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Laparoscopic omental patch for perforated peptic ulcer disease reduces length of stay and complications, compared to open surgery: A SWSC multicenter study



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ABSTRACTS

RCTs showed benefits in Lap repair of perforated peptic ulcer (PPU).

The SWSC Multi-Center Trials Group sought to evaluate whether Lap omental patch repairs compared to Open improved outcomes in PPU in general practice.

Data was collected from 9 SWSC Trial Group centers. Demographics, operative time, 30-day complications, length of stay and mortality were included.

461 patients: Open in 311(67%) patients, Lap in 132(28%) with 20(5%) patients converted from Lap to Open. Groups were similar at baseline. Significant variability was found between centers in their utilization of Lap (0–67%).

Complications at 30 days were lower in Lap (18.5% vs. 27.5%, $p < 0.05$) as was unplanned re-operation (4.7% vs 14%, $p < 0.05$). Lap reduced LOS (6 vs 8 days, $p < 0.001$). Ileus was more in Lap (42% vs 18 $p < 0.001$) operative time was 14 min higher in Lap($p < 0.01$) and admission to OR time was 4 h higher in Lap(<0.05). No significant difference readmission or mortality.

Our results suggest Lap should be considered a first-line option in suitable PPU patients requiring omental patch repair in centers that have the capacity and resources 24/7.

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Introduction

Perforated peptic ulcer (PPU) is a serious complication of peptic ulcer disease (PUD), requiring immediate surgical intervention. PPU are relatively uncommon, developing in 2–10% of patients

with PUD.¹ PPU are associated with a mortality and morbidity up to 30% and 50%, respectively and are associated with more than 70% of deaths in patients with PUD.^{1,2} *Helicobacter pylori* infection is a common causative factor for PUD.³ Eradication of this infection concomitant with surgical therapy can reduce recurrence of PPU and lower post-operative complications.⁴

Traditional surgical management of simple PPU involves laparotomy with primary suture closure or omental patch (Open).⁵ The first laparoscopic (Lap) treatment of a perforated peptic ulcer with

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an omental patch and fibrin glue was described in 1990 by Mouret et al.⁶ A laparoscopic approach to PPU offers potential advantages such as smaller incisions, better visualization of the perforated ulcer during the procedure, fewer postoperative complications, and a faster patient recovery.⁷ However, laparoscopic surgery usually takes longer than an open operation, although the time difference is likely to decrease with improved surgeon familiarity with the procedure.

The benefits of laparoscopic repair for PPU have been debated for decades, without demonstration of clear superiority from meta-analyses or retrospective studies.^{8–12} One study reported a higher incidence of suture site leakage with laparoscopic repair.⁸ Overall, when comparing laparoscopic vs open repair, reported outcomes of mortality and morbidity have been similar for over a decade. A recent meta-analysis of eight randomized clinical trials suggested reduced post-operative pain and wound infections with a laparoscopic approach, with otherwise similar outcomes.¹² While there are theoretical advantages of a minimally invasive approach, it is unclear how often these procedures are performed in general practice. While adoption of laparoscopy for appendicitis and acute cholecystitis has been rapid, it is less commonly used in other emergency general surgical procedures such as colectomy, where the majority are still performed open.¹³ The SWSC Multi-Center Trials Group sought to evaluate the prevalence of laparoscopic surgery for PPU, and to compare the outcome of laparoscopic versus open omental patch repairs.

Materials and methods

This retrospective study included patients who underwent omental patch repair for PPU at 9 SWSC institutions from January 2011–June 2018. Each of the participating centers obtained Institutional Review Board approval. We compared Lap vs Open vs cases converted from Lap to Open. Five of the centers were university teaching hospitals and 4 were community-based. All were level I trauma centers, with a mean bed capacity of 669 (range 412, 914) that was similar between sites ($p = 0.3$). Patients with PPU were identified using ICD-9 coding. Patients undergoing additional or alternate procedures, such as vagotomy or Bilroth II were excluded.

During the study period the choice of laparoscopic vs open technique was at surgeon's discretion. Data collected included but was not limited to age, sex, race, smoking status, alcohol consumption, and history of PUD, preoperative use of proton pump inhibitors or steroids, type of operation performed and use of drains. In addition, Charlson Comorbidity Index (CCI) was used to standardize comorbidities.¹⁴ Outcomes including time from admission to operation, length of stay (LOS), mortality, duration of operation and 30-day complications (e.g. superficial, deep surgical site infections (SSI), organ space infections (OSI) ileus, small bowel obstruction (SBO), unplanned readmission and reoperations) were noted.

American College of Surgeons National Improvement Program (NSQIP) definitions of complications were used during data collection.

Data was analyzed using SPSS ver. 25.0 (IBM, Armonk, USA). Continuous variables were examined for normality; Kruskal-Wallis test was used for continuous variables with nonparametric distributions and Dunn's post hoc test adjusted with Bonferroni correction was used for subgroup analysis when needed. Categorical variables were dealt with using Pearson's χ^2 test or Fisher's exact test as appropriate. A p value < 0.05 was considered to be significant.

Results

Of 632 charts reviewed, omental patch was performed in 465 patients: 4 patients had insufficient data and were excluded from the study. Of the remaining 461 patients, open surgery was performed in 311 (67.4%) patients, Lap in 130 (28.2%). Twenty (4.3%) patients were converted from Lap to Open, and included in the analysis. The mean age was 56 years \pm 18years; 60% of patients were male and 61% White. Groups were similar at baseline, except Lap was more commonly performed in women (34% vs. 24.5%, $p = 0.05$). Conversion was more common in men 15% vs 5%.

There was no difference between groups in comorbidities, with most patients having a low Charleson Comorbidity Index. Hypertension (45%) and diabetes (17%) were the most common comorbidities in both groups. A documented history of peptic ulcer disease was seen in 18% in Lap vs 17% open vs 33% in converted cases ($p = 0.22$) (Tables 1a, 1b).

There was significant variability between centers in their utilization of Lap ranging from 0 to 67% ($P < 0.001$) (Table 2).

Time from admission to operation was significantly longer in the Lap group (Median 7.4 h in Open vs 11.46 in Lap) as was duration of operation (Median 96 min Lap vs 82 Open $p < 0.01$).

Regarding outcomes, Lap patients had a significantly reduced

Table 1a
Sample characteristics and demographics.

	Open Repair	Lap Repair	Converted	p-value
Sex, n (%)				0.05
Female	116 (63.4)	62 (33.9)	5 (2.7)	
Male	195 (70.1)	68 (24.5)	15 (5.4)	
Race Categories, n (%)				0.02
White	182 (64.3)	92 (32.5)	9 (3.2)	
Hispanic	51 (77.3)	12 (18.2)	3 (4.5)	
Black	62 (72.9)	19 (22.4)	4 (4.7)	
Others	16 (59.3)	7 (25.9)	4 (14.8)	
Age (ANOVA)	56.28 (1.04)	56.7 (1.5)	56.8 (3.52)	0.97
HTN, n (%)				0.20
Yes	141 (68.8)	59 (28.8)	5 (2.4)	
No	170 (66.4)	71 (27.7)	15 (5.9)	
DM, n (%)				0.43
Yes	49 (61.3)	27 (33.8)	4 (5)	
No	262 (68.8)	103 (27)	16 (4.2)	
Previous PUD, n (%)				0.22
Yes	69 (61.1)	39 (34.5)	5 (4.4)	
No	242 (69.5)	91 (26.1)	15 (4.3)	
PPI Use, n (%)				0.93
Yes	54 (65.9)	24 (29.3)	4 (4.9)	
No	257 (67.8)	106 (28)	16 (4.2)	
Steroid Use, n (%)				0.87
Yes	34 (70.8)	12 (25)	2 (4.2)	
No	277 (67.1)	118 (28.6)	18 (4.4)	
Smoking Status				0.36
Non	141 (70.5)	51 (25.5)	8 (4)	
Previous	53 (60.2)	32 (36.4)	3 (3.4)	
Current	117 (68.4)	45 (26.3)	9 (5.3)	
Alcohol Intake				0.31
None	207 (69.5)	82 (27.5)	9 (3)	
Mild	33 (62.3)	17 (32.1)	4 (7.3)	
Moderate	27 (57.4)	17 (36.2)	2 (3.9)	
Heavy	44 (69.8)	14 (22.2)	5 (7.9)	

Table 1b
CCI Score in Lap vs open.

Score	Open, N (%)	Lap, N (%)	Converted, N (%)	Chances of 10-year survival	p-Value
0–2	133 (66.8)	54 (27.1)	12 (6.0)	90–98%	0.44
3–5	94 (65.7)	43 (30.1)	6 (4.2)	21–77%	
≥6	84 (70.6)	33 (27.7)	2 (1.7)	0–2%	

Table 2
Percentage of Lap vs Open per Center.

Center Number	Open, N (%)	Lap, N (%)	Converted, N (%)	
1	53 (96.4)	1 (1.8)	1 (1.8)	<0.001
2	7 (17.9)	26 (66.7)	6 (15.4)	
3	49 (60.5)	24 (29.6)	8 (9.9)	
4	42 (93.3)	3 (6.7)	0 (0)	
5	27 (93.1)	2 (6.9)	0 (0)	
6	30 (31.6)	61 (64.2)	4 (4.2)	
7	23 (92)	2 (8)	0 (0)	
8	32 (97)	0 (0)	1 (3)	
9	48 (81.4)	11 (18.6)	0 (0)	

hospital LOS (Median 6 vs 8 days, $p < 0.001$). Complications at 30 days were lower in Lap (18.5% vs. 27.5%, $p < 0.05$). However, ileus was significantly higher in the Lap group (42% vs 18%, $p < 0.001$). There were fewer unplanned re-operations in Lap, which was statistically significant (4.7% vs 14%, $p < 0.05$).

There was no significant difference in readmission (4.6% Lap vs

7.1%) or mortality (2.3% Lap vs 5.8%) (Table 3).

Two out of 9 centers had 67% and 64% of their cases respectively done Lap. To determine if LOS was shorter in Open surgery as well within those 2 centers, we extracted the data individually and studied the differences in LOS means between Lap and Open. Although we found no statistical difference but the median LOS of Lap in both centers was reduced, 9 days for open vs 7.5 in lap, vs 8.5 in converted group, $p = 0.78$ in center 2 and 8 for open vs 7 for lap vs 7.5 in converted, $p = 0.43$ in center 6.

Discussion

This multi-center study showed wide variation in utilization rates of laparoscopic surgery for PPU in the 9 participating centers. Overall, laparoscopic surgery was utilized in less than a third of PPU patients in this cohort. Several benefits of Lap versus Open were noted: Lap was associated with reduced LOS, post-operative complication and reoperation rates. Readmission and mortality rates were similar between the 2 groups. The only adverse outcome

Table 3
Outcomes in Lap vs Open Groups.

	Open	Lap	Converted	P-Value
Length of Stay (Days), Median	8	6	8.71	<0.001
Duration of Operation (Minutes), Median	82	96	121.8	<0.01
Admission to Operation (Hours), Median	7.40	11.46	8.71	<0.05
Mortality, n (%)				0.17
Yes	18 (85.7)	3 (14.3)	0 (0)	
No	293 (66.6)	127(28.9)	20 (4.5)	
30-day Morbidity, n (%)				<0.05
Yes	91 (75.8)	24 (20)	5 (4.2)	
No	219 (64.4)	106 (31.2)	15 (4.4)	
Unplanned Readmission, n (%)				0.20
Yes	22 (71)	6 (19.4)	3 (9.7)	
No	282 (66.7)	124 (29.3)	17 (4)	
Unplanned Reoperation, n (%)				<0.05
Yes	43 (84.3)	6 (11.8)	2 (3.9)	
No	262 (65)	123 (30.5)	18 (4.5)	
SSI, n (%)				0.53
No	286 (67.3)	122 (28.7)	17 (4)	
Superficial	13 (68.4)	5 (26.3)	1 (5.3)	
Deep	11 (68.8)	3 (18.8)	2 (12.5)	
OSI, n (%)				0.29
Yes	31 (77.5)	7 (17.5)	2 (5)	
No	280 (66.5)	123 (29.2)	18 (4.3)	
Ileus, n (%)				<0.001
No	187 (73.3)	61 (23.9)	7 (2.7)	
Yes	43 (46.2)	44 (47.3)	6 (6.5)	
SBO, n (%)				0.26
Yes	10 (83.3)	1 (8.3)	1 (8.3)	
No	297 (66.7)	129 (29)	19 (4.3)	

was a higher rate of ileus in Lap. Operative time was also longer in Lap, with a median increase of 14 min compared to Open. These findings suggest a potential benefit for Lap as first-line surgical treatment in PPU.

In our patient population, we observed a 9% lower rate of complications at 30 days with laparoscopic surgery. On further breakdown of the 30-day complication rates, in this study, the rates of superficial and deep surgical site infections (SSI) were comparable in both groups. Those results are similar to previous reviews that either confirm a lower early postoperative complication rate in lap group or note no difference in complication rates between open and lap repair.^{15–17} However, although statistically non-significant ($p = 0.29$), organ space infections (OSI) was almost double in the open group at 9.5%. This finding is similar to that of Lee et al. who found a rate of 4.7% open vs 2.5% lap.¹⁷

One unexpected finding was a 24% higher rate of ileus in lap vs open. Given that Lap should theoretically reduce exposure of the intestines to hypothermia and handling, this was the opposite of predicted. In contrast, Siow *et al.* described ileus in 3.2% of Lap vs 5.9% in open group ($p = 0.68$)¹⁸, while Zhou et al. in a recent meta-analysis reported a shorter period of ileus in Lap with relative risk 0.33 compared to open.¹⁶ One likely explanation for the difference in our results are varying definitions of ileus in different studies. In this study the American College of Surgeons' NSQIP definition of delay in return of bowel function >3 days was used. Other authors have used varying definitions, such as daily nasogastric tube output >500 ml, lack of flatus, or failure to commence enteral feeds by 5th post-operative day.

Another unexpected finding was that time from admission to operation was longer for Lap patients. While it is almost impossible in a multi-center retrospective study to identify the exact causes that contributed to this relative delay, it is likely that increased resources required for Lap may have been a factor. Many centers are not equipped for complex laparoscopic procedures especially after-hours, and it is possible that led to some of this delay. While it does not appear that patient outcomes were jeopardized by this lag, it is an important variable to take into account for surgeons who intend to change their practice toward Lap for PPU. In contrast, and of importance in the current healthcare economic climate, laparoscopic surgery had a significantly shorter length of stay in the hospital, ($P < 0.05$). This is in contrast to most of the reports in literature that found comparable LOS.^{15,19} However, Lee et al. showed LOS of 4 days in lap vs 11 days in open ($P < 0.05$), similar to our findings.¹⁷ Wright et al. found that lap omental patch repair cost \$8000 less than open repair with no significant difference in readmission rates or mortality between open and laparoscopic repair.²⁰ While we did not perform a cost analysis of the cohort, the reduction in LOS, complications and reoperations with only slight increase in operative times, suggests a potential overall cost benefit for laparoscopic surgery for PPU.

Patients in the Lap group had nearly half the mortality of patients in the Open group, although this did not reach statistical significance. It is likely that patients in the Open group had higher illness severity than those selected for Lap, even if these differences were not always detectable by retrospective review. It is also possible that this study, despite including multiple centers, was underpowered especially in the laparoscopic cohort, and thus a real survival difference was not found to be statistically significant.

There are a number of limitations to this study: the retrospective nature of the study, different surgical practices and medical record systems across all 9 institutions increase the probability of missing data. Several variables that are likely of clinical significance were not able to be included in this analysis due to missing data in a majority of charts; these include size of perforation, details of exact procedure such as primary repair in addition to omental patch and

prior laparotomy history. It is likely that these factors may have influenced decision on laparoscopic versus open repair. The exclusion of patients undergoing non-omental patch procedures and the variability in utilization of Lap across the participating centers will reduce the generalizability of these results to those patients with relatively straightforward perforations. Finally, we did not specifically analyze the subset of patients who might have developed a perforated peptic ulcer during the course of another illness, or who had a recurrent PPU after prior surgical treatment. However, the number of patients in this cohort who might fit in these categories is fewer than 10, therefore it would not have altered our overall findings.

Conclusion

Laparoscopic surgery was utilized in less than a third of PPU patients in this study across 9 centers in the Southwestern US. Where used successfully, it reduced 30-day complications, unplanned reoperations and length of stay. Laparoscopic surgery should be considered in centers that have the capacity and resources to provide this resource 24/7, for appropriate PPU patients requiring omental patch repair.

Conflict of interest

The authors have no conflicts and no reported funding.

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