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ORIGINAL ARTICLE

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Laparoscopic repair of perforated gastroduodenal ulcer by running suture

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Abstract *Background and aims:* Perforated gastroduodenal ulcer represents an emergency situation that requires immediate surgical intervention. Laparoscopic ulcer repair is a feasible and safe procedure, especially in cases of a short duration of ulcer perforation and good clinical condition. However, to be well accepted as a treatment modality, an endoscopic procedure should be as simple as possible. We describe a technique that does not require intracorporal or extra-corporal knotting. *Patients and methods:* Over a 4-year period, we performed 786 diagnostic laparoscopies for various, acute abdominal conditions. We identified 20 gastroduodenal perforations. All ulcers were closed with a one-row running suture (Lahodny) and controlled radiologically on the third postoperative day. *Results:* Three different surgeons performed the surgeries. There were no conversions to open surgery. Median operating time was 50 min, and median hospital stay was 9 days. We observed no insufficiency, no wound infection, and no stenosis or persisting peritonitis. *Conclusion:* The closure of perforated gastric ulcers with the Lahodny suture is safe and simple to perform.

Keywords Ulcer perforation · Endoscopic surgery · Acute abdomen · Diagnostic laparoscopy · Lahodny suture

Introduction

The occurrence of perforated peptic ulcer disease is associated with *Helicobacter pylori* infections, non-steroidal anti-inflammatory agents and elderly patients [1, 2, 3]. Since this group of patients seldom requires complex procedures, which may be associated with increased morbidity and mortality [4, 5, 6], simple closure of the perforation with an omental patch has become the preferred approach for its management in many institutions [7, 8, 9, 10, 11, 12, 13].

Diagnostic laparoscopy is an excellent procedure for the management of acute abdominal conditions [14]. Ulcer perforation is a routine finding in emergency clinics and requires immediate surgical intervention [15, 16, 17]. In addition to conservative treatments [18] or open abdominal surgery, various laparoscopic techniques have also been used to treat this condition over the past few years. There is still, however, disagreement as to the relative merits of laparoscopic ulcer repair. Laparoscopic techniques such as omental patch repair, gelatine sponge, fibrin glue [11, 12] and gastroscopy-assisted methods [19, 20] are time consuming and require extended surgical skills with respect to suturing and knotting techniques [5, 11, 12, 18, 19, 21, 22, 23, 24, 25, 26, 27].

Because perforated peptic ulcers often present as an emergency situation, laparoscopic techniques for their management have to be simple and safe to be acceptable.

We tested the feasibility and safety of a PDS suture (Lahodny suture), a technique familiar to endoscopic

hernia-repair surgeons, as a procedure that does not require intra-corporal or extra-corporal knotting.

Patients and methods

In this prospective trial, we performed 768 diagnostic laparoscopies for acute abdominal conditions over a 4-year period. We identified 20 gastroduodenal perforations in this group, that were less than 6 hours old. All 20 patients (mean age 47 years, range 27–73 years) were operated on endoscopically by three different surgeons.

In the same period six patients who presented with gastroduodenal perforations were not included in the study. In one patient, diagnostic laparoscopy revealed perforated gastric cancer, and the intervention was converted to an open approach. In the other five patients, laparoscopy was not used as a diagnostic tool. One patient had perforated gastric carcinoma and four presented with delayed severe peritonitis and septic shock.

Surgical technique and perioperative management

All patients had nasogastric catheter decompression and perioperative therapy with 40 mg omeprazole, amoxicillin and clavulanic acid. Trocar placement was identical to laparoscopic cholecystectomy and was performed according to the French technique, with the surgeon standing between the patient's legs and the assistant on the left side. In addition to the two 5-mm trocars used for diagnostic laparoscopy (umbilicus and right side of the abdomen, 5-mm camera, Karl Storz, Tuttlingen, Germany), a further 5-mm trocar was placed at the epigastrium, and a 10-mm trocar for the needle holder on the left side of the abdomen. The surgery was started with a biopsy at the ulcer site for histological examination and immediate *Helicobacter* testing whenever the patient had not undergone gastroscopy preoperatively.

The ulcer was closed with three to five stitches of a monofile running suture, (Lahodny suture, 3.0 PDS II, Ethicon Endo-Surgery, Johnson&Johnson, USA, Fig. 1), which was first pre-laid for orientation. The stitches were applied through the full thickness of healthy tissue. The suture was started a little above the ulcer and was ended one or two stitches below it, so that the ulcer was folded in when the suture was hitched. After the suture had been fixed with a re-absorbable clip (Fig. 2), a wad of omentum was fixed with one or two further stitches of the same suture over the defect, and another clip was applied (Fig. 3). Abdominal lavage was performed with 5–10 l of pre-warmed isotonic saline solution. Two drains were placed at the end of the operation: a Salem drain close to the ulcer and an easy-flow in the Douglas space. *Helicobacter* eradication (omeprazole, ampicillin, clarithromycin, metronidazole) was started immediately when intraoperative testing was positive.

The duration of antibiotic therapy and abdominal drainage was dependant on the clinical findings. Persistent fever, abdominal pain and intestinal paralysis prolonged the antibiotic therapy. Drains were removed when all secretions were clear. Nasogastral suction was normally removed after the first postoperative day, except in patients with prolonged intestinal paralysis.

All sutures were controlled by contrast radiography on the third day, postoperatively.

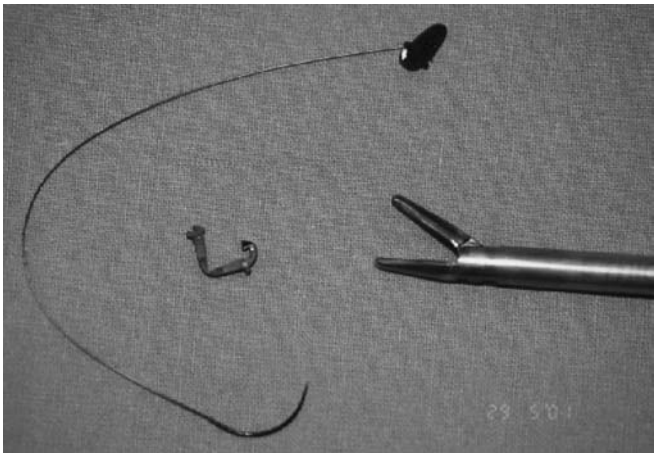

Fig. 1 Lahodny suture, 3.0 PDS II, Ethicon Endo-Surgery, USA

Fig. 2 Situs after ulcer closure with monofile running suture. *The arrows* indicate the resorbable clips

Fig. 3 Wad of omentum to cover the suture. *The arrow* indicates the final clip

Table 1 Patients' characteristics and perioperative details

Parameter		Value
Patients' data (n=20)	Age[a] (years)	49 (27–73)
	Gender (m:f)	13:7
	Non-steroidal anti-rheumatics	10
	Smoker	11
	Helicobacter pylori positive	13
Operating time and intraoperative complications	Operating time[a] (min)	50 (35–85)
	Intraoperative complications	0
	Conversions	0
	Number of deaths	0
Perioperative management	Duration of antibiotic therapy[a] (days)	3 (1–5)
	Starting enteral feeding[a] (days)	1 (1–4)
	Time of drain removal[a] (days)	4 (3–8)
	Duration of nasogastric suction[a] (days)	1 (1–3)
Postoperative complications	Leakage of repair or stenosis	0
	Intra-abdominal abscess	0
	Wound infection	0
	Hospital stay[a] (days)	9 (9–10)

[a] Values are median (range)

Results

Table 1 shows patients' characteristics and perioperative details. There were ten patients who were being treated with non-steroidal anti-rheumatics (NSARs), 13 were infected with *Helicobacter*, and 11 patients were smokers.

The surgery was performed by one of three different surgeons on call at the institution. The closure of the ulcer with the running suture was always simple to perform. All patients in whom peptic ulcer perforation was detected laparoscopically were successfully operated on with the described technique. Six patients presented with peritonitis limited to the upper right abdomen, and 14 patients had pus and fibrin throughout the abdomen. There were no intraoperative complications and no conversions to open surgery. Median operating time, including intraoperative lavage and drainage placement, was 50 min (range 35–85 min).

In 14/20 patients, gastric suction was removed quickly on the first day postoperatively and enteral feeding was started with tea. In six patients the gastric tube remained for 3 days because of delayed gastric emptying.

Median length of antibiotic therapy was 3 days (range 1–5) and was dependent on the severity of peritonitis discovered during laparoscopy, postoperative fever and persistent abdominal pain. Drains were removed once the secretions were clear.

After administration of a gastric enema to each patient on the third day postoperatively, the passage of the radiografin revealed no leakage or stenosis. No intra-abdominal abscess or wound infection occurred.

Discussion

Total trauma incurred by a patient during an operation is the sum of the access trauma and the surgical procedure trauma. When the access trauma is relatively large compared with the procedural trauma, the benefit of minimal-access laparoscopic surgery will be maximised [6]. In this regard, ulcer repair may be a condition for which laparoscopic procedures have definite advantages [11, 12, 13, 21, 23, 16, 17, 28]. With diagnostic laparoscopy, the primary access trauma is minimised, and the site and pathology of the perforation can be identified. In addition, the procedure allows for the closure of the perforation and adequate peritoneal lavage without a large upper abdominal incision. Nevertheless, laparoscopic ulcer repair does not seem to be widely used in daily practice.

After the initial, anecdotal reports of laparoscopic treatments of a perforated peptic ulcer, various techniques of ulcer closure have been described. Walsh et al. [29] begin with diagnostic laparoscopy. If the ulcer is already covered by omentum, the authors generally restrict themselves to peritoneal drainage and lavage, since they consider it the most important part of any intervention. Other techniques of ulcer repair are: suturing with single stitches [8, 30], closure with gelatine sponges and fibrin glue [11, 12], sutured or stapled omental patch repair [10, 11, 12, 17, 18, 21, 22, 23, 24, 26, 27] and gastroscopy-aided insertion of the ligamentum teres hepatis or omental plug [19, 20].

All these techniques are relatively time consuming, when compared with open surgery. Median operating times reported have varied between 80 and 120 min (Table 2). In addition, most of these procedures require advanced surgical skills, especially with respect to suturing and knotting techniques and extended preoperative planning (gelatine sponge and fibrin glue repair, gastroscopy-aided techniques). The reported complication rates are acceptably low, if the surgeons restrict laparoscopic repairs to patients in relatively good clinical condition who have small perforations of short duration [8, 31].

All these reports show that laparoscopic ulcer repair is, in principle, possible, but a definitive advantage over the established open techniques has not been shown. Moreover, ulcer perforation often represents an "out-of-hours" emergency that must be performed by "any" surgeon on call. The technique, therefore, should be simple to perform, and the results comparable to open techniques [29].

In 1997, Siu et al. first reported on the closure of a perforated gastroduodenal ulcer with one single stitch, longitudinally through the perforation [6]. In a recently published, randomised trial [30], the authors showed that this very simple technique was highly effective. This is the first randomised trial where the median operating

Table 2 Representative randomised and non randomised trials comparing open and laparoscopic repair of perforated peptic ulcer

Title and authors	Design of the study	Number of laparoscopic patients	Technique of repair	Operating time (range) in minutes	Conversion rate
Siu et al. (2002): Laparoscopic repair for perforated peptic ulcer: a randomized controlled trial. Ann Surg	Prospective, randomised	63	Laparoscopic, single-stitch closure/open omental patch repair	42/52	13%
Arnaud et al. (2002): Laparoscopic suture closure of perforated duodenal peptic ulcer. Surg Laparosc Endosc Percutan Tech	Prospective, not randomised	30	Suture and omental patch repair	92 (58–114)	16%
Alamowitch et al. (2000): Laparoscopic treatment of perforated duodenal ulcer. Gastroenterol Clin Biol	Prospective, not randomised	35	Suture and omental patch repair	120	–
Michelet et al. (2000): Perforated peptic ulcer: laparoscopic approach. Eur J Surg	Retrospective, not randomised	16	Suture and omental patch repair	90 (60–130)	6%
Cougardet al. and the French Society of Laparoscopic Surgery (2000): Laparoscopic repair of perforated duodenal ulcer. Results of a retrospective multicentric study. Ann Chir	Multicentre, retrospective	419	Suture and omental patch repair	85	11%
Bergamaschi et al. (1999): Open vs laparoscopic repair of perforated peptic ulcer. Surg Endosc	Retrospective	17	Omental patch repair	92	24%
Katkhouda et al. (1999): Laparoscopic repair of perforated duodenal ulcers: outcome and efficacy in 30 consecutive patients. Arch Surg	Prospective, not randomised	30	Graham patch repair	106 (76–22)	17%
Druart et al. (1997): Laparoscopic repair of perforated duodenal ulcer: a prospective multicenter clinical trial. Surg Endosc	Prospective, multicentre	100	Suture and omental patch repair	80 (40–135)	8%
So et al. (1996): Comparison of laparoscopic and conventional omental patch repair for perforated duodenal ulcer. Surg Endosc	Retrospective	15	Omental patch repair	80	7%
Lau et al. (1996): A randomized study comparing laparoscopic versus open repair of perforated peptic ulcer using suture and sutureless technique. Ann Surg	Prospective, randomised	52	Omental patch repair, open/laparoscopic/gelatine sponge and fibrin glue, open/laparoscopic	40/94/42/53	27% Suture, 15%, sutureless
Lau et al. (1995): Laparoscopic repair of perforated peptic ulcer. Br J Surg	Prospective, not randomised	56	Omental patch repair, open/laparoscopic/gelatine sponge and fibrin glue, laparoscopic	52/101/61	17% Suture, 5% sutureless

times in the laparoscopic group were significantly shorter than in the open surgery group (42 vs 52 min). The laparoscopic approach was associated with an impressively low leakage rate (1/63). Conversion to open surgery was necessary in only 9/63 patients who had perforated, non-pyloric, gastric ulcers and unidentifiable perforations with a diameter larger than 10 mm. Patients in the laparoscopic group were discharged earlier and recovered significantly faster (return to work 10.4 vs 26.1 days).

In our series, we selected the suture-closure method because it is based on the principle of conventional open repair. Our method differed from others because we used a monofile running suture (Figs. 1, 2, 3) familiar to endoscopic hernia surgery, which does not require any intra-corporal or extra-corporal knotting. Owing to the monofile structure of the file, 3–5 stitches can be placed with a maximum overview and the ulcer easily closed in a very controlled manner.

Over 4 years, three different surgeons who covered the 24-hour emergency unit in our department used this

technique successfully. There were no major intraoperative difficulties that resulted in excess surgery time or conversion to open surgery. Compared with the single-stitch technique [6, 30], the operating time seems to last slightly longer with our technique, but, in contrast to Siu et al., we installed abdominal drains and performed a very meticulous lavage of the whole abdominal cavity.

The advantage of the monofile running suture may lie in the more meticulous closure of the perforation. In the case of severe peritonitis, when the overview is poor, placement and knotting of single stitches may provoke bleeding that can jeopardise the controlled performance of the intervention [32]. In these cases, and when the edges of the perforation are rigid, the closure of the defect may be easier with 3–5 stitches of a monofile running suture. In fact, we had no conversion to open surgery. All of our patients were controlled on the third day postoperatively by contrast radiography, and we did not observe any leakage. *However, the number of patients treated in this trial was relatively low. Consequently, we cannot make a serious prediction about expectable complication and leakage rates.*

Patients with large ulcers, prolonged anamnesis and/or reduced conditions due to severe peritonitis may not present a good case for laparoscopic repair, but the discussion is still controversial. In several studies, the severity of the disease and reduced general conditions were prognostic factors for postoperative complications (i.e. leakage, persisting peritonitis, intra-abdominal abscess and sepsis) [10, 33]. *For this reason, we restricted ourselves to patients with acute history. Whether a delay of more than 6 hours is a contraindication for laparoscopic repair is not clear and cannot be answered by our study. However, 14 of our patients presented with severe peritonitis, with pus and fibrin covering the whole abdominal cavity, and laparoscopic surgery was successful, nevertheless.* But, like Arnaud et al., Katkhouda et al. and Lagoo and Pappas [8, 34, 35], we find that the best indication for the use of the laparoscopic technique is in patients with acute abdominal pain, where the pathological condition *is* demonstrated or diagnosed by laparoscopy, and should be restricted to patients in relatively good general condition (ASA1–3).

In conclusion, laparoscopic ulcer repair with the Lahodny suture is safe and simple to perform. Compared with more sophisticated endoscopic techniques, it is highly effective and results in significantly reduced operating time.

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