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ORIGINAL ARTICLE

Laparoscopic versus open repair of perforated peptic ulcer: Improving outcomes utilizing a standardized technique

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Summary *Background/Objective:* The objective of this study was to compare the outcomes of patients who underwent laparoscopic and open repair of perforated peptic ulcers (PPUs) at our institution.
Methods: This is a retrospective review of a prospectively collected database of patients who underwent emergency laparoscopic or open repair for PPU between December 2010 and February 2014.
Results: A total of 131 patients underwent emergency repair for PPU (laparoscopic repair, $n = 63$, 48.1% vs. open repair, $n = 68$, 51.9%). There were no significant differences in baseline characteristics between both groups in terms of age ($p = 0.434$), gender ($p = 0.305$), body mass index ($p = 0.180$), and presence of comorbidities ($p = 0.214$). Both groups were also comparable in their American Society of Anesthesiologists (ASA) scores ($p = 0.769$), Boey scores 0/1 ($p = 0.311$), Mannheim Peritonitis Index > 27 ($p = 0.528$), shock on admission ($p < 0.99$), and the duration of symptoms > 24 hours ($p = 0.857$). There was no significant difference in the operating time between the two groups ($p = 0.618$). Overall, the laparoscopic group had fewer complications compared with the open group (14.3% vs. 36.8%, $p = 0.005$). When reviewing specific complications, only the incidence of surgical site infection was statistically significant (laparoscopic 0.0% vs. open 13.2%, $p = 0.003$). The other parameters were not statistically significant. The laparoscopic group did have a significantly shorter mean postoperative stay ($p = 0.008$) and lower pain scores in the immediate postoperative period ($p < 0.05$). Mortality was similar in both groups (open, 1.6% vs. laparoscopic, 2.9%, $p < 0.99$).

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Conclusion: Laparoscopic repair resulted in reduced wound infection rates, shorter hospitalization, and reduced postoperative pain. Our single institution series and standardized technique demonstrated lower morbidity rates in the laparoscopic group.

1. Introduction

Minimally invasive surgery has advanced exponentially since the beginning of the 20th century with the improvement of optics, materials, manufacturing, and above all, refinement of surgical technique. Laparoscopic surgery has become the gold standard for many elective procedures, such as laparoscopic cholecystectomy, antireflux procedures, and in colorectal surgery. However, the adoption of laparoscopy in the emergency setting such as in the management of perforated peptic ulcer (PPU) has been slow and limited. There remains much debate regarding the benefits of laparoscopic repair with most literature showing that although feasible, there is no significant benefit.[1]

Since the first report of laparoscopic repair of PPU in 1990,[2] emerging evidence in the literature have confirmed the feasibility and efficacy of the laparoscopic approach.[3–7] Previous meta-analysis and systemic review have even reported that it should be the procedure of choice in low-risk patients.[8,9] However, a recently published Cochrane review failed to demonstrate the advantages of laparoscopic over open repair.[1] Nevertheless, the Cochrane report included a cautionary note that more randomized controlled trials with greater number of patients are needed before drawing any definite conclusions.[1]

There is a paucity of reports in the Southeast Asian region on performing laparoscopic repair for PPU. A literature search found only a single report from Singapore which suggests that laparoscopic repair is not well accepted in this region.[3] Our study was conducted at the main tertiary referral institution that covers the population of Sarawak in East Malaysia. Our team compared the clinical outcomes of patients who underwent laparoscopic and open repair for PPU over a 38-month period.

2. Methods

All patients who underwent either open or laparoscopic omental patch repair between December 2010 and February 2014 were identified and extracted from a prospectively maintained database after obtaining approval from the Hospital Ethics Committee of Sarawak General Hospital and Director General of Health, Malaysia. The data analyzed included patients' demographics, medical comorbidities, operative details, details of postoperative complications, and other postoperative outcomes. Patients with a history of previous upper abdominal surgery, clinically sealed off perforations without signs of peritonitis or sepsis, evidence of concomitant ulcer bleeding, or gastric outlet obstruction were excluded. Large and suspicious ulcers that necessitated definitive excisional surgery were also excluded.

The decision regarding the method of repair (laparoscopic or open) was dependent on the availability of surgeons with advanced laparoscopic expertise, and input from the attending anesthetist. Laparoscopic repair was performed with intracorporeal suturing and pedicled omental patch using a standardized technique whereas the open repair was performed via a conventional midline laparotomy and pedicled omental patch repair.

Prior to surgery, all patients were resuscitated preoperatively with isotonic crystalloids; patients were given adequate analgesia, and administered intravenous broad-spectrum antibiotics (cefoperazone and metronidazole). A dose of intravenous proton-pump inhibitor (PPI) was also administered. Nasogastric decompression was performed to minimize the amount of peritoneal spillage and reduce the risk of aspiration. Foley's bladder catheterization was performed to monitor urine output and to assess the adequacy of fluid resuscitation. Blood samples were taken and tested for full blood counts, urea and electrolyte panel, and serum amylase. Perforated viscus was usually diagnosed via an erect chest radiograph which demonstrated the presence of air beneath the diaphragm. In a few cases where there was some doubts, computed tomography scan was required to establish the diagnosis.

The preoperative American Society of Anesthesiologists (ASA) scores were based on the recorded observations by the attending anesthetist on the perioperative form. The scores have been adjusted according to the ASA physical status 2014.[10] The Boey score was the sum of the three independent risk factors with a value of 1 assigned to each factor: (1) concomitant severe medical illness (ASA III–V); (2) shock on admission (systolic blood pressure < 90 mmHg; and (3) delayed presentation with duration of symptoms $>$ 24 hours. For each positive risk factor, one point was given, with possible scores of 0–3.[11] The Mannheim Peritonitis Index (MPI) was a scoring system based on eight prognostic factors.[12] It has a minimum score of 0 and maximum score of 47. A score of > 26 is associated with a higher mortality rate.

The standardized technique of laparoscopic repair for PPU in our institution has been previously described.[13] The suturing was performed intracorporeally with a sequential laparoscopic lavage to ensure adequate clearance of peritoneal contamination. We employed a primary closure of the perforation with parallel interrupted 2/0 polyglactin suture, followed with reinforcement using a single tie-over suture over a pedicled omentum. The open repair was performed through an upper midline incision; using a standardized technique described in surgical textbooks.[14] This repair of the perforated ulcer with omental reinforcement was performed as described by Cellan-Jones.[15]

Postoperatively, the nasogastric tube was removed after 24 hours when the residual gastric aspirates were minimal. The urinary catheter was typically removed the day after surgery unless close hemodynamic status monitoring was necessary. Oral intake was commenced once there was return of bowel function, typically at Day 1 after surgery.

At our institution, patients who undergo laparotomies are provided intravenous patient-controlled analgesia (PCA) using opioids by the pain service team. Thus, all patients who underwent open PPU repair typically received PCA morphine in the immediate postoperative period. Patients who undergo laparoscopic procedures at our institution are usually started on intravenous boluses of tramadol as baseline and escalated if their analgesia is inadequate.

Twice daily dosing of intravenous proton pump inhibitor (PPI), together with intravenous antibiotics (cefoperazone and metronidazole) was maintained for the first 48–72 hours. Once patients were able to tolerate orally, the intravenous PPI therapy was discontinued and replaced by empirical *Helicobacter* eradication regimen consisting of twice daily dosing of oral PPI, clarithromycin, and amoxicillin for 1 week, followed by 5 weeks of once daily oral PPI. Oesophagogastroduodenoscopy was usually performed within 6 weeks of surgery to assess ulcer healing and to obtain biopsies of the ulcer along with random biopsies of the antrum and body of the stomach for exclusion of malignancy and *Helicobacter pylori* testing respectively.

Postoperative complications were defined as complications that occurred during the hospital stay, which may be related to the disease or the surgery performed. The types of complications analyzed were: respiratory complications (pneumonia or atelectasis), cardiac complications, intra-abdominal collection (confirmed by ultrasound or CT abdomen), surgical site infection, postoperative ileus, and mortality.

A surgical site infection (SSI) was defined as infection occurring within the 30 days after the operation, involving skin, subcutaneous tissue, or deep soft tissue (e.g., fascia, muscle) of the incision wound, associated with at least one of the following: (1) purulent discharge; (2) organisms isolated from aseptically obtained wound culture; or (3) at least one of the signs or symptoms of infection-pain or tenderness, localized swelling, redness, or heat.[16]

Postoperative mortality was defined as death that occurred during the hospital stay or within 30 days of primary surgery. Prolonged postoperative ileus was defined as failure of return of bowel functions, characterized clinically by abdominal distension, nausea or vomiting, lack of bowel sounds, and failure to pass flatus and stools for > 3 days postoperatively, in the absence of mechanical obstruction. Postoperative pain was assessed using a visual analog scale (VAS) on the first 4 days, with the score ranging from 0 (no pain) to 10 (severe pain).

All statistical analyses were performed using the statistical package SPSS version 16.0 for Windows (SPSS Inc., Chicago, IL, USA). Categorical variables were described using frequency distributions and continuous variables, descriptive statistics were calculated and reported as mean $\pm$ SD (if distribution was normal) or median with range (if distribution was skewed). For statistical analysis, Student *t* test was used to compare means of numerical variables. Pearson's Chi-square test was used for nominal variables and Fisher's exact test was used in instances with low expected frequencies. A p value < 0.05 was accepted as statistically significant.

3. Results

A total of 142 patients were diagnosed with PPU during the study period. Eleven patients were excluded as they required definitive excisional surgery. The remaining 131 patients made up the study population. There were 114 males (87.0%) and 17 female patients (13.0%). The mean patient age was 53.5 (range, 17–87) years. Laparoscopic repair was performed for 63 patients (48.1%), and the remaining 68 patients underwent open repair. There was no conversion in the laparoscopic group.

Table 1 Comparison of patient demographics and admission characteristics between laparoscopic and open repair groups.

Variables	Laparoscopic group ($n = 63$) (%)	Open group ($n = 68$) (%)	p
Sex (M/F)	57/6	57/11	0.305
Age (y)	52.3 $\pm$ 17.3	54.6 $\pm$ 15.6	0.434
BMI (kg/m^2)	21.4 $\pm$ 3.0	22.4 $\pm$ 4.0	0.180
ASA (%)			
1E	15 (23.8)	12 (17.6)	0.769
2E	9 (14.3)	10 (14.8)	
3E	8 (12.7)	12 (17.6)	
4E	31 (49.2)	34 (50.0)	
Comorbidities			
None	41 (65.1)	36 (52.9)	0.214
Respiratory	7 (11.1)	7 (10.3)	<0.99
Cardiovascular	10 (15.9)	10 (14.7)	<0.99
Renal impairment	0 (0.0)	3 (4.4)	0.245
Diabetes	4 (6.3)	6 (8.8)	0.746
Hypertension	7 (11.1)	4 (5.9)	0.352
Multiple	3 (4.8)	2 (2.9)	0.671
Boey score			
0	18 (28.6)	15 (22.1)	0.311
1	27 (42.9)	25 (36.8)	
2 or 3	18 (28.6)	28 (41.2)	
Mannheim Peritonitis Index			
Score < 27	51 (81.0)	51 (75.0)	0.528
Score ≥ 27	12 (19.0%)	17 (25.0%)	
Shock on presentation	5 (7.9)	6 (8.8)	<0.99
Duration of symptoms > 24 h	41 (65.1)	43 (63.2)	0.857
Temperature (°C)	37.0 (0.6)	37.0 (0.64)	0.992
WCC ($\times 10^9$)	13.6 (5.7)	13.5 (6.6)	0.882

Data are presented as n (%) or mean $\pm$ standard deviation, unless otherwise indicated.
ASA = American Society of Anesthesiologists Physical Status Classification 2014; BMI = body mass index; E = emergency; F = female; M = male; SD = standard deviation; WCC = white cell count.

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The demographics and characteristics of the patient populations in laparoscopic and open repair group are summarized in Table 1. There were no significant differences in baseline characteristics between the groups, in terms of gender, age, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status score, comorbidities, Boey score, Mannheim Peritonitis Index (MPI), shock on presentation, duration of symptoms, temperature, and white cell count (WCC) on presentation.

The operative details for laparoscopic and open repair group are presented in Table 2. In the overall study population, the most common location for perforation was juxtapyloric (87 patients, 66.4%), followed by duodenum (30 patients, 22.9%), and stomach (14 patients, 10.7%). No significant difference was observed between the two groups in terms of perforation size (16.2 mm vs. 15.8 mm, $p = 0.714$), site of perforation (juxtapyloric, 66.7% vs. 66.2%, $p = 0.323$), and operating time (108.3 minutes vs. 104.9 minutes, $p = 0.618$).

Table 3 shows the overall complication rates and the incidence of specific complications in both laparoscopic and open repair group. The most common complication in both groups was respiratory. Overall, more patients in the open repair group (25 patients, 36.8%) had complications versus nine patients (14.3%) in the laparoscopic group ($p = 0.005$). Specific complications such as respiratory, cardiovascular, and postoperative sepsis were higher in the open group but not statistically significant ($p = 0.129$, $p = 0.245$, $p = 0.059$ respectively). There were three patients in our series that had intra-abdominal abscess postoperatively; one (1.6%) from the laparoscopic group and two (2.9%) from the open group ($p < 0.99$). All of them were managed by intravenous antibiotics and did not require percutaneous drainage as they were small. The incidence of postoperative ileus was similar in both groups (3.2% in the laparoscopic and 5.9% in the open group; $p = 0.682$). However, the incidence of surgical site infection was significantly lower in the laparoscopic group (no patient) versus nine patients (13.2%) in the open group ($p = 0.003$). Seven patients in the open group had superficial surgical site infection and two patients had wound dehiscence requiring reoperation. The length of postoperative stay was also significantly shorter in the laparoscopic repair group (4.4 $\pm$ 3.3 days vs. 7.3 $\pm$ 7.8 days, $p = 0.008$). There were three perioperative deaths in our series (2.3%). There was one death (1.6%) in the laparoscopic group and two deaths (2.9%) in the open group ($p < 0.99$). The causes of death in the open group were pneumonia ($n = 1$), and combination of pneumonia and cardiac complication ($n = 1$). The only death in the laparoscopic group was due to respiratory insufficiency secondary to hospital acquired pneumonia.

Table 2 Comparison of operative data between laparoscopic and open repair group.

Variables	Laparoscopic group ($n = 63$)	Open group ($n = 68$)	p
Perforation size (mm)	16.2 $\pm$ 6.3	15.8 $\pm$ 5.6	0.714
Site of perforation			
Juxtapyloric	42 (66.7)	45 (66.2)	0.323
Duodenum	12 (19.0)	18 (26.5)	
Stomach	9 (14.3)	5 (7.4)	
Operation time (min)	108.3 $\pm$ 40.4	104.9 $\pm$ 37.2	0.618

Data are presented as n (%) or mean $\pm$ standard deviation.

Table 3 Surgical outcomes of laparoscopic and open repair group.

Variables	Laparoscopic repair ($n = 63$)	Open repair ($n = 68$)	p
Overall complication rate	9 (14.3)	25 (36.8)	0.005
Respiratory	9 (14.3)	18 (26.5)	0.129
Cardiovascular	0 (0.0)	3 (4.4)	0.245
Sepsis	0 (0.0)	5 (7.4)	0.059
Intraabdominal collection	1 (1.6)	2 (2.9)	<0.99
Surgical site infection	0 (0.0)	9 (13.2)	0.003
Prolonged ileus	2 (3.2)	4 (5.9)	0.682
Mortality	1 (1.6)	2 (2.9)	<0.99
Postoperative stay (d)	4.4 $\pm$ 3.3	7.3 $\pm$ 7.8	0.008

Data are presented as n (%) or mean $\pm$ standard deviation.

Postoperative pain scores for both groups were assessed using the visual analog scale (VAS) and depicted in Table 4. The mean scores for postoperative from Day 1 to Day 4 were assessed in all patients when they were alert and not sedated. There were significantly lower pain scores in the laparoscopic group compared with the open group from Day 1 to Day 4 ($p = 0.048$, $p = 0.001$, $p = 0.000$, and $p = 0.010$, respectively).

4. Discussion

Lagoo et al[17] in 1992 proposed that laparoscopic approach should be routinely considered in the management of perforated duodenal ulcer. However, more than two decades later, open surgery remains the preferred method of repair despite adequate evidence attesting the safety and feasibility of laparoscopic repair. The main obstacles are multifactorial: (1) the decline in the incidence of PPU has rendered a reduced exposure to the number of cases

Table 4 Comparison of postoperative mean VAS pain scores for laparoscopic and open repair groups.

Variables	VAS pain score Laparoscopic repair ($n = 63$)	VAS pain score Open repair ($n = 68$)	p
Day 1	2.7 $\pm$ 1.7	3.3 $\pm$ 2.0	0.048
Day 2	1.2 $\pm$ 1.2	2.2 $\pm$ 1.9	0.001
Day 3	0.6 $\pm$ 0.7	1.3 $\pm$ 1.5	0.000
Day 4	0.2 $\pm$ 0.4	0.6 $\pm$ 1.3	0.010

Data are presented as n (%) or mean $\pm$ standard deviation.
VAS = visual analog scale.

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required to attain surgical competency; (2) there is a lack of surgeons capable of performing minimally invasive technique on-duty for 24 hours and 7 days a week in hospital treating patients with PPU; and (3) the lack of laparoscopic expertise of the performing surgeon may result in a high conversion rate, and deters other surgeons from pursuing the same approach.

The present study compared the two cohorts of patients who underwent either open or laparoscopic approaches in a 39-month period. The majority (64.1%) of our patients presented late with symptoms > 24 hours prior to arrival to our institution. More than a fifth of these patients (22.1%) presented with Mannheim Peritonitis scores of 27 or more which is associated with higher risk of morbidity and mortality as well as risk for conversion in laparoscopy.[18] The most common site of perforation was at the juxtapyloric region, a finding that concurs with studies from Thailand[19] and The Netherlands[20] but differs from that of other investigators,[3,7,21,22] in which the first part of the duodenum is the commonest site. The patient demographics and characteristics, comorbidities, Boey scores, ASA scores, and Mannheim Peritonitis Indices, and operating times were well matched in both groups. Patients in the laparoscopic group had significantly less overall morbidities ($p = 0.005$) as compared with patients in the open group. The incidence of surgical site infection was the major difference between the two groups ($p = 0.003$), with no significant difference in other specific complications.

Laparoscopic surgery in our series is as effective and safe as open surgery, with the advantage of reduced surgical site infection. The present study utilized the Boey score which predicts morbidity and mortality specifically in PPU patients together with the Mannheim Peritonitis Index for better comparison of the severity of physiological derangement between both groups. However, the Boey score was not used as a method for patient selection and we proceeded to perform laparoscopic repair even on patients with scores of 2 and 3. We observed that the Boey score did seem to predict morbidity more accurately in the open repair group where 25 out of 28 patients (89.3%) with a score of 2 or 3 had postoperative complications. This was not similarly seen in the laparoscopic repair group where only 50% (9 out of 18 patients) with such scores had postoperative complications. We are confident in stating that a higher Boey score should not preclude patients from laparoscopic repair. The issue to whether laparoscopic repair is capable of reducing the risk of postoperative morbidity and mortality in patients with high Boey scores needs further evaluation with a larger patient population.

At our institution, we employ a standardized technique of pedicled omental patch, described by Cellan-Jones[15] in 1929, for both the open and laparoscopic approaches. The rationale of an omental graft is to provide stimulus for fibrin formation[23] and to prevent sutures from cutting through the friable edges causing enlargement of the perforation.[24] This durable repair method is reproducible with no suture leakage in the current groups of patients. There were also reports of higher incidence of leakage in studies involving sutureless repair or when pedicled omentoplasty was not used.[8,9,24] In addition, it facilitates suturing large ulcers with nonmobile edges.[25] Furthermore, we believe that the choice of the surgery should be tailored to the properties of the ulcer's edges. We do not advocate repairing large perforations (perforations $\geq$ 3 cm in diameter) or perforations with friable edges as these should be managed with definitive excisional surgery due to their higher leak rates.

The experience of the surgeons in both open and laparoscopic group may have an effect on the operating time and surgical outcomes. The experience of the surgeons differed in both groups. There were three surgeons involved in the laparoscopic group. Two surgeons have had > 5 years' experience as a surgeon and one surgeon was 1 year post completion of surgical training. All three surgeons underwent extensive laparoscopic training and were capable of advanced laparoscopic work. There were five surgeons in the open repair group. Three surgeons have > 5 years' experience as a surgeon, while two surgeons were 1 year post completion of surgical training. All surgeons had adequate experience in performing open repair. Although the experience of the surgeons is a relevant factor, the ability of the team to perform a standardized technique is very crucial in achieving optimal surgical outcomes.

Surgical site infection is a significant morbidity associated with open PPU repair. Laparoscopic repair has been shown to have lower rates of SSIs.[7,8,20,24] This is presumably due to smaller incision, less tissue manipulation, and less tissue injury resulting in reduced inflammatory and immune responses.[26] Biscione et al[27] demonstrated in a cohort study that laparoscopy is associated with a reduction in the risk of incisional SSI by 60% and organ/space SSI by 80% as compared with open diagnostic exploration of the abdominal cavity. Our study showed similar outcomes where no patient in the laparoscopic repair group had SSIs as compared with the nine patients (13.2%) in the open group, which contributed to the significant statistical difference in overall morbidities.

The operating times in our series seem to be longer compared with what has been reported in previous literature.[8,24] The mean operating times for both open and laparoscopic repair in our series exceeded 100 minutes. We attribute this to two factors: (1) it is our institutional policy to perform copious unrestricted peritoneal lavage until all abdominal recesses are cleared. This minimizes the risk of residual abdominal collections necessitating relaparotomy or relaparoscopy. As a rule, we advocate taking the necessary time to perform surgery as thorough as possible. We promote and encourage this behavior among trainees and junior officers at our institution which possibly explains why our operating times may be longer than most. This practice was unchanged throughout the course of this study; and (2) we also suspect that the degree of peritoneal contamination seen at our institution may be more severe than those in more affluent areas where other studies were performed due to late presentation. The state of Sarawak is a vast area, with less-than-perfect infrastructure and transportation. The health seeking attitude of the population who live beyond the immediate vicinity of the city of Kuching is poor and most patients had suffered for days before presenting with severe peritonitis and gross abdominal contamination. Thus, these patients not only have severe intraoperative contamination but often require some amount of adhesiolysis to release inflammatory adhesions in the effort to identify the site of the perforation and also to mobilize the bowels so as to ensure adequate lavage and avoid residual interloop collections. Meticulous peritoneal lavage is therefore extremely important to ensure that the contamination is cleared. We believe that the increased cost incurred by the longer operating time is offset by the shorter hospital stay.

The benefit of a standardized peritoneal lavage technique is represented in our low incidence of postoperative intraabdominal collections. In the open group, we utilized the traditional dilutional approach with large volumes of normal saline but for the laparoscopic group, we performed a more focused type of lavage under direct visualization with lesser volumes of normal saline.[13] Both yielded similar good outcomes. Only three patients (2.2%) had intraabdominal abscess postoperatively, comprising of one patient in the laparoscopic repair group and two more patients in the open repair groups. All three patients in our series were treated conservatively as the collections were small and did not require percutaneous drainage. They resolved with parenteral antibiotics.

The benefits associated with minimally invasive surgery such as lesser postoperative analgesic usage and lower pain score have been clearly demonstrated in two randomized controlled trials (RCTs).[7,20] However, one RCT demonstrated a significant reduction in analgesic requirement but not the pain score.[28] The finding of significant reduction in opiate analgesic requirement in the laparoscopic group was also substantiated by numerous nonrandomized studies.[3–6,29,30] Our study demonstrated the mean values of pain score of both groups in the initial 4 days after surgery. Unfortunately, the method of analgesic administration to both groups was different. Patients who underwent open repair via a midline laparotomy were provided with a patient-controlled infusion pump which administered 1 mg of morphine per bolus on demand with a 5-minute lock-out. This is a standard regimen employed by the Acute Pain Service of our institution for all patients who undergo major surgery. Patients who underwent laparoscopic repair, however, received 50 mg of intravenous tramadol administered 8-hourly. These patients are referred to the Acute Pain Service if pain is still intolerable. The mean VAS scores were significantly lower in the laparoscopic group from Day 1 until Day 4. Considering that the open group received the more potent morphine infusion as compared with intermittent tramadol received by the laparoscopic group, this shows that the laparoscopic group had less postoperative pain.

Improvement in postoperative pain is of paramount importance as it encourages early mobilization of patients. Patients with poor pain scores ambulate hesitantly and are uncooperative when performing incentive spirometry. Failure to achieve good respiratory effort postoperatively increases the risk of atelectasis and hospital-acquired pneumonia, which is the most common and significant complication in our study. Lau[8] in his meta-analysis showed that laparoscopic repair is associated with a lower incidence of pulmonary complications when compared with the open repair. In our study, we had fewer pulmonary complications in the laparoscopic group as compared with open repair (14.3% vs. 26.5%). Nine patients in the laparoscopic group had respiratory insufficiency requiring supplemental oxygen. Unfortunately, one of them required mechanical ventilation and succumbed to hospital-acquired pneumonia with left lung collapse on the 7th postoperative day, the only mortality in the laparoscopic group. Eighteen out of 25 patients (72.0%) who had postoperative morbidity in the open repair group had respiratory complications. Two of these patients also had postoperative sepsis with cardiovascular compromise and unfortunately succumbed to overwhelming sepsis. We cannot emphasize enough the importance of early mobilization and aggressive chest physiotherapy in improving outcomes in addition to good repair and meticulous peritoneal lavage. In this respect, laparoscopic repair with superior postoperative pain control is important in enabling patients to ambulate and to breathe unrestricted by pain.

Shorter hospital stay and earlier return to normal activities are some of the reported advantages of laparoscopic surgery.[5,20] Similarly, a systemic review of several studies comparing 843 patients in laparoscopic group and 1031 patients in open surgery group demonstrated a decrease in length of hospital stay from 10.3 days to 6.3 days for patients undergoing laparoscopic repair when compared with open surgery.[24] In our study, there was a lower incidence of overall postoperative morbidity and less postoperative pain, resulting in a significantly shorter period of hospitalization for the laparoscopic repair group. There was a mean decrease of 2.9 days which was a statistically significant reduction favoring laparoscopic repair.

The main limitation of the present study was the nonrandomization of the patients as laparoscopic expertise was not available at all hours. The decision for either open or laparoscopic repair was then dependent on whether any of the laparoscopic-trained surgeons were available on hand. We also encountered difficulty convincing our anesthetic colleagues to support our decision for laparoscopic repair in patients with high Boey scores. However, acceptance towards laparoscopic approach improved over time after we presented our preliminary data in the forms of audit and review. We managed to sway their opinion as we demonstrated that the procedure was feasible, safe, and had better postoperative recovery, especially with regards to analgesic requirement.

5. Conclusion

Our series shows that laparoscopic repair for PPU results in less postoperative pain and shorter hospitalization when compared with open repair. There are overall fewer complications in the laparoscopic group though a larger randomized trial is needed to confirm this. Most importantly, a standardized technique with attention to suturing, focused sequential lavage, and early mobilization postoperatively is essential for improved outcomes. The improved postoperative pain control is essential in enabling patients to ambulate early and avoid pulmonary complications.

Conflicts of interest

All authors declare no conflicts of interest.

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