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Original article

Laparoscopic repair of perforated peptic ulcers. The role of laparoscopy in generalised peritonitis

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This non-randomised concurrent cohort study conducted in two teaching hospital Departments of Surgery examined the assumption that the benefits of elective laparoscopic upper gastrointestinal surgery would apply to those with generalised peritonitis due to perforated peptic ulcers.

It compared 20 consecutive laparoscopic repairs of perforated peptic ulcers with a concurrent group of 16 consecutive open repairs.

There were no differences pre-operatively between the two groups. The mean duration of surgery was similar ($P = 0.46$). There were no differences in the rate of GI tract recovery, but opiate analgesia requirement in the laparoscopic group was significantly less ($P < 0.0001$).

Intensive care was required in three patients in the laparoscopic group (two with renal failure) and two in the open (no renal failure). Two patients in the laparoscopic and one in the open group died. The median duration of stay was five days in the laparoscopic group and six in the open.

This comparison shows that the patho-physiological insult of laparoscopy in the setting of generalised peritonitis does not obviously increase the peri-operative risk of organ failure but objective benefits are small.

Key words: Laparoscopy – Perforated duodenal ulcer – Peritonitis

Laparoscopic repair of perforated peptic ulcers is now technically feasible and, in the small series reported to date, carries many of the minimal access advantages apparent in other upper gastrointestinal and biliary procedures.[1,2] With the establishment of the role of *Helicobacter pylori* eradication making simple

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oversewing of perforated ulcers an effective long-term solution,[3] the laparoscopic procedure is increasingly within the compass of surgical trainees and, as the role of routine laparoscopy in the diagnosis and management of peritonitis becomes accepted,[4,5] it is in danger of being seen as the procedure of choice without prior evaluation or evidence of benefit.[1,2,6]

Unlike many of the procedures that have established the role of laparoscopy in elective upper GI surgery, however, it is performed in patients with generalised peritonitis and the often severe physiological disturbances which may accompany this.[7,8] The pathophysiological insult of a 'tension CO_2 pneumoperitoneum' during laparoscopy may be exaggerated in such patients, while the effect on the immune system and its mediators is unpredictable. The balance of exchanging the obvious postoperative benefits of rapid recovery, reduced wound complications, improved respiratory function and improved cosmetic appearance for an increase in intra-operative physiological compromise may be in favour of laparoscopic surgery in relatively fit elective patients, but may be considerably more marginal in ill patients at risk of multiple organ dysfunction syndrome (MODS).

To examine the risks and benefits of laparoscopic surgery for perforated peptic ulcers, this non-randomised concurrent cohort comparison compared a consecutive series of laparoscopic repairs of perforated peptic ulcers (lap group) with a concurrent series of consecutive open repairs (open group).

Patients and Methods

Over a period of 18 months from January 1997 to June 1998, 36 patients were operated on for perforated peptic ulcers, 20 laparoscopically (lap group) and 16 open. The availability of a laparoscopically-trained surgeon as part of the emergency team was the only determinant of the surgical approach. Four patients had known peptic ulceration and were on H_2 antagonists at the time of their perforation, nine were taking NSAIDs, 1 was on steroids, 17 smoked and 14 drank moderate amounts of alcohol. The diagnosis was made clinically in 33 patients, 30 of whom had free gas on an erect chest X-ray, two patients required a contrast study and one patient who in retrospect had free gas was shown to have free peritoneal fluid on ultrasonography. Aspects of patient presentation which might predict outcome including their APACHE II score on admission[7,8] were recorded prospectively (Table 1) as were surgical details.

In all cases, a simple oversewing of the ulcer using an omental patch was performed. In the lap group, closure

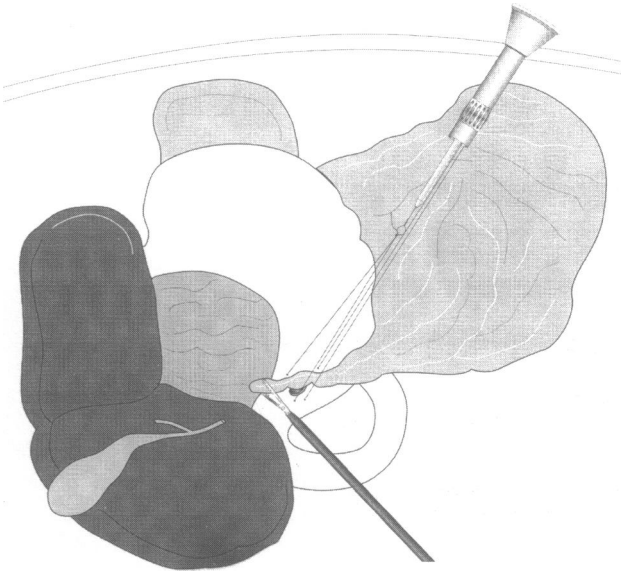

Figure 1 Securing the omental patch with 2 or 3 sutures with the ends brought out through the 10 mm port and tied using extracorporeal knots. One of these is shown being pushed in with a knot pusher before being locked intracorporeally

was accomplished using 2 x 10 mm ports and either one (n = 12) or two (n = 8) x 5 mm ports with an omental patch sutured over the perforation using 2/O PDS, the knots being tied extracorporeally (Fig. 1). A CO_2 pneumoperitoneum at a pressure of 14 mmHg was used to allow port insertion and the pressure then reduced to 10 mmHg. Patients in the laparoscopic group with prepyloric ulcers were endoscoped perioperatively once the ulcer had been closed, allowing the ulcer to be examined and biopsied endoscopically.

Postoperatively, the amount of opiate analgesia required, complications including organ failure and intensive care admissions, the duration of nasogastric (Ng) drainage and intravenous fluids (IVI), the time taken to tolerate free oral fluids and normal diet and the duration of hospital stay were recorded (Table 2). All patients were given intravenous antibiotics and had intravenous H_2 blockers until they were drinking freely, at which point they commenced a one week course of *H. pylori* eradication therapy. Only 14 patients (two in the open group and 12 in the laparoscopic) attended their planned postoperative endoscopy at 6 weeks to confirm ulcer healing and *H. pylori* eradication. All patients were, however, reviewed in out-patients at eight weeks and then discharged.

Table 1 Comparison of pre-operative factors predicting outcome in the 2 groups at the time of surgery

Factor	Lap (n = 20)	Open (n = 16)	Significance of difference
Age (years)*	62 (17–88)	55 (18–91)	95% CI = –19 – 8.6, W = 264, P = 0.32
Male sex	11	6	χ^2 = 1.1, df = 1, P = 0.70
Duration of perforation (h)*	16 (5–112)	10 (4–72)	95% CI = –12.0 – 4, W = 264, P = 0.32
APACHE II score*	9 (0–22)	9 (0–16)	95% CI = –5.0 – 3.0, W = 280, P = 0.62
ASA grade (IE, IIE, IIIE, IVE)	4,5,6,4,1	6,4,4,2	χ^2 = 2.2, df = 4, P = 0.71
Last hours urine output (ml)*	33 (0–70)	55 (20–200)	95% CI = –0.85, W = 109, P = 0.06

*Median and (range).

Statistical analysis

All patients commenced laparoscopically were analysed as the lap group. Continuous data were compared using the two tailed t-test (reported as 95% confidence interval (95% CI), t-test statistic (t), degrees of freedom (df) and associated P value (P)) for parametric data and the Mann-Whitney U test (95% CI, test value (W) and P value) for nonparametric data. The chi-squared test (reported as chi-squared statistic (χ^2), with degrees of freedom (df), and P value) was used for categorical data. A P value <0.05 was considered statistically significant.

Results

There were no significant differences in the two groups of patients pre-operatively (Table 1) although the urine output in the hour prior to surgery tended to be lower in the laparoscopic group (P = 0.06) suggesting a higher risk of renal impairment. Surgery commenced between 9.00 am and 17.00 pm in 15 patients (seven in the lap group, χ^2 = 0.823, df = 1, P = 0.36) reflecting the 24 h availability of an emergency list and laparoscopic equipment in both hospitals. At the time of surgery, 11 patients (six in the lap group) required central venous pressure monitoring performed. The mean duration of surgery in the open group was 72 min (SD = 23.2 min) compared with a mean of 77 min (SD = 20.0 min) in the lap group (95% CI = –20.4 – 9.5, t = –0.74, df = 29, P = 0.46). An anterior/superior perforated duodenal ulcer was found in 34 patients, two patients both in the lap group, had a prepyloric ulcer shown to be benign on endoscopic biopsy. Only nine perforations were larger than 5 mm (five in the lap group). A median of 2 sutures (range 1–4) were used to secure the omental patch. Significantly more lavage was used during laparoscopic procedures, a mean of 6.3 l in the lap group compared with 4.0 l in the open group (95% CI = 1.3–3.4, t = 4.66, df = 27, P = 0.0001). Drains were used in 27 patients, 17 in the lap group.

In the lap group, early in the series, the gallbladder was perforated in two patients when liver retraction was attempted using grasping forceps applied to the gallbladder as they would be during a laparoscopic cholecystectomy. One was repaired laparoscopically and one necessitated conversion. There was one other conversion when the perforation could not be visualised laparoscopically.

Postoperative parameters are compared in Table 2, only the amount of opiate analgesia required by the patients differed significantly. Five patients required ITU admission and two patients in the laparoscopic group and one patient in the open group died, their details are summarised in Table 3. One lady required a further laparoscopy converted to an open repair when

Table 2 Postoperative course in the 2 groups

Factor	Lap (n = 20)	Open (n = 16)	Significance of difference
Opiate dosage (mg morphine)*	15 (0–80)	100 (11–270)	95% CI = 60 – 90, W = 423, P < 0.0001
Duration of NG drainage*	2 (1–27)	2 (0–7)	95% CI = 0.0 – 1.0, W = 230, P = 0.37
Duration of IVI*	3 (2–30)	3 (2–11)	95% CI = –1.0 – 2.0, W = 271, P = 0.56
Time to free fluids*	3 (1–27)	3 (2–11)	95% CI = 0.0 – 2.0, W = 282, P = 0.33
Time to normal diet*	4 (3–31)	5 (3–14)	95% CI = 0.0 – 2.0, W = 286, P = 0.28
Duration of stay*	5.0 (3–65)	7 (4–28)	95% CI = –1.0 – 4.0, W = 276, P = 0.47

*Median and (range).
All the upper range values in the Lap group belong to patient 6 in Table 3.

Table 3 Details of the 7 patients who died or required ITU admission

	Lap/open	Age	Days on ITU	Reason for ITU admission	APACHE II score	Outcome
1	Open	91	–	–	16	Died of MI 36 h postop
2	Open	72	7	Cardiac and respiratory failure	14	Discharged day 28
3	Open	70	4	Cardiac failure	14	Discharged day 22
4	Lap	88	1	Cardiac, renal and respiratory failure	18	Died 12 h postop
5	Lap	75	1	Pre-existing respiratory disease	19	Discharged day 8
6	Lap	85	–	–	22	Died of pre-existing respiratory failure 12 h postop
7	Lap	59	32	Cardiac, renal and ARDS failure	15	Discharged day 65

she continued to drain bile stained fluid four days following an initial inadequate laparoscopic closure.

Following discharge, OGD in 14 patients showed a residual erosion in only one patient. One lady from the lap group, represented one month postoperatively with a GI bleed from a posterior DU which required a polya gastrectomy. There were no other problems during the two-month follow-up.

Discussion

Although this study was not randomised and the laparoscopic group tended to be done by more experienced surgeons, laparoscopic repair of perforated peptic ulcers is clearly feasible and takes a comparable length of time to the open surgical procedure. Moreover, it avoids the painful upper abdominal incision, improving patient comfort and cosmetic appearance postoperatively. Conversions when they occurred could be done through relatively small incisions tailored to the established diagnosis. There were no postoperative infected intra-abdominal collections diagnosed in either group confirming that laparoscopic lavage under vision is at least as effective as that at open surgery. It does not support the suggestion that laparoscopy might disseminate infection within the peritoneal cavity making such complications more likely.

Despite such advantages, however, we have some reservations. Laparoscopy in this context does not appear to result in a more rapid recovery of gastrointestinal function or shorten hospital stay. There is also undoubtedly a learning curve. The tissues are much more friable than normal and the reduced tactile feedback during laparoscopic surgery means avoiding damage to adjacent organs such as the gallbladder or undue tension on sutures causing them to cut out requires great care. It can also be difficult to see the perforation particularly a superior one and a 30 degree scope proved valuable in some cases. Nevertheless, one perforation was inadequately closed laparoscopically and required open intervention, and one perforation could not be seen laparoscopically necessitating conversion.

Of greater concern was the patho-physiological effects of laparoscopy in elderly patients with peritonitis. Such patients may already have borderline renal, respiratory and cardiac function and the additional insult of a CO_2 tension pneumoperitoneum for up to 2 h might, in theory, precipitate MODS. This study does offer some reassurance in this respect.

The changes in cardiovascular and respiratory function during laparoscopy are relatively well documented.[9] There is also good evidence that an increase in intra-abdominal pressure to as little as 12 mmHg can lead to a reduction in renal blood flow and glomerula filtration rate and lead to anuric renal failure.[10] It reduces mesenteric arterial blood flow and intestinal mucosal blood flow producing intramucosal acidosis[11] and perhaps increasing bacterial translocation from the gut.[12,13] A reduction in hepatic arterial, portal venous and hepatic microcirculatory blood flow has also been documented.[11] These effects may be more significant in septic and hypovolaemic patients.

There is less debate over the relative effects of laparoscopy and open surgery on the immune system and stress response, with laparoscopic surgery reducing the depression in cell mediated immunity,[14] the neuroendocrine response[15] and postoperative catabolism[16] documented following laparotomy.

The interaction of these effects with the factors responsible for MODS can only be conjecture but there appear to be significant changes in mediators such as C reactive protein[17]) and TNFα.[18]

Although there were no obvious deaths attributable to peroperative physiological impairment, we feel that, with the debate that exists in these areas, there is sufficient uncertainty over the risk/benefit ratio of laparoscopy in patients with generalised peritonitis particularly those who are systemically unwell, to join

others[1,19] in calling for a randomised controlled trial. Perhaps, as has been suggested in laparoscopic surgery for malignancy, such operations should not be done outside the confines of such studies.

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