

Perforated Duodenal Ulcer: Has Anything Changed?

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Abstract

Introduction: To assess the current management and outcome of perforated duodenal peptic ulcer managed with open repair, a focused analysis was conducted, excluding gastric, traumatic and iatrogenic perforations.

Patients and Methods: A retrospective study of a 6-year period identified 61 patients. Mean age was 59 (range 19–87) years and 33 (54%) were male. Medical history included nonsteroidal anti-inflammatory drugs in 46%, smoking in 30%, atherosclerosis in 26% and excessive alcohol use in 23%.

Results: Generalized abdominal tenderness was recorded in 64% of the cases. The mean (SD) C-reactive protein value was 100 (141) g/l and white blood cell count was 12.8 (7.9) E9/l. Plain abdominal X-ray was positive for air in 87% (41/47) and CT scan in 86% (18/21). Four patients (7%) were operated without radiological imaging. There were 31 patients (51%) with a delay of 24 h or more from the start of symptoms to surgery. The mean (SD) delay from admission to surgery was 9 (3) (range 3–12) h. The treatment consisted of open suture repair in 92%, peritoneal lavage in 92%, external drainage in 80% and nasogastric decompression in 92%. The overall hospital mortality and morbidity rates were 11 and 21%, respectively. The duodenal suture leak rate was 7% and intra-abdominal abscess rate was 2%.

Conclusion: The majority of patients with perforated duodenal ulcer can be diagnosed with conventional clinical and radiological methods, and treated according to established surgical principles. The mortality and duodenal morbidity rates have remained unchanged for the last decade. Shortening preoperative delay could improve the prognosis.

Key Words

Emergency surgery · Peptic ulcer · Peritonitis · Perforation

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Introduction

Secondary peritonitis is caused by a perforation of the duodenum or stomach in about 8–30% [1–5]. In spite of advances in the medical treatment of peptic ulcer disease, the incidence of emergency surgery for perforated peptic ulcer has remained the same or has even slightly increased. Although varying from 4 to 31%, the mortality has remained unchanged despite improvements in perioperative monitoring and treatment [6].

Although often grouped together, the etiology, potential for malignancy, surgical treatment, complications and especially the consequences of a suture line leak are different in perforated stomach and duodenal ulcers, respectively. There is remarkable variability in the reporting of the location of perforation in the perforated peptic ulcer in the literature, as shown in Table 1.

In an attempt to specifically characterize the clinical characteristics, diagnostics, management and outcome of perforated duodenal ulcers, a retrospective focused analysis of 61 operatively treated patients was performed.

Patients and Methods

During a 6-year period (2000–2005), 61 consecutive patients with perforated peptic ulcer of the duodenum

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Table 1. Reported location of operatively treated perforated peptic ulcer.

Author	No. of patients	Location of perforation (%)
Lau et al. [7]	103	Duodenal (74) Juxtapyloric (11) Gastric (6)
Siu et al. [8]	121	Duodenal (77) Pyloric (5) Prepyloric (17) Gastric (1)
Nogueira et al. [9]	210	Pyloroduodenal (82) Gastric (18)
Robson et al. [10]	240	Duodenal (83) Gastric (17)
Bhogal et al. [11]	33	Duodenal (82) Juxtapyloric (9) Gastric (9)
Lohsiriwat et al. [12]	152	Duodenal (14) Prepyloric (74) Gastric (12)
Bertleff et al. [13]	95	Postpyloric (36) Pyloric (21) Prepyloric (43)

were identified. Gastric (including pyloric), traumatic and iatrogenic perforations were excluded. Although some patients with iatrogenic perforations were managed nonoperatively, no patients with perforated duodenal ulcer were managed nonoperatively during the study period. With one exception, all patients underwent open surgical treatment.

In statistical analysis, continuous variables were compared with the Mann–Whitney U test, with statistical significance set at the 0.05 level. The retrospective analysis did not allow the calculation of the Mannheim peritonitis index. Septic shock was defined as patients with clinical and laboratory signs of sepsis and refractory hypotension (systolic blood pressure < 90 mmHg) on admission.

Results

Clinical Presentation and Diagnostics

The mean (SD) age was 59 (18) (range 19–87) years and 33 (54%) were male. The mean (SD) body mass index was 23 (4) (range 16–39) kg/m². The incidence of etiological factors is summarized in Table 2.

On admission, 12 patients (20%) had septic shock, 37 (61%) had generalized abdominal tenderness, and localized abdominal tenderness and guarding was noted in 18 (30%) patients.

Table 2. Incidence of etiological factors (when known or tested) in 61 operatively treated patients with perforated duodenal ulcer. NSAIDs: nonsteroidal anti-inflammatory drugs.

Etiological factor	Incidence (%)
Use of NSAIDs	25/54 (46)
Smoker	3/10 (30)
Atherosclerosis	13/50 (26)
Excessive alcohol use	10/44 (23)
Tested positive for <i>H. pylori</i>	1/10 (10)
Previous ulcer disease	5/61 (8)
Diabetes	5/61 (8)
Steroid medication	0/58 (0)

The mean (SD) C-reactive protein (CRP) value on admission was 100 (140) (range 2–626) g/l, and the white blood cell (WBC) count was 12.8 (7.9) (range 2.4–40.5) E9/l. The WBC count was higher than 12 E9/l in only 26 patients (43%). Elevated serum amylase levels (3 × upper normal value) were found in four patients (7%).

Plain abdominal X-rays were positive for air in 41/47 patients (87%) and computed tomography (CT) in 18/21 cases (86%). Out of the six patients with negative plain X-rays, three had a positive finding on CT and three did not have a CT scan. All three patients with negative CT scans had positive plain X-rays. None of the 15 patients undergoing both studies gave negative findings in both studies. Overall, four patients were operated without any preoperative radiological studies. One patient had an upper gastrointestinal contrast study, and that showed a contrast leak from the duodenum.

The mean (SD) delay from the start of symptoms to surgery was 32 (30) (range 5–170) h. In most cases, the delay was caused by either a patient delay or a transfer delay from the primary health care center. There was no significant difference in the mean ± SD delay among survivors and nonsurvivors (32 ± 31 vs. 30 ± 21 h). There were 48 patients (79%) with a delay of 12 h or more and 51 patients (51%) with a delay of 24 h or more from the symptoms to surgery. The mean (SD) delay from admission to surgery was 9 (3) h with a range of 3–12 h.

Management

At operation, the perforation was intraperitoneal in 54 (89%) and retroperitoneal in 7 cases (11%). Source control was achieved with simple open suture repair in 56 patients (92%), and with an omental patch in 41 of them. The management of the remaining five patients consisted of suture repair enforced with tissue glue,

suture and pyloroplasty, Billroth II resection, laparoscopic omental patch repair only, and drainage without suture, respectively. Intraluminal duodenal decompression was performed with a nasogastric tube in 56 cases (92%). External drainage was installed in 49 patients (80%), and peritoneal lavage in 56 patients (92%). Two patients had a feeding jejunostomy.

The antibiotic therapy consisted of intravenous cefuroxime (or ceftriaxone in one case) and metronidazole in 56 patients (92%), combined with fluconazole in one case, and cefuroxime alone in three. One patient did not receive any antibiotics.

Outcome

The overall hospital mortality and morbidity rates were 7/61 (11%) and 13/61 (21%), respectively, with a complication-free survival rate of 67%. The mean (SD) hospital length of stay was 9 (12) (range 1–88) days. Eleven patients required treatment in the ICU for 1–21 (mean 7) days.

Five patients (8%) required a relaparotomy, one for iatrogenic splenic laceration requiring splenectomy, and the remaining for duodenal complications. Specifically, there were five patients (8%) with a duodenal leak or fistula, or an intra-abdominal abscess. The first patient with an intraperitoneal perforation treated with suture, decompression, lavage and external drainage had a suture line leak, underwent relaparotomy, resuturation, lavage, drainage, decompression, feeding jejunostomy, and ultimately died from multiple organ failure. The second patient with a retroperitoneal perforation managed with suture, decompression, lavage and external drainage had a suture line leak, underwent relaparotomy, resuturation, lavage, drainage, decompression, and also right hemicolectomy with fecal diversion for colon necrosis, and ultimately survived after a prolonged hospital stay. The third patient with an intraperitoneal perforation underwent a laparoscopic omental patch repair, decompression, lavage and external drainage, developed a leak, underwent open relaparotomy, suture repair (with omental patch), peritoneal lavage and drainage, and survived without further complications. The fourth patient with a retroperitoneal perforation managed with nasogastric decompression, peritoneal lavage and external drainage (with no suture) developed a retroperitoneal abscess requiring relaparotomy, suture repair, T-tube decompressive choledochostomy, lavage, drainage and feeding jejunostomy, had prolonged drainage from a duodenal fistula, and survived. The fifth patient with an intraperitoneal perforation managed with suture, decompression, lavage and external drainage devel-

oped a retroperitoneal abscess with no manifest leak, was treated with percutaneous drainage (of pus, no bile), and survived. Thus, the overall duodenal suture leak rate (including the patient undergoing suture repair at relaparotomy) was 4/61 (7%) with one death, and the intra-abdominal abscess rate was 1/61 (2%).

Discussion

This study confirms that the previously published epidemiological features for peptic ulcer perforation, namely mean age in the mid-fifties and equal proportion of both genders, are also true of exclusively duodenal ulcer perforations [6]. However, the present study shows a more marked role of the use of non-steroidal anti-inflammatory drugs (46%) and a reduced frequency of *H. pylori* infection (10%) than in previous studies, but caution should be applied to these results due to the small number of patients and the retrospective nature of the study. Our patients were not routinely tested for *H. pylori*, which may also explain the low incidence. The majority of patients underwent follow-up in the primary health care system, and only those that were asked for a follow-up visit in our department were tested and treated if positive. Finally, a history of smoking, excessive alcohol use and atherosclerosis showed significant associations in about 20–30%, respectively, whereas a previous history of ulcer disease or steroid medication was rare in this series of patients. The relatively high incidence of nonsteroidal anti-inflammatory drug use in this study population reflects the Finnish patient population.

The diagnosis of perforated duodenal ulcer relies on clinical assessment and radiological and laboratory evaluations. In this study, generalized abdominal tenderness was detected in only 61% of the patients. This can be partly associated with early presentation and the retroperitoneal location of the perforation in some patients.

Radiological evidence of extraluminal air was found in a significant proportion of the patients, as has been reported previously [6]. Although 87% of the plain X-rays and 86% of the CT scans were positive for air in this study, with some overlap, none of the 15 patients undergoing both studies gave negative findings in both studies. Overall, four patients were operated without either study being performed preoperatively. Taking the significant radiation exposure associated with even new CT scanners into account, the performance of both studies routinely is not justified. In the majority of cases, clinical evaluation with plain X-rays should be sufficient for decision-making. In some

patients with equivocal clinical findings and free peritoneal fluid detected on ultrasound examination, an ultrasound-guided aspiration and visual and laboratory analysis (bilirubin, amylase, creatinine) could confirm a hollow viscus perforation and guide the surgeon in choosing the appropriate incision. The signs of inflammatory reaction from blood analysis (CRP, white blood cell count) can support the decision-making, but considerable variation on admission mostly limits their use to differential diagnosis.

The prognosis of perforated peptic ulcer is related to multiple factors that could be grouped into factors associated with the physiological reserve of the patient (age, comorbidity, ASA class, immunosuppression), disease acuity and the degree of physiological derangement (delay, shock on admission, acidosis, elevated creatinine and lowered albumin, APACHE II score, Mannheim peritonitis index), operative findings (localized vs. diffuse peritonitis), treatment (inability to obtain source control, inadequate empiric antibiotics), as well as postoperative treatment (poor nutrition, subsequent nosocomial infection) and complications [3, 6, 14]. This study is too small to perform a meaningful analysis of independent risk factors for mortality, but there were some marked differences between the survivors and nonsurvivors, such as mean ($\pm$ SD) age (57 ± 18 vs. 71 ± 14 , $p = 0.059$) and admission CRP values (72 ± 100 vs. 328 ± 224 , $p = 0.003$).

The overall mortality rate in this study was 11%, which is well within the range of 4–31% obtained from studies published on all types of peptic ulcer perforations [6]. In a systematic review of 1,113 patients treated for perforated peptic ulcer, the mortality rate was 4% after laparoscopic and 11% after open repair [15]. The authors concluded that laparoscopic repair seems better for low-risk patients, whereas open repair might be more appropriate for high-risk patients.

There are a limited number of studies with exclusively perforated duodenal ulcers. In a study comparing laparoscopic ($n = 60$) and open repair ($n = 162$) of perforated duodenal ulcer, the overall mortality rate was 20/222 (9%); all deaths occurred in the open repair group, giving a mortality rate of 20/162 (12%) [16]. The choice of method of repair depended entirely on the individual surgeon's preference, opinion and expertise. The population undergoing open repair was older, had a higher ASA score, more previous operations, a longer delay and a larger perforation size. In a study of 145 operatively treated duodenal ulcer perforations from Nepal, the mortality rate was 7%, and was significantly associated with delay from perforation to operation, presence of comorbid conditions, respira-

Table 3. Reported duodenal leak and intra-abdominal abscess (iaa) rates in patients operated for perforated peptic ulcer. DU: duodenal ulcer; NS: not stated.

Reference	N	% DU	Mortality	Leak	iaa
Lau et al. [7]	103	74	3	2	2
Siu et al. [8]	121	77	3	2	2
Nogueira et al. [9]	210	82	10	3	3
Lunevicius et al. [16]	222	100	9	3	1
Koc et al. [18]	75	NS	11	3	1
Bhagal et al. [11]	33	82	3	3	3
Lohsiriwat et al. [12]	152	14	9	-	5
Bertleff et al. [13]	95	36	6	2	3
Present study	61	100	11	7	2

tory rate, raised blood urea and serum creatinine, size of the perforation, amount of peritoneal fluid, and need for postoperative intensive care unit support [17].

Suture line leaks and the development of intra- or retroperitoneal abscesses are traditionally viewed as significant complications and risk factors for poor outcome. Table 3 shows the leak and abscess rates in published reports of peptic ulcer perforation. In the study comparing laparoscopic ($n = 60$) and open repair ($n = 162$) specifically for perforated duodenal ulcers, the rates for suture line leakage were 4/60 (7%) and 3/162 (2%), and those for intra-abdominal abscess rates were 2/60 (3%) and 1/162 (1%), respectively [16]. In addition, there was one patient (2 and 1%) with a fistula in each group. No reliable factors were identified for predicting suture line leakage, including choice of surgical approach.

In a meta-analysis of 11 retrospective and 12 prospective studies of laparoscopically treated duodenal ulcers, the suture leak rates were 4–16% in retrospective and 2–16% in prospective studies. The corresponding intra-abdominal abscess rates were 2–8% and 0–9%, respectively [19].

Overall, the duodenal leak/fistula rate of 7% and abscess rate of 2% obtained in this study are similar to those found in earlier reports, confirming that there has been little change over the last decade or more in the outcome of these patients.

Since the first reported operation for perforated peptic ulcer by Mikulitz in 1885 (the patient died), and the first successful operation performed by Barker in 1896 [20], there have been some remarkable advances in diagnostics (CT scan, laboratory tests), antimicrobial therapy and intensive care that have improved the outcome significantly. However, the cornerstones of surgical intervention have changed little and still consist mainly of source control with suturing (with

omentum as needed), decompression, peritoneal lavage and external drainage. The usefulness of the omental patch to reinforce the suture line has not been established, but it intuitively makes sense to use it when the closure of the perforation is unreliable because of the ulcer size or extensive scar tissue. Although the minimally invasive approach provides a new type of access to the intraperitoneal space, the same procedures and surgical principles are still valid, although the need for decompression, extensive lavage or external drainage in every patient can be questioned. Since the end of the study period (2006 onwards), laparoscopic repair has become more widely used at our institution, but the choice of surgical approach has been left to the individual surgeon. In a Cochrane analysis of randomized studies comparing laparoscopic surgery versus open surgery for the repair of perforated peptic ulcer, there were no statistically significant differences in the proportion of abdominal septic complications or pulmonary complications, and the authors concluded that, based on the available evidence, laparoscopic surgery results are not clinically different from those of open surgery [21].

The prognosis of peptic ulcer perforation today seems to be determined by the patient's age, the site of perforation and the delay in treatment [22]. Previous studies indicate that the risk of postoperative death and complications is closely related to the duration of perforation, increasing when the delay exceeds 12 h, and remarkably so after a delay of more than 24 h [20]. The mean (SD) delay from the start of symptoms to surgery in this study was 32 (30) (range 5–170) h. Although there was no significant difference in the delay among survivors and nonsurvivors, the delay from symptoms to surgery was 12 h or more in 79% and 24 h or more in 51% of the patients.

None of the patients were assigned to have definitive ulcer surgery later on. Although an evaluation of long-term results was beyond the scope of this study, it is noteworthy, however, that one additional patient died 6 months postoperatively from renal failure, bowel necrosis and multiple organ failure unrelated to the management of the perforated ulcer.

Modern health care, with the involvement of many professional groups and the availability of extensive possibilities for preoperative diagnostic measures, is hampered by time-consuming routines [22]. Perhaps it is time to go back to basics: prompt clinical assessment, essential radiological studies, determined decision-making, early and appropriate preoperative antibiotics and surgical management following sound surgical principles.

Conclusions

The majority of patients with perforated duodenal ulcer can be diagnosed with conventional clinical and radiological methods, and treated according to established surgical principles. The mortality and duodenal morbidity rates have remained unchanged for the last decade, and are likely to remain so for the near future. To improve the outcome of this increasingly elderly population, minimization of the delay from the start of the symptoms to surgical management by appropriate education of the population and referring health care professionals as well as prompt preoperative evaluation are needed. Avoidance of time-consuming investigations and determined surgical leadership are required to shorten the preoperative delay.

Conflict of interest statement

The authors declare that there is no actual or potential conflict of interest in relation to this article.

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