except the patients who were converted to laparotomy who were kept fasting for 3 days post-operatively. The duration of hospital stay ranged between 3 and 5 days with a mean of 4.5 days.

Regarding post-operative complications, only 1 patient (5.6%) developed pelvic intra-abdominal collection that was treated by

ultrasound guided drainage and I.V. antibiotics. One patient (5.6%) developed umbilical port site wound infection that was treated by wound drainage under local anesthesia, daily dressing, and oral antibiotics. In these 2 patients the procedure was completed laparoscopically. No chest infection, leakage from the repair site, or mortality were recorded in the study. All patients tolerated oral intake without prolonged ileus.

All patients were followed up in the out-patient clinic 2 weeks, 3 and 6 months post-operatively with no significant long term complications.

Discussion:

Laparoscopic surgery is replacing gradually the open one in the treatment of different gastrointestinal diseases as it is associated with less pain, shorter hospital stay, less scarring, and faster recovery.⁷ However, the implementation of laparoscopic approach in the management of perforated peptic ulcer is slowly evolving and is still unavailable in many surgical departments. This may be explained by the fact that the decision to do laparoscopy depends on the laparoscopic experience of the surgeon on duty. Laparoscopic repair of the perforation is usually done by few enthusiastic surgeons capable of performing advanced laparoscopic procedures.⁸

So, we conducted this study trying to assess the efficacy of laparoscopy in perforated peptic ulcer repair. Peptic ulcer disease is more prevalent in males than females, more in middle age group. Predisposing factors include NSAID use, *Helicobacter pylori* infection, smoking, high body mass index, and habitual tea and coffee drinking.⁹⁻¹¹ This study included 18 patients with a mean age of 35.6 years. 77.8% of them were males and 22.2% were females. These results are consistent with the results of Bertleff & Lange¹² who reported in their study a mean age of 48 years and male predominance (79%). Also, Vaidya et al¹³ reported a mean age of 38.5 years among their patients with a male to female ratio of 27:4.

However, Bertleff et al¹⁴ reported a mean age of 66 years in their study with a male: female ratio of 1.3:1 for patients submitted to laparoscopic repair of perforated peptic ulcer.

History of peptic ulcer disease was positive in 16.7% of our patients. These results are in accordance with the results of many other studies like Lee et al¹⁵ and Ates et al¹⁶ who reported a positive ulcer history in 23% and 14.3% of patients respectively.

In our study, 50% of the patients were smokers and 27.8% of patients were using NSAIDs more than 2 weeks prior to the perforation. Bertleff & Lange¹² reported 62% incidence of smoking and 20% incidence of NSAIDs use in their study. Also, Vaidya et al¹³ reported a smoking rate of 61.3% and NSAIDs use rate of 32.3% in their study.

The perforation was diagnosed in our study by demonstration of free air under the diaphragm in the plain X-ray of the abdomen in the erect position in 15 patients (83.3%), while in the other 3 patients (16.7%) the free air was demonstrated by the CT scan of the abdomen. Bertleff & Lange¹² reported that the free air can be seen on the plain X-ray in 85% of the patients. Ates et al¹⁶ reported a higher incidence (94%) of demonstration of free air in the plain abdominal X-ray.

However, even in the absence of the free air in the plain abdominal X-ray, the laparoscopy can be very useful in cases of acute abdomen for diagnosis and localization of the site of perforation. Sauerland et al¹⁷ found in their study that in 7% of cases, there was a diagnosis different from perforated peptic ulcer and they concluded the benefit of laparoscopy as a diagnostic procedure indicating either an upper or lower laparotomy incision or continuation of the laparoscopy.

It is important to preselect patients who are good candidates for laparoscopic repair of the perforation.¹⁸ Boey's classification appears to be useful for patients' selection.¹⁹ This classification depends on 3 risk factors: shock on admission, American Society of Anesthesiologists (ASA) grade III-IV, and more than 24 hours duration of symptoms. The minimum score is 0 and the maximum one is 3. Many authors reported that laparoscopic repair is only safe for patients with Boey's score 0 and 1.^{20,21} Also, Thorsen et al²² reported in their study that 86% of patients with perforated peptic ulcer treated laparoscopically were Boey's score 0 and 1. So, in our study,

we excluded patients who presented by septic shock, hemodynamic instability, patients with upper abdominal surgeries, and patients with duration of symptoms more than 24 hours.

During surgery, we put the patient in Lloyd-Davis' position with the surgeon standing between patient's thighs. Many surgeons prefer to do laparoscopy in this position.^{13,16} However, other surgeons prefer to stand on the patient's left hand.^{19,23} The number of ports used for laparoscopic repair of perforated peptic ulcer differs from one study to another. Some surgeons prefer to use 4 ports: 10-mm umbilical port for the camera, two 5-mm working ports in right and left mid-clavicular lines, and a fourth 5-mm port just below xiphoid process for liver retraction.^{13,19,23} In our study, we succeeded to perform the laparoscopic procedure in all the patients with only 3 ports without the use of the 4th port for liver retraction which is similar to the technique used by Lo et al.¹⁶ The ulcer was closed by 1 to 3 stitches over a pedicled omental flap by intra-corporeal knotting as the extra-corporeal suturing is likely to cut through the friable edge of the perforation.²⁴

Cellan-Jones was the first one who described the use of the pedicled omental flap to plug the perforated ulcer in 1929.²⁵ He advised this technique to prevent tearing out of the sutures and prevent enlargement of the size of the perforation by the damage of the friable edges. This technique is usually called "Graham's patch". However, Graham in his original article published in 1937²⁶ described plugging the site of the perforation by a free omental plug, a technique that is rarely used by surgeons nowadays.

Ates et al¹⁶ tried to shorten the operative time by simple closure of the perforated ulcer without using pedicled omentoplasty. However, avoiding omentoplasty might be the reason for a higher incidence of leakage from the repaired ulcer site.²⁷

Another cause of increasing the operative time of the laparoscopic technique is the meticulous peritoneal irrigation which is a very crucial step to prevent post-operative intra-abdominal collections and sepsis. We did in our cases thorough peritoneal irrigation till we were sure that adequate control of the intra-

abdominal soiling had been achieved. The irrigation through the 5-mm port is time consuming and it takes up to 1 hour in some studies.²⁸ Many authors^{13,29} demonstrated the great effect of laparoscopic irrigation in controlling the intra-abdominal contamination and decreasing the septic abdominal complications in cases of prolonged peritonitis.

However, some surgeons claimed that there is no evidence that irrigation lower the risk of sepsis.³⁰ So, irrigation may be necessary only if there are food particles in the abdomen.

On the other hand, some studies showed that gas insufflation in the peritoneal cavity with excessive irrigation may be associated with increasing bacterial translocation and septic complications in patients with prolonged peritonitis.^{27,31} They concluded that the use of laparoscopy in patients with prolonged peritonitis might be associated with increasing risk of sepsis.^{24,27} Gupta et al³² considered that increased use of irrigation fluid, possibly producing greater contamination of the peritoneal cavity, might have an impact on the intra-abdominal abscess formation after laparoscopic procedures like appendectomy. Memon³³ reported in his study that carbon dioxide pneumoperitoneum may contribute to the mechanical diffusion of bacteria inside the peritoneal cavity, but experimental proof is lacking.

The reasons for use of abdominal drains post-laparotomy are variable. They may obliterate the dead space, evacuate any collected blood and serum, drain residual contamination, detect any early leak, provide a track for late leaking, and reassure the surgeon when he is unhappy about the anastomotic technique.³⁴ On the contrary, other surgeons believe that the drains actually stimulate serous fluid formation; increase risk of infection; increase rate of leakage by preventing omental mobilization, thereby obstructing its sealing action on the anastomotic suture line; and even create leakage by mechanical erosion of the anastomosis.^{35,36} Drains also may increase the rate of surgical wound infection, increase patient discomfort, prolong hospital stay, and thereby increase the cost.³⁷ The early detection of the anastomotic leak by the drain remains speculative. Urbach et al³⁸ in a meta-analysis

of 4 randomized controlled trials that included 414 adult patients with colonic or rectal anastomosis, reported that of 20 observed leaks that occurred in patients with drains in place, in only 1 case did pus or enteric contents appeared in the effluent of the existing drain.

In our study, we did not insert intra-abdominal drain in any of our patients because we thought that adequate peritoneal wash is enough and the presence of the drain does not prevent the development of intra-abdominal collections. In spite of omitting drain insertion, we had only 1 patient who developed post-operative intra-abdominal collection (5.6%). These results are consistent with the results of Lo et al³⁹ that did not use drains in their cases. None of these cases developed post-operative collection. Also, Lam et al⁴⁰ mentioned in their study that the drain use is optional. They used the drain only in cases of severe contamination. They had only one patient with post-operative intra-abdominal collection out of 35 patients with perforated peptic ulcer treated laparoscopically.

Nevertheless, many other studies adopted the routine use of the drain after laparoscopic repair of perforated peptic ulcer.^{13,16,19,23}

Causes of conversion in the literature are many. These causes included big perforation size,¹² technical difficulties,¹³ and failure to locate the perforation.⁴¹ Shock on admission was associated with a higher conversion rate.³¹ Furthermore, time lapse between perforation and presentation negatively influenced the conversion rate.³¹ The conversion rate in our study was 11.1% as 2 patients required mid-line laparotomy for proper control of the intra-abdominal sepsis. This rate is in accordance with many other studies. Vaidya et al¹³ reported conversion in 2 out of 31 patients (6.5%) although all of their patients presented more than 24 hours after the onset of pain. Siu et al⁴² reported a conversion rate of 14.2% among 63 patients. On the other hand, some studies reported 0% conversion rate as Palanivela et al²⁴ and Lee et al¹⁵ who treated 120 patients and 13 patients consecutively with laparoscopic repair of perforated peptic ulcer. In a review of 29 studies, Bertleff & Lange¹² found that the overall conversion rate is 12.4% in a total of 2788 patients.

In the beginning of the study, the operative time was about 110 minutes and decreased gradually to be around 75 minutes towards the end of the study with a mean of 90 minutes. The operative time is widely variable in the literature. Linevicius & Morkevicius¹⁹ reported an operative time of 76.2 ± 35.3 minutes. Lam et al⁴⁰ reported an operative time of 86 minutes. Lo et al³⁹ reported an operative time of 50 minutes for patients treated by ulcer closure with omental patch and 45 minutes for patients treated with simple ulcer closure only. Lee et al¹⁵ reported a shorter operative time; only 20.7 ± 4.9 minutes.

Our study showed that the laparoscopic treatment of perforated peptic ulcer gives the patient all the advantages of the minimally invasive surgical technique. The patients had less post-operative pain (a mean VAS score of 3.5 in the 1st post-operative day), less narcotics need (a mean of 1.5 days), earlier recovery of the post-operative ileus (all of them tolerated soft diet by the 3rd post-operative day), and shorter hospital stay (a mean of 4.5 days). The different studies in the literature confirmed the better post-operative course for the laparoscopic technique if compared to the open one.^{8,14,27,42,43}

Post-operatively, 1 patient (5.6%) developed pelvic intra-abdominal collection, and 1 patient (5.6%) developed umbilical port site wound infection. No post-operative leakage, prolonged ileus, chest infection, or mortality was reported in our study. Bertleff et al¹⁴ reported a mortality rate of 3.8%, ileus and wound infection rate of 0%, and leakage rate of 3.8%.

Elbroend & Andersen⁸ reported in their study that 67% of cases had smooth post-operative course with no complications, 10% had intra-abdominal abscess, 11.7% had wound infection, 5.8% had pneumonia, and the mortality rate was 4%.

In conclusion, laparoscopic repair of perforated peptic ulcer is safe and reliable technique. It gives the patient all the advantages of laparoscopic surgery with accepted post-operative morbidity and mortality rates. However, laparoscopic closure of the perforation is technically demanding. It should be considered as a good choice in the presence of reasonable laparoscopic skills and experience.

References:

- 1- Bertleff MJ, Lange JF: Perforated peptic ulcer disease: A review of history and treatment. *Dig Surg* 2010; 27(3): 161-169.
- 2- Hopkins RJ, Girardi LS, Turney EA: Relationship between Helicobacter pylori eradication and reduced duodenal and gastric ulcer recurrence: A review. *Gastroenterology* 1996; 110: 1244-1252.
- 3- Mouret P, Francois y, Vignal J, et al: Laparoscopic treatment of perforated peptic ulcer. *Br J Surg* 1990; 77: 1006.
- 4- Nathanson LK, Easter DW, Cuschieri A: Laparoscopic repair / peritoneal toilet of perforated duodenal ulcer. *Surg Endos* 1990; 4: 232-233.
- 5- Druart ML, Van Hee R, Etienne J, et al: Laparoscopic repair of perforated peptic ulcer. A prospective multi-center clinical trial. *Surg Endos* 1997; 11: 1017-1020.
- 6- Lunevicius R, Morkevicius M: Systematic review comparing laparoscopic and open repair for perforated peptic ulcers. *Br J Surg* 2005; 92: 1195-1207.
- 7- Bhogal RH, Athwal R, Durkin D, et al: Comparison between open and laparoscopic repair of perforated ulcer disease. *World J Surg* 2008; 32: 2371-2374.
- 8- Sommer T, Elbroend H, Friis-Andersen H: Laparoscopic repair of perforated ulcer in Western Denmark - A retrospective study. *Scand J Surg* 2010; 99: 119-121.
- 9- Xia B, Xia HH, Ma C, et al: Trends in the prevalence of peptic ulcer disease and Helicobacter pylori infection in family physician-referred uninvestigated dyspeptic patients in Hong Kong. *Aliment Pharmacol Ther* 2005; 22: 243-249.
- 10- Wang FW, Tu MS, Chuang HY, et al: Prevalence and risk factors of asymptomatic peptic ulcer disease in Taiwan. *World J Gastroenterol* 2011; 17(9): 1199-1203.
- 11- Lu Cl, Chang SS, Wang SS, et al: Silent peptic ulcer disease: Frequency, factors leading to silence, and implications regarding the pathogenesis of visceral symptoms. *Gastrointest Endosc* 2004; 60(1): 34-38.
- 12- Bertleff MJ, Lange JF: Laparoscopic correction of perforated peptic ulcer: First choice? A review of literature. *Surg Endos* 2010; 24: 1231-1239.
- 13- Vaidya BB, Chaitanya PG, Shah JB: Laparoscopic repair of perforated peptic ulcer with delayed presentation. *J Laparoendosc Adv Surg Tech* 2009; 19(2): 153-156.
- 14- Bertleff MJ, Halm JA, Bemelman WA, et al: Randomized clinical trial of laparoscopic versus open repair of the perforated peptic ulcer: The LAMA trial. *World J Surg* 2009; 33: 1368-1373.
- 15- Lee J, Sung K, Lee D, et al: Single-port laparoscopic repair of a perforated duodenal ulcer: Intracorporeal "cross and twin" knotting. *Surg Endos* 2011; 25: 229-233.
- 16- Ates M, Sevil S, Bakircioglu E, Colak C: Laparoscopic repair of peptic ulcer perforation without omental patch versus conventional open repair. *J Laparoendosc Adv Surg Tech* 2007; 17(5): 615-619.
- 17- Sauerland S, Agresta F, Bergamaschi R, et al: Laparoscopy for abdominal emergencies. *Surg Endos* 2006; 20: 14-29.
- 18- Lau WY: Perforated peptic ulcer: open versus laparoscopic repair. *Asian J Surg* 2002; 25: 267-269.
- 19- Boey J, Wong J: Perforated duodenal ulcers. *World J Surg* 1987; 11: 319-324.
- 20- Lunevicius R, Morkevicius M: Comparison of laparoscopic versus open repair of perforated duodenal ulcers. *Surg Endos* 2005; 19: 1565-1571.
- 21- Katkhouda N, Mavor E, Mason RJ, et al: Laparoscopic repair of perforated peptic ulcers: Outcome and efficacy in 30 consecutive patients. *Arch Surg* 1999; 134: 845-848; discussion 849-850.
- 22- Thorsen K, Glomsaker TB, Meer AV, et al: Trends in diagnosis and surgical management of patients with perforated peptic ulcer. *J Gastrointest Surg* 2011; 15: 1329-1335.
- 23- Lunevicius R, Morkevicius M: Risk factors influencing the early outcome results after laparoscopic repair of perforated duodenal ulcer and their predictive value. *Langenbecks Arch Surg* 2005; 390: 413-420.
- 24- Palanivelu C, Jani K, Senthilnathan P: Laparoscopic management of duodenal ulcer perforation: Is it advantageous? *Indian*

- J Gastroenterol* 2007; 26: 64-66.
- 25-Cellan-Jones CJ: A rapid method of treatment in perforated duodenal ulcer. *BMJ* 1929; 1076-1077.
- 26-Graham R: The treatment of perforated duodenal ulcers. *Surg Gynecol* 1937; 235-238.
- 27-Lau H: Laparoscopic repair of perforated peptic ulcer: A meta-analysis. *Surg Endos* 2004; 18: 1013-1021.
- 28-Arnaud JP, Tuech JJ, Bergamaschi R, et al: Laparoscopic suture closure of perforated duodenal peptic ulcer. *Surg Laparosc Endosc Percutan Tech* 2002; 12: 145-147.
- 29-Schein M, Gecelter G, Freinkel W, et al: Peritoneal lavage in abdominal sepsis. A controlled clinical study. *Arch Surg* 1990; 125: 1132-1135.
- 30-Lagoo S, McMahon RL, Kakihara M, et al: The sixth decision regarding perforated duodenal ulcer. *JSLS* 2002; 6: 359-368.
- 31-Robertson GS, Wemyss-Holden SA, Maddern GJ: Laparoscopic repair of perforated peptic ulcers. The role of laparoscopy in generalized peritonitis. *Ann R Coll Surg Engl* 2000; 82: 6-10.
- 32-Gupta R, Sample C, Bamehriz F, Birch DW: Infectious complications following laparoscopic appendectomy. *Can J Surg* 2006; 49: 397-400.
- 33-Memon MA: Laparoscopic appendectomy: Current status. *Ann R Coll Surg Eng* 1997; 79: 393-402.
- 34-Petrowsky H, Demartines N., Rousson V: Evidence-based value of prophylactic drainage in gastrointestinal surgery: A systematic review and meta-analysis. *Ann Surg* 2004; 240: 1074-1085.
- 35-Merad F, Yahchouchi E, Hay JM, et al: Prophylactic abdominal drainage after elective colonic resection and suprapromontory anastomosis: A multicenter study controlled by randomization. French Association for Surgical Research. *Arch Surg* 1998; 133: 309-314.
- 36-Dandapat MC, Panda C: A perforated appendix: Should we drain? *J Indian Med Assoc* 1992; 90: 147-148.
- 37-Nasir AA, Abdurahman LO, Adeniran JO: Is intra-abdominal drainage necessary after laparotomy for typhoid intestinal perforation? *J Ped Surg* 2012; 47: 355-358.
- 38-Urbach DR, Kennedy ED, Cohen MM: Colon and rectal anastomosis do not require routine drainage: A systematic review and meta-analysis. *Ann Surg* 1999; 229: 174-180.
- 39-Lo HC, Wu SC, Huang HC, et al: Laparoscopic simple closure alone is adequate for low risk patients with perforated peptic ulcer. *World J Surg* 2011; 35: 1873-1878.
- 40-Lam PWF, Lam MCS, Hui EKL, et al: Laparoscopic repair of perforated duodenal ulcers. The "three - stitch" Graham patch technique. *Surg Endos* 2005; 19: 1627-1630.
- 41-Lunevicius R, Morkevicius M: Management strategies, early results, benefits, and risk factors of laparoscopic repair of perforated peptic ulcer. *World J Surg* 2005; 29: 1299-1310.
- 42-Siu WT, Leong HT, Law BK, et al: Laparoscopic repair for perforated peptic ulcer: A randomized controlled trial. *Ann Surg* 2002; 235: 313-319.
- 43-Kirshtein B, Bayme M, Mayer T, et al: Laparoscopic treatment of gastro-duodenal perforations. *Surg Endosc* 2005; 19: 1487-1490.