Operative and non-operative management of endoscopic retrograde cholangiopancreatography-associated duodenal injuries

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ABSTRACT

INTRODUCTION Endoscopic retrograde cholangiopancreatography (ERCP) is indispensable in everyday surgical practice. Despite this, as an invasive procedure, it has its own mortality and morbidity, the most feared of which is periduodenal perforations. Our experience with ERCP related periduodenal perforations and its treatment strategies are presented. Additionally, a rarely encountered subtype is highlighted.

METHODS Patients who underwent ERCP and sustained a periduodenal perforation between August 2008 and October 2011 were reviewed.

RESULTS During the period from August 2008 to October 2011, 597 ERCP procedures were performed in our hospital. Ten of these patients (3 male, 7 female) had a perforation. The mean patient age was 56.6 years. During the procedure, injury was suspected in four patients; it passed unnoticed in the remaining six. The decision to operate or follow a conservative policy was based on a combination of clinical and radiological findings. Operative intervention was required in three patients, with one mortality, while conservative treatment was followed in the remaining seven. A laparotomy was performed early in two patients whereas it was performed after an initial period of conservative treatment in one. The presence of periduodenal fluid collection, contrast extravasation or free intraperitoneal air were decisive factors for performing laparotomy.

CONCLUSIONS ERCP-related periduodenal perforations include different categories. Certain types require operative repair while others should be treated conservatively. The choice of the management approach should be individualised, depending on the clinical picture and radiological findings. Although rare, these are potentially serious complications that may end fatally. Early recognition and appropriate intervention is the only way to avert a fatal outcome.

KEYWORDS

Cholangiopancreatography – Endoscopic retrograde – Duodenum – Wound – Injury

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The introduction of endoscopic retrograde cholangiopancreatography (ERCP) heralded a new era in the management of biliopancreatic disorders. Currently, it is indispensable in the daily practice of the gastrointestinal surgeon and gastroenterologist alike. Despite this, as an invasive procedure, it has its own complications, which may be life threatening. These complications, which are prone to occur even under optimal conditions,¹ include pancreatitis, cholangitis, haemorrhage and periduodenal perforation in addition to cardiorespiratory complications.² Timely recognition and institution of the proper management is of the utmost importance to avert a potentially fatal outcome.

Methods

Our records were reviewed to identify patients who underwent ERCP and sustained periduodenal perforation between August 2008 and October 2011. Relevant data were extracted, including patient demographics, clinical presentation, indication for ERCP, injury related data, management approach and the final outcome.

Results

Overall, 10 patients (3 males and 7 females) sustained periduodenal injury during a total of 597 ERCPs performed in this period. Their mean age was 56.6 years (range: 25–91

Table 1 Admission diagnose

Diagnosis	Patient serial number
Obstructive jaundice	1, 2, 3, 7, 10
Acute pancreatitis and obstructive jaundice	4, 5, 6
Biliary colic	8
Acute cholecystitis and obstructive jaundice	9

Table 2 Discharge diagnoses

Diagnosis	Patient serial number
Gallstone disease	1, 2, 3, 4, 5, 8, 9
Periampullary tumour with liver metastasis	6
Gallstone disease with duodenal diverticulum	7
Fungating periampullary mass (adenocarcinoma)	10

Table 3 Endoscopic retrograde cholangiopancreatography (ERCP) findings, results and number of attempts

Patient serial number	Findings	Success	Number of ERCP attempts
1, 2, 4, 5, 7*, 8	Dilated bile ducts with filling defects	Yes	Patients 1, 2 and 4: 1 attempt Patient 5: 2 attempts
3	Dilated bile ducts with filling defects	No	1
6, 10	Periampullary tumour, fungating mass around papilla	No	1
9	Stenosed papilla with no filling defects	Yes	1

*Duodenal diverticulum

years). The admission and discharge diagnoses are shown in Tables 1 and 2.

ERCP findings and its success (defined as clearance of common bile ducts [CBDs]) as well as the number of attempts in each patient are shown in Table 3. During the ERCP, injury was suspected in four patients and it passed unnoticed in the remaining six. When perforation was suspected during or after the ERCP, computed tomography (CT) with oral and intravenous contrast was arranged. Following injury, all patients except Patients 1 and 6 were managed initially in the intensive care unit.

The decision to operate or follow a conservative policy was based on a combination of clinical and radiological

Table 4 Clinical picture following endoscopic retrograde cholangiopancreatography, computed tomography findings, management, mortality and presumed injury grade

Clinical picture	Patient serial number
Minimal abdominal signs*	1, 6, 8
Marked abdominal signs**, fever and leucocytosis	2, 3, 4, 5, 7, 9
Minimal abdominal signs* and leucocytosis	10
Computed tomography findings	
Retroperitoneal air	1, 3, 4, 8, 9
Retroperitoneal air, contrast extravasation and fat stranding	2
Retroperitoneal air and fat stranding	5
Retroperitoneal air and liver metastasis	6
Retroperitoneal and intraperitoneal air, fat stranding and fluid collection	7
Retroperitoneal air, fat stranding and fluid collection	10
Management	
Conservative	1, 4, 5, 8, 9
Laparotomy	2, 3, 7
Conservative with percutaneous cholecystostomy	6
Conservative with percutaneous drainage of collection	10
Mortality	
No	1, 3, 4, 5, 6, 7, 8, 9, 10
Yes	2
Injury grade (according to Stapfer <i>et al</i>) ⁴	
I	2, 3, 7
II	10
III/IV	4, 5, 9
IV	1, 6, 8

*No or mild abdominal pain, tenderness and rigidity

**Marked abdominal pain, tenderness and rigidity

findings (Table 4). Operative intervention was required in Patients 2, 3 and 7 (Fig 1) and conservative treatment was followed in the remaining seven patients (Figs 2 and 3). Laparotomy was performed early in Patients 2 and 7 whereas it was performed after an initial period of conservative treatment in Patient 3. Periduodenal fluid collection, contrast extravasation or free intraperitoneal air were decisive factors for performing the laparotomy. Patient 10, who had a fungating periampullary mass (adenocarcinoma), was an exception. This patient was treated conservatively despite

Figure 1 Computed tomography of Patient 2 following endoscopic retrograde cholangiopancreatography, showing air and contrast extravasation around the right kidney

Figure 2 Retroperitoneal air in Patient 6 with periaampullary cancer and liver metastasis. Owing to the lack of marked signs, no operative intervention was needed. Percutaneous cholecystostomy was performed and patient was discharged with the draining catheter in situ.

Figure 3 Massive retroperitoneal air extending from the neck (A) down to the groin (B) and thigh (C) in Patient 10, who had a periaampullary adenocarcinoma. Laparotomy was not performed; only percutaneous drainage of the collection was required.

the presence of fluid collection, which was drained percutaneously. The average length of hospital stay was 20 days for those who followed conservative treatment and 24 days for those who received an operation.

Operative interventions

In Patient 2, there was retroperitoneal injury to the lateral aspect of the second part of the duodenum (Fig 4), with extensive necrosis of retroperitoneal fat involving the right perirenal area and suprarenal gland. Primary repair of the duodenal injury was carried out with a cholecystectomy, a retrograde jejunostomy to decompress the duodenum, a feeding jejunostomy and CBD catheter drainage. Despite this, the patient showed further deterioration and sepsis. Another exploration was carried out and extensive retroperitoneal necrosis was found in the right upper abdomen, extending across the midline and down into the pelvis. A

necrosectomy was performed, and the procedure was ended with a laparotomy and packing for repeated debridement. Unfortunately, she succumbed to sepsis, representing the only mortality in this series despite early intervention.

In Patient 3, a perforation was found in the lateral aspect of the second part of the duodenum with CBD stones. Primary repair of the duodenal injury was performed and a cholecystectomy was carried out with CBD exploration, stone extraction and T-tube drainage. A retrograde jejunostomy and feeding jejunostomy concluded the procedure. The patient tolerated the surgery well.

In Patient 7, there was retroperitoneal injury of the second part of the duodenum extending into the third part with injury to the retropancreatic CBD. The duodenum was repaired primarily and a cholecystectomy was performed with T-tube drainage of the CBD. The patient had a stormy post-operative course but eventually recovered.

Figure 4 Retroperitoneal lateral duodenal wall perforation (red arrow) in Patient 3. Common bile duct was explored (white arrow) and stone extracted.

Discussion

The advent of ERCP has greatly facilitated the management of pancreaticobiliary disorders. Nevertheless, the procedure is not entirely safe. A 15.9% complication rate and 1% procedure-related mortality rate have been reported.² Among the known complications, duodenal perforation is the most serious, even with early diagnosis and timely intervention.³ Its incidence has been estimated to be 1%,⁴ with a mortality rate of up to 50% when surgical intervention is needed.⁵ However, a recent trend towards a lower mortality rate of 8% has been observed.⁶ This was linked to early detection and prompt treatment. Delayed diagnosis and intervention, failed conservative management requiring surgery, multiple operations and old age have been associated with a poor outcome.⁶

Evidence of perforation on CT may include thickening of the duodenal wall, intramural duodenal air, stranding of the retroperitoneal fat, fluid collection, contrast extravasation or the presence of free retroperitoneal, intraperitoneal or subcutaneous air. Pneumomediastinum and pneumothorax may also be present.⁷ These signs might be divided into hard and soft. Hard signs are contrast extravasation, periduodenal fluid collection and intraperitoneal air while the others represent soft signs. In the presence of hard signs, laparotomy should be considered early whereas with soft signs a conservative policy might be followed, particularly in the absence of florid clinical signs.

In this series, the management decision was individualised, based on the critical analysis of the clinical as well as the radiological findings. In this regard, the presence of retroperitoneal air alone in CT, in the absence of marked clinical signs, led to a conservative policy.

A laparotomy was performed early in Patients 2 and 7 as both showed marked clinical signs and contrast extravasation (in addition to free intraperitoneal air in Patient 7).

Figure 5 Guidewire penetrating the pancreatic duct (white circle) of Patient 4

Meanwhile, in the rest of the patients, the absence of extravasation or fluid collection allowed for a conservative policy initially. Failure to improve within 24 hours or signs of deterioration indicated the need for a laparotomy, as happened with Patient 3, who needed a laparotomy after 24 hours of observation.

An exception to this rule was Patient 6 (who had a periampullary tumour and liver metastasis), where conservative treatment was followed despite the presence of fluid collection, obviously owing to the gloomy prognosis of the primary illness. Despite this, the patient responded well to conservative treatment aided by percutaneous drainage of the collection. In this respect, persistence with conservative treatment in the absence of signs of improvement should be avoided as the mortality rate increases dramatically with delayed surgical intervention.^{8,9}

In Patient 4, the florid abdominal signs, in addition to the presence of fever and leucocytosis, militated against conservative treatment. Nevertheless, careful interpretation of the ERCP and CT, revealed a rarely reported guidewire injury of the pancreatic duct, resulting in peripancreatic air collection (Figs 5 and 6), which was assumed to respond well to conservative treatment. Likewise, in Patients 5 and 9, despite the marked signs, the absence of contrast extravasation, fluid collection and intraperitoneal air allowed for a conservative management with a successful outcome.

Figure 6 Peripancreatic air collection (white arrows) in Patient 4

In 1999 Howard *et al* classified ERCP-related perforations into three categories: guidewire perforation, periampullary perforation and duodenal perforation.¹⁰ This was followed by a classification into four categories by Stapfer *et al* in 2000.⁴ In order of decreasing severity, these are: injury to the lateral or medial duodenal wall caused by the endoscope, almost always requiring surgery (type I); injury to the sphincter of Oddi, less likely to require surgery (type II); bile duct injury related to the guidewire or basket instrumentation, the least likely to require surgery (type III); and the sole presence of retroperitoneal air (type IV).

This last type has not been considered a true perforation and, as such, does not require surgery. It has been attributed to the creation of pneumatosis intestinalis by air forced into the duodenum during the procedure, which then leaks into the retroperitoneum. Performed 24 hours after ERCP, CT may detect retroperitoneal air in as much as 29% of cases.¹¹ As seen in Table 3, the presumed injury categories in our patients were mainly of the minor classes whereas the three patients who required a laparotomy had type 1 injury according to Stapfer *et al*.⁴

The diagnosis of duodenal perforation may be suspected during the procedure. A vigilant endoscopist will observe extraluminal contrast leak or air in the periduodenal area.^{4,7} In such cases, a limited contrast study through the endoscope should follow. In all cases, however, a contrast gastrointestinal series and/or CT is usually required.^{4,7} In our series, the injury was frequently overlooked, probably owing to the unfamiliarity of the endoscopist with this mishap. It might also be related to the difficulty of detecting the injury through the side viewing endoscope.

Risk factors for periduodenal perforation have been recognised. They include: sphincter of Oddi dysfunction, old age, a dilated bile duct, performing sphincterotomy, prolonged procedure,¹² precut, intramural injection of

the contrast and abnormal anatomy (Billroth II gastrectomy).¹⁵

Generally, conservative treatment should be followed if the following can be fulfilled: minimal abdominal signs with no evidence of sepsis and no or minimal leak with no retroperitoneal fluid collections on CT. On the other hand, surgery should be considered early in the presence of any of the following: extensive contrast extravasation, extra/intra-peritoneal fluid collection, intraperitoneal air, perforation associated with retained stones, basket or guidewire and massive subcutaneous emphysema associated with duodenal diverticula.⁴ Once a conservative approach is followed, repeated clinical evaluation backed with serial radiological studies, principally CT, should be employed so as to detect non-responsiveness or deterioration early and switch, consequently, to the surgical option.

Despite early intervention in Patient 2, the extent of necrotic tissue and debris found in the right upper quadrant was impressive. Owing to deterioration, she was re-explored seven days later. Very extensive necrosis with blackish tissues and debris in the retroperitoneum extending across the midline and down into the pelvis were found, probably the result of insufflation of the duodenal contents into the retroperitoneum during the endoscopic procedure.

In the past 50 years, 3 techniques have governed the repair of duodenal injuries. The first concept was introduced by Donovan and Hagen: the duodenal diverticulisation technique.¹⁴ It was soon realised that less surgery is probably better and triple tube duodenal decompression, pioneered by Stone and Fabian,¹⁵ surfaced. This consists of gastrostomy, retrograde jejunostomy (to decompress the duodenum) and prograde jejunostomy for feeding. Vaughan *et al* later popularised pyloric exclusion after duodenal repair.¹⁶ More recently, however, the value of pyloric exclusion has been questioned¹⁷⁻²⁰ as it was associated with more complications, prolonged hospital stay and increased mortality.

Triple tube decompression was used in the first two patients to be operated on (Patients 2 and 3), utilising a nasogastric tube instead of a gastrostomy as described originally by Stone and Fabian.¹⁵ For the third patient to be operated on (Patient 7), simple repair of the duodenum with T-tube drainage of the CBD and suction drainage of the periduodenal area was carried out. In no case was pyloric exclusion performed.

Currently, there is no consensus on the management of ERCP-related duodenal perforation as all published data represent retrospective case series with a limited number of patients. In 2012 Dubecz *et al* recommended simple repair of the perforation when surgery is performed.²⁰ They put extra weight on physical examination rather than radiological evaluation, to aid in the choice between a conservative or operative approach. Furthermore, they followed a conservative approach in a situation where others would opt clearly for surgery, namely the presence of intraperitoneal air, a situation they likened to that of a perforated peptic ulcer.

Means other than surgery have appeared in the literature, and endoscopic treatment of grade 2 and 3 perforations has been advocated by some. This takes the form of nasoduodenal, nasobiliary or internal stent insertion to di-

vert the pancreatic and biliary juices away from the site of perforation.^{9,21,22} These techniques are, in fact, an addition to the non-operative treatment of such injuries. Moreover, endoscopic closure of duodenal perforations with metallic endoclips during endoscopy has been reported in recent years.^{22–24} This procedure requires significant experience with the endoscopic clipping techniques. If proved effective, it may be the first choice for perforations recognised early during endoscopy. However, if the procedure fails, the consequences might be grave owing to the inevitable delay in surgical intervention.

In our small series, the management policy was concordant with the current standards as a minimalistic approach was followed and our decisions were individualised for each patient. Simple closure of the duodenum was performed in the three cases operated on. This was aided by a retrograde jejunostomy to decompress the duodenum (in addition to a feeding jejunostomy) in two cases. We believe that the addition of a retrograde jejunostomy did not add much to the invasiveness or duration of the procedure and may have aided in healing the duodenal wound. Moreover, the benefits of a feeding jejunostomy in the restitution of enteral feeding early on are obvious. However, in no case was pyloric exclusion or duodenal diverticulisation used.

Conclusions

ERCP-related periduodenal perforations include different categories. Certain types require operative repair while others should be treated conservatively. The choice of the management approach should be individualised depending on the clinical picture and radiological findings. Although rare, these are potentially serious complications that may end fatally. Early recognition and appropriate intervention is the only way to avert a fatal outcome.

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