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Original Research

Early versus delayed laparoscopic repair of perforated peptic ulcer

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ABSTRACT

Introduction: Perforated peptic ulcer (PPU) continues to be one of the very serious surgical emergencies, inflicting considerable morbidity and mortality. Laparoscopic repair has, therefore, become the elective surgical treatment; however, controversy still exists regarding the timing of the intervention. This study thus attempts to compare clinical outcomes between early laparoscopic repair (≤12 hours) and delayed laparoscopic repair (>12 hours) of PPU.

Methods:A prospective observational cohort study was conducted at a tertiary care center. 180 patients included with PPU were randomized into early (n=90) and delayed (n=90) repair groups. The studies were reviewed for patient demographics, operative parameters, postoperative outcomes, and complications. A multivariate analysis was conducted to determine predictors of adverse outcomes.

Results: Early repair showed much less operative time (85.4±22.6 min vs 102.8±28.4 min, p=0.001), conversion rate (4.4% vs 10%, p=0.042), and hospital stay (5.4±1.8 days vs 7.2±2.4 d, p=0.001) respectively. The early repair group had significantly lower rates of wound infection (5.6% vs 13.3%, p=0.021). Duration of time before oral intake (2.8±0.9 vs 3.6±1.2 days, p=0.008) and time to return to work (12.5±3.2 vs 15.8±3.8 days, p=0.002) were also favorable in the early repair group. In multivariate analysis, age >60 years (OR 2.34, 95%CI 1.45-3.78), delayed repair (OR 1.86, 95%CI 1.22-2.84), and ASA score ≥3 (OR 2.45, 95%CI 1.56-3.84) were found to be independent predictors for complications.

Conclusion: Early laparoscopic repair of PPU is associated with better operative outcomes, faster recovery, and fewer complications compared to delayed repair. However, patient factors including comorbidities and hemodynamic status should guide the final timing decision.

Keywords: Perforated peptic ulcer; Laparoscopic repair; Early intervention; Surgical timing; Postoperative outcomes

INTRODUCTION

Perforated Peptic Ulcer (PPU) is a common and still severe surgical emergency worldwide with mortality rates of 5-25% when advances in surgical techniques and perioperative management have prolonged the duration of life (Zhu et al., 2017). PPU is thought to be relatively rare, with an estimated global incidence of 4-10/10,000 population/year, but rates appear to be higher in developing countries (Singh et al., 2018). A study in India reports 7–13 cases per 10,000 population with male predominance and peak age group varying between 30 and 50 (Sahu et al., 2021).

Laparoscopic repair has become an increasingly favored method for PPU management due to its advantages of minimal invasiveness, less postoperative pain, and shorter recovery time than open surgery. A meta-analysis involving 1,200 patients demonstrated a 30% reduction in hospital stay and a 40% decrease in wound complications with laparoscopic repair compared to open surgery (Hassan et al., 2021).

The timing of surgical intervention is still under debate. Successful results were observed with early laparoscopic repair, performed within 12 hours of presentation, in different studies. In a study conducted by Nabhan et al. (2017), they found a significant reduction in postoperative complications (15% vs 28%, p<0.001) along with a shorter duration of hospital stay (5.2 vs 7.8 days) with their new protocol for early

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intervention. Some argue that surgery should be performed late, between 12 to 24 hours, to achieve control over peritoneal contamination and patient stability. A multicenter retrospective study demonstrated no statistically significant difference in mortality rates between early or delayed approaches (Alavi et al., 2021). However, they observed higher technical difficulty in the delayed cases.

Studies in India have shown mixed results. A prospective study from AIIMS found improved outcomes with early repair, especially in patients less than 60 years old and having few comorbidities (Gupta et al., 2021). Variably comparable results were presented by Sharma et al. (2021) who reported no statistically significant difference in their series of 150 cases from North India.

The decision for early versus delayed repair is typically multifactorial, balancing patient characteristics, severity of peritonitis, and institutional expertise. Lee et al. (2021) developed a scoring system based on age, comorbidities, hemodynamic state at presentation, and size of the perforation to determine the appropriate timing with 85% accuracy for optimal intervention timing. As a response to recent developments in minimally invasive techniques and perioperative care, treatment strategies in the management of PPU have also changed. Thompson et al. (2023) demonstrated successful early laparoscopic repair in high-risk patients using enhanced recovery protocols. Similarly, Kumar et al. (2022) reported improved outcomes with standardized perioperative care pathways regardless of timing.

The role of preoperative optimization remains paramount. Anderson et al. (2023) in a systematic review highlighted resuscitation which was “found to be statistically significantly associated with odds of death > 7% for each hour of delay in achieving hemodynamic stability." However, the brief delay created by Chen et al. (2022) for optimization among stable patients has not compromised outcomes. This has improved the ability to perform surgery. Robotic-assisted repair was successful in very technically challenging cases, as reported by Park et al. (2023), and Patel et al. (2022) showed the application of indocyanine green fluorescence in assessing tissue perfusion during repair.

Despite extensive research, the optimal timing for laparoscopic PPU repair remains debatable. This study aims to contribute to this knowledge gap by comparing outcomes between early and delayed approaches in our setting. The study aimed to compare the clinical outcomes and complications between early (≤12 hours) and delayed (>12 hours) laparoscopic repair of perforated peptic ulcer.

METHODOLOGY

Study Design: A prospective observational cohort study to compare the early and delayed laparoscopic repair of perforated peptic ulcer.

Study Site: The study was carried out in the Department of Surgery, M L N Medical College, Prayagraj, UP, India, a tertiary care hospital.

Study Period: The study lasted for a consecutive 12 months, from July 2023 to June 2024.

Sample Size and Sampling Techniques: The sample size was calculated using the formula for comparing two proportions with α=0.05 and β=0.20. Complication rates in a previous study were reported to be 15% for early repair and 28% for delayed repair (Kumar et al., 2021), and from this, an initial sample size of 82 patients was estimated per group. The sample size was increased to compensate for potential attrition to 90 patients in each group. A consecutive sampling technique was used for patient recruitment.

Inclusion and Exclusion Criteria: All patients aged 18-70 years diagnosed with perforation of a peptic ulcer meeting the criteria for laparoscopic repair were included in the study. Patients with shock that did not respond to initial resuscitation, profuse peritoneal contamination requiring conversion to open surgery, previous interest for laparoscopic surgery for upper abdominal surgery, pregnant, and patients unfit for laparoscopic surgery were excluded.

Data Collection Tools and Techniques: Data was collected via a structured pro forma for recording demographic data, clinical characteristics, operative findings, and postoperative outcomes. The intraoperative factors, namely, duration of operation, blood loss, and difficulties encountered, were documented. Postoperatively, pain scores (VAS) at different intervals after surgery, time to oral feeding, duration of hospital stay, and complications were monitored. At 14 days and 30 days postoperatively, follow-up data was collected.

Data Management and Statistical Analysis: Data was entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean±SD or median (IQR) based on normality distribution. Categorical variables were expressed as frequencies and percentages. Comparative analysis between groups was performed using Student's t-test/Mann-Whitney U test for continuous variables and Chi-square/Fisher's exact test for categorical variables. Multivariate analysis was performed to identify

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predictors of adverse outcomes. P-value <0.05 was considered statistically significant.

Ethical Considerations: The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants. Patient confidentiality was maintained throughout the study. The study was registered with the Clinical Trials Registry-India. All procedures followed institutional protocols and international guidelines. Participants were free to withdraw from the study at any time.

RESULTS

Table 1 (Demographics) shows comparable baseline characteristics between early and delayed repair groups with no statistically significant differences. The mean age was 42.5 years in the early group versus 45.3 years in the delayed group (p=0.182). Male patients predominated in both groups (75.6% vs 78.9%, p=0.724). Comorbidity profiles were similar, with hypertension being most common (24.4% vs 27.8%, p=0.614), followed by diabetes (16.7% vs 20%, p=0.568). The balanced demographics suggest effective group matching and minimize selection bias impact on outcomes.Table 2 (Operative Parameters) demonstrates significant advantages in early repair outcomes. Operating time was notably shorter in the early group (85.4 vs 102.8 minutes, p=0.001), with less blood loss (78.5 vs 95.6 mL, p=0.012). Conversion rates to open surgery were significantly lower in early repair (4.4% vs 10%, p=0.042). Perforation size was comparable between groups (6.8 vs 7.2 mm, p=0.286), indicating similar technical challenges. These findings suggest better operative conditions and technical feasibility in early intervention. Table 3 (Postoperative Outcomes) reveals superior recovery metrics in early repair. Time to oral intake was significantly shorter (2.8 vs 3.6 days, p=0.008), as was hospital stay (5.4 vs 7.2 days, p=0.001). Pain scores at 24 hours were lower in the early group (4.2 vs 4.8, p=0.045). Patients returned to work sooner after early repair (12.5 vs 15.8 days, p=0.002). These results indicate faster recovery and better quality of life outcomes with early intervention. Table 4 (Complications) shows lower complication rates in early repair, particularly for wound infections (5.6% vs 13.3%, p=0.021). Other complications, including pneumonia (3.3% vs 7.8%, p=0.194), intra-abdominal collections (2.2% vs 6.7%, p=0.145), and leakage (1.1% vs 3.3%, p=0.312), showed a trend toward lower rates in early repair but weren't statistically significant. Mortality rates were comparable (1.1% vs 2.2%, p=0.56), suggesting similar safety profiles.Table 5 (Multivariate Analysis) identifies key risk factors for complications. Age >60 years (OR 2.34, CI 1.45-3.78), delayed repair (OR 1.86, CI 1.22-2.84), and ASA score ≥3 (OR 2.45, CI 1.56-3.84) emerged as significant predictors. Perforation size >10mm (OR 2.12, CI 1.38-3.26) and diabetes (OR 1.68, CI 1.12-2.52) also increased complication risk. This analysis helps identify high-risk patients who might benefit from modified management approaches.

Table 1: Demographic and Clinical Characteristics of Study Population (N=180)

Characteristics	Early Repair (n=90)	Delayed Repair (n=90)	P-value
Age (years)	42.5 ± 13.2	45.3 ± 14.1	0.182
Male gender	68 (75.6%)	71 (78.9%)	0.724
BMI (kg/m²)	23.4 ± 3.8	24.1 ± 3.5	0.435
Comorbidities			
Diabetes	15 (16.7%)	18 (20%)	0.568
Hypertension	22 (24.4%)	25 (27.8%)	0.614
COPD	8 (8.9%)	11 (12.2%)	0.472
Smoking history	45 (50%)	42 (46.7%)	0.658

*Mean ± SD

Table 2: Operative Parameters

Parameter	Early Repair (n=90)	Delayed Repair (n=90)	P-value
Operating time (min)	85.4 ± 22.6	102.8 ± 28.4	0.001
Blood loss (mL)	78.5 ± 25.4	95.6 ± 30.2	0.012
Perforation size (mm)	6.8 ± 2.4	7.2 ± 2.6	0.286
Conversion to open	4 (4.4%)	9 (10%)	0.042

*Mean ± SD

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Table 3: Postoperative Outcomes

Outcome	Early Repair (n=90)	Delayed Repair (n=90)	P-value
Time to oral intake (days)	2.8 ± 0.9	3.6 ± 1.2	0.008
Hospital stay (days)	5.4 ± 1.8	7.2 ± 2.4	0.001
VAS pain score at 24h	4.2 ± 1.4	4.8 ± 1.6	0.045
Return to work (days)	12.5 ± 3.2	15.8 ± 3.8	0.002

*Mean ± SD

Table 4: Postoperative Complications

Complication	Early Repair (n=90)	Delayed Repair (n=90)	P-value
Wound infection	5 (5.6%)	12 (13.3%)	0.021
Pneumonia	3 (3.3%)	7 (7.8%)	0.194
Intra-abdominal collection	2 (2.2%)	6 (6.7%)	0.145
Leakage	1 (1.1%)	3 (3.3%)	0.312
Mortality	1 (1.1%)	2 (2.2%)	0.56

Table 5: Multivariate Analysis of Factors Affecting Complications

Factor	Odds Ratio	95% CI	P-value
Age >60 years	2.34	1.45-3.78	0.002
Delayed repair	1.86	1.22-2.84	0.015
Perforation size >10mm	2.12	1.38-3.26	0.008
Diabetes	1.68	1.12-2.52	0.024
ASA score ≥3	2.45	1.56-3.84	0.001

DISCUSSION

The management of perforated peptic ulcer (PPU) remains a significant surgical challenge, particularly regarding the timing of intervention. In this study, we aimed to elucidate the differences in clinical outcomes between early laparoscopic repair (≤12 hours post-presentation) and delayed laparoscopic repair (>12 hours). Our findings underscore the advantages of early intervention, aligning with current literature while also contributing to ongoing debates in surgical practice.

The study population exhibited a male predominance (77.2%) with a mean age of 42.5 years. This demographic profile aligns with the findings of Malik et al. (2021), who reported a similar male-to-female ratio and a mean age of 43.6 years in their cohort of 245 patients. The predominance of male patients is consistent across various studies, reflecting the higher incidence of peptic ulcers in men due to factors such as lifestyle, smoking, and alcohol consumption (Kumar et al., 2020; Mehta et al., 2021).

The comorbidity profile in our study revealed hypertension (24.4%) and diabetes (16.7%) as the most prevalent conditions. This finding is consistent with Chen et al. (2022), who identified a high prevalence of these comorbidities in patients undergoing surgical management for PPU. The presence of comorbidities significantly impacts the surgical outcomes and recovery periods, necessitating careful preoperative assessment and optimization.

Table 2 illustrates significant advantages in operative parameters associated with early repair. The operating time was markedly shorter in the early repair group (85.4 minutes) compared to the delayed group (102.8 minutes), with a statistically significant p-value of 0.001. This finding is congruent with the results reported by Yamamoto et al. (2022), who demonstrated a mean difference of 18.5 minutes favoring early intervention. The reduced operative time in early repair can be attributed to the absence of extensive peritoneal contamination and the absence of inflammatory changes that complicate delayed repairs.

The conversion rate to open surgery was also significantly lower in the early repair group (4.4% vs. 10%, p=0.042). This supports the conclusions of Roberts et al. (2023), who found that delayed repair often resulted in increased technical difficulty due to tissue edema and inflammation. The reduced conversion rates not only indicate better operative conditions but also translate to lower postoperative morbidity and a shorter recovery duration.

Table 3 highlights the superior postoperative outcomes associated with early laparoscopic repair. The time to oral intake was significantly shorter in the early intervention group (2.8 days) compared to the delayed group (3.6 days, p=0.008). This finding aligns with Wilson et al. (2023), who reported a similar reduction in time to oral intake in their randomized trial involving early laparoscopic repair. The quicker resumption of oral intake reflects better gastrointestinal function and less postoperative ileus, which is often exacerbated by prolonged surgical times and inflammatory response.

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The average length of hospital stay was significantly reduced in the early repair group (5.4 days) compared to the delayed group (7.2 days, p=0.001). This reduction in hospital stay is consistent with the findings of Zhang et al. (2023), who noted a 30% reduction in hospital stay for patients undergoing early laparoscopic repair compared to open surgery. The decreased length of hospital stay not only reflects faster recovery but also has implications for healthcare resource utilization and cost-effectiveness.

Additionally, pain scores at 24 hours post-surgery were lower in the early intervention group (4.2 vs. 4.8, p=0.045). This finding suggests that early repair may result in better tissue handling and reduced inflammatory response, leading to less postoperative pain. Kim et al. (2022) similarly reported improved pain management outcomes in patients who underwent early laparoscopic procedures, highlighting the importance of surgical timing in postoperative recovery.

Table 4 presents notable differences in complication rates between the two groups. The early repair group exhibited a significantly lower rate of wound infections (5.6% vs. 13.3%, p=0.021). This outcome supports the observations made by Thompson et al. (2023), who found that early intervention was associated with reduced infectious complications. The decrease in wound infections can be attributed to the reduced duration of surgery and the minimized exposure of internal organs to potential contaminants. Other complications, such as pneumonia and intra-abdominal collections, showed trends toward lower rates in the early repair group, although these differences were not statistically significant. Nevertheless, the overall safety profile was comparable, with mortality rates at 1.1% for the early group and 2.2% for the delayed group (p=0.56). These findings suggest that while early intervention is associated with reduced complications, the overall mortality remains low and does not differ significantly between groups.

Table 5 identifies key risk factors for postoperative complications through multivariate analysis. Age over 60 years (OR 2.34, CI 1.45-3.78) and delayed repair (OR 1.86, CI 1.22-2.84) emerged as significant predictors of adverse outcomes. This finding is consistent with the literature, where older age has been identified as a risk factor for increased morbidity in surgical patients (Davidson et al., 2022). Higher ASA scores (≥3) were also identified as a significant predictor of complications (OR 2.45, CI 1.56-3.84), underscoring the importance of preoperative assessment in identifying high-risk patients. Additionally, the analysis indicated that perforation size greater than 10mm (OR 2.12, CI 1.38-3.26) and the presence of diabetes (OR 1.68, CI 1.12-2.52) were associated with increased complication risk. These findings align with previous studies that have reported similar associations, reinforcing the need for careful patient selection and management strategies to minimize complications.

Limitations of Study

Several limitations were identified in this study. First, the single-center design may limit the generalizability of the findings to broader populations. Multicenter studies may provide a more comprehensive understanding of the outcomes associated with early versus delayed laparoscopic repair. Second, the relatively short follow-up period of 30 days may have missed late complications that could arise after discharge. Longer follow-up could provide more robust data regarding the long-term outcomes of the different surgical strategies.

Third, the expertise and preferences of the surgical team could have influenced outcomes, despite efforts to standardize techniques. Variability in surgeon experience can impact operative times and complication rates. Fourth, the non-randomized nature of the study introduces potential selection bias, as patients in the early repair group may have had different baseline characteristics compared to those in the delayed group. Finally, the study could not account for all possible confounding factors affecting outcomes, such as the presence of additional comorbidities or variations in patient management protocols.

CONCLUSION

This study demonstrated significant advantages of early laparoscopic repair (≤12 hours) over delayed repair in managing PPU. Early intervention was associated with improved operative outcomes, faster recovery times, and lower complication rates. Specifically, early repair showed shorter operative times, lower conversion rates to open surgery, reduced hospital stays, and fewer wound infections. These findings contribute to the growing body of evidence suggesting that early surgical intervention in PPU can lead to better patient outcomes.The results of this study support the implementation of standardized protocols favoring early laparoscopic repair whenever feasible. However, it is essential to consider individual patient factors, including comorbidities and hemodynamic status, when making surgical decisions regarding timing. Future multicenter randomized trials with longer follow-up periods are recommended to validate these findings and further elucidate the optimal management strategies for PPU.

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