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# Minimally Invasive Superiority: Laparoscopic Surgery Reduces Complications and Enhances Recovery in Perforated Peptic Ulcer Peritonitis

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## ABSTRACT

**Background:** Perforation peritonitis is a life-threatening surgical emergency having high morbidity and mortality. While open surgery has been the standard treatment, laparoscopic repair offers potential benefits, including faster recovery and fewer complications.

**Method:** This prospective, randomised, comparative study compared outcomes between laparoscopic (n = 25) and open (n = 25) surgical repair in 50 patients with perforated peritonitis. The inclusion criteria were hemodynamic stability, a confirmed diagnosis of perforation, and the absence of diffuse fecal peritonitis. Outcomes assessed included operative time, postoperative pain, ICU stay, recovery of bowel function, hospital stay, return to daily activities, and complication rates.

**Results:** It showed that laparoscopic repair had significant advantages: shorter operative time (91.80±18.59 vs. 128.44±31.13 min, p<0.001), lower postoperative pain (2.84±0.69 vs. 6.36±1.04, p<0.001), reduced ICU stay (1.96±0.79 vs. 4.72±1.40 days, p<0.001), faster bowel recovery (1.92±0.95 vs. 4.48±1.33 days, p<0.001), and shorter hospital stay (5.44±1.26 vs. 11.80±2.63 days, p<0.001). Patients undergoing laparoscopy resumed daily activities earlier (12.20±2.18 vs. 21.92±4.11 days, p<0.001). Importantly, laparoscopy significantly reduced surgical site infections (8.0% vs. 84.0%, p<0.001) and pulmonary complications (32.0% vs. 76.0%, p=0.002).

**Conclusion:** Laparoscopic repair is superior to open surgery for perforation peritonitis, offering shorter operative times, less pain, quicker recovery, and fewer complications. These findings support laparoscopy as the preferred approach for hemodynamically stable patients.

**Key-words:** Perforation peritonitis, Laparoscopic repair, Open surgery, Postoperative complications, Surgical outcomes, Randomized comparative study

## INTRODUCTION

Perforation peritonitis is a serious condition where perforation in the gastrointestinal tract leads the contents to leak into the abdominal cavity, leading to peritonitis.

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Secondary peritonitis, often caused by infection or bowel perforation, can lead to serious complications like sepsis and increased mortality rates. [1,2] In contrast, spontaneous bacterial peritonitis (SBP), a common infection in patients with cirrhosis and ascites, has a reported incidence ranging from 7% to 30% in hospitalized patients. [3] Postoperative peritonitis, which occurs following abdominal surgery due to complications like anastomotic leaks or bowel perforations, carries a variable risk depending on the type of surgery and underlying conditions. [4] The lifetime prevalence of peptic ulcer disease (PUD) ranges from 5-10%. Within this group, the lifetime prevalence of perforation, a

 

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major cause of peritonitis, is estimated to be around 5%. The annual incidence of ulcer perforation is reported to be 4 to 14 cases per 100,000 individuals [5,6]. Particularly when the appendix perforates, the prevalence of peritonitis due to appendicitis ranges from 13.8% to as high as 44.1%. Perforation, whether localized or generalized, is a major cause of morbidity and mortality related to appendicitis. [7]

Peritonitis, particularly perforation peritonitis, is associated with significant complications, including sepsis, a life-threatening condition that can progress to shock and death if not promptly managed [8]. Other complications include wound infections at the surgical site [9] and electrolyte imbalances due to fluid shifts and systemic inflammation [10]. The condition carries a high mortality rate, which varies depending on disease severity, complications, and timely intervention [8]. In terms of surgical management, laparoscopic surgery offers advantages over open surgery, such as reduced operative time, less postoperative pain, and faster recovery, though the choice depends on patient-specific factors and disease severity [11-13]. Our ongoing study aims to compare open versus laparoscopic surgery in managing perforation peritonitis, focusing on postoperative complications, hospital stay duration, and patient outcomes, including morbidity and mortality, among patients managed at our tertiary care center.

## MATERIALS AND METHODS

**Study Design and Setting-** This prospective randomized comparative study was conducted at BKL Walawalkar Rural Medical College and Hospital, Kasarwadi, Sawarda, Taluka- Chiplun after approval from the ethical committee of the hospital between March 2023 and March 2025. A total of 50 patients diagnosed with perforation peritonitis and fulfilling the inclusion criteria were enrolled after obtaining informed written consent.

**Inclusion Criteria**

- Patient age 18–75 years.
- Confirmed perforation peritonitis based on: Clinical signs of peritonitis or Radiological evidence (free air/fluid on imaging) or Intraoperative findings.
- Presentation within 48 hours of symptom onset.
- Hemodynamic Stability (SBP ≥90 mmHg without vasopressor support)
- ASA Physical Status: I–III.

**Exclusion Criteria**

- Hemodynamic Instability (Requiring vasopressors / Septic shock at presentation)
- Severe Peritonitis such as Diffuse fecal peritonitis.
- Previous extensive abdominal surgeries (risk of dense adhesions).
- Prior abdominal radiotherapy.
- High-Risk ASA Class: IV–V.
- Uncontrolled Comorbidities such as Diabetes with HbA1c >9%, Severe COPD (FEV1 <50% predicted & Decompensated cardiac disease.
- Known or suspected intra-abdominal malignancy

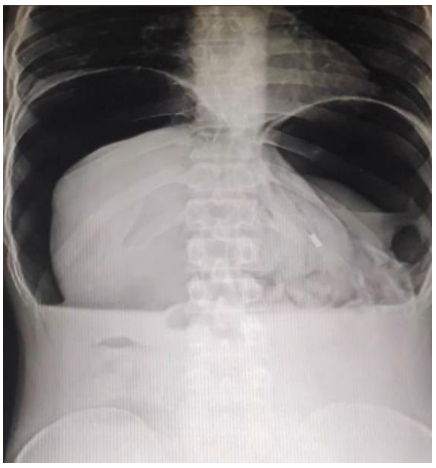

**Fig. 1:** Xray abdomen erect for diagnosis showing air under the diaphragm

Patients were randomly categorized into two groups using a computer-generated randomization table:
**Group A:** Underwent open surgical repair
**Group B:** Underwent laparoscopic repair

Pre-operative investigations, including complete blood count, serum electrolytes, liver and renal function tests, and abdominal imaging, were performed in all patients. Standard antibiotic prophylaxis was administered preoperatively.

The open surgical approach was performed through a midline laparotomy incision extending from the xiphoid to the symphysis pubis for generalized peritonitis. Systematic exploration of all abdominal quadrants was conducted, with a complete examination of the bowel from the ligament of Treitz to the rectosigmoid junction. Duodenal ulcers underwent modified Graham patch repair using interrupted 3-0 non-absorbable sutures. Meticulous peritoneal lavage with 6-10 liters of warm saline was performed until effluent cleared. Two large-

 

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bore drains were placed in the subhepatic and pelvic regions, with mass closure of the abdominal wall using continuous #1 PDS suture.

**Fig. 2:** Sutured incision post exploratory laparotomy

**Fig. 3:** Port positions in laparoscopic surgery

**Fig. 4:** Perforation site in laparoscopic view

The laparoscopic technique began with a 10mm optical trocar placement at the umbilicus via the Hasson technique, followed by two 5mm working ports in the lower quadrants and an additional epigastric port when needed. The pneumoperitoneum was maintained at 8-10mmHg with continuous cardiorespiratory monitoring. A 30° laparoscope enabled systematic 360° exploration to identify the perforation and assess contamination. Upper GI perforations were repaired with intracorporeal 3-0 V-Loc sutures. Sequential quadrant lavage with 3-5 liters of saline was performed with patient repositioning, using suction irrigation to clear debris. Specimens were retrieved in endoscopic bags, with fascial closure of ports >5mm. Conversion to open surgery occurred due to inadequate exposure, uncontrolled bleeding, or physiological deterioration.

Data were systematically collected for all patients, with key parameters recorded to compare outcomes between surgical approaches. Operating time was measured from initial incision to wound closure. Postoperative pain was assessed using the Visual Analog Scale (VAS) at 48 hours. Pulmonary complications (pneumonia/atelectasis) were documented based on clinical and radiographic findings. Analgesic requirements were quantified by total morphine equivalents administered during the first 72 postoperative hours. Hospital stay duration was calculated from surgery to discharge, while return to daily activities was assessed through patient-reported timelines. Thirty-day morbidity and mortality were recorded, including surgical site infections, anastomotic leaks, and cardiopulmonary events.

**Statistical Analysis**- Data analysis was performed using SPSS version 26.0. Categorical variables (e.g. complication rates) were expressed as frequencies and percentages. Normally distributed continuous data (operative time, hospital stay) were reported as mean±standard deviation; Intergroup comparisons utilized unpaired t-tests for parametric data, with $p<0.05$ considered statistically significant.

**Ethics Approval and Consent to Participate-** Ethical approval was obtained from the Institutional Ethics Committee of BKL Walawalkar Rural Medical College and Hospital, Kasarwadi, Sawarda, Taluka-Chiplun, Maharashtra. Written informed consent was obtained from the patient for participation in the study.

## RESULTS

The study population comprised 50 patients with a mean age of 49.4 years (SD±15.86), ranging from 22 to 74 years. Gender distribution showed near-equivalent representation, with 26 male patients (52%) and 24 female patients (48%). This demographic profile suggests the sample encompassed a broad adult age range with

 

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balanced sex distribution, potentially reducing gender-related bias in surgical outcome comparisons.

The study demonstrated significant advantages of laparoscopic surgery across all measured parameters compared to open surgery for perforated peritonitis. Operative time was markedly shorter in the laparoscopic group (91.80±18.59 minutes vs 128.44±31.13 minutes, p<0.001), reflecting the minimally invasive nature of the approach. Postoperative pain scores were dramatically lower with laparoscopy (2.84±0.69 vs 6.36±1.04 on the VAS scale, p<0.001), correlating with reduced tissue trauma. Critical recovery milestones showed consistent benefits: laparoscopic patients required shorter ICU stays (1.96±0.79 vs 4.72±1.40 days, p<0.001), experienced faster return of bowel function (1.92±0.95 vs 4.48±1.33 days, p<0.001), and had nearly 50% shorter hospitalizations (5.44±1.26 vs 11.80±2.63 days, p<0.001). The laparoscopic approach also enabled the significantly earlier return to daily activities (12.20±2.18 vs 21.92±4.11 days, p<0.001), highlighting its functional recovery advantages (Table 1).

**Table 1:** Comparison of outcomes: Laparoscopic vs Open Surgery in Perforation Peritonitis

| Parameter | Laparoscopic surgery (Mean±SD) | Open surgery (Mean±SD) | p-value |
|---|---|---|---|
| Operation time (min) | 91.80±18.59 | 128.44±31.13 | 0.000 |
| Post-op pain score (0–10) | 2.84±0.69 | 6.36±1.04 | 0.000 |
| ICU stay (days) | 1.96±0.79 | 4.72±1.40 | 0.000 |
| Return of bowel movements (days) | 1.92±0.95 | 4.48±1.33 | 0.000 |
| Hospital stays (days) | 5.44±1.26 | 11.80±2.63 | 0.000 |
| Return to daily activity (days) | 12.20±2.18 | 21.92±4.11 | 0.000 |

The study revealed striking differences in postoperative complications between laparoscopic and open surgical approaches for perforated peritonitis. Surgical site infections (SSIs) occurred significantly less frequently in the laparoscopic group (8%, n=2) compared to the open surgery group (84%, n=21), with this difference being highly statistically significant (p<0.001). Similarly, pulmonary complications including pneumonia and atelectasis were markedly reduced with the laparoscopic approach (32%, n=8) versus open surgery (76%, n=19), demonstrating both clinical and statistical significance (p=0.002). These findings strongly suggest that the minimally invasive nature of laparoscopy confers substantial benefits in reducing two of the most common and clinically relevant postoperative complications associated with perforation peritonitis surgery. The dramatic reduction in SSIs (10.5-fold difference) and near 60% relative reduction in pulmonary complications highlight how laparoscopic techniques may minimize surgical trauma, preserve immune function, and facilitate earlier mobilization - all critical factors in preventing these serious postoperative sequelae (Table 2).

**Table 2:** Comparison of Postoperative Complications: Laparoscopic vs Open Surgery

| Complication | Laparoscopic (n=25) | Open (n=25) | p-value (Chi-square / Fisher's Exact) |
|---|---|---|---|
| Surgical Site Infection | 2 (8.0%) | 21 (84.0%) | 0.000 / 0.000 |
| Chest Complications | 8 (32.0%) | 19 (76.0%) | 0.002 / 0.004 |

## DISCUSSION

The laparoscopic approach for perforated peptic ulcer repair, first introduced by Siu *et al*. [14] has since been validated as a safe and viable technique through numerous clinical trials worldwide. [15] Our study, comprising 50 patients with a mean age of 49.4 years

 

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(SD±15.86) and a balanced gender distribution (52% male, 48% female) reflects a broad adult demographic, minimizing potential gender-related bias in surgical outcomes. Similar findings were reported by Siow *et al*. where no significant differences were observed in age (laparoscopic group: 52.3±17.3 years vs. open group: 54.6±15.6 years, p=0.434) or gender distribution (p=0.305) between laparoscopic and open repair groups. [12] Likewise, Khedr *et al*. demonstrated comparable age (44.88±15.44 vs. 47.56±11.99 years, p=0.321) and gender proportions (84.7% male in laparoscopic vs. 83.8% in open, p=0.765) between the two surgical approaches [11]. These consistent demographic profiles across studies reinforce the generalizability of findings regarding laparoscopic versus open repair for perforation peritonitis, suggesting that outcomes are unlikely to be confounded by age or sex disparities. The reproducibility of these results in diverse populations further supports the laparoscopic technique as a standardized option for managing perforated peptic ulcers.

The site of perforation in our study was exclusively duodenal, which contrasts with findings from other studies where variations in location have been reported. Siow *et al*. [12] observed that the juxtapyloric region was the most common site of perforation, consistent with studies from Thailand and the Netherlands [16,17]. However, this differs from other investigations, where the first part of the duodenum was the predominant site. [18-22] These discrepancies may be attributed to regional differences in the underlying etiology of peptic ulcer disease, such as variations in *Helicobacter pylori* prevalence, NSAID use, or genetic factors. The consistent duodenal involvement in our study suggests a potential localized predisposition to perforation in our patient population.

The operative time in laparoscopic versus open repair for perforation peritonitis remains a topic of debate, with varying results across studies. In our study, laparoscopic surgery demonstrated a significantly shorter operative time (91.80±18.59 min) compared to open surgery (128.44±31.13 min, p=0.000), suggesting greater efficiency in the minimally invasive approach. This finding contrasts with Siow *et al*, who reported no significant difference in operative time between laparoscopic (108.3±40.4 min) and open (104.9±37.2 min, p=0.618) groups. [12] Conversely, Zedan *et al*. observed a longer operative duration in the laparoscopic group (145±8.4 min vs. 110±13 min), possibly due to the learning curve associated with advanced laparoscopic suturing techniques [23]. The discrepancy in operative times may be influenced by surgeon experience, patient selection, and variations in surgical techniques.

Postoperative pain control remains a significant advantage of laparoscopic surgery in perforation peritonitis, as demonstrated by our findings and previous studies. In our cohort, patients undergoing laparoscopic repair reported significantly lower pain scores (2.84±0.69) compared to open surgery (6.36±1.04, p=0.000), reinforcing the benefits of minimally invasive techniques in reducing postoperative discomfort. These results align with the observations of Siow *et al*. [12], who highlighted that laparoscopic repair is associated with lesser analgesic requirements and lower pain scores, a conclusion supported by multiple randomized controlled trials. [17,19] The reduced tissue trauma and smaller incisions inherent to laparoscopic surgery likely contribute to this difference, facilitating earlier mobilization and improved recovery. These findings underscore the role of laparoscopy not only as a feasible alternative but as a preferable approach for minimizing postoperative morbidity in perforated peptic ulcer repair.

The duration of hospital stay serves as a key indicator of postoperative recovery, and our study demonstrates a clear advantage of laparoscopic over open surgery in perforation peritonitis. Patients undergoing laparoscopic repair had a significantly shorter hospital stay (5.44±1.26 days) compared to those who underwent open surgery (11.80±2.63 days, p=0.000). This finding is consistent with multiple studies, including Siow *et al*. [12], who reported that laparoscopic surgery facilitates earlier discharge and quicker return to normal activities, as supported by previous randomized controlled trials [17]. A systematic review comparing 843 laparoscopic and 1,031 open repair cases further confirmed this benefit, showing a reduction in hospital stay from 10.3 to 6.3 days with laparoscopy [24]. Similarly, Khedr *et al*. observed a shorter hospitalization period in the laparoscopic group (6.11±2.01 days vs. 9.65±3.11 days, p<0.001), as did Zedan *et al.* (6.9±2.2 days vs. 8.9±3.3 days) [11,23]. These consistent findings across diverse populations highlight the role of minimally invasive surgery in accelerating recovery, likely due to reduced surgical trauma, lower postoperative pain, and

 

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fewer complications. The shorter hospital stays not only benefit patient recovery but also reduce healthcare costs, reinforcing laparoscopy as the preferred approach for perforated peptic ulcer repair where feasible.

The comparative analysis of postoperative complications between laparoscopic and open repair for perforation peritonitis reveals significant advantages favouring the minimally invasive approach. In our study, laparoscopic surgery demonstrated markedly lower rates of surgical site infection (8.0% vs. 84.0%, p=0.000) and chest complications (32.0% vs. 76.0%, p=0.002) compared to open surgery. These findings align with Siow *et al*. who reported a significantly lower overall complication rate in the laparoscopic group (14.3% vs. 36.8%, p=0.005), with reductions in surgical site infections (0.0% vs. 13.2%, p=0.003) and trends toward fewer respiratory complications (14.3% vs. 26.5%, p=0.129). [12] The dramatic reduction in wound infections observed in both studies likely stems from smaller incisions and reduced tissue trauma in laparoscopic surgery, while the decreased pulmonary complications may reflect earlier mobilization due to less postoperative pain. Notably, our study showed higher absolute complication rates than Siow *et al*. possibly due to differences in patient populations or surgical expertise [12]. The consistency in findings across studies particularly regarding infectious complications strongly supports laparoscopy as a safer alternative when technically feasible. These results, combined with previously discussed advantages in pain control and hospital stay, position laparoscopic repair as the preferred approach for perforated peptic ulcers in suitable candidates. Future research should focus on standardizing surgical techniques and identifying optimal patient selection criteria to further minimize complications.

## CONCLUSIONS

The accumulated evidence suggests that laparoscopic repair should be considered the gold standard for surgical management of perforated peptic ulcers in hemodynamically stable patients without contraindications. The procedure's benefits in reducing hospital costs, accelerating return to normal activities, and minimizing surgical trauma make it not just clinically superior but also economically advantageous. Future efforts should focus on expanding laparoscopic training programs to increase surgeon proficiency and establishing clear guidelines for patient selection to optimize outcomes further. As surgical techniques and technology continue to advance, the role of laparoscopy in emergency abdominal surgery will likely expand, potentially improving outcomes for an even broader range of patients with perforation peritonitis.

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**Research concept**– Dr. Sangram Dabholkar
**Research design**– Dr. Sangram Dabholkar
**Supervision–** Dr. Aishwarya Chavarkar
**Materials**– Dr. Sangram Dabholkar
**Data collection**– Dr. Sangram Dabholkar
**Data analysis and interpretation**–Dr. Aishwarya Chavarkar, Dr. Sangram Dabholkar
**Literature search**– Dr. Sangram Dabholkar
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**Critical review**– Dr. Aishwarya Chavarkar
**Article editing**– Dr. Aishwarya Chavarkar
**Final approval**– Dr. Aishwarya Chavarkar, Dr. Sangram Dabholkar

## REFERENCES

[1] Daley BJ. Peritonitis and abdominal sepsis: background, anatomy, pathophysiology [Internet]. Medscape. 2019 [cited 2025 May 30]. Available from:https://emedicine.medscape.com/article/180234-overview.
[2] Szeto CC. Peritonitis rates of the past thirty years: from improvement to stagnation. Perit Dial Int., 2014; 34(2): 151–53.
[3] Marciano S, Díaz JM, Dirchwolf M, Gadano A. Spontaneous bacterial peritonitis in patients with cirrhosis: incidence, outcomes, and treatment strategies. Hepat Med., 2019; 11: 13–22.
[4] Musoke J, Bisiwe F, Natverlal A, Moola I, Moola Y, et al. The prevalence and bacterial distribution of peritonitis amongst adults undergoing continuous ambulatory peritoneal dialysis at Universitas Hospital. S Afr J Infect Dis., 2020; 35(1): 104–06.
[5] Stern E, Sugumar K, Journey JD. Peptic ulcer perforated [Internet]. StatPearls Publishing; 2023

 

doi: 10.21276/SSR-IIJLS.2025.11.3.47

[cited 2025 May 30]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK538326/.

[6] Chung KT, Shelat VG. Perforated peptic ulcer–an update. World J Gastrointest Surg. 2017; 9(1): 1–12.

[7] Keita S, Keita K, Coulibaly M, Sissoko M, Soumare L, et al. Peritonitis management through appendicular perforation in the Department of Surgery, Bougouni Hospital (Mali). Surg Sci., 2020; 11: 446–52.

[8] Bali RS, Verma S, Agarwal PN, Singh R, Talwar N. Perforation peritonitis and the developing world. ISRN Surg., 2014; 2014: 105492.

[9] Balamaddiah G, Ravindranath GG. Etiology and complications of perforated peritonitis: a retrospective study. Int Surg J., 2018; 5: 908–12.

[10]Perforation peritonitis – a case report [Internet]. Kauvery Hospital. 2024 [cited 2025 May 30]. Available from:https://www.kauveryhospital.com/kauverian-scientific-journal/perforation-peritonitis-a-case-report-v5i12/.

[11]Khedr EM, Awad SS, Salem A, Alzahrani A, Asiri M, et al. Assessment of perioperative outcome of laparoscopic versus open management of gastroduodenal perforation: two-center experience. Surg Gastroenterol Oncol., 2023; 28(2): 96–99.

[12]Siow SL, Mahendran HA, Wong CM, Hardin M, Luk TL. Laparoscopic versus open repair of perforated peptic ulcer: improving outcomes utilizing a standardized technique. Asian J Surg., 2018; 41(2): 136–42.

[13]Singh J, Gill AS. Comparison of open versus laparoscopic repair for the treatment of hollow viscus perforation. Asian J Med Res., 2020; 9(1): SG04–06.

[14]Siu WT, Leong HT, Law BK, Chau CH, Li AC, et al. Laparoscopic repair for perforated peptic ulcer: a randomized controlled trial. Ann Surg., 2002; 235(3): 313–19.

[15]Lagoo SA, Pappas TN. Laparoscopic repair for perforated peptic ulcer. Ann Surg., 2002; 235(3): 320–21.

[16]Lohsiriwat V, Prapasrivorakul S, Lohsiriwat D. Perforated peptic ulcer: clinical presentation, surgical outcomes, and the accuracy of the Boey scoring system. World J Surg., 2009; 33: 80–85.

[17]Bertleff MJ, Halm JA, Bemelman WA, et al. Randomized clinical trial of laparoscopic versus open repair of the perforated peptic ulcer: the LAMA trial. World J Surg., 2009; 33: 1368–73.

[18]So JBY, Kum CK, Fernandes ML, Goh P. Comparison between laparoscopic and conventional omental patch repair for perforated duodenal ulcer. Surg Endosc., 1996; 10: 1060–63.

[19]Siu WT, Leong HT, Law BK, et al. Laparoscopic repair for perforated peptic ulcer: a randomized controlled trial. Ann Surg., 2002; 235(3): 313–19.

[20]Bertleff MJ, Liem RS, Bartels HL, et al. The “stamp method”: a new treatment for perforated peptic ulcer? Surg Endosc., 2006; 20: 791–93.

[21]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: 2371–74.

[22]Koujalagi RS, Kenawadekar R, Gogate AS, Sunil TN. A 1-year randomized controlled study to compare laparoscopic versus open repair for hollow viscus perforation. Indian J Surg., 2019; 81(4): 320–25.

[23]Zedan AS, Lolah MA, Badr ML, Ammar MS. Laparoscopic versus open repair of perforated duodenal peptic ulcer: a randomized controlled trial. Menoufia Med J., 2015; 28: 62–68.

[24]Bertleff MJ, Lange JF. Laparoscopic correction of perforated peptic ulcer: first choice? A review of literature. Surg Endosc., 2010; 24: 1231–39.