Surg Endosc (1997) 11: 1017–1020

Surgical Endoscopy

Laparoscopic repair of perforated duodenal ulcer

A prospective multicenter clinical trial

M. L. Druart,[1] R. Van Hee,[2] J. Etienne,[3] G. B. Cadière,[3] J. F. Gigot,[3] M. Legrand,[3] J. M. Limbosch,[1] B. Navez,[3] M. Tugilimana,[3] E. Van Vyve,[3] L. Vereecken,[3] E. Wibin,[3] J. P. Yvergneaux[3]

[1] Medical and Surgical Unit of Gastroenterology, Hospital Center Etterbeeck-CHEI, Brussels, Belgium
[2] Academic Surgical Center Stuivenberg, University of Antwerp—UIA, A.Z. Stuivenberg, Lange Beeldekensstraat 267, B-2060 Antwerpen, Belgium
[3] The Belgian Group for Endoscopic Surgery, Feluy, Belgium

Received: 16 August 1996/Accepted: 1 April 1997

Abstract
Background: A series of 100 consecutive patients with perforated peptic ulcer were prospectively evaluated in a multicenter study. The feasibility of the laparoscopic repair was evaluated.
Methods: All patients had peritonitis, 20% were in septic shock, and 57% had delayed perforation. Conversion to laparotomy was necessary in eight patients. The morbidity rate was 9% and mortality rate 5%.
Results: The mean delay of postoperative gastric aspiration (mean 3.4 days) and resumed food intake (mean 4.4 days) as well as the mean postoperative hospital stay (mean 9.3 days) were comparable to conventional surgery, but postoperative comfort was subjectively increased by laparoscopy and noticed by all laparoscopic surgeons participating in this study.
Conclusions: Laparoscopic repair of perforated peptic ulcer proves to be technically feasable and carries an acceptable morbidity and mortality rate, compared with conventional surgery.

Key words: Peptic ulcer — Perforation — Raphy — Omentoplasty — Peritonitis — Laparoscopic treatment

Duodenal ulcer perforation is a serious complication of peptic ulcer disease that occurs in 5–10% of duodenal ulcer patients and accounts for over 70% of deaths associated with peptic ulcer disease.

The treatment of this pathology is essentially surgical [3, 21, 35]. Many authors advocate simple suture of the perforation associated or not with omentoplasty [27, 28, 33]. In some cases, definitive treatment of the ulcer disease may be indicated and associated to the suture repair by means of a truncal, selective, or highly selective vagotomy, or by means of an anterior seromyotomy or gastric stapling, combined with posterior truncal vagotomy [12, 31, 34]. However, these procedures may be contraindicated in case of peritonitis [4]. They are only justified in approximately one-third of cases in view of the natural history of the ulcer disease and the existence of new medical drugs [27]. The purpose of this study is to evaluate the efficacy of the laparoscopic approach to perforated gastroduodenal ulcer without association of other type of surgical treatment for the healing of the ulcer disease.

Correspondence to: R. Van Hee

Patients and methods

A total of 100 consecutive patients with perforated gastroduodenal ulcer were evaluated prospectively in a multicenter trial set up by the Belgian Group for Endoscopic Surgery. None of the patients underwent vagotomy or seromyotomy for the healing of the ulcer disease. The purpose of our study was only to evaluate the efficacy and safety of the laparoscopic raphy of the gastroduodenal G.D. ulcer perforation. All data were recorded on a specially designed checklist, entered into a computer system, and statistically analyzed.

The series consisted of 64 male and 36 female patients with a mean age of 52.5 years (range 14–92 years).

At clinical presentation signs of an acute abdomen were present in all patients. Associated septic shock, identified in 20 patients and treated preoperatively, was accepted for inclusion in the trial.

The white blood cell count was less than 10,000/mm^3 in 22 patients, between 10,000 and 15,000/mm^3 in 40 patients, and greater than 15,000/mm^3 in 35 patients.

An overview of different risk factors is given in Table 1.

Previous symptoms of gastroduodenal ulcerative disease were present in 40 patients. Preoperative investigation consisted of plain abdominal X-ray in 97 patients, ultrasound in 33 patients, CT scanning in 27, X-ray investigation after a Gastrografin swallow in 20 patients, and endoscopy in four patients.

The delay between perforation and operation is outlined in Table 2. Sixty-seven patients had an empty stomach at the time of operation. At operation, all patients had a peritonitis, either localized ($n = 35$) or gen-

Table 1. Risk factors present in this patient series ($n = 100$)

Risk factors	%
Age ⩾70 years	25
Cardiac pathology	18
Chronic respiratory insufficiency	5
Obesity	5
Corticoid treatment	8
Cirrhosis	5

Table 2. Delay between perforation and operation

Delay	%
<2 h	4
2–6 h	38
6–12 h	40
>24 h	17

Table 3. Type of laparoscopic treatment, chosen by the individual surgeon

	n
Raphy	81
Raphy + omentoplasty	67
Fibrin glue (R/Tissucol) treatment	7
Peritoneal lavage	100
Peritoneal drainage	82

Table 4. Reasons for conversion in eight patients

Reasons	*n*
Inadequate ulcer localization	4
Posterior location of gastric ulcer	1
Pancreatic infiltration	1
Localized abscess formation	1
Inadequate instrumentation	1

eralized ($n = 65$). The ulcer location proved to be duodenal in 63 patients, juxtapyloric in 29 patients, and remained unspecified in eight patients.

For laparoscopic surgical treatment, the patient is placed in a 15–20° reverse Trendelenburg position. The operating surgeon stands between the patient's legs. Through a supraumbilical stab incision the pneumoperitoneum is established with a Veress needle and the laparoscope is introduced through a 10–12-mm trocar; the other trocars are placed under laparoscopic control: a 5-mm cannula in the epigastrium, used for liver retraction, and two 12-mm cannulae in the right and left subcostal regions, respectively, on the midclavicular and anterior axillary lines.

After irrigation with warm saline solution, the perforation is identified. Raphy is performed as in conventional surgery with grasping forceps and needle holder introduced through the lateral 12-mm cannula. The needle is passed through normal duodenum some millimeters from the edge of the perforation to prevent any risk of tearing the ulcer edges and enlarging the perforation. Depending on the choice of the laparoscopic surgeon an omentoplasty was added or fibrin glue was used to seal the closed perforation. Thorough peritoneal lavage is then accomplished by systematic warm saline infusion and aspiration of the peritoneal fluid. Special attention is given to the supra- and subhepatic regions, the left subdiaphragmatic space, and the pelvic cavity. After lavage, all fluid is aspirated and a drain is left under laparoscopic sight in the right subhepatic pouch close to the perforation closure. In case of general peritonitis, a second drain is left in the Douglas recessus and positioned under visual control.

Other laparoscopic procedures were associated in three patients—respectively, an adhesiolysis, a cholecystectomy, and one liver biopsy.

Postoperative management consisted of administration of H_2-receptor antagonists, intravenous fluids, antibiotics, and nasogastric aspiration.

Subjective well-being of the patients was evaluated postoperatively by the surgeons with respect to abdominal discomfort and rehabilitation.

Results

Laparoscopic treatment was successful in all but eight cases. The type of treatment and the use of lavage and drainage is shown in Table 3.

Conversion to laparotomy was necessary in eight cases. Reasons for conversion are listed in Table 4. The mean operating time, registered in 78 patients, was 80.0 min (range 40–135 mins).

In the postoperative period, nasogastric aspiration was performed during a mean of 3.4 days (range 1–10 days). Food intake was resumed after a mean of 4.4 days (range 1–10 days). The mean postoperative hospital stay lasted 9.3 days (range 2–40 days) and was less than 5 days in 22 patients and more than 10 days in 19 patients.

Ten patients underwent a postoperative gastrographin swallow, showing a suture leak in two patients and a gastric outlet obstruction in two other patients.

Nine patients suffered complications, either local or general, or both, resulting in five deaths.

As local complications two suture line leaks were observed, necessitating surgical treatment (gastrectomy); two digestive hemorrhages, treated either surgically (gastrectomy) or medically; one Douglas abscess (surgical treatment); one subphrenic abscess treated by CT-guided aspiration under local analgesia; and one parietal abscess treated by antibiotics. Four general pulmonary complications occurred and were successfully treated with medical management.

As mentioned, five patients died:

- An 82-year-old man (ASA 4), in septicemic shock and generalized peritonitis, admitted 6 h after a giant ulcer perforation. A fistula occurred after laparoscopic repair and the patient died in multiple organ failure on the 4th postoperative day.
- A 74-year-old man (ASA 4), in septicemic shock and generalized peritonitis, lasting more than 24 h. He developed ARDS and died 10 days after laparoscopic repair.
- A 75 year old man (ASA 4), in septicemic shock and generalized peritonitis, lasting more than 24 h, died of heart failure on the 15th postoperative day.
- An 85-year-old man with the same clinical conditions as the previous patient died from ARDS on the 10th postoperative day.
- A 72-year-old man (ASA 4) with similar clinical conditions had a posterior ulcer necessitating a gastrectomy. He developed a digestive hemorrhage and died on the 28th postoperative day from respiratory failure.

Discussion

Perforated peptic ulcer remains a challenging disease for the surgeon, occurring far more often than elective peptic ulcer surgery.

Not only does perforation occur in almost 10% of all duodenal ulcers, but it often remains the first clinical presentation of the disease.

Ever since the epoch-making work of Taylor [30] conservative treatment of perforated ulcer has had its advocates [22, 23].

As 75–80% of such ulcers could eventually heal spontaneously with appropriate nasogastric suction and resuscitation [8], a deliberative approach was suggested, reserving surgical intervention for nonresponders to medical treatment [6].

Broad application of such an approach is, however, destined to lead to a more significant morbidity and mortality, especially in the older age group [24].

Laparoscopic surgical treatment of perforated ulcer seems an attractive alternative for conservative treatment because of the absence of complications compared to conventional laparotomy, especially parietal complications (wound infection and late eventration) and general complications in older patients (pulmonary disease or embolism).

Laparoscopic treatment, first reported in 1990 [26], follows the same principles as open surgery—namely, closing the perforation combined with lavage and drainage of the abdominal cavity.

For the perforation closure different techniques were proposed: suturing with either intra- or extracorporeal knot tying [9], gastroscopically aided insertion of the ligamentum teres hepatis into the perforation hole [7], stapled omental patch repair [10], or sealing a gelatine sponge or an omental flap into the perforation hole with fibrin glue [1, 29].

In our series we mainly performed suture ($n = 81$), whether or not with omental patch repair ($n = 67$), just as we used to do in open surgery [33], whereas seven patients benefited from fibrin glue sealing.

Special attention is given to intraperitoneal lavage, which in our patients was liberally performed with a warm saline solution. Lavage is an adequate measure to counteract the negative effects of peritonitis, which form the major cause of morbidity and mortality in these patients. Some investigators [32] even obtained very satisfactory results performing only laparoscopic lavage and drainage in combination with a conservative Taylor method, confirming the earlier-reported important role of lavage in the perforation management [11]. Our 100-patient series matches favorably with the Hong Kong consecutive series of 100 cases operated by means of either omental patch repair ($n = 44$) or suture patch repair ($n = 35$) or fibrin glue repair ($n = 21$) [25]. As far as parameters can be compared, our series may, however, prove to be subjected to more complications as the mean age is older (52 vs 45 years), presentation delayed for more than 24 hours is more frequent (17% vs 3%), septic shock is more prominent (20% vs 8%), and underlying medical disease is more frequent (33% vs 5%). These differences may account for the higher mortality rate in this series (5% vs 3%), whereas type and number of complications remain similar. Also, the conversion rate was analogous to that in the Hong Kong series [25], 8% and 7%, respectively.

Neither study shows a great difference in morbidity or mortality rates, nor in length of hospital stay, compared with conventional surgical treatment, but subjective postoperative comfort of the patients was markedly increased by the laparoscopic approach. Most of the patients could even have been discharged from hospital earlier but remained in the hospital to receive intravenous antibiotics for 3–5 days because of the peritonitis, and in view of the Gastrografin swallow on the 4th or 5th postoperative day, before starting to eat.

In this patient series, our policy consisted only of raphy of the perforation, without any attempt for definitive ulcer surgery [33]. Laparoscopic types of definitive surgical ulcer treatment may, however, be added to the perforation repair in younger patients with chronic relapsing peptic ulcer disease [20, 34] or may be performed some months later without notable surgical difficulties [20]. Especially anterior gastric stapling, combined with posterior truncal vagotomy, a procedure first introduced by us in 1984 [18, 19] and popularized by Gomez-Ferrer [14], seems to be laparoscopically most appropriate and takes virtually no additional time after perforation repair [15, 17].

The results of this study show the feasability of the laparoscopic approach for perforated peptic ulcer repair with an acceptable morbidity and mortality rate in this multicenter study. Analysis of our results confirm that older patients ($\geqslant$70 years) in septic shock and with prolonged peritonitis or other associated diseases remain a high-risk category [5, 24].

Insufflation during a laparoscopic approach has been incriminated as a possible risk factor. Carbon dioxide pneumoperitoneum has indeed increased the incidence of bacterial translocation from the peritoneum into the bloodstream in an animal model [13, 16]. Previous studies equally suggested pneumoperitoneum is a potential risk in cases of preexisting peritonitis [2]. One nonrandomized study showed that two out of 14 patients treated laparoscopically for perforated gastric ulcer (with 15 mmHg pneumoperitoneum) died from peritonitis and septic complications. The increased incidence of bacteremia during insufflation may be related to increasing abdominal pressure as well as to turbulence [2], thereby perpetuating the extent and severity of peritonitis by disseminating contaminated secretions. Notwithstanding the fact that manipulation at open laparotomy may result in similar dissemination, the results of our study made us argue that older patients with septic shock and generalized peritonitis should better be served by conventional surgery.

Posterior gastroduodenal perforation should equally be treated by conventional laparotomy (raphy or gastrectomy) because of the difficulty in assessing the posterior side of the gastrointestinal tract by coelioscopy and the risk of postoperative complications like fistula. A randomized prospective large series of patients is needed to confirm the postoperative benefit of this new form of treatment for perforated gastroduodenal ulcer. However, the known advantages of the minimally invasive procedure, such as parietal wall integrity, cosmetic benefit, and early subjective postoperative comfort and rehabilitation, were already noted by all surgeons in this study.

References

1. Benoit J, Champault GG, Labhar E, Sezeur A (1993) Sutureless laparoscopic treatment of perforated duodenal ulcer. Br J Surg 80: 1212 (Letter)
2. Bloechle C, Emmermann A, Treu H, Achilles E, Mack D, Zornig C, Broelsch CE (1995) Effect of pneumoperitoneum on the extent and

severity of peritonitis induced by gastric ulcer perforation in the rat. Surg Endosc 9: 898–901
3. Boey J, Wow GJ, Ong GB (1982) A prospective study of operative risks factors in perforated duodenal ulcers. Ann Surg 195: 265–269
4. Bornman PC, Theodorou NA, Jeffrey PC, Marks IN, Essel HP, Wright JS, Terblanche J (1990) Simple closure of perforated duodenal ulcer; a prospective evaluation of a conservative management policy. Br J Surg 77: 73–75
5. Bulut O, Rasmussen C, Fischer A (1996) Acute surgical treatment of complicated peptic ulcers with special reference to the elderly. World J Surg 20: 574–577
6. Cocks R, Kernett RH, Sinclair GWG, McL. Dawson JH, Hong BH (1989) Perforated peptic ulcer: a deliberative approach. Austr NZJ Surg 59: 379–385
7. Costalat G, Dravet F, Noel P, Alquier Y, Vernhet J (1991) Coelioscopic treatment of perforated gastroduodenal ulcer using the ligamentum teres hepatis. Surg Endosc 5: 154–155
8. Crofts TJ, Steele RJC, Cheung SCS, Park K, Li AKC (1987) Prospective randomised controlled trial of conservative therapy versus surgery for perforated duodenal ulcer. Gut 28: A1375
9. Darzi A, Carey PD, Menzies-Gow N, Monson JRT (1993) Preliminary results of laparoscopic repair of perforated duodenal ulcer. Surg Laparosc Endosc 3: 161–163
10. Darzi A, Cheshire NJ, Somers SS, Super PA, Guillou PJ, Monson JRT (1993) Laparoscopic omental patch repair of perforated duodenal ulcer with an automated stapler. Br J Surg 80: 1552
11. Delaitre B, Attailla A, Chihaoui M (1988) Ulcères gastroduodénaux perforés. Traitement par dialyse péritonéale (72 observations). Press Med 17: 1297–1300
12. Donovan AJ, Vinson TL, Maulsby GO, Gewin JR (1979) Selective treatment of duodenal ulcer with perforation. Ann Surg 189: 627–631
13. Evasovich MR, Clark TC, Horattas MC, Holda S, Treen L (1996) Does pneumoperitoneum during laparoscopy increase bacterial translocation? Surg Endosc 10: 1176–1179
14. Gomez-Ferrer F (1992) Gastrectomie linéaire antérieure et vagotomie tronculaire postérieure. J Coeliochirurg 4: 35–38
15. Gomez-Ferrer F, Balique JG, Azagra S, Bicha-Castelo H, Castro-Sousa F, Espalieu P, Rodero D, Estour E (1996) Laparoscopic surgery for duodenal ulcer: first results of a multicentre study applying a personal procedure. Br J Surg 83: 547–550
16. Gurtner GC, Robertson CS, Chung SC, Ling TK, Ip SM, Li AK (1995) Effect of carbon dioxide pneumoperitoneum on bacteraemia and endotoxaemia in an animal model of peritonitis. Br J Surg 82: 844–848
17. Hannon JK, Snow L, Weinstein LS (1993) Linear gastrectomy: an endoscopic staple-assisted anterior highly selective vagotomy combined with posterior truncal vagotomy for treatment of peptic ulcer disease. Surg Laparosc Endosc 2: 254–257
18. Hendrickx L, Van de Kelft E, Van Hee R, Hubens A (1984) Anterior lesser curvature stapling and posterior truncal vagotomy: a new method for gastric acid reduction in dogs. Eur Surg Res 16 (Suppl 1): 98
19. Hendrickx L, Van Hee R, Van de Kelft E, Hubens A (1987) Anterior gastric stapling combined with posterior truncal vagotomy: an experimental technique for gastric acid reduction. Eur Surg Res 19: 225–232
20. Hendrickx L, Van Hee R (1994) Laparoscopic surgery in the treatment of gastroduodenal ulcer disease. In: Röher H-D, Heise JW, Verreet PR, Varney M (eds) Update in gastric surgery. Georg Thieme Verlag, Stuttgart, pp 10–13
21. Jordan PH, Morrow C (1988) Perforated peptic ulcer. Surg Clin North Am 68: 315–329
22. Keane TE, Dillon B, Afdhal NH, McCormack CJ (1988) Conservative management of perforated duodenal ulcer. Br J Surg 75: 583–584
23. Kristensen ES (1980) Conservative treatment of 155 cases of perforated peptic ulcer. Acta Chir Scand 146: 189–193
24. Kulber DA, Hartunian S, Schiller D, Morgenstern L (1990) The current spectrum of peptic ulcer disease in the older age groups. Am Surg 56: 737–?
25. Lau WY, Leung KL, Zhu XL, Lam YH, Chung SCS, Li AKC (1995) Laparoscopic repair of perforated peptic ulcer. Br J Surg 82: 814–816
26. Mouret P, François Y, Vagnal J, Barth X, Lombard-Platet R (1990) Laparoscopic treatment of perforated peptic ulcer. Br J Surg 77: 1006
27. Raimes SA, Devlin HB (1987) Perforated duodenal ulcer. Br J Surg 74: 81–82
28. Sawyers JL (1992) Acute perforation of peptic ulcer. In: Scott HW Jr, Sawyers JL (eds) Surgery of the stomach, duodenum and small intestine. 2nd ed. Blackwell Scientific, Boston, MA pp 566–572
29. Tate JJT, Dawson JW, Lau WY, Li AKC (1933) Sutureless laparoscopic treatment of perforated duodenal ulcer. Br J Surg 80: 235
30. Taylor H (1946) Perforated peptic ulcer treated without operation. Lancet ii: 441–444
31. Taylor TV, Holt S, Headin RC (1985) Gastric emptying after anterior lesser curve seromyotomy and posterior truncal vagotomy. Br J Surg 72: 620–622
32. Urbano D, Rossi M, De Simone P, Berloco P, Alfani D, Cortesini R (1994) Alternative laparoscopic management of perforated peptic ulcers. Surg Endosc 8: 1208–1211
33. Van Hee R (1984) Results of simple suture for perforated peptic ulcer. Acta Chir Belg 84: 97–102
34. Van Hee R, Mistiaen W, Hendrickx L, Blockx P (1995) Anterior gastric wall stapling combined with posterior truncal vagotomy in the treatment of duodenal ulcer. Br J Surg 82: 934–937
35. Watkins RM, Dennison AR, Collin J (1984) What has happened to perforated peptic ulcer? Br J Surg 71: 774–776