

Laparoscopic versus open management of duodenal perforation: a comparative study at a District General Hospital

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Prz Gastroenterol 2013; 8 (5): 315–319

DOI: 10.5114/pg.2013.38735

Key words: management, duodenal perforation, laparoscopic vs. open.

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Abstract

Introduction: Duodenal perforation is one of the common pathologies in patients presenting in emergency with acute abdominal pain in an emergency ward and requires prompt surgery as life saving and curative intervention. The present study was conducted to determine whether the minimal access approach by laparoscopy was equally feasible as the open method.

Aim: To compare laparoscopic vs. open management duodenal perforation in all aspects.

Material and methods: Inclusion criteria: patients presenting to the emergency ward with acute pain in the abdomen with clinical signs of peritonitis and air under the diaphragm on X-ray abdomen standing were selected. Exclusion criteria were: patient age < 15 years and > 70 years, presentation > 2 days, shock with systolic blood pressure < 90 mm Hg which did not improve after hydration with 2000 ml of Ringer lactate solution, respiratory distress, history of cardiac disorder or respiratory disorders such as ischemic heart disease, arrhythmias, chronic obstructive pulmonary disease or asthma, bleeding and clotting disorders, pregnancy in females, previous upper abdominal surgery, and intra-operatively patients having perforation other than duodenal perforation. After excluding patients fitting the above criteria, two groups – test and control – were formed.

Results: We found that complications both early and late were significantly fewer in patients treated by laparoscopy. Thus laparoscopy was both feasible and had comparable mortality and leakage rate.

Conclusions: Laparoscopic management of perforated duodenal ulcer is feasible, effective and decreases morbidity and overall treatment time and cost if performed in properly selected patients.

Introduction

Duodenal perforation is a common complication of duodenal ulcer. Perforated duodenal ulcer is mainly a disease of young men but because of increasing smoking in women and use of nonsteroidal anti-inflammatory drugs (NSAIDs) in all the age groups, nowadays it is common in the whole adult population. Up to 80% of perforated duodenal ulcers are *Helicobacter pylori* positive. Treatment for perforated ulcer ranges from conservative treatment (Taylor's approach) to radical surgery (vagotomy, gastrectomy). However, with the use of powerful acid suppressing medication and the eradication of *H. pylori*, the need for radical surgery in emergencies has sharply declined. The surgical technique most often used is closure of the perforation combined with extensive peritoneal lavage. Repair of duodenal perforation by Graham

patch plication (as was described in 1937) represents an excellent alternative approach. Perforated duodenal ulcer is a surgical emergency. In 1990 Mouret *et al.* [1] reported the first laparoscopic sutureless fibrin glue omental patch for perforated duodenal ulcer repair. The first successful laparoscopic suture repair for perforated peptic ulcer was described by Nathanson *et al.* also in 1990 [2]. Soon after that, the laparoscopic approach became a widespread procedure. Laparoscopic repair of duodenal perforation is a useful method for reducing hospital stay and complications, and hastening return to normal activity. Treatment for perforated ulcer can be performed laparoscopically in 85% of cases, making it possible to avoid a median laparotomy which can lead to wound infection and late incisional hernia. With better training in minimal access surgery now available, the time has arrived for it to take its place in the surgeon's repertoire.

Aim

The present study was conducted to examine if the minimal access approach by laparoscopy was equally feasible as the open method and whether it could minimize incidence of infective complications such as wound infection, intra-abdominal abscess and also respiratory infections due to decrease in incisional pain related respiratory compromise.

Material and methods

Inclusion criteria: Patients presenting to the emergency ward with acute pain in the abdomen with clinical signs of peritonitis and air under the diaphragm on X-ray abdomen standing were selected.

Exclusion criteria were: patient age < 15 years and > 70 years, presentation > 2 days, shock with systolic blood pressure < 90 mm Hg which did not improve after hydration with 2000 ml of Ringer lactate solution, respiratory distress, history of cardiac disorder or respiratory disorders such as ischemic heart disease, arrhythmias, chronic obstructive pulmonary disease or asthma, bleeding and clotting disorders, pregnancy in females, previous upper abdominal surgery, and intra-operatively patients having perforation other than duodenal perforation.

Ethical committee approval regarding the study was obtained from the research and ethics committee of the college.

After excluding patients fitting the above criteria, two groups – test and control – were formed. Patients were randomly assigned to these two groups, patients alternately being allotted to one group and to the other (serial randomization). Written informed consent of patients and relatives was obtained regarding open and laparoscopic approaches as relevant to the group allotted to patients.

In the test group the perforation was treated by laparoscopy with insertion of 4 ports: 10 mm umbilical, 10 mm epigastric, 5 mm medial to left mid-clavicular line and 5 mm in right mid-clavicular line. After suction of contaminant fluid the perforation was identified and closed with 2.0 silk using a round body needle and intra-corporeal knotting and a live omental patch was kept. All intra-abdominal cavities were thoroughly irrigated, and suction was done. A drain was kept in the Morrison's pouch and all ports were withdrawn. Umbilical and epigastric incisions were closed with catgut. In the control group standard exploratory laparotomy with primary closure of duodenal perforation and also application of a live omental patch were done. A drain was kept in Morrison's pouch and closure was done with 0 prolene for the rectus sheath.

Patients were monitored until discharge. Patients were followed until an average of 3 years post-operatively and told to come if there were any complaints. All patients were discharged with *H. pylori* eradication therapy and long-term proton pump therapy. Seventy such patients in each group were studied.

Results

The results of study was presented in Table I. Average time since onset of acute pain 1.5 days. The patients with a history of acid peptic disease had taken medical treatment from local practitioners. None had undergone upper GI endoscopy (Table II).

Liver injury occurred due to retraction. These were slight contusions (4) and one small laceration. All were managed conservatively. Average size of ulcer was 1.5 cm × 1.5 cm with size ranging from 0.5 cm × 0.5 cm to 2.5 cm × 2.5 cm. There was no intra-operative mortality (Table III).

Table I. Age and sex characteristics

Parameter	Male	Female	Total
Test	45 (64.28)	25 (35.72)	70
Control	42 (60)	28 (40)	70

Table II. Significant history

Parameter	Test group	Control group
Smoking	37	38
Suggestive of acid peptic disease	14	12

Table III. Intra-operative observations

Observations	Test group	Percentage	Control group	Percentage
Average intra-op time [min]	50	NA	48	NA
Uncontrolled bleeding	0	0	NA	NA
Iatrogenic perforation	0	0	0	0
Liver injury	0	0	5	7.14
Conversion to laparotomy	3	4.28	NA	NA

NA – not applicable

Table IV. Post-operative observations and late post-operative complications

No.	Observation	Test	Percentage	Control	Percentage	Values of <i>p</i>
1	Average time since start of oral feeding	3 days	NA	5 days	NA	NA
2	Average time of discharge (total hospital stay)	6.5 days	NA	9.5 days	NA	NA
3	Respiratory complication: atelectasis, pneumonia, need for ventilatory support	3	4.28	14	20	0.001
4	Intra-abdominal abscess	0	0	4	5.71	0.0394
5	Wound infection/wound dehiscence	3 (no dehiscence)	4.28	18 (4 dehiscence)	25.71	< 0.0001
6	Post-operative leakage of sutured perforation	2	2.85	1	1.42	0.4731
7	Mortality	3		6	1.641	0.2002
8	Post-operative gastric outlet obstruction on long-term follow-up (3 years)	0	0	3	4.28	0.0767
9	Post-operative adhesion obstruction on follow-up (3 years)	0	0	15	20.14	< 0.0001

There was post-operative leak in 2 patients in the test group and no patients in the control group. The leaks were managed by exploratory laparotomy and re-suturing. There was no mortality in these patients. The leaks were in large perforations of size 2 cm × 2 cm and 2.5 cm × 2.5 cm respectively with friable edges (Table IV).

All patients in both groups who died were chronic smokers, developed respiratory infections with subsequent need of ventilatory support and died due to respiratory failure.

In the above groups χ^2 test was used to find the probability of a difference between results in test and control groups. The various values are given in the above tables with each variable tested.

Laparoscopic management of duodenal perforation required a similar average time to laparotomy with time required decreasing as the surgeons acquired more practice. It was 50 min in the test group and 48 min in the control group. The time for closure of the long laparotomy incision was eliminated. Also giving intra-abdominal lavage was quicker and easier.

There were fewer infective complications in patients managed by laparoscopy as compared those with laparotomy. Laparoscopy afforded better lavage of intra-abdominal cavities and lessened the chances of an intra-abdominal abscess. Also smaller port openings lead to less post-operative pain and less respiratory compromise. This lessens the chances of lung atelectasis and basal pneumonia. Also smaller port site wounds lead to much smaller chances of wound infections and eliminate wound dehiscence. In the long term this also lessens the chances of adhesion obstruction. In our study there was no incidence of intra-abdominal abscess or wound dehiscence in the test group. In the control group there were 4 cases of intra-abdominal abscess.

Chi square (χ^2) test analysis result for each comparison is given in the Table III. Respiratory infections: χ^2 test equals 10.804 with 1 degree of freedom. Two-tailed *p* value is 0.001. This is very significant. Intra-abdominal abscess: χ^2 test equals 4.2 with 1 degree of freedom. Two-tailed *p* value is 0.0394. This is significant. Wound infection and wound dehiscence: χ^2 test equals 16.827 with 1 degree of freedom. Two-tailed *p* value is 0.0001. This is extremely significant. Postoperative gastric outlet obstruction: χ^2 test equals 3.134 with 1 degree of freedom. Two-tailed *p* value is 0.0767. This is significant. Post-op adhesion colic: χ^2 test equals 19.091 with 1 degree of freedom. Two-tailed *p* value is 0.0001. This is highly significant. Post-op leakage of perforation: χ^2 test equals 0.515 with 1 degree of freedom. Two-tailed *p* value is 0.4731. This is not significant. Thus the rate of post-op leak is similar in both groups. Mortality: χ^2 test equals 1.641 with 1 degree of freedom. Two-tailed *p* value is 0.2002. This is not statistically significant. Thus there was no significant difference in mortality between groups.

Thus we found that complications both early and late were significantly fewer in patients treated by laparoscopy. The mortality and post-operative leakage were not different between groups. Thus laparoscopy was both feasible and had comparable mortality and leakage rates.

Discussion

Duodenal perforation is one of the commonest causes of acute abdominal pain requiring urgent surgical management. Various methods of closure such as Graham's patch closure, simple closure and both are applied for the closure of the perforation. However, management of peritonitis and its sequelae, i.e. shock,

Table V. Various studies

Study	No. of patients	Mean operative time [min]	Conversion to open surgery	Mean hospital stay	Morbidity	Mortality	Mean time for laparotomy	Mean hospital stay [days]	Morbidity in laparotomy patients	Mortality in laparotomy patients
Palamivelu <i>et al.</i> [3]	120	46	0	5.5	9	0	NA	NA	NA	NA
Druart <i>et al.</i> [4]	100	80	8	9.3	9	5	NA	NA	NA	NA
Lau <i>et al.</i> [5]	24	112	7	5	5	0	NA	NA	NA	NA
Schirru <i>et al.</i> [6]	39	77	5	9	5	4	NA	NA	NA	NA
Matsuda <i>et al.</i> [7]	14	135	3	17	1	0	NA	NA	NA	NA
Abid <i>et al.</i> [8]	84	95	12	-	15.4	-	NA	NA	NA	NA
Vaidya <i>et al.</i> [9]	31	105	2	5.5	9	0	NA	NA	NA	NA
Shiraz <i>et al.</i> [10]	27/27	55.74	0	4.67	8	0	47.41	6.52	22	0
Mehendale <i>et al.</i> [11]	34/33	50	4	6	-	0	55	9	-	0
LAMA trial [12]	52/50	75	4	6.5	10	2	50	8.0	20	4
Our study	70/70	88	6	6.5	7	0	48	9.5	17	0

respiratory distress, wound and intra-abdominal infections, are very important in overall outcome of the patient. One major cause of morbidity is the laparotomy incision due to its associated pain, respiratory compromise due to pain during breathing, wound infection and chances of dehiscence, and long-term chances of adhesion obstruction.

The laparoscopic approach has been developed to minimize the above complications to a significant extent due to its minimal access approach. It was first reported by Mouret *et al.* [1] and first successfully performed by Nathanson *et al.* [2]. If performed properly and with training, the conversion to laparotomy is minimal. Open conversion or open laparotomy is indicated in older patients with cardio-respiratory distress, shock, inadequate ulcer localization, or pancreatic infiltration (penetrating ulcer and large ulcer with friable inflamed ulcer edges).

Studies by other researchers also concur that laparoscopy is a feasible and effective method of management of duodenal perforation on a stable patient (Table V).

In our study the operative time for laparoscopic closure was comparable to other studies. Though it was still more than double the time required for open closure, it decreased as more proficiency for laparoscopic closure was attained with more cases. Conversions to open surgery occurred due to either severe inflammation or friability of the perforation edges [3]. In perforation edge inflammation sutures easily tear out and it is more difficult to take large bites and to tie knots properly. Use of a single-stitch method described by Siu *et al.* [13], fibrin glue, or a patch might solve this problem [14, 15].

There is a definite decrease in septic complications in patients treated laparoscopically. This can be explained by the decrease in length of incision and thus wounding of the anterior abdominal wall, and better suction of the intra-abdominal cavity. The significant decrease in pain due to absence of a long intra-abdominal incision leads to deeper respiration, better lung expansion and consequently lesser lung lower zone atelectasis and basal pneumonia.

The net result of these advantages is a comfortable patient, shorter hospital stay and infection, and thus overall lower cost. In the long term also the significantly smaller incisions (port site) lead to much lower chances of post-operative adhesions as compared to conventional laparotomy incisions.

Conclusions

Laparoscopic management of perforated duodenal ulcer is feasible and effective, and decreases morbidity and overall treatment time and cost if performed in

properly selected patients. With training and experience it can be performed at peripheral centers as well.

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Received: 17.11.2012

Accepted: 11.03.2013