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ORIGINAL SCIENTIFIC REPORT

Laparoscopic Repair for Perforated Peptic Ulcer: A Retrospective Study

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Abstract

Backgrounds The incidence of patients presenting with perforated peptic ulcers (PPU) has decreased during the last decades. At the same time, a laparoscopic approach to this condition has been adopted by increased number of surgeons. The aim of this study was to evaluate the early postoperative results of the laparoscopic treatment of perforated peptic ulcer performed in eight Romanian surgical centers with extensive experience in laparoscopic surgery.

Methods Between 2009 and 2013, 297 patients with perforated peptic ulcer were operated in the eight centers participating in this retrospective study. The patients' charts were reviewed for demographics, surgical procedure, complications and short-term outcomes.

Results Boey score of 0 was found in 122 patients (41.1%), Boey 1 in 169 (56.9%), Boey 3 in 6 (2.0%). For 145 (48.8%) patients, primary suture repair was performed, in 146 (49.2%) primary suture repair with omentopexy. There were 6 (2.0%) conversions to open surgery. The operative time was between 25 and 120 min, with a mean of 68 min. Two (0.7%) deaths were noted. Mean hospital stay was 5.5 days, ranges 3–25 days. Postoperative complications included: 7 (2.4%) superficial surgical site infections, 5 (1.6%) cardiovascular, 3 (1.0%) pulmonary, 2 (0.7%) duodenal leakages, 3 (1.0%) deep space infections and 1 (0.3%) upper digestive hemorrhage.

Conclusions This study shows that the laparoscopic approach for PPU is feasible; the procedure is safe, with no increased risk of duodenal fistulae or residual intraperitoneal abscesses. We now consider the laparoscopic approach for PPU as the "gold standard" in patients with Boey score 0 or 1.

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Introduction

Surgical interventions for perforated peptic ulcer (PPU) have decreased substantially in the last 25 years. This is due mainly to the introduction of the highly efficacious proton pump inhibitor (PPI) medication. Even though peptic ulcers occur less frequently due to this successful medication, ulcer perforation can still occur in up to 10% of the patients with a peptic ulcer [1], in some of them representing the onset event.

The first laparoscopic surgical treatment of the PPU, published by Mouret et al. [2] and Nathanson et al. [3], has represented an important step forward in the surgery for this complication of the peptic gastroduodenal ulcers. In Romania, this procedure had been employed in tertiary hospitals since 1996, but more frequently from 2000 onward.

The aim of this retrospective study was to evaluate the short-term results of laparoscopic treatment in PPU, performed in eight Romanian surgical centers with substantial experience in laparoscopic surgery with the goal to confirm that this is indeed a safe approach with comparable if not potentially better patient outcomes when compared to classical approaches.

Materials and methods

A retrospective review was performed on all patients who underwent a laparoscopic procedure for PPU between 2009 and 2013 in eight large tertiary hospitals across Romania.

Ethics Committees of each hospital involved approved this retrospective study. Electronic databases were searched for codes of PPU, with individual chart review performed on all patients identified with a laparoscopic procedure for PPU.

Data extracted included: demographics, history of the peptic ulcer disease, previous treatment of the disease, time from initial diagnosis of the PPU to acute presentation, comorbidities, American Society of Anesthesiologists (ASA) risk class and Boey score.

The preoperative diagnosis was based on radiological signs (pneumoperitoneum) and clinical symptoms: upper abdomen pain and tenderness.

Peri-operative data included: operating room time (OR time), patient positioning on the operating table, number of trocars used, peritonitis type, ulcer perforation size, the method used for the closure of the perforation, conversion to open surgery, number of the tubes used for the drainage of the peritoneal cavity and nasogastric tube placement. Positioning, in relation to the position of the surgeon to the patient, was either the French position or American position, the French position being the same as described by Druart et al. [1]. The number of trocars inserted was different depending on the difficulty of the surgery and surgeon's preference. Postoperative data recorded: days until first bowel movement, days until nasogastric tube removal, complications, re-operations, hospital stay and 30-day postoperative mortality.

Statistical analysis

Data were collected and analyzed using the SPSS v.17 software suite (SPSS Inc. Chicago, IL, USA) and are presented as percentages and number of individuals for categorical variables. To assess the significance of the differences between groups, the Fisher's exact test (proportions) was used. The risk analysis was evaluated using odds ratio (OR) and its 95% population confidence interval.

The individual impact of several confounding factors on the variance of a continuous variable was assessed by building multivariate logistic regressions. The predictors, in the final regression equations, were accepted according to a repeated backward stepwise algorithm (inclusion criteria $p < 0.05$, exclusion criteria $p > 0.10$) in order to obtain the most appropriate theoretical model to fit the collected data. The quality of the model was described using the accuracy of the prediction and also by adjusted R^2 (multivariate linear regression), respectively, Nagelkerke's R^2 (logistic regression).

Results

Two hundred and ninety-seven patients met the inclusion criteria, and another 176 were operated in an open approach.

Preoperative data are showed in Table 1.

Males represented 83.8% of patients and females 16.2%. In 156 (52.5%) patients, perforation was the first symptom of the disease. Only 25 (8.4%) patients reported taking anti-ulcer therapy for the six months prior to perforation.

Delay to surgery was mainly due to late presentation of patients to hospital. Boey score was calculated retrospectively for assessing the postoperative risks: 122 (41.1%) patients were Boey 0, 169 (56.9%) were Boey 1 and 6 (2.0%) were Boey 2 and 3.

At presentation, all patients had clinical signs of peritonitis. The chest and abdomen radiograph depicted pneumoperitoneum in 94.3% of the patients. This sign was used as the most important indicator to proceed to surgery.

Table 1 Pre-operative data of the patients

Number of patients	$n = 297$ (100%)
Male/female	249 (83.8%):48 (16.2%)
Mean age (years)	45.1 (range 15–85)
Previous disease	
DU with previous medical treatment	25 (8.4%)
DU with no treatment	272 (91.6%)
PDU first symptom	156 (52.5%)
Associated diseases	68 (22.9%)
Delay between perforation and surgery	
<6 h	61 (20.6%)
6–12 h	186 (62.6%)
12–24 h	44 (14.8%)
>24 h	6 (2.0%)
Boey score	
0	122 (41.1%)
1	169 (56.9%)
2 and 3	6 (2.0%)

Two methods were used for closure of the perforation: primary suture repair or primary suture repair plus omentopexy. There were 6 (2.0%) conversions to open surgery. The indications for conversion included 2 (0.6%) cases of dense intra-peritoneal adhesions, one case (0.3%) where the callosity made it impossible the suture and 3 (1.0%) cases where gastric resection was required (Table 2).

In all cases, warm saline was used for peritoneal lavage until clear fluid was obtained.

Table 2 Intra-operative data of the patients

Number of patients	$n = 297$ (100%)
ASA risk class	
I	202 (68.0%)
II	89 (30.0%)
III	6 (2.0%)
Perforation size	
Pinpoint	44 (14.8%)
<5 mm	209 (70.4%)
5–10 mm	44 (14.8%)
Perforation closure method	
Primary suture repair	145 (48.8%)
Primary suture repair and omentopexy	146 (49.2%)
Conversions to open surgery	6 (2.0%)
Mean operating time	68 min (range 25–120)
Peritoneal lavage	$n = 291$ (only for laparoscopic cases)
<3 l	77 (26.5%)
3–5 l	199 (68.4%)
>5 l	15 (5.1%)

Peritoneal cavity drains were placed postprocedure in all cases; one drain was used in 87 cases (29.9%), two drains in 152 cases (52.2%), three drains in 34 cases (11.7%) and four drains in 18 cases (6.2%). The period of drainage varied between 2 and 23 days, with a mean time of our days. A nasogastric tube was placed in 239 (80.5%) patients till diet resumed.

Total operative time varied from 30 to 125 min, with an average procedure length of 65 min.

The reintroduction of oral diet varied across the group and was dependent on the severity of peritonitis, the size of perforation, time to first bowel movement and the surgeon's experience. One hundred and fifty-four (51.9%) patients received liquids only after the obvious onset of passing wind despite our policy of allowing liquid diet in all patients 24 h after surgery. Nine patients (3.0%) with Boey score 0 started to eat 8–12 h after surgery without medical instruction to do so; however, no complications was noted in this group.

Two (0.6%) duodenal leakages occurred (Table 3). The first was in a 37-year-old male, ASA I, Boey score 1. This was identified on the 4th postoperative day (POD) when gastric fluid like content was drained by the subhepatic tube. The Taylor method was employed and the leakage stopped POD 23. The drainage tube was then removed that same day and on POD 25 the patient was discharged, with no further readmissions. The other leakage occurred in a male patient, 53 years old, ASA II, Boey score 2. Again on the 4th POD, gastric content was observed in the drainage bag. The Taylor method was employed and the leakage stopped on the 11th POD, and the drainage tube was removed on the 12th POD, with discharge POD 14. Both of these patients developed superficial surgical skin site infections.

Two (0.6%) deaths occurred during the study period. Both patients were similar in age (72 and 75 years old, respectively), and both were ASA III, Boey score 2. Patient

Table 3 Post-operative data of the patients

Number of patients	$n = 297$ (100%)
Complications	19 (6.4%)
Surgical site infections	7 (2.5%)
Deep abdominal space infections	3 (1.0%)
Upper digestive hemorrhage	1 (0.3%)
Cardio-vascular complications	5 (1.6%)
Pulmonary complications	3 (1.0%)
Duodenal leakage	2 (0.7%)
30 day mortality	2 (0.6%)
Resume oral diet	
After 24 h	143 (48.1%)
After first bowel movement	154 (51.9%)
Mean first bowel movement	3 days (range 1–6)
Mean hospital stay	5.5 days (range 3–25)

Table 4 Univariate complication rates analysis

	Complications number (%)	*p* value
Primary suture repair ($n = 145$)	8 (5.5%)	0.634
Primary suture repair + omentopexy ($n = 146$)	11 (7.5%)	
Perforation size		
Pinnpoint ($n = 44$)	2 (4.5%)	0.862
<5 mm ($n = 209$)	14 (6.7%)	
5–10 mm ($n = 44$)	3 (6.8%)	
Boey score		
0 ($n = 122$)	1 (0.8%)	0.010
1 ($n = 169$)	12 (7.1%)	<0.001
2 or 3 ($n = 6$)	6 (100%)	

p value <0.05 was considered statistically significant, *n* number of patients

one presented with generalized peritonitis, and symptoms for at least 24 h, while patient two had a similar delayed presentation of generalized peritonitis and symptoms for longer than 24 h. No leakage was observed at autopsy in either patient. The cause of the death was myocardial infarction in both cases.

Three (1.0%) deep space infections occurred during the study period: Two subdiaphragmatic abscesses were drained by ultrasound guidance, the other pelvic abscess required drainage by laparoscopy. In all three cases, no leakage was observed. All three abscesses occurred in the first week after surgery, fever was always present over 38 °C, and the white blood cell count was elevated.

There was one (0.3%) case of postoperative upper gastrodoudenal hemorrhage.

Univariate complication rates analysis

Type of repair: According to our results, we found no significant association ($p = 0.634$; Fisher's exact test) between the type of the repair and the rate of complications (Table 4).

Perforation size: The perforation size had no significant influence ($p = 0.862$; Fisher's exact test) on the complications' rates.

Boey score: A higher Boey score was significantly associated with an increased rate of complications ($p < 0.001$; Fisher's exact test).

ASA risk score: ASA risk score was significantly associated with a higher rate of complications ($p < 0.001$; Fisher's exact test).

Intervention's delay: The time elapsed from the onset to intervention was proved to be significantly associated with a higher incidence of complications ($p < 0.001$; Fisher's exact test).

Multivariate risk analysis: To evaluate the impact of different predictors in the development of complications, we created a multivariate logistic regression model having as outcome the presence of complications and as initial predictors: patient's age, gender, type of repair, perforation size, Boey score, ASA risk and the delay of presentation. To find the best model which suits this relationship, the final regression equation was validated according to a backward stepwise algorithm, having an inclusion threshold criterion for predictors a *p* value for goodness of fit lower or equal to 0.05, respectively, an exclusion threshold a *p* value higher than 0.10. In the final regression equation, the following predictors were accepted: Boey score and ASA risk.

According to our model, the incidence of complications was significantly associated with Boey score ($\text{Exp}(\beta) = 3.26$; $p < 0.001$) and ASA risk ($\text{Exp}(\beta) = 7.22$; $p < 0.001$). The other predictors evaluated in the initial equation were excluded by the stepwise algorithm, being thus considered as non-valid independent predictors of complications.

Discussions

Prior to laparoscopic treatment, the classical open surgery approach dominated the treatment of PPU. There was evidence that healing of perforated ulcers could be reached by conservative medical treatment such as the Taylor method [4]—which showed recovery in more than half of the cases, different authors found that the need for emergency surgery is required in more than 70% of the cases [5]. Surgical treatment was, however, preferred because conservative therapy was marked by more complications, mainly in elderly patients [6].

The development of the laparoscopic approach coincided with the introduction of anti-secretory medication. Using these medications in conjunction with surgery allowed the procedure to be limited to perforation closure only, with further interventions in order to reduce the gastric secretion of acid no longer being necessary. Perforation closure can be accomplished by primary suture (simple or with omentopexy), by omentopexy alone or by using a biological adhesive [7–9].

For the laparoscopic approach to be accepted over traditional methods, there is a need for quality evidence of its safety and efficacy, in particular comparing the rates of duodenal leakage and deep abdominal space infections with the open approach. Also literature has raised concerns over bacteremia in the setting of pneumoperitoneum [10]. During our study period, 176 patients were operated in an open approach in the same hospitals as those operated laparoscopic. Due to retrospective nature of our study, we

were not able to find all the reasons why surgeons preferred the open access, but the higher risk patients, the limited number of laparoscopic operating sets, the preference of some surgeons for the open approach were amongst.

From the current study, 97.9% of patients were classified as ASA I or II, with only six (2.0%) patients ASA III. There were no patients in ASA risk class IV; this is because within the study centers an open approach is still the preferred method for high risk surgical candidates.

Patient positioning was at the surgeon's discretion, choosing either the French or the American positions. Our results show that currently Romanian surgeons prefer the American position over the French. This is not consistent with worldwide trends showed in 29 studies, only 33% of the worldwide surgeons preferred to operate from the left side of the patient (American position) [11]. The likely reasons for favoring this approach include the similarity in positioning to that of laparoscopic cholecystectomy (performed in Romania by the majority of surgeons in American position) and also a simpler surgical table positioning than the French position.

A learning curve in the technique of the procedure was observed over the study period. The number of access sites was influenced by the need to perform adhesiolysis and the size of the patient, especially at the end of the procedure when peritoneal lavage was done, and the pelvic region was out of reach of the regular laparoscopic instruments.

The operative time depended on the surgeon's training and lesion type. Since the onset of the laparoscopic approach, the authors have identified that more time is consumed with the peritoneal lavage rather than actually with the suturing of the perforated ulcer [12]. The shortest operative time in this study was achieved at patients with less than 6 h since the perforation and with less spillage in the peritoneal cavity.

The surgeons participating in this study have estimated that surgeons with good experience in laparoscopic cholecystectomy and intracorporeal suturing skills needed 8–10 laparoscopic interventions for PPU in order to achieve an optimal operating time.

There were only 6 (2%) conversions in the study period due to dense adhesions, a large ulcer callosity and infiltration of nearby organs leading to gastrectomy; others had same results with low conversions rate and complications [13].

The most utilized technique for perforation closure was primary suture repair with omentopexy. There was no evolution or shift in technique observed over the study period. An omentopexy was thought to be necessary, in cases of large diameter perforation or when perforations margins were friable. However, recent literature has shown a shift in cases of smaller perforations with no callous edges that primary suture repair provides satisfactory results [14]. In fact, some authors have reported good results performing only perforation pluging with greater omentum flap or using biological adhesives [15].

With a large case volume, we have been able to refine our own technique. In cases with larger perforations with friable edges, suturing can often be technically difficult. In these cases, the suture thread can be passed far from the friable edges with intracorporeal knots carefully tied, without tightening, till the edges joined. A part of the great omentum is brought and fixed with 2 threads over this suture, for further sealing. Even despite this technical refinement, there was a case of conversion to open surgery because of the inability to perform primary suture repair due to thickened callous margins of the ulcer.

The amount of the saline used for peritoneal lavage was of utmost importance. Our current study showed no increased risk of residual abscesses. Previously, there have been concerns that the laparoscopic approach might not allow complete lavage of the peritoneal cavity. Authors have shown that actually laparoscopic peritoneal lavage is more efficient than in open surgery. It allows a better view and exploration of the subfrenic, subhepatic and Douglas spaces when compared to a xipho-supraumbilical incision [16].

With increased experience, the number of drainage tubes diminished during the study period, most recently the majority of cases had only one drainage tube in the peritoneal cavity after lavage. The tube was placed in the right subhepatic space. A meta-analysis on 29 studies regarding laparoscopic PPU has shown that in 21% of the operated patients no intraperitoneal drainage was used with no subsequent increased rate of complications [11].

At the beginning of our study, oral feeding was resumed cautiously after the first 2–3 days, but toward the end of the study, liquid ingestion was recommended 24 h after the operation [17]. Less compliant patients, due to alcohol abuse usually, removed their nasogastric tube 6–12 h after the operation. Against medical recommendations they started nutrition with solid food in the first 24 h after the operation. Despite this, no complications were reported in these patients.

There were only 2 (0.6%) deaths in our study, which is much lower than in the reported literature. This is likely in part because only 6 (2%) patients with ASA III risk underwent laparoscopic treatment. Most studies reporting deaths include ASA III and ASA IV patients with associated pathology. Hence, in a meta-analysis including 29% ASA III and IV patients, an average mortality of 5.8% [11] was reported. Our current low mortality rate reflects our policy of laparoscopic approach of PPU being reserved for patients classified ASA I and ASA II.

Our results show that severe peritonitis or its time from onset should not contraindicate a laparoscopic approach to

PPU. This is because the laparoscopic approach permits a very efficient peritoneal lavage with reduced surgical injury. This is supported by recent published evidence [16, 17].

Conclusion

This study shows that laparoscopic approach of the PPU is feasible; the procedure is safe, with no increased risk of duodenal fistulae or residual intraperitoneal abscesses. We consider that laparoscopic approach of PPU should be the "gold standard" in the treatment of patients with a Boey score 0 or 1 or ASA I and II.

Authors' contributions All authors have contributed to the design, acquisition of data, revised the manuscript for important data and approved the final form of the manuscript.

Disclosure Dr. Flore Varcus, Dr. Mircea Beuran, Dr. Ioan Lica, Dr. Claudiu Turculet, Dr. Adrian Valentin Cotarlet, Dr. Stefan Georgescu, Dr. Dan Vintila, Dr. Dan Sabau, Dr. Alexandru Sabau, Dr. Constantin Ciuce, Dr. Vasile Bintintan, Dr. Eugen Georgescu, Dr. Razvan Popescu, Dr. Cristi Tarta, Dr. Valeriu Surlin have nothing to disclose.

References

1. Druart ML, Van Hee R, Etienne J et al (1997) Laparoscopic repair of perforated duodenal ulcer. A prospective multicenter clinical trial. Surg Endosc 11:1017–1020
2. Mouret P, Francois Y, Vignal J et al (1990) Laparoscopic treatment of perforated peptic ulcer. Br J Surg 77:1006
3. Nathanson LK, Easter DW, Cuschieri A (1990) Laparoscopic repair/peritoneal toilet of perforated duodenal ulcer. Surg Endosc 4:232–233
4. Songne B, Jean F, Foulatier O et al (2004) Non operative treatment for perforated peptic ulcer: results of a prospective study. Ann Chir 129(10):578–582
5. Crofts TJ, Park KG, Steele RJ et al (1989) A randomized trial of nonoperative treatment for perforated peptic ulcer. N Engl J Med. 320(15):970–973
6. Millat B, Fingerhut A, Borie F (2000) Surgical treatment of complicated duodenal ulcers: controlled trials. World J Surg 24(3):299–306. doi:10.1007/s002689910048
7. Hermansson M, Staël von Holstein C, Zilling T (1999) Surgical approach and prognostic factors after peptic ulcer perforation. Eur J Surg 165(6):566–572
8. Tate JJT, Dawson JW, Lau WY et al (1993) Sutureless laparoscopic treatment of perforated duodenal ulcer. Br J Surg 80:235
9. Siu WT, Leong HT, Law BKB et al (2002) Laparoscopic repair for perforated peptic ulcer: a randomized controlled trial. Ann Surg 235(3):313–319
10. Bloechle C, Emmermann A, Treu H et al (1995) Effect of pneumoperitoneum on the extent and severity of peritonitis induced by gastric ulcer perforation in the rat. Surg Endosc 9:898–901
11. Bertloff MJ, Lange JF (2010) Laparoscopic correction of perforated peptic ulcer: first choice? A review of literature. Surg Endosc 24:1231–1239
12. Bergamaschi R, Marvik R, Johnsen G et al (1999) Open versus laparoscopic repair of perforated peptic ulcers. Surg Endosc 13:679–682
13. Palanivelu C, Jani K, Senthilnathan P (2007) Laparoscopic management of duodenal ulcer perforation: is it advantageous? Indian J Gastroenterol 26:64–66
14. Lo HC, Wu SC, Huang HC et al (2011) Laparoscopic simple closure alone is adequate for low risk patients with perforated peptic ulcer. World J Surg 35:1873–1878. doi:10.1007/s00268-011-1106-7
15. Lau WY, Leung KL, Kwong KH et al (1996) A randomized study comparing laparoscopic versus open repair of perforated peptic ulcer using suture or sutureless technique. Ann Surg 224(2):131–138
16. Sanabria A, Villegas MI, Morales Uribe CH (2013) Laparoscopic repair for perforated peptic ulcer disease. Cochrane Database Syst Rev 2:CD004778
17. Vaidya BB, Garg CP, Shah JB (2009) Laparoscopic repair of perforated peptic ulcer with delayed presentation. J Laparoendosc Adv Surg Tech 19(2):153–156