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Study of Risk Factors Leading to Conversion of Laparoscopic Simple Closure to Open Surgery in Perforated Peptic Ulcer

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ABSTRACT

Background: When compared to open surgery for perforated peptic ulcers, laparoscopic treatment has many advantages, including less pain, a quicker recovery time, and less consequences. **Objective:** This study aimed to assess the risk factors that lead to conversion of laparoscopic simple closure of perforated peptic ulcer to open procedure in Zagazig University Hospitals.

Subjects and Methods: Our study is prospective randomized clinical trial was done in the General Surgery Department at Zagazig University Hospital on a study sample of 24 patients who visited an emergency room complaining of severe stomach discomfort and were told they had a perforated peptic ulcer. Those patients underwent laparoscopic repair at first. The steps of laparoscopic repair were performed after the perforation site was located laparoscopically, assuming that the initial diagnosis was correct.

Results: Studied groups differed significantly regarding duration of perforation and its size, hospital stay and duration of operation. These variables were higher among conversion group than laparoscopic group. The average laparoscopic simple closure (LSC) conversion rate was 12.4% (range: 0% to 28.5%). The size of the perforation was the primary factor in most cases of conversion, however the location of the perforation was also a typical contributing factor. Only 4 of the total 24 instances in the research were converted, at a percentage of (16.7%).

Conclusion: Laparoscopic management of perforated peptic ulcer is safe and practicable for the well-trained surgeon. It causes less pain postoperatively, and the rate of complications is less than an open approach.

Keywords: Laparoscopic simple closure, Open surgery, Perforated peptic ulcer.

INTRODUCTION

Medical advances like H_2 receptor antagonists, proton pump inhibitors (PPIs), and the elimination of Helicobacter pylori have led to a decline in the incidence of peptic ulcer disease in recent decades [(1)]. However, complications from peptic ulcers have not decreased in tandem with the decline in peptic ulcer disease [(2)].

However, the prevalence of perforated peptic ulcers (PPUs) has stayed relatively constant over the previous few decades despite their high mortality rate [(3)].

Many studies have been conducted since the first report of laparoscopic management of PPU in 1990 to assess its efficacy and safety [(4)]. When comparing laparoscopic repair of PPU to open surgery, laparoscopic repair is preferable since it results in less pain, a shorter hospital stay, and less overall damage to the body. As medical care for PPU has advanced and laparoscopic surgery has become more widespread, a new trend has emerged: the use of laparoscopic simple closure (LSC) instead of open repair. On the other hand, laparoscopic surgery isn't a good option for everyone [(5)].

Compared to open surgery, reoperation rates following laparoscopic repair have been shown to be much higher in several studies [(4-6)]. While many studies have shown laparoscopic and open repair to be effective for PPU. Surgeons still sometimes have complications with the procedure [(7)].

It was the goal of this study, to assess the risk factors that lead to conversion of laparoscopic simple closure of perforated peptic ulcer to open procedure in Zagazig University Hospitals.

SUBJECTS AND METHODS

Subjects:

Our study is prospective randomized clinical trial that was done in the General Surgery Department at Zagazig University Hospital on a study sample of 24 patients who were presented with acute abdominal pain and diagnosed with perforated peptic ulcer.

Methods of the study:

Perforated peptic ulcer was diagnosed based on:

- **Proper history and examination:** History of smoking and intake of NSAIDs. Perforation symptoms present themselves with a sudden onset of severe stomach discomfort, nausea, and vomiting. Abdominal rigidity, discomfort, and rebound tenderness are all symptoms of a perforation.
- **Lab investigations:** Testing for initial evaluation and resuscitation purposes, including complete blood count, serum electrolytes (Na, K), serum amylase, kidney, and liver functions.
- **Radiology:** Most commonly in the form of an upright abdominal X-ray and a plain chest X-ray to detect the presence of free air in the belly and verify a perforation. However, other tests, such as pelvic-abdominal ultrasonography for detecting intraperitoneal turbid fluid or collections, are also performed and when the diagnosis was uncertain, patients underwent a CT of the abdomen and pelvis with oral and intravenous contrast since free air under the diaphragm is not always visible on a standard X-ray.

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Initial resuscitation was performed in line with the diagnosis, and consisted of:

- Evaluation of clinical parameters.
- Intravenous fluid therapy and electrolyte balance restoration
- Opioid-based IV analgesics (such pethidine) are the treatment of choice for severe pain.
- IV antibiotics (e.g., 3rd generation cephalosporins and metronidazole).
- The administration of proton pump inhibitors.
- A nasogastric (Ryle's) tube is inserted into the oesophagus to relieve pressure on the stomach, reducing the likelihood that stomach contents would leak into the abdominal cavity, and a urinary catheter is placed.

Inclusion criteria:

Patients typically during the first day of experiencing symptoms, patients whose hemodynamic status continues to be stable following first resuscitation, as well as who fall within ASA (American Society of Anesthesiologists) categories I and II. Patients with an American Heart Association (ASA) fitness grade I having no systemic diseases and those with an ASA fitness grade II have only modest systemic diseases that do not hinder their daily activities, aged between 18 and 70, and who signed informed consent to participate in this study.

Exclusion criteria:

Patients admitted with a systolic blood pressure of less than 90 mmHg, patients with severe cardiorespiratory comorbidities who were unable to have a pneumoperitoneum due to anaesthetic contraindications, as well as patients who had previously undergone open procedures to the upper abdomen**.**

Method:

Twenty-four patients reported with severe abdominal discomfort, were diagnosed with perforated peptic ulcer, and were admitted to the Surgical Emergency Unit at Zagazig University's Faculty of Medicine for treatment. Initially, laparoscopic repair was used on those people. Laparoscopic perforation site identification was followed by laparoscopic repair processes if the initial diagnosis was not rejected. Intraoperative assessment of risk variables and potential challenges with surgical technique informed decisions about the type of surgery to be performed (laparoscopic vs. conversion; simple closure vs. gastrectomy).

Laparoscopic technique:

General anaesthesia is used for the surgery. The patient's legs were placed in stirrups on the operating table, and the knees and hips were bent slightly and flexed by around 10 degrees. About fifteen-degree incline was applied to the operating table's head end. The scrub nurse was able to assist with instrument placement in the surgical ports after moving the instrument trolley to the right side of the operating table.

Hasson's open approach was used, and the Verres needle was employed on sometimes. The supra umbilical location of the 10 mm camera port was chosen as an intermediate point between the different shapes and sizes of patients. Right upper quadrant, 8-10 cm from midline, between umbilicus and costal cartilage, 5 mm port insertion. Midway between the belly button and the sternal notch, a 10 mm port was surgically implanted in the patient's upper left chest. It was sometimes necessary to employ a fourth port positioned below the xiphisternum to retract the liver.

Non-pyloroduodenal perforation, perforation bigger than 20 mm, and technically challenging repair are also reasons to switch to an open operation. Whether or not individuals with a perforated ulcer that has been clinically sealed off should undergo surgery is debatable. The patient needs close observation if conservative treatment is adopted. If the patient's condition worsens, an urgent laparoscopy is necessary. After placing sutures, the wound was stitched shut. Following the tying of the sutures, the omentum was placed over them and secured. Intracorporeal knotting was used to secure the sutures.
It was laundered again, section by section. Drains were placed in the pelvic and hepatic ducts and the kidneys.

Figure (1A): Localizing the perforation

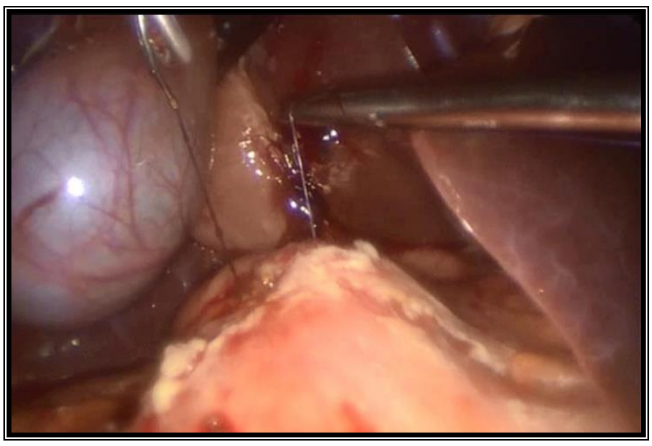

Figure (1B): Sutures placed on the edges of the perforation site and tied

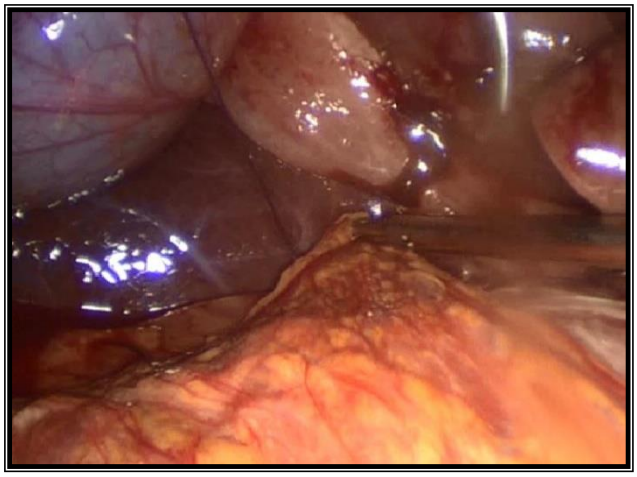

Figure (1C): The omental flap is centered over the tied sutures

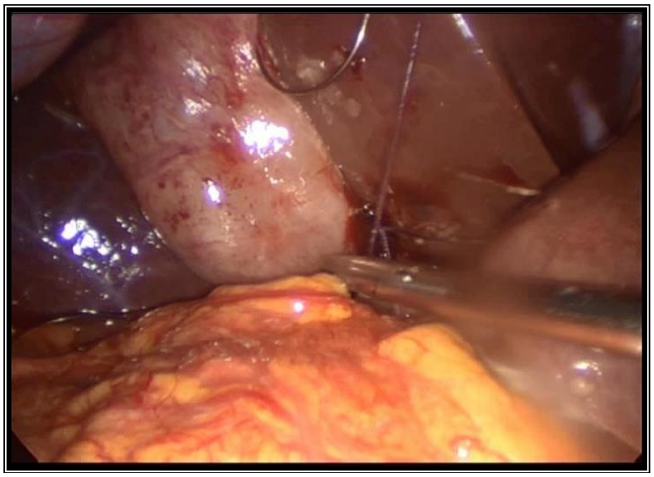

Figure (1D): Securing the knots over the omental flap

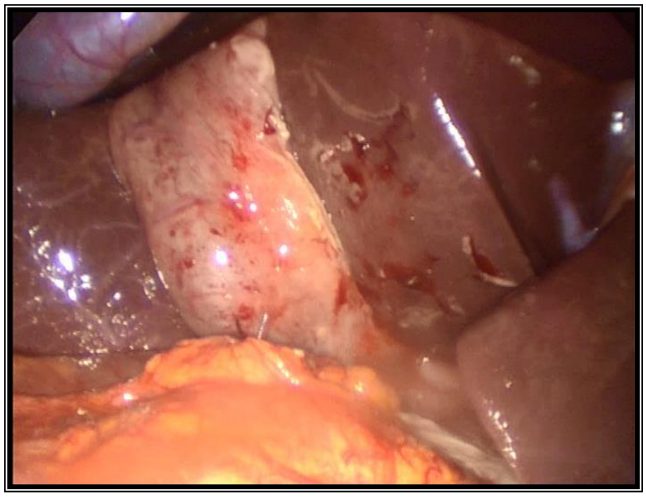

Figure (1E): Completion of the variation of omental flap repair

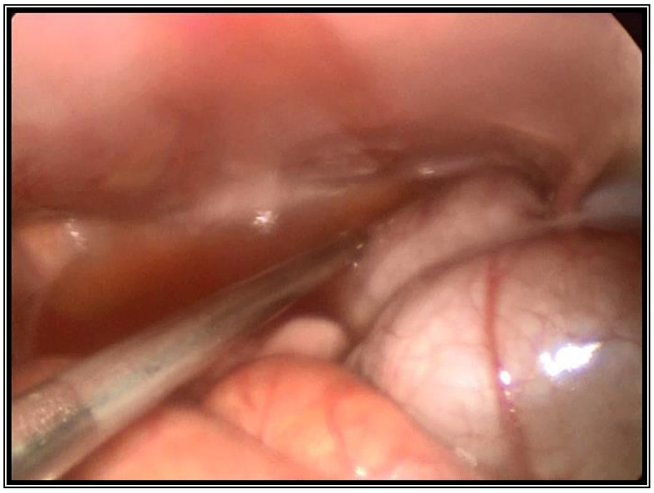

Figure (1F): Lavage of the abdomen

Figure (1): Description of laparoscopic technique.

♦ **Shift to open procedures:**

This represents a conversion rate of roughly 16.7%, based on the four patients who were converted to open surgery from the patient group. Because of the magnitude of the perforation and the difficulty in suturing the friable borders, these patients were converted.

Open repair technique:

To get access to the abdominal cavity, an incision was made in the upper midline, which could then be extended inferiorly and explored. As soon as the perforation was discovered, the stomach and duodenum were inspected, and the perforation was visualized if existent, after the gastrointestinal spillage and any purulent exudates had been suctioned from the entire abdomen. As soon as the puncture was discovered, preparations were made to fix it. The omental flap technique was employed (a modification of Graham's patch technique) to make the necessary repairs.

The perforation was closed with three (Vicryl 2/0) full-thickness sutures. Sutures were positioned roughly 0.5 cm from the perforation's margins. Sutures were tied from above to below across the omental flap, then placed over a pedicled area of omentum. The omentum needs to be held in place by sutures, which should be tight enough to prevent it from moving, but not so tight that the omentum's blood supply is cut off.

About 4 to 6 liters of warm saline are used to irrigate the peritoneal cavity in order to flush out any harmful bacteria. The supra- and infra-hepatic recesses, the paracolic gutters, and the pelvis are all carefully irrigated. The next step is to place a hepatorenal and pelvic drains. After that, polypropylene sutures were used to seal the abdominal area in one continuous motion.

Figure (2 A): Sutures placed on the edges and tied

Figure (2 B): Omentum placed over the tied sutures over the tied sutures.

Figure (2): Some steps of open repair technique

Follow up:

Following hospitalization, all patients were monitored for one month in an outpatient clinic, then once every three months.

Ethical consent: The Ethical Institutional Review Board at Zagazig University approved the study (IRB number#6080/5-5-2020). After explaining our research objectives, written informed consent was obtained from each study participant. This study was conducted in compliance with the code of ethics of the world medical association (Declaration of Helsinki) for human subjects.

Statistical analysis

In order to analyze the data acquired, Statistical Package of Social Sciences version 20 was used to execute it on a computer (SPSS). In order to convey the findings, tables and graphs were employed. The quantitative data were presented in the form of mean, median, standard deviation, and confidence intervals. The information was presented using qualitative statistics such as frequency and percentage. The student's t test (T) was used to assess the data while dealing with quantitative independent variables. Pearson Chi-Square and Chi-Square for Linear Trend (X^2) were used to assess qualitatively independent data. The significance of a P value of 0.05 or less was determined.

RESULTS

Age was distributed as **58.0 ± 8.6** with minimum 30 and maximum 67 years. Regard sex distribution male were majority with 83.3% and regarding smoking, smoker were 58.4% (Table 1).

Table (1): Demographic data distribution among studied group (N=24)

		Age	
Mean± SD		**58.0±8.6**	
Median (Range)		**60.5 (30-67)**	
		N	**%**
Sex	**Male**	**20**	**83.3**
	Female	**4**	**16.7**
Smoking	**No**	**10**	**41.6**
	Smoker	**14**	**58.4**
	Total	**24**	**100.0**

33.3% were diabetic and HTN were **29.2%,** NSAI used in 83.3% and alcohol administration only in **4.16%**. Ulcer history was positive in **25%** and endoscopic history was in **12.5%** (Table 2).

Table (2): Clinical history distribution among studied group

		N	%
DM	**Non**	**16**	**66.7**
	Diabetic	**8**	**33.3**
HTN	**Non**	**17**	**70.8**
	Hypertensive	**7**	**29.2**
Ulcer history	**-VE**	**18**	**75.0**
	+VE	**6**	**25.0**
NSAID	**-VE**	**4**	**16.7%**
	+VE	**20**	**83.3%**
Alcohol	**-VE**	**23**	**95.84%**
	+VE	**1**	**4.16%**
Endoscopy history	**-VE**	**21**	**87.5**
	+VE	**3**	**12.5**
	Total	**24**	**100.0**

Duration of perforation (hours) was distributed as 13.50 ± 6.73 and Size was distributed as 7.62 ± 4.23 (Table 3).

Table (3): Duration of perforation and size of perforation distribution among studied group

	Duration perforation (hours)	**Size (mm)**
Mean± SD	**13.50±3.30**	**7.62±1.81**

Hospital stay was distributed as 4.88 ± 1.52 with minimum 3 days and maximum 7 days Laparoscopic duration was 144.5 ± 13.23 and Surgery time for converted cases was 172.5 ± 5.25 (Table 4).

Table (4): Hospital stay and operation duration distribution among studied group:

	Hospital stay/ days	**Laparoscopic duration /minutes**	**Surgery time for converted cases/ minutes**
Mean± SD	**4.88± 1.11**	**144.5±13.23**	**172.5±5.25**

Nasogastric tube remove was after 33.4 ± 6.58 and VAS was distributed as 3.21 ± 0.95, Infection founded in 12.5%, suture leakage in 8.33% only one case died, and 4 cases had conversion with 16.7% (Table 5).

Table (5): Outcome and complication distribution among studied group

		Mean ±SD Median (Range)	
Nasogastric tube removes after the procedure/H		**33.4±6.58**	
VAS		**3.21±0.80**	
		N	**%**
Infection(wound or chest)	**No**	**21**	**87.5**
	Yes	**3**	**12.5**
Suture leakage	**No**	**22**	**91.67**
	Yes	**2**	**8.33**
Mortality	**No**	**23**	**95.8**
	Died	**1**	**4.2**
Conversion	**Totally laparoscopic**	**20**	**83.3**
	Conversion	**4**	**16.7**
	Total	**24**	**100.0**

Duration of perforation (hours), size in mm, longer operation duration late nasogastric tube removal, higher VAS and hospital stay were significantly higher among conversion cases and conversion cases were significantly associated with suture leakage (Table 6).

Table (6): risk factors for conversion

			Totally laparoscopic	Conversion	t/ X^2	P
Age			**58.55±7.87**	**64.25±3.23**	**1.847**	**0.068**
Duration perforation hours			**11.7±2.91**	**22.50±5.41**	**3.613**	**0.002***
Size mm			**5.60±1.35**	**17.75±4.31**	**5.714**	**0.00****
Operation duration			**144.5±13.23**	**172.5±5.25**	**4.189**	**0.00****
Sex	**Male**	**N**	**17**	**3**		
		%	**85.0%**	**75.0%**		
	Female	**N**	**3**	**1**	**0.24**	**0.62**
		%	**15.0%**	**25.0%**		
Smoking	**Non**	**N**	**11**	**2**		
		%	**55.0%**	**50.0%**		
	Smoker	**N**	**9**	**2**	**0.034**	**0.85**
		%	**45.0%**	**50.0%**		
DM	**Non**	**N**	**15**	**1**		
		%	**75.0%**	**25.0%**		
	Diabetic	**N**	**5**	**3**	**3.75**	**0.053**
		%	**25.0%**	**75.0%**		
HTN	**Non**	**N**	**14**	**3**		
		%	**70.0%**	**75.0%**		
	Hypertensive	**N**	**6**	**1**	**0.04**	**0.84**
		%	**30.0%**	**25.0%**		
NSAID	**-VE**	**N**	**4**	**0**		
		%	**20.0%**	**0.0%**		
	+VE	**N**	**16**	**4**	**0.37**	**0.77**
		%	**80.0%**	**100.0%**		
Ulcer history	**-VE**	**N**	**14**	**4**		
		%	**70.0%**	**100.0%**		
	+VE	**N**	**6**	**0**	**1.60**	**0.206**
		%	**30.0%**	**0.0%**		
Alcohol	**-VE**	**N**	**20**	**3**		
		%	**100.0%**	**75.0%**		
	+VE	**N**	**0**	**1**	**0.83**	**0.36**
		%	**0.0%**	**25.0%**		
Infection	**-VE**	**N**	**19**	**2**		
		%	**95.0%**	**50.0%**		
	+VE	**N**	**1**	**2**	**2.47**	**0.11**
		%	**5.0%**	**50.0%**		
Suture leakage	**-VE**	**N**	**20**	**2**		
		%	**100.0%**	**50.0%**		
	+VE	**N**	**0**	**2**	**7.85**	**0.013***
		%	**0.0%**	**50.0%**		
Endoscopy history	**-VE**	**N**	**17**	**4**		
		%	**85.0%**	**100.0%**		
	+VE	**N**	**3**	**0**	**0.68**	**0.41**
		%	**15.0%**	**0.0%**		
Total		**N**	**20**	**4**		
		%	**100.0%**	**100.0%**		

Significant AUC with sensitivity 75.0%, 78.0% , 77.5%, 85.0% and 77.5% respectively and specificity 90.0%, 82.0%, 83.3%, 78.0% and 75.0% respectively (Figure 3 and table 7).

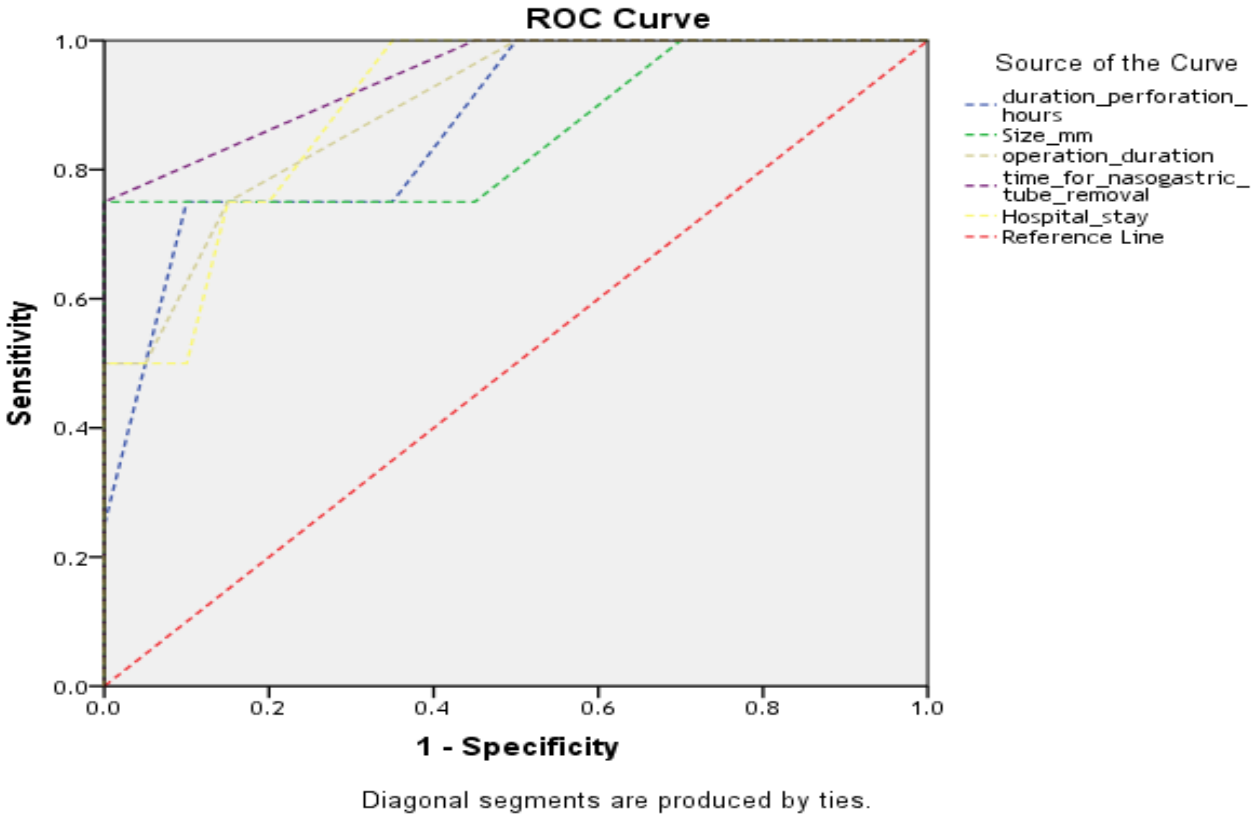

Figure (3): ROC curve for detection of conversion cutoffs.

Table (7): Conversion cutoffs

Test Result Variable(s)	Area	Cutoff	P	95% Confidence Interval		Sensitivity	Specificity
				Lower Bound	Upper Bound		
Duration perforation hours	**0.869**	**>16.5**	**0.022***	**0.676**	**0.999**	**75.0%**	**90.0%**
Size /mm	**0.856**	**>8.5**	**0.027***	**0.600**	**0.985**	**78.0%**	**82.0%**
Operation duration	**0.894**	**>155**	**0.015***	**0.731**	**0.987**	**77.5%**	**83.3%**
Time for nasogastric tube removal	**0.944**	**>39.0**	**0.006***	**0.817**	**0.963**	**85.0%**	**78.0%**
Hospital stay	**0.900**	**>5**	**0.013***	**0.756**	**0.954**	**77.5%**	**75.0%**

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DISCUSSION

Perforated peptic ulcer disease (PPU) is a serious complication of peptic ulcer disease that occurs in 3-5% of cases. While PPU incidence has decreased over the past two decades thanks to developments in modern peptic ulcer medication, death has not decreased at the same pace despite improvements in operational approach and perioperative care [(1)].

Recent meta-analyses and randomised controlled trials comparing laparoscopic repair and open surgery have not yielded a clear winner. Geographic variation in peptic ulcer illness has been well-documented, with the majority of included randomised trials coming from Europe and China [(8)].

During the period beginning in January of 2020 and ending in September of 2020, a total of 24 patients received PPU surgery. Twenty (83.3%) of the patients had successful laparoscopic procedures, whereas four (16.7%) required conversion to open surgery. This is consistent with a study made by **Rohan *et al.*** [(9)] between January 2011 and December 2015, a total of 109 patients received PPU surgery. A total of 71 patients (65%) had their procedures completed laparoscopically, with the remaining 15% requiring open surgery conversion. Furthermore, that study found no statistically significant distinction between open and laparoscopic patients.

Age was distributed as 58.0 ± 8.6 with minimum 30 and maximum 67 years, while sex distribution showed that male were majority with 83.3% and smoker were 58.4%. 33.3% were diabetic and HTN were 29.2%, NSAID used in 83.3% and alcohol administration only was 4.16%, ulcer history was positive in 25% and endoscopic history was in 12.5%. In terms of age, gender, systolic blood pressure at admission, diabetes mellitus, smoking status, alcohol consumption, and non-steroidal anti-inflammatory drug use, there was no statistically significant difference between open and laparoscopic patients.

In this study the duration of perforation in hours was distributed as 13.50 ± 6.73 with minimum 7 hours and maximum 36 hours. Perforation size (in mm) was distributed as 7.62 ± 4.23 with minimum 3 mm and maximum size 28 mm. Studied groups differed significantly as regards duration of perforation and its size. Both variables were higher among conversion group (P value < 0.05). The duration of perforation was 11.7 ± 3.87 in laparoscopic repair group while in conversion group was 22.5 ± 8.24 (P 0.002).

As regards size of perforation, it was 5.6 ± 1.75 in laparoscopic repair group and 17.75 ± 6.85 in conversion group (P 0.00). This agree with the study made by **Kim *et al.*** [(10)] Specifically, the time it took for the perforation to heal was considerably longer in the conversion group than in the completely laparoscopic repair group (21.0 14.0 h vs.10.2 5.8 h, respectively: p 0.002). The mean perforation size was larger in the conversion group (14.0 11.8 mm vs. 3.8 1.9 mm, respectively; p 0.001) than in the completely laparoscopic repair group.

Laparoscopic repair operative duration was 144.5 ± 13.23 minutes with minimum 90 minutes and maximum 180 minutes. Surgery operative time for converted cases was 172.5 ± 5.25 minutes with minimum 120 minutes and maximum 200 minutes. The only discouraging result of the laparoscopic approach could be the slightly longer duration of the operation as studied by **Al-Khaleegy *et al.*** [(11)].

There was statistically significant difference between the studied groups as regards suture leakage, which was only among the conversion group 2 cases (50%) but totally laparoscopic group showed no leakage. This is consistent with the study made by **Kim *et al.*** [(10)] where two out of eight patients in the conversion group experienced suture leaking, while only one patient in the completely laparoscopic group did (25.0% vs 3.9%, respectively; p 0.027).

Distribution of hospitalization duration was 4.88 ± 1.52, with a minimum of 3 days and a maximum of 7 days. In a statistically significant comparison between the two groups, the laparoscopic repair group had a shorter median hospital stay (4.18 ± 1.25 days) than the conversion group (6.42 ± 1.58 days; p 0.002). This is consistent with **Kim *et al.*** [(10)] study whereby patients in the conversion group spent more time in the hospital than those in the completely laparoscopic repair group (9.75 ±11.3 vs. 9.3 ±2.8 days, respectively; p 0.018).

Nasogastric tube removal was after 33.4 ± 6.58 hours and VAS was distributed as 3.21 ± 0.95. Infection was founded in 12.5%, suture leakage in 8.33% only one case died, and 4 cases had conversion with 16.7%. Time of nasogastric tube removal and post-operative pain VAS were significantly higher among conversion cases than totally laparoscopic cases and conversion cases were significantly associated with suture leakage.

Particularly susceptible to confounding is the length of time a nasogastric tube is left in place or a drain tube is left in place after surgery, as these variables might vary widely based on surgeon or institution preference [(12)]. For this reason, it's quite unlikely that these factors reflect genuine variations in surgical technique. To reduce the potential for bias, future research should adhere strictly to any established protocols for measuring and recording these factors [(9)].

Post-operative pain was assessed by VAS where we found in our study that it was higher in conversion group than totally laparoscopic repair group (4.21±1.23 vs 2.14±.72 respectively; p 0.018). So, the use of post-operative analgesia was less in the totally laparoscopic group. This can be explained by the fact

that laparoscopic correction causes less pain postoperatively [13].

There was no statistically significant difference between studied groups as regard infection post operatively. In the totally laparoscopic group infection occurred only in 1 cases (5%) among total 20 cases. While in conversion group, infection was found in 2 cases (50%) out of total 4 cases of conversion (P 0.1). This cannot be verified statistically significant because of the small total number of cases.

The average LSC conversion rate was 12.4% (range: 0% to 28.5%). The size of the perforation was the most frequent cause of change, however other factors, such as the perforation's location, also had a role [14]. The presence of a friable ulcer edge has been linked to increased probability of conversion in another study [15].

Our conversion rate was (16.7%) including only 4 cases out of total 24 cases in the study one of them was converted due to inability to locate the perforation site, which was detected after conversion at the posterior wall and closed primary with no post-operative complications.

The other 3 cases were converted because of wide perforation size > 18 mm and delayed presentation to ER more than 24 hours duration after perforation acute symptoms appeared, since they were diabetic patients the friable edges of the perforation was a true difficulty to ensure 1ry repair and two cases showed suture leakage on testing stomach distention using Methylene blue solution and complicated with infection post operatively that required more time of hospital stay and strong antibiotic coverage and follow up. That ended with that only one of them could make it and the infection was controlled and the general condition improved and the other died.

In our study only one case died (mortality rate 4.2%) due to post-operative leakage and septic peritonitis. This is consistent with a study made by **Lunevicius and Morkevicius** [15] where the postoperative mortality was from 0 to 3%.

CONCLUSION

Larger than 15 mm perforations are the sole consistent predictor of conversion. A helpful risk factor for conversion and suture leaking would be a perforation length of >12 hours. It was shown that conversion was associated with increased mortality and morbidity. Well-designed randomised clinical trials comparing the surgical outcomes of traditional open versus laparoscopic repair in high-risk patients are needed, and patient selection for laparoscopic repair remains a source of concern.

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