



International Journal of Hepatology & Gastroenterology

Research Article

Laparoscopic versus Open Simple Closure for Perforated Peptic Ulcer -

Ahmed M. Abdel Modaber^{1*}, Ahmed Hammad¹ and Vusal Aliyev²

¹General Surgery Department, Faculty of Medicine, Mansoura University Hospitals, Egypt

²General Surgery Department, Emsey Hospital, Istanbul, Turkey

***Address for Correspondence:** Ahmed MA. Modaber, Department of General Surgery, Mansoura University, Egypt, E-mail: ahmedhammad2005@yahoo.com

Submitted: 04 January 2018 **Approved:** 07 January 2018 **Published:** 10 January 2018

Cite this article: Abdel Modaber AM, Hammad A, Aliyev V. Laparoscopic versus Open Simple Closure for Perforated Peptic Ulcer. Int J Hepatol Gastroenterol. 2018; 4(1): 001-009.

Copyright: © 2018 Abdel Modaber AM, et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



ABSTRACT

This prospective randomized study included 36 patients who presented to the Emergency department with perforated peptic ulcers. All these patients presented within 24 hours from the start of symptoms, with no shock and no major medical co-morbidities. The odd number patient entered the laparoscopic group while patients with even number entered open group. Technique used for repair in both groups was a modification of Grahams maneuver. The mean operative time in the laparoscopic group was (150.1 ± 13.2 minutes), while in the open one, it was (106.3 ± 12.1 minutes). Two patients of the laparoscopic group were converted to open and were excluded from the study with a conversion rate 10%. The reasons were very large perforation in one patient and difficulty in placing the sutures through the friable edges of the perforation in the second patient. The site of perforation was mainly in the duodenum (83%) in the laparoscopic group and (77%) in the open group. The size of perforation was less than 10mm in both groups. The mean post-operative pain score in the open group (5.3), while in the laparoscopic one was (1.3). Bowel habit returns earlier in the laparoscopic group than the open one. Start of oral diet intake was significantly early in the laparoscopic group than the open one (3.7 days). Naso-gastric tube removal was significantly earlier in the laparoscopic group than the open one. Hospital stay was significantly longer in the open group than the laparoscopic one. Deep venous thrombosis occurred more in open group than in laparoscopic group. The wound complications were more common in the open group, six cases. Pulmonary infections was higher after open surgery than laparoscopic surgery. There are two cases of Suture leakage that were diagnosed by gastrograffin meal, One patient in the open group developed suture leakage which was managed by surgery, also one patient developed suture leakage was reported in the laparoscopic group which was managed conservatively. Post-operative intra-abdominal collection occurred only in one patient of the laparoscopic group. The patient was diagnosed by ultrasonography and C.T. The patient was managed conservatively by U/S guided aspiration and improved. Two patients from the open group presented with incisional hernia on follow up in the outpatient clinic, while patients belonging to the laparoscopic group did not. Also, we found that there were recurrence of peptic ulcer disease in two patients in laparoscopic group and three patients in the open group. We found that the laparoscopic repair of perforated peptic ulcers is superior to the open repair in regard to postoperative pain, return of bowel habit, start of oral diet and length of hospitalization. Currently, the main drawbacks of laparoscopic repair are a longer operation and a higher incidence of intra-abdominal collection. The open repair has a higher rate of pulmonary infections, wound infection. Suture leakage was reported in one case in the open group and in one case in laparoscopic group.

Keywords: Peptic ulcer; Laparoscopic repair; Open repair; Simple closure; Incisional hernia; Leakage

INTRODUCTION

Globally, the incidence of peptic ulcer disease was fallen in recent years. Despite this and recent advances in both diagnosis and management of peptic ulcer disease, namely the improvement in endoscopic facilities, eradication of *Helicobacter pylori* and the introduction of proton pump inhibitors “complications such as peptic ulcer perforation remain a substantial healthcare problem”, because of its high morbidity, mortality and economic loss [1].

Peptic ulcer perforation is a serious complication which affects almost 2-10 % of peptic ulcer patients. Peptic ulcer perforation presents with an overall mortality of 10%, although some authors reported range between 1.3% and 20% [2].

Being a life threatening complication of peptic ulcer disease, it needs special attention with prompt resuscitation and appropriate management if morbidity and mortality are to be avoided [3].

The patient of perforated peptic ulcer has been reported to vary from one geographical area to another depending on the prevailing socio-demographic and environmental factors. In the developing world, the patient population is young with male predominance, and there is a strong association with smoking. In the west the patients tend to be elderly and there is a high incidence of ulcerogenic drug ingestion [4].

The diagnosis of perforated peptic ulcer poses a diagnostic challenge in most of cases. The spillage of duodenal or gastric contents into peritoneal cavity causing shock, abdominal pain, peritonitis, marked tenderness, board like abdominal wall rigidity and decreased liver dullness offers little difficulty in diagnosis of perforations. The presence of gas under the diaphragm on plain abdominal erect X-ray is diagnostic in 75% of the cases [5].

Since the first description of surgery for acute perforated peptic ulcer, many techniques have been recommended. The recent advances

in anti-ulcer therapy have shown that simple closure of perforation with omental patch followed by eradication of *Helicobacter pylori* is a simple and safe option in many centers and have changed the old trend of truncal vagotomy and drainage procedures [6].

Several single-center and randomized control studies have been conducted to compared laparoscopic simple to conventional open simple closure for perforated peptic ulcer. Results from these studies indicate that laparoscopic simple closure is a safe and reliable procedure. Many investigations have evaluated the risk factors associated with laparoscopic simple closure and it has been found that advanced age, co-morbidities, and critical preoperative state are strong indicators of poor outcome [7].

Selection of laparoscopic simple closure would therefore be biased towards the younger, lower-risk segment of the population; this must be considered before drawing any conclusions regarding the cost effectiveness of the procedure [8].

In this study, we compared between laparoscopic and open simple repair of perforated peptic ulcer to determine the best method of management in order to achieve better patient outcome and minimize complications.

PATIENTS AND METHODS

This prospective randomized comparative study included patients who presented to the Emergency Department with perforated peptic ulcers.

Inclusion criteria

1. Patients presented within 24 hours from the start of symptoms.
2. Patients who remain hemodynamically stable after initial resuscitation.
3. Patients with ASA grade I, II.

4. Age group from 18 to 70 years old.
5. Perforation size 2cm or less.
6. Patients who consented for joining this study.

Exclusion criteria

1. Patients who presented late.
2. Patients who were hemodynamically unstable in spite of good resuscitation.
3. Patients who were presenting with ASA grade III or IV.
4. Age group less than 18 years old or more than 70 years old.
5. Perforation size more than 2 cm.
6. Patients where conversion to open procedure was decided.

Methods of randomization

Patients were randomly divided into open and laparoscopic groups based on the approach that was going to be subjected to them. Each patient who fulfilled the inclusion criteria was numbered sequentially. The odd number patient entered the laparoscopic group while patients with even number entered open group. If a patient was excluded from the study (due to conversion), so the next patient entered instead of him.

Open group: 18 patients were subjected to a laparotomy to manage their condition.

Laparoscopic group: 18 patients were managed using the laparoscopic approach.

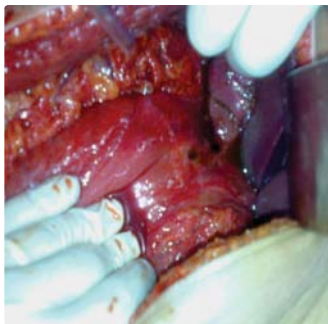


Figure 1: Localization of perforation.

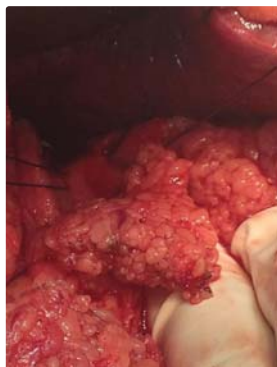


Figure 2: Sutures placed on the edges and tied.



Figure 3: Omentum placed over the tied sutures.



Figure 4: Sutures also taken to fix the omental flap.



Figure 5: Localizing the perforation.



Figure 6: Sutures placed on the edges of the perforation site and tied.

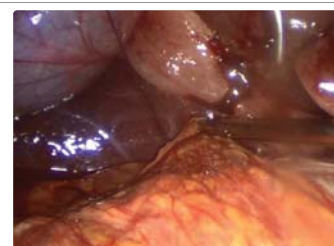


Figure 7: The omental flap is centered over the tied sutures.

Methods of the study

The diagnosis of perforated peptic ulcer was made on the basis of:

1. Proper history and examination.
2. Laboratory investigations in the form of complete blood count, serum electrolytes, serum amylase, kidney and liver function tests to aid in the initial assessment and resuscitation of the patients.

Radiological investigations primarily in the form of plain Chest X-ray and Abdominal X-ray in erect position to identify the presence of free air in the abdomen and confirm a perforation. However, other investigations in the form of pelvi-abdominal Ultra-Sonography and CT abdomen and pelvis with oral and IV contrast were used when the diagnosis was doubtful in cases where the free air under diaphragm not present in plain X-ray.

In conjunction with the diagnosis, Initial resuscitation was done in the form of:

1. Assessment of the vital signs.
2. IV Fluids and correction of electrolyte imbalances.
3. IV Analgesics to relieve the pain.
4. IV Antibiotics.



Figure 8: Securing the knots over the omental flap.



Figure 9: Completion of the variation of omental flap repair.



Figure 10: Lavage of the abdomen

5. IV proton pump inhibitors.
6. Ryle’s tube.

Description of the open repair technique

- The procedure is done under general anesthesia.
- The patient was placed in a supine position over the operating table, the abdomen is prepared and draped in a standard fashion.
- An upper midline incision was performed which allows adequate exposure and also allow extension inferiorly and exploration of the entire abdomen.
- Suction of the gastrointestinal spillage and any purulent exudates was quickly performed all around entire abdomen in all abdominal spaces and compartments then the attention is turned to inspect the stomach and the duodenum and visualization of the perforation where present.
- After the perforation was identified, repair was planned.
- Three full-thickness sutures using (Vicryl 2/0) were placed between the edges of the perforation and tied.
- A pedicled patch of omentum was brought without tension and positioned over the tied sutures, were tied from the superior to the inferior aspect across the omental flap.
- The applied tension to the sutures should be strong enough to stabilize the omentum in place but loose enough to preserve the omental blood supply.
- The peritoneal cavity is irrigated with about 4-6 liters of warm saline to remove contamination.
- A pelvic and a hepatorenal drains are then inserted.
- The abdomen is then closed in a continuous fashion using polypropylene sutures.

Description of the laparoscopic technique

The procedure is done under general anesthesia.

Positioning: The patient was placed on the operating table with the legs in stirrups, the knees slightly bent and the hips flexed approximately 10°C.

- The operating table was tilted head up by approximately 15 degrees
- The surgeon stood on left side of the patient
- The camera man stood on the patient’s left side.
- The instrument trolley was placed on the patient’s right side allowing the scrub nurse to assist with placing the appropriate instruments in the operating ports.
- Television monitors was positioned at the top end of the operating table at a suitable height; so surgeon, anesthetist, as well as assistant can see the procedure.

Creation of pneumoperitoneum: The open technique was used and sometimes the Verres needle is used.

Port placement: A 10mm camera port was placed in the umbilicus; this position will vary according the build of the patient.



A 5mm port was inserted in the right upper quadrant 8-10 cm from the mid-line, midway between umbilicus and costal cartilage.

A 10mm port was placed in the left upper quadrant at midclavicular line between umbilicus and costal cartilage.

Occasionally, a 4th port placed below the xiphisternum to retract the liver was used.

Locating the Perforation: The gallbladder, which usually adheres to the perforation was retracted by the surgeon's left hand and moved upwards.

The gallbladder was passed to the assistant using the subxyphoid port which was placed to the right of the falciform ligament.

The exposed area was checked and the perforation was usually identified as a black spot on the anterior aspect of the duodenum or pylorus.

Closure of the perforation with an omental patch: Three sutures were placed on either side of the perforation then tied.

- The omentum was placed over the tied sutures then fixed.
- The sutures were tied using the intracorporeal knotting technique.

Cleaning the abdomen: The whole abdomen was irrigated and aspirated with about 4-6 liters of warm saline.

Each quadrant was cleaned methodically, starting at the right upper quadrant, going to the left, moving down to the left lower quadrant, and then finally over to the right.

Pyogenic membranes were removed as much as possible, since they might contain bacteria.

Ending of the operation: Lavage was done again quadrant by quadrant.

- Pelvic and Hepatorenal drains were inserted.
- The abdomen was carefully examined for any possible bowel injury or hemorrhage.
- The Instruments and then canule were removed, the wounds were closed and dressing was applied over them.

Conversion to open surgery: Two patients of the laparoscopic group were converted to open, with a conversion rate 10 %. The reasons of conversion were a large size of the perforation in one patient and difficulty in placing the sutures through the friable edges in these patient. These two laparoscopic converted patients were not compared to the other patients in regard to the operative and postoperative sequels; in order to obtain a fair comparison between both open and laparoscopic groups.

Postoperative care

- All the patients received the following care after surgery.
- IV Analgesics was given when indicated.
- IV Fluids were given until oral feeding can be started.
- IV Antibiotics were given in the form of 3rd generation Cephalosporin's and Metronidazole.
- IV Proton pump inhibitors then eradication of *Helicobacter Helicobacter* in out patient's clinic in eight weeks.

- Nasogastric tube was removed when oral feeding started.
- Oral feeding was started within a minimum of 3 days after surgery.
- Drain tubes were removed when no more than 50 ml of drained fluid per day.

The following variables were then compared between the 2 groups: operative time, postoperative pain, return of bowel habit, length of postoperative hospital stay, wound complications, pulmonary infections, suture leakage, and postoperative intraperitoneal collections.

Follow up in outpatient clinic

All patients were followed in outpatient clinic after discharge from hospital weekly for one month then monthly for six months, they were followed by Telephone.

STATISTICAL ANALYSIS

Data were statistically described in terms of mean Standard Deviation (SD), median and range, or frequencies (number of cases) and percentages when appropriate.

Comparison of numerical variables between the study groups was done using Man Whitney U test for independent samples.

For comparing categorical data, Chi square (2) test was performed. Exact test was used instead when the expected frequency is less than 5. (P) Values less than 0.05 was considered statistically significant.

All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

RESULTS

Patients were divided according to gender in each group. Most of the patients were males as shown in figure 11. Patient's age ranged from 20 years old to 70 years old with the mean age 42 years old in laparoscopic group and 44 years old in open group. Large number in age group between 30 to 40 years old in both groups as shown in table 1 and table 2. No history of peptic ulcer disease in more than half of patients in both groups (Table 3). NSAID intake was not common in both groups as shown in table 4.

The commonest presenting symptoms were sudden onset of severe epigastric pain in (100%), abdominal distention in (65%) and vomiting in (50%) patients. Abdominal tenderness and classical signs of peritonitis were demonstrable in (90%) and (75%) patients respectively as shown in table 5.

The mean operative time was significantly longer in the laparoscopic group than the open one (Table 6). Size of perforation

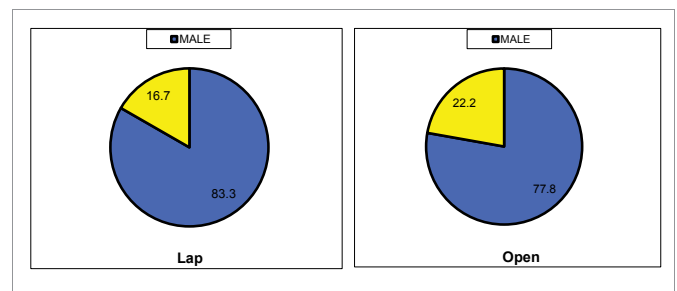


Figure 11: Distribution of patients according to gender.

in both groups were less than 10 mm as shown in table 7. Duodenum was the most common site among both groups as shown in table 8. The post-operative pain was significantly higher in the open group than the laparoscopic one (Table 9). Bowel habit returns earlier in the laparoscopic group than the open one, a statistically significant result (Table 10). Start of oral diet intake was significantly early in the laparoscopic group than the open one (Table 11). Nasogastric (N/G) tube removal was significantly early in the laparoscopic group than the open one (Table 12). Hospital stay was significantly longer in the open group than the laparoscopic one (Table 13). Deep venous thrombosis more in open group than in laparoscopic group (Table 14). The incidence of wound complications was more common in the open group as shown in table 15. Pulmonary infections was higher after open surgery than laparoscopic surgery, statistically significant result (Table 16).

There are two cases of Suture leakage that were diagnosed by

Table 1: Distribution of patients according to age.

	Group	N	Mean ± SD	t	P
Age	Lap	18	42.4444 ± 10.33112	-0.396	0.695
	Open	18	44.0556 ± 13.83292		

Table 2: Distribution of patients in age groups.

Age group	Lap (18)		Open (18)		X ²	P
	No	(%)	No	(%)		
20-30	2	11.1	3	16.7	0.61	0.96
30-40	6	33.4	5	27.7		
40-50	5	24.7	4	22.2		
50-60	3	16.7	3	16.7		
60-70	2	11.1	3	16.7		

Table 3: History of peptic ulcer disease.

History of peptic ulcer disease		Group			Total	X ²	P
		Lap (18)	Open (18)				
No	Count (%)	10 55.6%	11 61.1%	21 58.3%	0.00	1.00	
Yes	Count (%)	8 44.4%	7 38.9%	15 41.7%			

Table 4: Incidence of NSAID intake in both groups.

Cross tab							
NSAID		Group			Total	X ²	P
		Lap (18)	Open (18)				
No	Count (%)	10 55.6%	12 66.7%	22 61.1%	0.46	0.49	
Yes	Count (%)	8 44.4%	6 33.3%	14 38.9%			

Table 5: Clinical presentation in both groups.

Clinical presentation	Lap (18)		Open (18)		X ²	P
	N	%	N	%		
Severe abdominal pain	18	100	18	100	1.28	0.25
Abdominal distention	11	61	13	72	1.83	0.17
Vomiting	9	50	9	50	0.0	1.1
Abdominal tenderness	16	88	17	94	3.4	0.055
Classical signs of peritonitis	14	77	13	72	0.21	0.64

Table 6: Comparison between operative times in minutes in both groups.

	Group	N	Mean ± SD	t	P
Operation Time	Lab	18	150.5556 ± 20.28393	4.293	0.00**
	Open	18	106.3889 ± 38.64642		

Table 7: Comparison between operative sizes in both groups.

	Group	N	Mean ± SD	t	P
Perforation Size	Lap	18	6.24 ± 1.7	1.1	0.095
	Open	18	6.85 ± 1.8		

Table 8: Comparison between operative sites in both groups.

Perforation Site		Group		Total	X ²	P
		Lap (18)	Open (18)			
Duodenum	Count (%)	15 83.4%	14 77.8%	29 80.6%	0.17	0.67
Stomach	Count (%)	3 16.6%	4 22.2%	7 19.4%		

Table 9: Estimation of the postoperative pain using the Numerical pain scale scoring system (0-10) in both groups.

	Group	N	Mean ± SD	t	P
Post operation pain	Lab	18	1.3722 ± 0.46248	-3.846	0.001**
	Open	18	5.3611 ± 2.37589		

Table 10: Return of bowel habit after surgery in both groups (per days).

	Group	N	Mean ± SD	t	P
Return of bowel habit	Lab	18	1.3333 ± 0.92355	2.912	0.021*
	Open	18	2.5333 ± 0.47574		

Table 11: Time of the start of oral intake (in days) after surgery among the two groups.

	Group	N	Mean ± SD	t	P
Start oral	Lab	18	2.5778 ± 0.46089	-3.913	0.00**
	Open	18	3.7222 ± 1.07406		

Table 12: Time of N/G tube removal (in days) after surgery among the two groups.

	Group	N	Mean ± SD	t	P
N/G tube removal	Lab	18	1.4167 ± 0.46177	-3.487	0.001**
	Open	18	2.7222 ± 0.89479		

Table 13: Length of postoperative hospital stay (in days) among the two groups.

	Group	N	Mean ± SD	t	P
Hospital stay	Lab	18	4.8889 ± 1.27827	-2.687	0.011*
	Open	18	6.8333 ± 2.79179		

Table 14: Deep venous thrombosis in both groups.

DVT	Lap	Open	X ²	P
Yes	0 0.0%	2 11.1%	2.11	0.14
No	18 100%	16 88.9%		

Table 15: Incidence of wound complications among both groups.

Wound infection		group		Total	X ²	P
		Lap (18)	Open (18)			
No	Count %	18 100.0%	12 66.7%	30 86.1%	7.2	0.007*
Yes	Count %	0 0.0%	6 33.3%	6 13.9%		

Table 16: Incidence of pulmonary infections among both groups.

Pulmonary infections		Group		Total	X ²	P
		Lap (18)	Open (18)			
No	Count	17 94.4%	12 66.7%	29 80.6%	4.43	0.035*
Yes	Count	1 5.6%	6 33.3%	7 19.4%		

gastrographin meal as shown in figure 12. One patient in the open group developed suture leakage which was managed by surgery (omental patch repair) after failure of conservative treatment in this patient. Also one patient developed suture leakage was reported in the laparoscopic group which was managed conservatively as shown in table 17.

Post-operative intra-abdominal collection occurred only in one patient of the laparoscopic group. The patient was diagnosed by ultra-sonography and C.T scan as shown in figure 13. The patient was managed conservatively by U/S guided aspiration and improved.

By follow up in out-patient clinic, we found that two patients presented by incisional hernia in open group, while no one in laparoscopic group as shown in table 18.

By follow up patients in out-patient clinic, we found that there were recurrence of peptic ulcer manifestations in two cases in laparoscopic group and three cases in open group as shown in table 19.

DISCUSSION

The incidence and management of peptic ulcer disease have changed considerably since the first surgical interventions, carried out less than a century ago.

Firstly, understanding the etiology of the disease process has taken a dramatic step forward with the discovery of *Helicobacter pylori* now known to be associated with 95% of cases of duodenal ulceration.

Secondly, the pharmacological development of H2-receptor antagonists and proton pump inhibitors means that the control of acid secretion in the stomach is now achievable without resorting to invasive and often debilitating surgical procedures [9].

Despite these advances, emergency presentations with either hemorrhage or perforation continue to occur with relative frequency

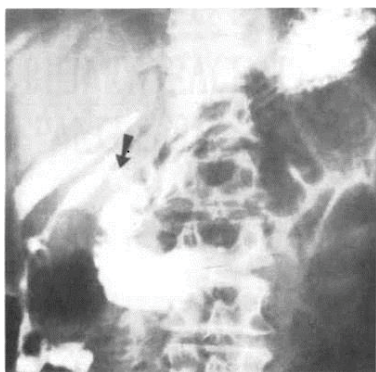


Figure 12: Gastrographin meal show leakage of dye in peritoneal cavity.

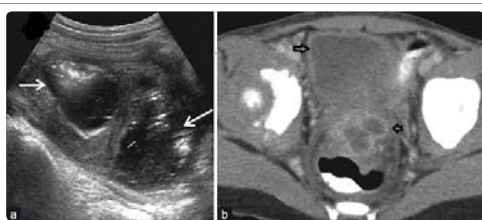


Figure 13: Ultra-sonography (A) and C.T (B) scan showing pelvic collection.

Table 17: Incidence of suture leakage among both groups.

Suture leakage		Group		Total	X ²	P
		Lap	Open			
No	Count % within group	17 94.4%	17 94.4%	34 94.4%	0.00	1.00
Yes	Count % within group	1 5.6%	1 5.6%	2 5.6%		

Table 18: Incidence of incisional hernia among both groups.

Incisional hernia	Lap (18)	Open (18)	X ²	P
Yes	0 (0.0%)	2 (11.1%)	3.27	0.07
No	18 (100.0%)	16 (88.9%)		

Table 19: Incidence of recurrence of manifestations of P.U.D among both groups.

Recurrence of manifestations of P.U.D	Lap		Open		X ²	P
	No	(%)	No	(%)		
Yes	2	11.1%	3	16.7%	0.23	0.63
No	16	88.9%	15	83.3%		

and it remains the responsibility of the surgical trainee to understand the fundamentals of patient management in these situations

Perforated peptic ulcer is a condition in which laparoscopic repair is an attractive option. Nonetheless, not all patients are suitable for laparoscopic repair. Despite many trials, the routine treatment for perforated peptic ulcer still seems to be by upper laparotomy, representing the main motive of this study.

This prospective randomized study was conducted in emergency department, and included 36 patients with perforated peptic ulcers. Patients were divided into two groups; open group and laparoscopic group according to the approach that was used to manage their.

Most of the patients in this study were males (83%), in the middle age group from 30 to 40 years old (Mean age: 43 years). These results were near similar to other study by Bertleff and Johan [8] who found that most patients were male (79%) and mean age 48 years old, also study by Sreeramulu et al. [10] found that most patients were male (80%), but most patients were in age group from 41 to 60 years old.

In this study, history of peptic ulcer disease in patients in laparoscopic group (44.4%), while in open group (38.9%). History of NSAID intake in laparoscopic group (44.4%), while in open group (33.3%), also history of smoking in laparoscopic group (77.8%), while in open group (72.2%), there were no significant difference in both groups in these variables.

Karimian et al. [11] found in their retrospective study that history of peptic ulcer disease in laparoscopic group (25.9%), while in open group (11.1%), also history of NSAID intake in laparoscopic group (40.7%), while in open group (33.3%), also history of smoking in laparoscopic group (37%) and in open group (33.3%), there were no significant difference in both groups in these variables.

In this study, the commonest presenting symptoms were sudden onset of severe epigastric pain in (100%), abdominal distention in (65%) and vomiting in (50%) patients. Abdominal tenderness and classical signs of peritonitis were demonstrable in (90%) and (75%) patients respectively. While in study by Phillippo et al. [12], the commonest presenting symptoms were sudden onset of severe epigastric pain in (97.6%), abdominal distention in (76.2%) and vomiting in (36.9%) patients. Abdominal tenderness and classical

signs of peritonitis were demonstrable in (88.1%) and (66.7%) patients respectively.

In this study, we found that two patients of the laparoscopic group were converted to open surgery, with a conversion rate 10%. The reasons of conversion were large size of the perforation in one patient (more than 2 cm) and difficulty in placing the sutures through the friable edges in the other patient. In 2013, Sreeramulu and his co-workers reported near similar conversion rate (9.6%) in a non-randomized prospective study on 61 patients, this due to large perforation (more than 2 cm.) and dense adhesion. However, Bertleff and Johan [8] reported a lower conversion rate (7.7%) in a prospective randomized controlled study.

This difference in the rate of conversion to open repair is related to multiple factors, the most important are the experience of surgeons, the learning curve and good equipment's.

The operative time in this study was significantly longer in the laparoscopic groups ($p = 0.00$). The mean operative time was found to be (150.6 min) in the laparoscopic group compared to the open group (106.4 min).

The same was proved by Sreeramulu et al. [10] who demonstrated a significantly longer operative time for laparoscopic repair. Study by Gyou et al. [13] found shorter time for laparoscopic repair than for open repair.

The variation in the operative time between different studies due to the fact that the operative teams are not equivalent in terms of experience and availability of good equipment. In our study, we found that by improving learning curve, the operative time in laparoscopic group become shorter by time.

In this study, we found the site of perforation mainly in duodenum in (83.4%) in laparoscopic group and nearly (77.8%) in open group, while only in pylorus (16.6%) in laparoscopic group and (22.2%) in open group. This of no significance difference. Also, study by Gyou et al. [13] found the site of perforation mainly in duodenum (80%) in laparoscopic group and (78%), while in pylorus (20%) in laparoscopic group and (22%) in open group. Also of no significance difference.

In this study, we found the size of perforation mainly less than 10 mm. Mean size in laparoscopic group (6.24 mm), while in open group (6.85 mm). This of non-significance difference.

Karimian et al. [11] found that mean size of perforation (6.9 mm) in laparoscopic group, while (6.26 mm) in open group. Also this of non-significance difference.

Postoperative pain, measured using the NRS (Numerical Rating Scale), was highly significantly less in the laparoscopic group ($p = 0.001$). The same was proved by Sreeramulu et al. [10] who showed a lower pain score after laparoscopic repair than after open repair.

The return of bowel habit was significantly early in the laparoscopic group (mean 1.33 days) compared to the open group (mean 2.53 days), $p = 0.021$. Consequently, the start of oral diet was also earlier in the laparoscopic group (mean 2.57 days) than the open group (mean 3.72 days), $p = 0.00$. This was reflected on the length of hospital stay which was significantly less in the laparoscopic group (mean 4.88 days) compared to the open group (mean 6.83 days), $p = 0.011$

The same was shown in a prospective study reported by Bertleff and Johan [8], where the start of oral diet was also earlier in the

laparoscopic group (mean 3.5 days) than the open group (mean 5.72 days), a significant reduction in the hospital stay was found in the laparoscopic group (mean = 6.5 days) versus 8 days in open group. Also, Sreeramulu et al. [10] confirmed earlier start of oral diet and shorter hospital stay in the laparoscopic group.

In this study, a higher incidence of pulmonary infections was observed in the open group compared to the laparoscopic group with statistical significance ($p = 0.035$). Also, in a randomized trial significant reduction in pulmonary infections rate was reported for the laparoscopic group, as compared with that for the open group ($p = 0.005$) [14].

The high incidence of pulmonary infections in ulcer disease patients is related to the high prevalence of smoking among these groups of patients in general (75%).

The incidence of pulmonary infections increases more in the open group due to the higher incidence of upper abdominal pain interfering with the proper expansion of the chest.

Wound complications during hospitalization were the most common morbidity after open repair of perforated peptic ulcers with a rate of 33.3% compared to the laparoscopic group 0%. This difference reach the statistical significance level ($p = 0.007$). The wound complications were in the form of superficial surgical site infection, wound seroma and wound dehiscence. Mehendale et al. [15] observed a higher incidence of wound complications in the open group. The difference did not reach statistical significance.

This difference in the incidence of wound complications between the two groups is a common feature to all surgical abdominal procedures; in which wound complications is higher is open surgical procedures than laparoscopic ones [16].

In this study, deep venous thrombosis was observed in two cases (11%) in open group and none of the laparoscopic group with no statistical significance ($p = 0.14$).

In a study conducted by Schmidt et al. [17], only one case (1.7%) of deep venous thrombosis was reported only in open group. The higher incidence of deep venous thrombosis more in open group may be due to late ambulation that is contributed to severe postoperative pain and delay of return of bowel habit.

In this study, suture leakage occurred in two cases, one in each group (5.5%) with no statistical significance. The same result was also observed by Ricky et al. [18].

However, in a study conducted by Bertleff and Johan [8], a higher incidence of leakage was found in the laparoscopic group (3%) compared to the open group (0%), but leakage mainly occurred in the sutureless repair group or in the group in which omentoplasty was not routinely used. However, in a study conducted by Gyou et al. [13], leakage rate reached zero%.

The incidence of suture leakage in ulcer disease patients is related to technical errors, friability of tissues and size of perforation.

In this study, we found a postoperative intra-abdominal collection was observed in one case (5.5%) after laparoscopic repair. This occurred in the first case mostly due to inadequate equipment's, no case in open group. This emphasizes the importance of performing an adequate lavage especially if the laparoscopic approach is chosen. In study by Gyou et al. [13], postoperative intra-abdominal collection was observed in three cases out of 35 cases (8.5%) after open repair, no single case in laparoscopic group.

In this study, incisional hernia was observed two cases (11.1%) in open group, while no hernia developed in laparoscopic group, but Schmidt et al. (17) found only one case in open group (2.2%). Incisional hernia more in open group due to long midline incision and more wound complications.

In this study, recurrence of peptic ulcer disease was observed in two cases (11.1%) in laparoscopic group, while in three cases (16.7%) in open group. This is of no statistically difference. While, Gyou et al. [13] found only one case in laparoscopic group (2.6%) and two cases in open group (5.4%), also of no statistically difference.

One benefit of the laparoscopic procedure in this study is cosmetic outcome. Nowadays patients are aware of this benefit, and sometimes this is the reason why they ask for laparoscopic surgery. Another benefit of the laparoscopic procedure in this study less postoperative adhesions that contributed to small incisions and less manipulations.

Based on the statistical analysis, we found that the laparoscopic repair of perforated peptic ulcers is superior to the open repair in regard to the postoperative pain, return of bowel habit, start of oral diet and length of hospital stay. Currently, the main drawbacks of laparoscopic repair are a longer operative time and difficult repair of large sized perforation. While the main drawbacks of the open repair are the higher rate of pulmonary infections, wound complications and less cosmetic outcome.

CONCLUSION

Based on this study, we conclude that laparoscopic repair of perforated peptic ulcers is a safe emergency procedure with many advantages such as less postoperative pain, early return of bowel habit, early start of oral diet, less length of hospitalization, good cosmetic outcome and less postoperative complications as (wound infections, pulmonary infections and incisional hernias). However, proper patient selection, presence of experienced surgeons and adequate instrumentation are essential for a successful patient outcome.

We recommend availability of high definition laparoscope and starting programs for junior staff training of intracorporeal suturing and management of perforated peptic ulcer.

REFERENCES

- Elnagib E, Mahadi S, Mohamed E. Perforated peptic ulcer in Khartoum. *Khartoum Medical Journal*. 2008; 1: 62-64. <https://goo.gl/LSRsmg>
- Montalvo JE, Corres SO, Athie GC. Factors associated with postoperative complications and mortality in perforated peptic ulcer. *Cir Cir*. 2011; 35: 128-135. <https://goo.gl/nPGaCM>
- Ohene YM, Togbe B. Perforated gastric and duodenal ulcers in an urban African population. *West Afr J Med*. 2006; 25: 205-211. <https://goo.gl/2VbEB7>
- Amela S, Serif B, Lidija L. Early radiological diagnostics of gastrointestinal infection in the management of peptic ulcer perforation. *Radiol Oncol*. 2006; 40: 67-72.
- Nasio N, Saidi H. Perforated Peptic Ulcer Disease at Kenyatta National Hospital, Nairobi. *East and Central African Journal of Surgery*. 2009; 14: 13-16. <https://goo.gl/gKG8NE>
- Khan S, Aziz S, Ul-Haq I. Perforated peptic ulcers: A review of 36 cases. *Professional Med J*. 2011; 18: 124-127.
- Bhogal RH, Athwal R, Durkin D, Deakin M, Cheruvu CN. Comparison between open and laparoscopic repair of perforated peptic ulcer disease. *World J Surg*. 2009; 32: 2371-2374. <https://goo.gl/BTJY2w>
- Bertleff MJ, Johan FL. Laparoscopic correction of perforated peptic ulcer: first choice? A review of literature. *Surg Endosc*. 2010; 24: 1231-1239. <https://goo.gl/mcGXaa>
- Stewart DJ, Roger A, Ariga T. Peptic ulcer and their complications. *Surgery (Oxford)*. 2011; 29: 568-574. <https://goo.gl/v6pgPT>
- Sreeramulu PN, Venkata chalopathy TS, Supreet CS. A comparative study of laparoscopic versus open surgery for management of duodenal ulcer perforation. *World Journal of surgery*. 2013; 6: 11-14.
- Karimian F, Aminian A, Lebaschi AH. Perforated peptic ulcer, comparison between laparoscopic and open repair. *Shiraz E Medical Journal*. 2009; 10: 21-28.
- Chalya PL, Mabula JB, Koy M, Mchembe MD, Jaka HM, Kabangila R, et al. Clinical profile and outcome of surgical treatment of perforated peptic ulcers in Northwestern Tanzania: A tertiary hospital experience. *World J Emerg Surg*. 2011; 10: 1186-1192. <https://goo.gl/v6pgPT>
- Gyou RL, Jong KP, Sung GK, Seung HC, Sang SY, Seong L, et al. Laparoscopic primary closure, a better method of treatment of perforated peptic ulcer than open repair. *J Minim Invasive Surg*. 2012; 15: 11-14. <https://goo.gl/6XipqH>
- Siu WT, Leong HT, Law BK, Chau CH, Li AC, Fung KH, et al. Laparoscopic repair for perforated peptic ulcer: a randomized controlled trial. *Ann Surg*. 2002; 235: 313-319. <https://goo.gl/w97rcr>
- Mehendale VG, Shenoy SN, Joshi AM, Chaudhari NC. Laparoscopic versus open surgical closure of perforated duodenal ulcer: a comparative study. *Indian J Gastroenterol*. 2002; 21: 222-224. <https://goo.gl/5yWTFb>
- Fanaie SA, Ziaec SA, Goodman KJ. Safety of oral feeding after repair of perforated peptic ulcer. *Indian J Surgery*. 2007; 67: 185-188.
- Bertleff MJ, Halm JA, Bemelman WA, van der Ham AC, van der Harst E, Oei HI, et al. Randomized clinical trial of laparoscopic versus open repair of perforated peptic ulcer. *World J Surg*. 2009; 33: 1368-1373. <https://goo.gl/tEQTTZ>
- Bhogal RH, Athwal R, Durkin D, Deakin M, Cheruvu CN. Comparison between open and laparoscopic repair of perforated peptic ulcer disease. *World J Surg*. 2008; 32: 2371-2374. <https://goo.gl/ff6gJrv>