

Comparative Study of Laparoscopic vs Open Surgery for Duodenal Ulcer Perforation

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Abstract: Perforated duodenal ulcers are a typical surgical emergency. While open surgery has long been the standard treatment, laparoscopic techniques are gaining popularity due to their minimally invasive nature and potential for improved postoperative outcomes. **Objective:** To compare the outcomes of laparoscopic versus open surgery in the management of perforated duodenal ulcers. **Methods:** This randomised comparative study included 64 patients diagnosed with perforated duodenal ulcers. Patients were randomly assigned into two groups: Group A (n = 32) underwent laparoscopic surgery, and Group B (n = 32) underwent open surgery. Postoperative outcomes were evaluated, including operative time, duration of hospital stay, time to resume normal activities, and postoperative complications. Statistical analysis was performed using standard methods, with significance set at $p \leq 0.05$. **Results:** Laparoscopic surgery was associated with a significantly longer operative time compared to open surgery (102.38 ± 22.62 minutes vs. 66.53 ± 11.49 minutes, $p < 0.001$). However, patients in the laparoscopic group experienced a significantly shorter hospital stay (8.47 ± 1.11 days vs. 10.03 ± 2.67 days, $p = 0.005$) and returned to normal activities sooner (15.09 ± 3.14 days vs. 19.44 ± 3.10 days, $p < 0.001$). Additionally, the laparoscopic group reported fewer postoperative complications compared to the open surgery group. **Conclusion:** Laparoscopic surgery, despite a longer operative time, demonstrates superior postoperative outcomes in the management of perforated duodenal ulcers, including reduced hospital stay, fewer complications, and faster recovery. It may be considered a preferable alternative to open surgery in suitable patients.

Keywords: Laparoscopic surgery, open surgery, perforated duodenal ulcer, postoperative complications, hospital stay, recovery time

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Introduction

The duodenal ulcer perforation represents a critical and severe medical emergency that seriously affects individuals' health and well-being. Early and prompt detection and treatment of the condition are essential to decrease the currently elevated mortality rates. The duodenum symbolises the initial segment of the small intestine, extending from the stomach. It is susceptible to perforation due to multiple factors, with peptic ulcer disease being particularly prevalent among these causes (1,2). Additional notable causes encompass trauma, malignancies, infections, especially typhoid, as well as tuberculosis, ischemia, diverticula, and certain autoimmune diseases. Duodenal perforation is more common in males, particularly those aged 19 to 45 years, as well as those belonging to lower socioeconomic backgrounds (3-6).

The risk factors for duodenal perforation vary according to geographical regions, influenced by sociodemographic and environmental conditions. In developing countries, issues such as overcrowding and inadequate hygiene are common, and the condition primarily arises spontaneously as a result of peptic ulcer disease (7). The average incidence of H. pylori infection among individuals with perforated peptic ulcers ranges from 65% to 70%, suggesting that additional factors may be involved in its pathogenesis (8). The prevalence of H. pylori infection is currently declining in numerous countries, correlating with enhancements in living standards (9). Patients frequently struggle with understanding the symptoms and signs of perforation, leading to delays in treatment that may compromise their lives. Consequently, the utilisation of CT scans is crucial and should be regarded as a significant measure for improving the detection of perforation (10).

The surgical treatment of PUP typically involves two prevalent approaches: open repair and laparoscopic repair. The open abdominal approach remains a conventional method; however, it is associated with

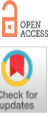
an elevated likelihood of intraoperative blood loss, extended length of stay, increased postoperative pain, as well as overall complication rates when compared to laparoscopic surgery for various emergency as well as elective surgical procedures. Nonetheless, laparoscopic surgery is linked with longer procedure duration and may present more significant challenges (11-13). Moreover, the application of laparoscopic procedures in emergency settings, particularly for perforations, exhibits variability (14).

A comparative study of laparoscopic and open surgery for duodenal ulcer perforation is crucial for evaluating the benefits and drawbacks of these two surgical approaches. The study aims to determine the most effective approach for improving patient outcomes, considering various factors. This will offer evidence-based recommendations for clinical decision-making in the management of duodenal ulcer perforation.

Methodology

A comparative observational study was conducted at the Department of Surgery from July 2024 to January 2025 at Saidu Teaching Hospital, Swat. We enrolled sixty-four patients diagnosed with perforated duodenal ulcers. We divided them into two groups, each comprising thirty-two patients: those undergoing open surgery and those undergoing laparoscopic surgery. We obtained demographic information from the patients along with existing comorbidities and clinical parameters.

The diagnosis of perforated duodenal ulcers was made based on clinical symptoms such as acute abdominal pain, signs of peritonitis, and radiological evidence. Patients presented more than 48 hours after the onset of symptoms, or patients in shock unresponsive to initial resuscitation, and those with cardiovascular diseases or respiratory disorders were excluded from participating in the study.



An experienced surgeon with five-plus years of experience performed the laparoscopic procedure. A four-port approach was used with the perforation closed using silk sutures and an omental patch. Peritoneal lavage was conducted, and a drain was placed in the Morrison's pouch. The open surgery group had a standard exploratory laparotomy with a similar repair method, having an omental patch and peritoneal lavage, which was followed by closure of the abdominal cavity. Both groups received standard postoperative care, and the outcome parameters, including hospital stay, time to return to routine, and complications, along with operative time, were assessed.

Statistical analysis was performed by utilising SPSS 24. We employed the T-test and chi-squared test to compare the outcome variables, with a significance level set at $p < 0.05$.

Results

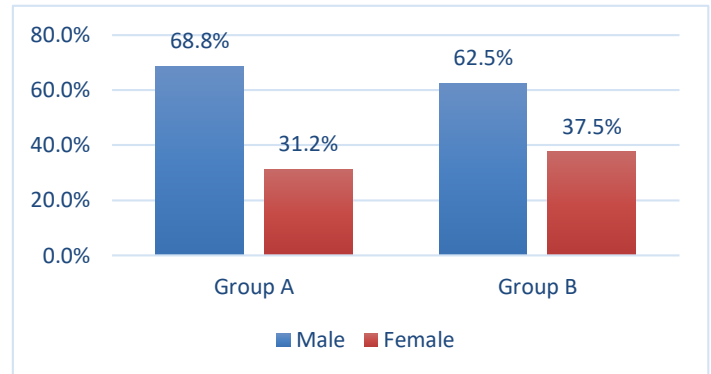
In this study, 64 patients were included, with 32 patients in group A (open surgery) and 32 in group B (laparoscopic surgery group). The mean age of patients in Group A was 56.13 ± 6.62 years, while Group B had a mean age of 51.88 ± 9.37 years. The body mass index (BMI) in group A was 25.11 ± 2.44 kg/m², and in group B, it was 25.16 ± 1.78 kg/m².

Regarding gender distribution, 22 (68.8%) patients in group A were male and 10 (31.2%) were female. In group B, 20 (62.5%) patients were male and 12 (37.5%) were female (Figure 1).

Table 1 presents the comorbidities in patients in both groups. The Boey score, which assesses the risk of postoperative complications, showed that in group A, 24 (75.0%) patients had a score of 0, six (18.8%) had a score of 1, and 2 (6.2%) had a score of 2. No patients in group A had a score of 3. In group B, 23 (71.9%) patients had a score of 0, five (15.6%) had a score of 1, three (9.4%) had a score of 2, and one (3.1%) had a score of 3.

The mean operative time for group A was 66.53 ± 11.49 minutes, while for group B, it was 102.38 ± 22.62 minutes ($p < 0.0001$). In group A, the mean hospital stay was 10.03 ± 2.67 days, compared to 8.47 ± 1.11 days in group B ($p = 0.003$). The time to return to regular activity in group B was 15.09 ± 3.14 days compared to 19.44 ± 3.10 days in group A ($p < 0.0001$) (Table 2).

Regarding postoperative complications, we observed that 5 (15.6%) patients in group A had infections, while only 1 (3.1%) patient in group B had an infection. Postoperative ileus occurred in 4 (12.5%) patients in group A and 2 (6.2%) patients in group B. Intra-abdominal abscesses were seen in 2 (6.2%) patients in group A and 1 (3.1%) patient in group B. Leakage from the perforation was seen in 3 (9.4%) patients in group A and 1 (3.1%) patient in group B. No complications were reported in 18



(56.2%) patients in group A and 27 (84.4%) patients in group B. Although this difference did not reach significance, group B showed a lower number of complications compared to group A (Table 3).

Figure 1: Gender distribution

Table 1: Comorbidities and Clinical Parameters

Comorbidities and clinical parameters		Groups			
		Group A		Group B	
		Frequency	Percentage	Frequency	Percentage
Diabetes	Yes	7	21.9%	5	15.6%
	No	25	78.1%	27	84.4%
HTN	Yes	10	31.2%	8	25.0%
	No	22	68.8%	24	75.0%
Boey score	0	24	75.0%	23	71.9%
	1	6	18.8%	5	15.6%
	2	2	6.2%	3	9.4%
	3	0	0.0%	1	3.1%
Smoking	Yes	7	21.9%	6	18.8%
	No	25	78.1%	26	81.2%
Perforation size	< 5 mm	0	0.0%	2	6.2%
	5 to 10 mm	27	84.4%	29	90.6%
	> 10 mm	5	15.6%	1	3.1%

Table 2 Comparison of outcomes between both groups

Outcome parameters	Groups	N	Mean	Std. Deviation	P value
Operative time (Mins)	Group A	32	66.53	11.486	0.0001
	Group B	32	102.38	22.621	
Hospital stay (days)	Group A	32	10.03	2.670	0.003
	Group B	32	8.47	1.107	
Time to Return to Normal Activity (Days)	Group A	32	19.44	3.100	0.0001
	Group B	32	15.09	3.135	

Table 3 Comparison of complications between both groups

Complications	Groups				P value
	Group A		Group B		
	N	%	N	%	
Infection	5	15.6%	1	3.1%	0.16
Postoperative Ileus	4	12.5%	2	6.2%	
Intra-abdominal Abscess	2	6.2%	1	3.1%	

Leakage from Perforation	3	9.4%	1	3.1%
No complication	18	56.2%	27	84.4%

Discussion

One of the most significant variables in any surgical study is the age of the patients. In our study, the mean age of patients in group A was 56.13±6.62 years compared to 51.88±9.37 years in group B. Open surgery is often associated with older and more comorbid patients who may have been deemed unsuitable for laparoscopic approaches due to the severity of the perforation. It is worth noting that age can impact surgical outcomes.

The BMI in our study was nearly consistent between the two groups. This result aligns with the findings of Deshmukh et al., who noted that BMI did not affect the comparison of laparoscopic and open surgery for duodenal perforation (15). A higher BMI can complicate laparoscopic and open surgical procedures; however, this did not appear to be an issue in our study.

The gender distribution in our study revealed a slightly higher proportion of males in both groups. This finding is consistent with other studies on perforated duodenal ulcers, which have shown that duodenal ulcer perforation is more prevalent in males (15, 16). Gender distribution does not typically influence the choice of surgical approach, but it can play a role in complication rates.

The Boey score, a well-established method for stratifying the risk of complications in patients with perforated duodenal ulcers, showed a higher proportion of patients with a score of 0 in both groups. This suggests that the majority of our patients were at low risk for postoperative complications, which is consistent with a study which reported that the majority of their patients had a 0 Boey score (16). The relatively low incidence of high-risk patients in both groups could explain the favourable outcomes observed in both surgical approaches.

Operative time was a notable difference between the two groups. The mean operative time for the laparoscopic group was 102.38±22.62 minutes, which was longer than the 66.53±11.49 minutes required for group A. This finding is consistent with other studies that report longer operative times for laparoscopic procedures, primarily due to the additional steps involved in laparoscopic techniques, such as camera positioning, port placement, and the use of specialised instruments (15). Despite the longer operative time, it is worth noting that laparoscopic surgery is associated with fewer complications, as evidenced by the lower rates of wound infections and shorter hospital stays in our study.

Hospital stay was also shorter in the laparoscopic group (8.47±1.11 days) compared to the open surgery group (10.03±2.67 days). This has been a well-documented advantage of laparoscopic surgery, where smaller incisions and reduced tissue trauma contribute to faster recovery times and shorter hospital stays (15-17). The reduced hospital stay not only benefits the patient in terms of more rapid recovery, but it is also a cost-effective option.

In terms of postoperative complications, the laparoscopic surgery group had notably fewer infections compared to the open surgery group. Additionally, only a few patients in the laparoscopic group experienced postoperative ileus or leakage from the perforation. These findings align with the existing literature, which has shown that laparoscopic surgery results in lower complication rates, particularly in terms of infections and ileus, due to reduced tissue handling and lower surgical trauma (15-17). The laparoscopic approach also facilitates better peritoneal lavage, which reduces the risk of intra-abdominal abscesses, as confirmed by the lower incidence of abscesses in the laparoscopic group (3.1%) compared to the open surgery group (6.2%).

Our study supports the growing body of evidence suggesting that laparoscopic surgery offers distinct advantages over open surgery for the treatment of perforated duodenal ulcers, particularly in terms of postoperative complications, hospital stay, and recovery times.

Conclusion

Our study concludes that laparoscopic surgery for perforated duodenal ulcers offers substantial advantages over open surgery, including fewer complications, a shorter hospital stay, and faster recovery times. Although it has a longer operative time, the overall positive outcomes support laparoscopic surgery as a more efficient and safer option for patients who are appropriately selected.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

UF (Postgraduate Resident),

Manuscript drafting, Study Design,

AS (Postgraduate Resident)

Review of Literature, Data entry, Data analysis, and drafting an article.

ZA (Postgraduate Resident)

Conception of Study, Development of Research Methodology Design,

HABS (Postgraduate Resident)

Study Design, manuscript review, and critical input.

ABK (Postgraduate Resident)

Manuscript drafting, Study Design,

JRM (Postgraduate Resident)

Review of Literature, Critical Input, and drafting an article.

All authors reviewed the results and approved the final manuscript version. They are also accountable for the integrity of the study.

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