Original Article
DOI: https://doi.org/10.70749/ijbr.v3i5.2929

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Comparison between Laparoscopic Vs Open Repair of Perforated Duodenal Ulcer

Zunnoorain[1], Muhammad Dilawaiz Mujahid[2], Shahbaz Ahmad[3], Maryam Aslam[4], Ali Zulqarnain[5]

[1]Department of Surgery, Surgical Unit-1, Allied Hospital-I, Faisalabad, Pakistan
[2]Department of Surgery, Surgical Unit-1, Allied Hospital-I, Faisalabad, Pakistan
[3]Department of Surgery, Allied Hospital-II, Faisalabad, Pakistan
[4]Department of Gynecology & Obstetrics, Aziz Fatima Hospital, Faisalabad, Pakistan
[5]Ghulam Muhammadabad Hospital, Faisalabad, Pakistan

ARTICLE INFO

Keywords: Duodenal ulcer perforation, laparoscopic repair, pain

Correspondence to: Zunnoorain, Department of Surgery, Surgical Unit-1, Allied Hospital-I, Faisalabad, Pakistan.
Email: drzunnoorain@gmail.com

Declaration
Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 05-03-2025 Revised: 12-05-2025
Accepted: 21-05-2025 Published: 30-05-2025

ABSTRACT

Background and objective: Patients with perforated peptic ulcer disease frequently arrive at medical facilities late for treatment, which raises morbidity and mortality rates in underdeveloped nations. The current study's findings will be useful to medical professionals, surgeons, and medical officers as they develop treatment plans for patients with perforated peptic ulcers in an effort to lower morbidity and death. **Methodology:** The study included 134 patients, aged 18 to 60 years who had been diagnosed with a perforated duodenal ulcer. Patients with known gastrointestinal cancers, a history of abdominal surgery, a systolic blood pressure of less than 90 mmHg at presentation, and co-morbid conditions such ischemic heart disease and chronic liver disease on prior medical records were not included. A computer-generated random number was used to divide the patients into two groups, A and B. Group A: Patients with perforated peptic ulcers receiving laparoscopic surgery. Group B: Individuals with perforated peptic ulcers undergoing open surgery. The same surgical team conducted all of the procedures. The following outcome variables were documented: intraoperative time, postoperative pain, and postoperative hospital stay. **Results:** The mean operation time for laparoscopic repair in my study was 109.35 ± 17.02 minutes, while the mean operation time for open repair was 91.35 ± 18.95 minutes (p-value = 0.0002). Patients in the laparoscopic group had a statistically significant (p = 0.0001) lower mean length of hospital stay (5.10 ± 0.87 versus 5.48 ± 0.99 days) than those in the open group. The mean post-operative pain for laparoscopic repair was 5.10 ± 0.87, while the mean for open repair was 9.32 ± 1.62 (p-value = 0.0001). **Conclusion:** This study found that, in terms of mean hospital stay and mean postoperative discomfort, laparoscopic surgery is superior to open repair for peptic duodenal ulcer rupture.

INTRODUCTION

The perforation rate of Peptic Ulcer Disease (PUD), which affects 4 million people globally each year, ranges from 2% to 14%.[1] Patients with a perforated peptic ulcer (PPU) frequently present with diffuse peritonitis and generalized sepsis, diseases that entail substantial risks for morbidity and mortality. Perforation is a potentially fatal consequence of PUD. NSAID use, H. Pylori, smoking, steroid use, physiological stress, fasting, cocaine use, and chemotherapy with bevacizumab are known risk factors for PPU.[2] In third-world nations like Pakistan, it is a prevalent issue. Although the widespread use of proton pump inhibitors has reduced its prevalence during the past three decades, problems still occur in 10–20% of cases.[3,4]

Emergency surgery is still required to treat the complications of peptic ulcer disease, and the frequency of PPU has not decreased despite advancements in care. The primary method of treating PPU is surgery, which can be performed with or without an omental patch to close the perforation.[5] The ideal surgical strategy is still up for debate, although there are no controversies around the surgical treatment of PPU. For decades, there has been debate over the most effective surgical strategy for the long-term management of this condition. Strong guidelines have not yet been developed, yet.[6] Although laparoscopic repair has been utilized to treat perforated peptic ulcers since 1990, there haven't been many randomized studies comparing open vs laparoscopic treatments. The limitations of an upper laparotomy can be avoided with laparoscopy, which enables minimally invasive lesion diagnosis and closure with sufficient peritoneal lavage.[7] Laparoscopic repair has several benefits, including less postoperative discomfort and

painkiller use, quicker recovery times, and fewer wound infections. Kumar et al. carried out a comparative analytical analysis to ascertain the clinical outcome of laparoscopic versus open PPU repair.[8,9] Fifty patients with perforated duodenal ulcers were split into two equal groups and given either open surgery or laparoscopic procedures. For laparoscopic repair, the mean post-operative stay (days) was 4.4±3.3, while for open repair, it was 7.3±7.8.[10] On the first day following surgery, the mean pain was 2.6±1.6 for laparoscopic repair and 3.4±2.1 for open repair. On day three, the discomfort was decreased to 1.4±1.6 for open repair and 0.6±0.8 for laparoscopic repair. The mean hospital stay and mean pain in both groups7 differed significantly.[10]

Patients with perforated peptic ulcer disease frequently arrive at medical facilities late for treatment, which raises morbidity and mortality rates in underdeveloped nations. The current study's findings will be useful to medical professionals, surgeons, and medical officers as they develop treatment plans for patients with perforated peptic ulcers in an effort to lower morbidity and death.

METHODOLOGY

With approval from the institutional ethical review committee, the Surgery Department of Faisalabad Medical University & Allied Hospital, Faisalabad, conducted this randomized controlled experiment from August 2, 2024, to February 1, 2025. Using 80% power and a 5% significance level, the estimated sample size was 134 (67 in each group). The mean hospital stay for laparoscopic repair was 4.4 ± 3.3 days, while the mean hospital stay for open repair was 7.3 ± 7.8 days.[10] The study included adults aged 18 to 60 who had been diagnosed with a perforated duodenal ulcer (patients with signs and symptoms of peptic ulcer disease leading to peritonitis, i.e., presence of all these on clinical examination was taken as positive): abdominal distension, pale (Hb <10 g/dl), sweating, hypotensive (B.P <80/40 mmHg), fast pulse (>100/min) supported by free air under diaphragm on chest X-ray), and agonizing pain (VAS 4-10) throughout the entire upper abdomen that got worse with deep breathing or movement. Patients with known gastrointestinal cancers, a history of abdominal surgery, a systolic blood pressure of less than 90 mmHg at presentation, and co-morbid conditions such ischemic heart disease and chronic liver disease on prior medical records were not included.

Patients who met the requirements for inclusion were gathered from the emergency room. After obtaining informed consent, the patients' name, age, and sex were collected. full baselines (full blood count, coagulation profile, kidney and liver function tests) and an upright abdominal X-ray were taken, along with diaphragms. Intravenous fluids were used to revive each sufferer. Each patient underwent urethral catheterization for output monitoring and nasogastric aspiration for stomach decompression. Intravenous antibiotics (i.e., 500 mg of metronidazole and 1 g of ceftriaxone) were administered prior to surgery. General anesthesia was used during the surgery. A computer-generated random number was used to divide the patients into two groups, A and B.

Group A: Patients with perforated peptic ulcers receiving laparoscopic surgery. The laparoscopic treatment was carried out by a skilled surgeon with over five years of experience. The perforation was sealed with an omental patch and silk sutures using a four-port technique. A drain was inserted into the Morrison's pouch, and peritoneal lavage was performed.

Group B: Individuals with perforated peptic ulcers undergoing open surgery. The open surgery group underwent a routine exploratory laparotomy using a comparable repair technique, which involved closing the abdominal cavity after an omental patch and peritoneal lavage.

The same surgical team conducted all of the procedures. A specially created questionnaire was used to record all of the data (attached). The following outcome variables were documented: intraoperative time, postoperative pain, and postoperative hospital stay.

SPSS version 22 was used to enter and analyze the data using its statistical software. Intraoperative time, postoperative discomfort, and postoperative hospital stay are the variables being examined. Simple descriptive statistics, such as mean and standard deviation, were used to analyze this. For gender, frequency and percentage were computed. The two samples T test (independent samples) was used to compare the means of the two groups. A significant p-value was defined as 0.05 or less. Age, gender, and BMI were utilized to stratify the data, and the independent samples T-test was applied. Post-stratification is deemed significant if the p-value is less than 0.05.

RESULTS

The study's participants ranged in age from 18 to 60, with a mean age of 37.21 ± 7.64 years. Patients in groups A and B had mean ages of 37.25 ± 7.80 and 37.19 ± 7.56 years, respectively. The majority of the 53 patients, or 85.48 percent, were in the 15–45 age range. The male to female ratio of these 134 patients was 1.5:1, with 80 (59.70%) being male and 54 (40.30%) being female. The average BMI was 28.91 ± 2.42 kg/m^2. The average weight was 74.92±12.85 kg, and the average height was 1.52±12.92 m. The mean operation time for laparoscopic repair in my study was 109.35 ± 17.02 minutes, while the mean operation time for open repair was 91.35 ± 18.95 minutes (p-value = 0.0002). Patients in the laparoscopic group had a statistically significant (p = 0.0001) lower mean length of hospital stay (5.10 ± 0.87 versus 5.48 ± 0.99 days) than those in the open group. According to Table 2, the mean post-operative pain for entire laparoscopic repair was 5.10 ± 0.87, while the mean for open repair was 9.32 ± 1.62 (p-value = 0.0001).

Tables 3, 4, and 5, respectively, demonstrate the stratification of operative time, post-surgical discomfort, and hospital stay by age, gender, and BMI.

Table 1

Distribution of Different Variables (n=134)

		Group A (n=67)	Group B (n=67)	P-value
		Number (%)	Number (%)	
Age (years)	18-40	47 (70.15%)	44 (65.67%)	0.579
	41-60	20 (29.85%)	23 (34.33%)	
Gender	Male	41 (81.19%)	39 (58.21%)	0.725
	Female	26 (38.81%)	28 (41.79%)	
BMI (kg/m^2)	≤25	25 (37.31%)	29 (43.28%)	0.481
	>25	42 (62.69%)	38 (56.72%)	

Table 2
Comparison of Outcome between Laparoscopic versus Open Repair of Peptic Duodenal Ulcer Perforation.

Outcome	Group A (n=67)	Group B (n=67)	p-value
	Mean ± SD	Mean ± SD	
Operation time (minutes)	109.35 ± 17.02	91.35 ± 18.95	0.0002
Post-operative pain	3.55 ± 0.85	5.48 ± 0.99	0.0001
Hospital stay (days)	5.10 ± 0.87	9.32 ± 1.62	0.0001

Table 3
Stratification of Operative Time with Respect to Confounders

		Group A (n=67) operative time (minutes)		Group B (n=67) operative time (minutes)		P-value
		Mean	SD	Mean	SD	
Age (years)	18-40	110.78	15.93	88.85	16.21	0.0001
	41-60	99.75	23.54	104.40	25.94	0.7891
Gender	Male	108.41	15.63	88.43	15.57	0.0001
	Female	111.67	20.89	97.50	24.41	0.1943
BMI (kg/m²)	≤25	112.83	16.55	86.50	16.87	0.0001
	>25	107.16	17.38	93.67	19.83	0.0285

Table 4
Stratification of Post-Operative Pain with Respect to Confounders.

		Group A (n=67) post-operative pain		Group B (n=67) post-operative pain		P-value
		Mean	SD	Mean	SD	
Age (years)	18-40	3.59	0.84	5.35	0.98	0.0001
	41-60	3.25	0.96	6.20	0.84	0.0001
Gender	Male	3.45	0.86	5.52	0.98	0.0001
	Female	3.78	0.83	5.40	1.07	0.0020
BMI (kg/m²)	≤25	3.50	0.80	5.10	1.10	0.0008
	>25	3.58	0.90	5.67	0.91	0.0001

Table 5
Stratification of Post-Operative Hospital Stay with Respect to Confounders

		Group A (n=67) post-operative hospital stay (days)		Group B (n=67) post-operative hospital stay (days)		P-value
		Mean	SD	Mean	SD	
Age (years)	18-40	5.11	0.89	9.12	1.58	0.0001
	41-60	5.0	0.82	10.40	1.52	0.0001
Gender	Male	5.05	0.84	9.62	1.56	0.0001
	Female	5.22	0.97	8.70	1.64	0.0001
BMI (kg/m²)	≤25	4.75	0.87	9.10	1.60	0.001
	>25	5.32	0.82	9.43	1.66	0.0001

DISCUSSION

The age of the patients is one of the most important factors in any surgical investigation. Our study's participants ranged in age from 18 to 60, with a mean age of 37.21 ± 7.64 years. Patients in groups A and B had mean ages of 37.25 ± 7.80 and 37.19 ± 7.56 years, respectively. The majority of the 53 patients, or 85.48 percent, were in the 15–45 age range. In one study[11], patients in group A were 56.13±6.62 years old on average, whereas those in group B were 51.88±9.37 years old. Older and more comorbid patients who may have been judged unsuitable for laparoscopic procedures because of the severity of the perforation are frequently the ones who undergo open surgery. It is important to remember that surgery results can be affected by age.[12]

In our investigation, the two groups' BMIs were almost identical. This outcome is consistent with the findings of Deshmukh et al., who observed that when comparing laparoscopic versus open surgery for duodenal perforation, BMI had no bearing.[13] Although a higher BMI can make open and laparoscopic surgeries more difficult, this did not seem to be a problem in our study. Our study's gender distribution showed that there were somewhat more men in both groups. Other research on perforated duodenal ulcers has demonstrated that duodenal ulcer perforation is more common in men, which is in line with this conclusion.[14,15] The distribution of genders can affect the rate of complications, although it usually has no bearing on the surgical strategy chosen.

One significant distinction between the two groups was operational time. The mean operation time for laparoscopic repair in my study was 109.35 ± 17.02 minutes, while the mean operation time for open repair was 91.35 ± 18.95 minutes (p-value = 0.0002). Because laparoscopic treatments require additional steps, like camera alignment, port insertion, and the use of specialist tools, this conclusion is in line with earlier studies that show higher operating times for these operations.[13] The lower incidence of wound infections and shorter hospital admissions in our study demonstrate that laparoscopic surgery is linked to fewer problems, despite the greater operating time. The groups that underwent open surgery and laparoscopic surgery did not vary significantly in a meta-analysis (MD 15.31, 95% CI −4.86 to 35.47, p = 0.14). Between-study heterogeneity was great (I2 = 99%, p<0.00001).[16]

In our study, the mean length of hospital stay for patients in the laparoscopic group was statistically substantially (p = 0.0001) lower than that of the open group (5.10 ± 0.87 versus 5.48 ± 0.99 days). This is comparable to a study[11] where the laparoscopic group's hospital stay was likewise shorter (8.47±1.11 days) than the open surgery group's (10.03±2.67 days). Laparoscopic surgery was also linked to a considerably reduced length of stay (LOS) than open surgery, according to a meta-analysis (MD −2.37, 95% CI: −3.64 to −1.10, p = 0.0003).[16] Between-study heterogeneity was high (I2 = 93%, p < 0.00001). This is a well-established benefit of laparoscopic surgery, where shorter hospital stays and quicker recovery times are facilitated by smaller incisions and less tissue damage.[17,18] In addition to helping the patient recover more quickly, the shorter hospital stay is also a more economical choice.

The laparoscopic group saw a reduction in post-operative pain and an early hospital discharge. Additionally, the laparoscopic repair procedure had a much lower rate of surgery-related complications. Similar results were also reported by Lau[19], who claimed that there was a substantial difference in the occurrence of pulmonary problems between the laparoscopic and open-surgery groups. The laparoscopic group in the current study experienced fewer pulmonary problems, whereas the open repair group experienced more. Some of the main advantages of laparoscopic surgery are an earlier return to daily activities and home.[20] Similar findings are supported by the results of a systematic review, which likewise

revealed a substantial difference between the two groups.[21] Our study group experienced a shorter hospital stay following laparoscopic surgery due to a lower incidence of post-operative discomfort and morbidity. Compared to open surgery, the length of hospital stay following laparoscopic repair was significantly reduced.

The group that underwent laparoscopic surgery experienced significantly fewer infections than the group that underwent open surgery in terms of postoperative consequences. Furthermore, postoperative ileus or leakage from the perforation was uncommon in the laparoscopic group. These results are consistent with previous research that has demonstrated that laparoscopic surgery reduces the risk of complications, especially ileus and infections, because it involves less tissue handling and less surgical trauma. The decreased incidence of abscesses in the laparoscopic group (3.1%) compared to the open surgery group (6.2%) confirms that the laparoscopic method also promotes better peritoneal lavage, which lowers the risk of intra-abdominal abscesses.

The laparoscopic group had a decreased rate of wound infection because laparoscopic incisions are so tiny. Similar outcomes were observed in the study conducted by Lunevicius et al.[21] The open group needed more time to resume normal work than the laparoscopic group, as seen by the mean time needed to return to regular activities in the open group being 33 days compared to 14 days in the Golash et al trial. Similar outcomes were also seen in the Mehendale et al. study, which found that the open group needed 34.23 days and the laparoscopic group needed 13.06 days to return to their regular activities.[22] The time required to resume a regular diet is shorter in the laparoscopic group because there is less bowel handling and a decreased risk of post-operative ileus.[23,24]

According to certain research, patients in the PPU may have postoperative death rates as high as 30%.[25] A meta-analysis found that the 30-day death rates were much lower in the laparoscopy group, with the rates in the open group being 6.8% and the laparoscopy group being 3.8%.[16] There was no discernible difference in mortality between the two groups in our investigation.

In numerous disciplines, laparoscopic surgery has been used, and better outcomes than open surgery have been documented.[13,17,18] Lower morbidity and a shorter overall hospital stay are linked to laparoscopy in peptic ulcer surgery. Mortality, postoperative sepsis, abscess, and reoperation rate did not significantly differ between the open and closed approaches. Some studies have demonstrated that, when carried out by skilled surgeons, laparoscopic surgery (LS) can be utilized as an alternate option even for hemodynamically unstable patients, despite the WSES guidelines' recommendation to employ a laparoscopic technique in these cases.[20,21]

Although it is difficult to identify patients at high risk for poor outcomes based on a single condition, older age, the presence of co-morbidities, and a delay in surgery have all been repeatedly linked to an increased risk of death. The "Boey score," which is based on significant medical illness, preoperative shock, and length of perforation greater than 24 hours before surgery, is the most commonly used disease-specific prediction rule for PPU patients. Other prognostic ratings, though, have been put forth.[23] Finding the best description to choose the right patient and perform the proper surgery is a continuous process.

There are various limitations to our study. This study only involved one center. There weren't many patients who had laparoscopic surgery. The outcomes may have been impacted by the preference for laparoscopy among younger patients in stable condition.

CONCLUSION

This study found that, in terms of mean hospital stay and mean postoperative discomfort, laparoscopic surgery is superior to open repair for peptic duodenal ulcer rupture. Therefore, in order to lower the mean hospital stay, mean postoperative discomfort, and morbidity of our population, we advise that laparoscopic repair be the main treatment for perforated duodenal ulcers.

REFERENCES

1. Pansa A, Kurihara H, Memon MA. Updates in laparoscopic surgery for perforated peptic ulcer disease: state of the art and future perspectives. Ann Laparosc Endosc Surg 2020;5(5): e 21037. https://doi.org/10.21037/ales.2019.11.03
2. Kabbash MM, Abdel Reheem OA, Hussein AE. Laparoscopic versus Open Repair of Perforated Peptic Ulcer. Egypt J Hosp Med. 2019;77(6):5958-64. https://doi.org/10.21608/ejhm.2019.65608
3. Ayyaz M, Shafiq A, Butt UI, Khan WH, Umar M, Abaid A. Outcome of Laparoscopic Repair for Perforated Peptic Ulcers in a Resource-Limited Setting. Cureus. 2022;14(4): e24159. https://doi.org/10.7759/cureus.24159
4. Patel PY, Akhani MK, Rathod R, Baria B. Post-operative Outcomes of Laparoscopic Versus Open Repair of Perforated Duodenal Ulcer: A Systematic Review. Cureus 2025;17(9): e92021. https://doi.org/10.7759/cureus.92021.
5. Karpuz S, Karpuz GF, Ergenç M. Laparoscopic versus open repair for perforated peptic ulcer: A single-center analysis. Laparosc Endosc Surg Sci 2024;31(2):45–49 https://doi.org/10.14744/less.2024.08216.
6. Chalmers KA, Lee MJ, Cousins SE, Cooper AP, Coe PO, Blencowe NS. Laparoscopic versus open repair of perforated peptic ulcer: systematic scoping review and in-depth evaluation of existing evidence, BJS Open, 2025;9(2):163. https://doi.org/10.1093/bjsopen/zrae163.
7. Shah SR, Almugadam BS, Hussain A, Ahmad T, Ahmed S, Sadiqui S. Epidemiology and risk factors of Helicobacter Pylori infection in Timergara city of Pakistan: A cross-sectional study. Clini Epidemiol Glob Health. 2021;12: e100909. https://doi.org/10.1016/j.cegh.2021.100909
8. Deshmukh SN, Parikh HP. Open versus laparoscopic repair of perforated duodenal ulcer: a comparative study. Int Surg J 2020;7(4):1004-8. https://doi.org/10.18203/2349-2902.isj20201380
9. Tartaglia D, Strambi S, Coccolini F, Mazzoni A, Miccoli M, Cremonini C, et al. Laparoscopic versus open repair of perforated peptic ulcers: analysis of outcomes and

identification of predictive factors of conversion. Update Surg. 2023 Apr;75(3):649-57. https://doi.org/10.1007/s13304-022-01391-6
10. Kumar D, Ali MT, Mirani SH, Memon MH, Zai AR, Abaidullah K. Comparison of Clinical Outcome of Laparoscopic with Open Repair Surgery for Duodenal Ulcer Perforation. Pak J Med Health Sci. 2022;16(05):314-16. https://doi.org/10.53350/pjmhs22165314
11. Fazal U, Shah A, Alam Z, Saddiqe HAB, Khan AB, Masood JR. Comparative study of laparoscopic vs open surgery for duodenal ulcer perforation. Biol. Clin. Sci. Res. J., 2025; 6(2): 134-137. https://doi.org/10.54112/bcsrj.v6i2.1590.
12. Chan KS, Ng STC, Tan CHB, Gerard G, Oo AM. A systematic review and meta-analysis comparing postoperative outcomes of laparoscopic versus open omental patch repair of perforated peptic ulcer. J Trauma Acute Care Surg 2023;94:e1–e13. https://doi.org/10.1097/ta.0000000000003799
13. Deshmukh SN, Parikh HP. Open versus Laparoscopic Repair of Perforated Duodenal Ulcer: A Comparative Study. Int Surg J. 2020; 7:1004-1008. https://doi.org/10.18203/2349-2902.isj20201380
14. Coe PO, Lee MJ, Boyd-Carson H, Lockwood S, Saha A. Open versus laparoscopic repair of perforated peptic ulcer disease: a propensity-matched study of the National Emergency Laparotomy Audit. Ann Surg 2022;275:928–932. https://doi.org/10.1097/sla.0000000000004332
15. Kim CW, Kim JW, Yoon SN, Oh BY, Kang BM. Laparoscopic repair of perforated peptic ulcer: A multicenter, propensity score matching analysis. BMC Surg 2022;22:230. https://doi.org/10.1186/s12893-022-01681-1
16. Sokhal BS, Mohamedahmed AYY, Zaman S, Wuheb AA, Abdalla HE, Husain N, et al. Laparoscopic versus open repair for peptic ulcer perforation: a systematic review, meta-analysis and trial sequential analysis of randomised controlled trials. Time to conclude. Ann R Coll Surg Engl 2025; 107: 331–345. https://doi.org/10.1308/rcsann.2024.0082.
17. Muhammedoğlu B, Topuz S. Peptic ulcer complications, surgical treatment, comparison of open and laparoscopic approach, minimally invasive approach recommendations. Laparosc Endosc Surg Sci 2024;31:8–13. https://doi.org/10.14744/less.2024.82687
18. Kiblawi R, Zoeller C, Zanini A. Laparoscopic versus open pediatric surgery: three decades of comparative studies. Eur J Pediatr Surg 2022; 32:9–25. https://doi.org/10.1055/s-0041-1739418
19. Lau H. Laparoscopic repair of perforated peptic ulcer: a metaanalysis. Surg Endosc 2004; 18: 1013e1021. https://doi.org/10.1007/s00464-003-8266-y
20. 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: 1368e1373. https://doi.org/10.1007/s00268-009-0054-y
21. Vaccari S, D'Andrea V, Lauro A, D'Intino R, Gulotta E, Cervellera M, Tonini V. Laparoscopic repair for perforated peptic ulcer: our experience, a comparison with the open approach and a review of the literature. Journal of Gastric Surgery. 2020 May 12;2(2):26-32. https://doi.org/10.36159/jgs.v2i2.28
22. Pan CW, Liou LR, Mong FY, Tsao MJ, Liao GS. Simple laparoscopic repair of perforated peptic ulcer without omental patch. Asian J Surg. 2020 Jan 1;43(1):311-4. https://doi.org/10.1016/j.asjsur.2019.08.007
23. Leusink A, Markar SR, Wiggins T, Mackenzie H, Faiz O, Hanna GB. Laparoscopic surgery for perforated peptic ulcer: an English national population-based cohort study. Surg Endoscop. 2018 Sep;32:3783-8. https://doi.org/10.1007/s00464-018-6058-7
24. Johnson CH, McLean RC, McCallum I, Perren D, Phillips AW. An evaluation of the epidemiology, management and outcomes for perforated peptic ulcers across the North of England over 15 years: A retrospective cohort study. Int J Surg. 2019 Apr 1;64:24-32. https://doi.org/10.1016/j.ijsu.2019.03.005
25. Saleh AA, Esquivel EC, Lung JT, Eaton BC, Bruns BR, Barmparas G, et al. Laparoscopic omental patch for perforated peptic ulcer disease reduces length of stay and complications, compared to open surgery: a SWSC multicenter study. Am J Surg. 2019 Dec 1;218(6):1060-4. https://doi.org/10.1016/j.amjsurg.2019.09.002