

Laparoscopic Repair of Duodenal Ulcer Perforation: A Randomized Controlled Clinical Trial

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Abstract

Background: Omental patch repair with peritoneal lavage is the mainstay of treatment for perforated duodenal ulcer in many institutions. The literature established that laparoscopic repair of perforation when compared to open repair, is associated to lower wound dehiscence, less analgesic use, less pain and hospital stays. The drawbacks are length of operative time and the laparoscopic surgeon's experience in intra corporeal suturing and knotting. **Methods:** Over a one year period 83 patients presenting with perforated duodenal ulcer were randomly assigned to undergo either an open or a laparoscopic omental patch repair. They were excluded for a history of upper abdominal surgery, concomitant evidence of bleeding from the ulcer, or gastric outlet obstruction. Those with clinically sealed-off perforations without signs of peritonitis or sepsis were treated without surgery. The endpoint was operative time, postoperative pain score, post-operative analgesic requirement, and length of postoperative hospital stay, morbidity, mortality and the date of return to normal daily activities. **Results:** Out of a total of 95 cases with diagnosis of duodenal perforations, 12 were excluded and 83 patients were analyzed. Both the groups were comparable in terms of age, gender, duration of symptoms, history of acid peptic disease, NSAIDs use, presence of comorbid conditions and size of perforation. Most of them presented after 24 hrs of onset of pain with the mean duration of 54.58 ± 32.4 hrs. There was one conversion in laparoscopic group due to intolerance to pneumoperitoneum. The duration of surgery was not significantly different but was high in the first five laparoscopic repairs (mean 91 mins as compared with 65 mins for the last 5 laparoscopic repairs). Those in laparoscopic group had significantly ($p < 0.001$) less postoperative pain, analgesic requirement, time to return to normal diet, full ambulation and hospital stay. Morbidity was significantly high in open group (36.29 % vs 13.88 % in laparoscopic group; $p = 0.01$). Open group had significantly high surgical site infection (19.14 vs 0%; $p = 0.005$) and chest infection (29.78 vs 11.11%; $p = 0.04$). One case in each group had mortality. **Conclusion:** Laparoscopic repair is safe and is a reliable procedure even in delayed presentation. It has significantly less postoperative pain, less need for analgesics, shorter hospital stay, early return to normal diet and work, and less complications without any difference in mortality.

Introduction

In perforated peptic ulcers laparoscopic approach offers significant attractions. Laparoscopy confirms the diagnosis and more importantly identifies position, site, and the size of the perforated ulcer. It achieves closure of the perforation and ensures adequate peritoneal toilet without the large abdominal incisions. Previous studies reported improved patient outcome after laparoscopic repair of perforated peptic ulcers [1].

Laparoscopic repair of duodenal perforation is a useful method for reducing hospital stay, post-operative pain or complications and earlier return to normal activity [2]. With a better training in minimal access surgery available worldwide at present, the time has come for this technique to be included in a surgeon's repertoire.

A total of 90 duodenal ulcer perforations (11.4% of emergency operations) were repaired at our center last year. Because of the high volume of patients visiting us with perforations; newer strategy, innovation and applications in the management is justified and is the need of the hour. In this era of minimal invasive surgery, laparoscopic repair might be the best alternative. Through this study we evaluated whether the laparoscopic repair resulted in an improved patient outcome when compared with the time honored conventional repair.

Objectives

To compare laparoscopic duodenal ulcer perforation repair with conventional open repair. We assessed the efficacy of laparoscopic duodenal perforation with the open repair by total operative time, time taken to return to normal diet, intravenous/intramuscular analgesics use, time to full mobilization, total inpatient hospital stay and complications (surgical site or chest infections, wound gaping, dehiscence etc.).

Materials and methods

It's a randomized controlled clinical trial done in a tertiary referral center over a period of one year. There were 83 patients with duodenal perforation. Patients with previous operation, evidence of bleeding ulcer, obstruction, unfit for anesthesia, haemodynamically unstable and those with clinically sealed off perforations were excluded from the study.

The patients were assessed for the duration of pain, peptic ulcer in the past and use of non-steroidal anti-inflammatory drugs. Physical examination performed, co-morbid conditions, and abdominal examination including tenderness, rebound tenderness, rigidity and

obliteration of the liver dullness were determined. A chest skaigram in an erect posture was done to look for the presence of free gas under the diaphragm. The clinical trial was started after formal approval by the hospital ethical committee and all the patients were informed about both procedure and technology. Informed written consent was obtained and randomization was done by a consecutively numbered opaque sealed envelope containing the treatment options, which was assigned by a computer generated random numbers. Both Laparoscopic and Open omental patch repair was done by the team of consultants who had experience in laparoscopic surgery. The ulcer was closed with three interrupted sutures using polygalactin (vicryl 2/0) over a piece of omentum. Drain was placed in the subhepatic space. Laparoscopic repair was done with four ports and a 30° laparoscope. The needle was introduced through the 10 mm operating port on the left. A single stitch was applied with a good bite of full thickness healthy tissue taken longitudinally across the middle of the perforation. The ulcer edges were approximated by intra corporeal suturing and, with two identical half knots forming a square knot followed by a third and opposite half knot. The same stitch was then passed through a piece of omentum and another three throws of knot made to anchor the omental patch over the repaired site. Thorough peritoneal lavage was performed with warm normal saline, all the purulent exudates and irrigation fluid was aspirated. A closed suction drain placed in sub hepatic space. All the port sites/peritoneum was infiltrated with 0.25% Bupivacaine.

An independent assessor visited patients in the morning to record the clinical progress, analgesic requirements, and pain score (by Visual Analog Scale of a 10 cm horizontal line without graduations) on postoperative days 1, 2 and 3. Feeding was resumed as soon as ileus subsided. Presence of wound infection and systemic infection (especially chest infection) were looked for. They were assessed by

surgeons for discharge when they tolerated a normal diet, could fully ambulate, and required only oral analgesics. H pylori eradication regime (omeprazole 20 mg, clarithromycin 500 mg and amoxicillin 1gm twice daily for a total of 7 days) was recommended. Both the independent assessor and in-charge surgeons were not blinded with respect to the study groups. All patients received the same instructions to return to normal activity and to work, and they were requested to keep a diary of the date of resumption of full daily activities or work and then reviewed at the outpatient department at 1st and 2nd week, for immediate follow up and subsequently as well. All the data were entered in the computer database and descriptive analysis was done manually, using SPSS version 10 software.

Results

A total of 95 patients with duodenal ulcer perforation were enrolled and twelve patients were excluded from the study. Out of these, five had perforation at other sites: three had in the ileum, one each in the stomach and jejunum. Three patients were haemodynamically unstable and one had previous history for surgery. Two patients with sealed perforation were treated with intravenous antibiotics. One patient left against medical advice. The remaining 83 patients were randomized into open (47) and laparoscopic (36) repairs.

Most of the patients were in the age group between 40-59 years. The mean age of the patient was 50.82 ± 14.58 year; ranging from 21 to 94 years. The mean age of patients in the laparoscopic group was 50 ± 12.71 years; those of open group were 51.45 ± 15.98 years. Age in both the groups was comparable (p 0.657). There were a total of fourteen females and sixty nine males. The male to female ratio was 4.9: 1. The male to female ratio in open and laparoscopic groups were 4.8: 1 and 5: 1 respectively (p 0.966) as shown in table 1.

Variables	Groups		p Value
	Open(n=47)	Laparoscopic (n=36)	
Male	39	30	0.966
Female	8	6	
Age (Yr)	51.45±15.98	50±12.71	0.657
Perforation size (mm)	6.6±3.5	5.4±2.2	0.086
Total operative time (min)	82.55±19.07	75.14±14.16	0.054
VAS Day 1	6.76±0.88	3.32±0.94	<0.001
VAS Day 2	4.41±0.92	1.76±0.60	<0.001
VAS Day 3	2.36±1.17	1.12±0.32	<0.001
I.V analgesics requirement (day)	3.71±0.69	2.56±0.66	<0.001
Time taken to return to normal diet (day)	6.60±1.30	4.65±1.59	<0.001
Time taken to fully mobilize (day)	4±1.08	3.24±0.65	0.001
Total hospital stay (day)	9.53±4.74	6.26±2.06	<0.001
Surgical site infection	9 (19.14%)	0 (0%)	0.005
Chest infection	14 (29.78%)	4 (11.11%)	0.04
Reexploration / Leak	1 (2.12%)	1 (2.77%)	0.84

Morbidity	18 (36.29%)	5 (13.88%)	0.01
Mortality	1 (2.12%)	1 (2.77%)	0.84

Table 1: Demography, Intra-operative and Post-operative variables

The mean presentation time was 54.58 ± 32.4 hrs (range 15-190 mins). 32.53% (n 27) attended within 48 hours of pain. Laparoscopic group presented early (mean 47.36 ± 19.51 hrs) as compared with open group (mean 60.11 hrs) (p 0.076). Thirty four (72.34%) in open group and thirty two (88.88%) in the laparoscopic group presented after 24 hrs.

Nineteen (22.89%) patients had history of acid peptic disease. Nine (19.14%) in open and ten (27.77%) patients in the laparoscopic (p 0.354), eleven (13.25%) patients had history of NSAIDs consumption: six (12.76%) in open and five (13.88%) in the laparoscopic group (p 0.88). A total of 7 (8.43%) patients with comorbid conditions; 3 (3.61%) had hypertension and 4 (4.81%) had chronic obstructive lung disease. The patients in both the groups with comorbid conditions were comparable (p 0.442). All 83 (100%) patients had pneumoperitoneum, however, five patients who were suspected to have duodenal ulcer had perforation in ileum (3) and one each in stomach and jejunum. The mean size of perforation was 6 ± 3.1 mm, ranging from 3 to 20 mm. The mean size of perforation in laparoscopic group was 5.4 ± 2.2 mm and in open it was 6.6 ± 3.5 mm (p 0.086). The total operative time for laparoscopic repair (75.14 ± 14.16 mins) was less as compared with open repair (82.55 ± 19.07 mins). However, the total operative time was not statistically significant (p 0.054). The operative time in the initial patient who underwent laparoscopic repair was high (mean 91 minutes for first five laparoscopic repairs) but it decreased by the end of the study (mean 65 minutes for last five laparoscopic repairs). The total operative time ranged from 50 to 120 minutes for laparoscopic repair and it ranged from 40 to 120 minutes in the open group.

One patient (16.66%) was converted to open, who presented 30 hrs after the onset of the pain and was a known case of chronic lung disease. The size of perforation was 2.5 mm. She suddenly developed bradycardia on insufflation and didn't tolerate pneumoperitoneum.

Those in the laparoscopic group had significantly less pain in the early postoperative period as compared with the open repair (p <0.001 for the first 3 days). The visual analogue score on first, second and third post-operative days were 3.32 ± 0.94 , 1.76 ± 0.60 , 1.12 ± 0.32 respectively for the laparoscopic group. Similarly, the visual analogue score on first, second and third post-operative days were 6.76 ± 0.88 , 4.41 ± 0.92 and 2.36 ± 1.17 respectively, for the open group as shown in figure 1.

Those with laparoscopic repair had less pain and required less Intravenous analgesics as compared with the open group. Open group required analgesics for 3.71 ± 0.69 postoperative days and those with laparoscopic group for 2.56 ± 0.66 postoperative days, which was statistically significant (p <0.001).

The patients in laparoscopic group required less time to return to normal diet as compared with the open group, those in open group took 6.60 ± 1.30 days to return to normal diet and 4.65 ± 1.59 days in the laparoscopic group, difference was statistically significant (p <0.001).

It took 4 ± 1.08 days in open group patients to be completely ambulant and for laparoscopic repair it took 3.24 ± 0.65 days to return to full activity, which was significantly less as compared with the open group (p 0.001). Those in open repair had a longer hospital stay of 9.53 ± 4.74 days; and laparoscopic repair had a shorter hospital stay of 6.26 ± 2.06 days which was significantly less too (p <0.001). The hospital stay was prolonged in those associated with complications. Four (11.11%) patients in the laparoscopic group had chest infection with the mean hospital stay of 10.5 days (range: 8 to 16 days); rest of the patients without complications stayed in the hospital from 5 to 7 days. Similarly, 17 (36.17%) patients in the open group had either chest and/or wound infection and their mean hospital stay was 13.35 days ranging from 7 to 25 days, and those without complications stayed in the hospital ranging from 5 to 13 days.

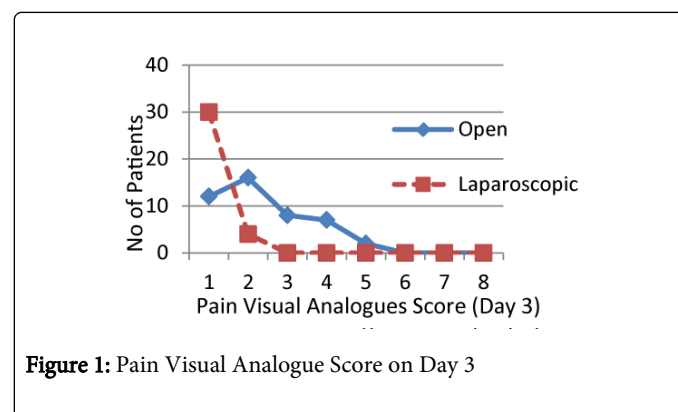


Figure 1: Pain Visual Analogue Score on Day 3

Twenty three (27.71%) patients had morbidity; 18 (36.29%) patients in open group and 5 (13.88%) in laparoscopic group (p 0.01). Chest infection, surgical site infection and leak in the open group, in the laparoscopic group 4 (11.11%) patients had chest infection and none of them had a surgical site infection. The operative time was significantly more in those who had complications (77.67 vs. 85.48 mins; p 0.062), requiring frequent analgesics due to post-operative pain, they had a longer hospital stay which was significant as well (6.43 ± 1.4 vs 12.81 ± 5.4 days; p <0.001).

In the open repair the leak manifested 7 days post operatively, he was clinically diagnosed with peritonitis. On exploration the suture was found to give way. Post operatively he had a prolonged hospital stay and was discharged on the 21st day. In the laparoscopic group too, a leak was detected on the 10 day. On exploration, he was found to have a perforation at a site approximately 2 cm distal to the previously sutured site. The patient had a prolonged hospital stay of 35 days.

The overall mortality was 2/83 (2.4%), one each in the laparoscopic 1/36 (2.77%) and open 1/47 (2.12%) group. The case in open group had a chest infection postoperatively, developed acute respiratory distress syndrome and in the laparoscopic group had a bradycardia following pneumoperitoneum which required cardiopulmonary resuscitation.

Discussion

Duodenal ulcer perforation was more common in males (M: F =4.9: 1), which is similar to the study by other groups 2, 3, 4. The mean age was 50.82 ± 14.58 years; 50 ± 12.71 years in the laparoscopic group and 51.45 ± 15.98 years in the open group, which was similar to Sui et al. 2002 [2] and Bhogal et al. 2008 [3]. Age in perforated peptic ulcer is increasing, i.e., above 60 yrs., it is because of more NSAID's and aspirin use by elderly population [4].

Majority (32.53%) presented on the second day with a mean of 54.58 ± 32.4 hrs, 17 (20.48%) patients presented before 24 hrs; in other studies presentation was early, majority (81-88.12%) within 24 hrs 3-5, and 5.7-11% [4] presented after 24 hrs, it is high in our series: 72.34% in open group and 88.88% in the laparoscopic group. It could be due to poor socioeconomic status, lack of health awareness, and people from inaccessible areas.

Nineteen (22.89%) patients had a history of acid peptic disease, similar to the Sui et al. 2002 and others [4,6], however in other studies [5,7], history of peptic ulcer disease was present in 50 to 75% patients. The era of H2 receptor blocker and proton pump inhibitor has led to a decline in prevalence. At the same time, the role of definitive surgery has waned, yet, in this era there is no fall in perforation rate but an increase rather. NSAID induced ulcers are on the increase and elective surgery for ulcer is disappearing in many areas of the world. Both these factors may have led to increase in perforation. In our study only 11 patients (13.25%) had history of NSAIDs, which is similar to Bertleff et al. 2010 [4] and Lango et al. 2002 [5] studies.

Four (4.21%) cases presented in shock, three didn't improve with resuscitation and were excluded, one improved and was randomized. Hemodynamically unstable patients had a poor outcome when compared with those without shock [7]. Different studies [5,7] have shown 5 to 20% incidence of shock at presentation.

All (100%) cases had pneumoperitoneum. Bertleff and Lango et al. 2002 [5] found free air in 85%. In 93-98%, definitive diagnosis was made by a diagnostic laparoscopy in an abdominal emergency and 86-100% treated laparoscopically during the same session.

In our study the mean size of perforation was 6 ± 3.1 mm, ranging from 3 to 20 mm, in the laparoscopic group it was 5.4 ± 2.2 mm and in open group it was 6.6 ± 3.5 mm. Perforation more than 1 cm has been found to have more postoperative complications in laparoscopic repair and hence were advised to go for open repair [2,8]. The size of perforation in our study was similar to that of Sui et al. 2002 [2] where the size of the perforation was 5.2mm in laparoscopic and 4.7 in open group. Out of 9 conversions in their study 2 was due to large size >10mm, in ours it was due to adverse effects of pneumoperitoneum. The study done by Bertleff and Halm et al. 2009 [6] had a mean perforation size of 10mm in the laparoscopic group and 7mm in open group without any statistical significance ($p = 0.379$), but the complications were more in open (24 Vs. 12 in laparoscopic group; $p = 0.061$) though statistically was not significant.

The total operative time for laparoscopic repair was less as compared with open repair (75.14 ± 14.16 mins Vs. 82.55 ± 19.07 mins) in our study, though it was not statistically significant ($p = 0.054$), which is comparable to the reports in the literature [2]. In our study, the time in the initial patient with laparoscopic repair was high (mean 91 mins for the first five laparoscopic repair), it decreased by the end of the study (mean 65 mins for the last five). Most trials reported longer operating time in the laparoscopic repair group ranging from 61 to 75

mins [2,4,6]. It has been explained by intracorporeal knotting which is technically demanding, especially if the edges are infiltrated and friable, and the time taken for suction irrigation procedure. Irrigating through 5 or even 10mm port is time consuming and suction decreases the volume of gas, reduces the pneumoperitoneum and alters the momentum of a procedure. However, a randomized prospective study performed by Siu et al. 2002 [2] revealed the time for laparoscopic repair is statistically significantly shorter than open repair, reflects to the development of modern irrigation systems and the increase in surgeons experience in laparoscopic surgery that has led to a shorter operating time. Other authors supported these findings in addition [9,10].

In our study, one patient (16.66%) was converted to open; it was a chronic obstructive lung disease, suddenly developed bradycardia intraoperatively, didn't tolerate pneumoperitoneum, and expired on the second postoperative day. Lunevicius and Morkevicius et al. 7 (2005) reported conversion rate in retrospective studies varied from 0 to 30%, and up to 60% in prospective studies. Prospective studies revealed more conversion predicting factors. Conversion per se did not affect the morbidity or mortality. Large ulcer size is commonly reported as a reason for conversion, resulting in 20 to 60% of all conversions. However, there is no generally accepted opinion on what ulcer size should be considered critical for a laparoscopic repair. Some authors advocate a perforation of >10mm [2,8] as a critical ulcer size; others mentioned it as 6mm diameter [9]. The other cause of conversions (4 to 11%) are the following: infiltration and fragility of ulcer edges [5], perforation associated with bleeding [2,11] and cardiovascular instability induced by pneumoperitoneum [5,9,11]. The first two factors are also related to progressing peritonitis, with a delay between the onset of symptoms and surgery being the main reason [9]. Posterior duodenal ulcer perforation is reported to be the cause of conversion in 12.5 to 33% of cases by both retrospective and prospective studies [12,13]. Failure of laparoscopic repair and increased risk of conversion are predicted by shock on admission (conversion rate of 50% in patients with shock versus 8% in those without shock on admission), delayed presentation for >24 hours (conversion rate of 33% in patients with delayed presentation versus 0% in those without it) [9]. Conversion can also be predicted by the Boey score. Boey score is a count of risk factors which are: shock on admission, American Society of Anesthesiologists (ASA) grade III-V, and duration of symptoms. The conversion rate increases with increasing Boey scores: 1, 2, and 3 points result in 21.4%, 30.2%, and 81.8% conversion rate respectively [8]. Siu et al. 2002 [2] reported significantly worse outcome in the converted patients group. They explained that the high morbidity and mortality rates in the converted group were related to the large perforations and associated technical difficulties. In our study, the conversion was due to intolerance to pneumoperitoneum and patient died due to its complication.

Visual analog score was in favor of laparoscopic repair in our study. Laparoscopic repair group had significantly less pain in the early postoperative period than the open group (VAS score $p < 0.001$ for first 3 days) which is similar to other studies where laparoscopic group had significantly less VAS score [2,6,14]. Laparoscopic approach reduces the access trauma as trauma of a midline laparotomy is relatively larger.

In our study, laparoscopic group required less intravenous analgesics (Open required IV analgesics for 3.71 ± 0.69 postoperative days and 2.56 ± 0.66 postoperative days for laparoscopic group; $p < 0.001$) which was similar to the other studies [2,3,6]. Interestingly,

Naesgaard et al. 1999 [15] did not see this decrease in need for analgesia in the first 10 postoperative days. It was felt that the pain from peritonitis regulated the need for analgesics more than the pain from incisions. Laparoscopic repair had resulted in less opiate analgesia use. A randomized study [16] comparing the acute phase response in patients with perforated ulcer undergoing laparoscopic or open repair concluded that the laparoscopic approach did not lead to the reduction in acute stress seen in elective surgery. As with most laparoscopic surgery, a decreased incidence was seen in postoperative wound infection and subsequent hernia formation. The subjective comfort following laparoscopic surgery had been noticed by patients and surgeons alike.

Laparoscopic group returned to normal diet early (4.65 ± 1.59 vs. 6.60 ± 1.30 days in open group; $p < 0.001$) similar to other studies of 3 to 4 days [2,3]. Sui et al. 2002 [2] mentioned laparoscopic procedure took 4 days (ranging from 3-35 days) and 5 days ranging from (3-24 days) in open group, which was statistically significant ($p = 0.06$). Similarly, laparoscopic group has an edge when it comes to early ambulation. In our study, those with laparoscopic repair could ambulate early (3.24 ± 0.65 days in laparoscopic vs. 4 ± 1.08 days in open group; $p = 0.001$), which is similar to other reports [2,3,7] where laparoscopic group took less days ranging from 2.3 to 10.4 days, probably due to less postoperative pain and early return to normal diet in laparoscopic group.

In our series, open repair cases had a hospital stay of 9.53 ± 4.74 days, and with laparoscopic repair of 6.26 ± 2.06 days. Laparoscopic repairs were discharged early ($p < 0.001$). Many studies showed laparoscopic repair is either shorter or equal with conventional repair. The difference was statistically significant in different reports [2,7], similar to our study. Bertleff and Halm et al. 2009 [6] found time to discharge is similar for the two groups, with a median difference of 1.5 days (lap 6.5 vs. open 8; $p = 0.235$), Lagoo et al. 2002 [5] found no statistically significant differences between the two groups in relation to hospital stay or return to work but postoperative comfort was subjectively increased and observed by most laparoscopic surgeons.

The best parameters to compare two different surgical techniques are morbidity and mortality. Perforation is still associated with high morbidity and mortality, with main problems caused by wound infection, sepsis, leakage at the repair site, and pulmonary problems. In our study a total of 23 patients (27.71%) had complications. Post-operative morbidity significantly favored the laparoscopic group in our study (13.88% vs. 36.29% open group; $p = 0.01$). Other studies showed a remarkable difference in morbidity (5.2 to 14.3% in the laparoscopic versus 26.9 to 50% in the open group) and mortality (3.6 versus 6.4%) [3,4]. Overall morbidity was significantly reduced with laparoscopy. It may be attributable to early removal of monitoring equipments and decreased tissue dissection associated with laparoscopy [3]. However, Bertleff and Halm et al. 2009 [6] resulted statistically equal complications (23.07% in laparoscopic and 48.97% in open group; $p = 0.061$). Postoperative complications in most studies increased with high mean age or shock at presentation, attending after 24 hours, and confounding medical conditions [5]; however in our study the demography of those who had complications was comparable with those who didn't have any complication including mean age (47.81 ± 13.78 yrs vs 58.52 ± 15.18 ; $p = 0.678$), shock but the delay was seen in either group with or without any complications. Though, delayed presentation has a lot to do for a poor outcome in laparoscopic surgery, Vaidya et al. 2009 [17] showed it can be done safely. Vaidya et al. 2009 [17] laparoscopically repaired perforated

peptic ulcers with delayed (>24 hours) presentation in 31 patients; two patients were converted; laparoscopy was successfully completed in 29 patients (94%). The median postoperative stay was 5.5 days while mean duration of pain was 3 days. Four patients had port site infections and 5 had intra-abdominal collections, which were managed conservatively. There were no chest infections or mortality which made him conclude a safe operation.

In our study, open repairs had more chest infection than those with laparoscopic repair (29.78 vs. 11.11%; $p = 0.04$) which is similar to other reports where chest infection was less in laparoscopy (0 to 3.84% vs. 7.14 to 12% in open). Sui et al. 2002 [2] reported 12.06% chest infection in open repair which was significantly ($p = 0.005$) higher than laparoscopic group with no chest infections. This might be due to a lengthy incision leading to pain during respiration and to chest infection. On the contrary, Bertleff and Halm et al. 2009 [6] found it to be more common in the laparoscopic group (3.84% vs 2.04%) though it was not statistically significant. Similarly, although the Naesgaard et al. 1999 [15] trial reported that the rate of pneumonia was increased in the laparoscopic group compared to the open, the duration of symptoms did not affect results because it was comparable in the two groups.

Port site infections were more common in open repair in our study (19.14% vs laparoscopic 0%; $p = 0.005$) was similar to other studies [2,3]. Wound dehiscence though reported after open repair [2] was not seen.

One case in each group leaked (open 2.12% vs laparoscopic 2.77%; $p = 0.84$), both of them required a 'redo', had an uneventful recovery. One in open group presented 90 hrs after pain, without any comorbid condition, with the size of 10 mm; one in the laparoscopic group presented 32 hrs after pain, without any comorbid condition, and 5 mm sized perforation. Postoperative leak was one of the most common complications (i.e., 1.5–16%), however, the leak rate of 16% was reported only in laparoscopic suture less fibrin glue repair patients [7]. In other groups, the suture leak rates were much smaller, averaging around 5% [2,3] in some series. Lee et al. 2001 [8] clarified that APACHE II (5 points) and ulcer size (>10 mm) were independent risk factors predicting increased risk for postoperative leak for laparoscopic suture less fibrin glue repair.

We had one mortality in each group (2.12% in open vs. 2.77% in laparoscopic group; $p = 0.84$), one in open died due to chest infection and acute respiratory distress syndrome and in the other group due to intraoperative complication of pneumoperitoneum, developed bradycardia required cardiopulmonary resuscitation and expired on the second day. In the study done by Bertleff and Halm et al. 2009 [6], mortality increased up to 50% in perforation beyond 24 hours. CO₂ insufflation in peritonitis increased bacterial translocation in rat models [6]. This led to the assumption that laparoscopic surgery might be dangerous in prolonged peritonitis. Vaidya et al. 2009 [17] performed laparoscopic repair in perforated peptic ulcer more than 24 hours and concluded it was safe like our study where 79.51% patients presented after 24 hours.

Mortality following open repair is high in different reports (laparoscopic 0 to 4% vs. open 5.1% to 8%) [2,6]. The study done by Sui et al. 2002 [2] had one mortality (1.85%) in the laparoscopic group and three (5.1%) in open, as the patients were ASA III/IV and above 75 years. Other series [6] showed cause of death in the laparoscopic group to be sepsis, in open due to pulmonary problems (ARDS, pneumonia), and post-cerebrovascular accident sequelae combined with respiratory insufficiency. With a proper case selection and timely

management we may be able to improve mortality and morbidity in the future.

Conclusion

Laparoscopic duodenal perforation repair is an effective, safe alternative than the conventional repair. Even in patients presenting after 24 hrs of symptoms, it can be done safely in hemodynamically stable patients who can tolerate pneumoperitoneum. The total operative time is less though not statistically significant. The intravenous analgesics use, early post-operative pain, time taken to return to normal diet, time to full mobilization, total inpatient hospital stay, and post-operative complications are at distinct advantage which favors a laparoscopic repair. Mortality rate however was similar in both the groups.

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