Post-ERCP perforations: rare but potentially harmful

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Summary

Endoscopic retrograde cholangiopancreatography (ERCP) is an advanced therapeutic procedure with a low incidence of perforations. ERCP-related duodenal perforation can be a severe complication with related mortality. Early diagnosis of post-ERCP perforations is essential for a better outcome and prognosis. The suspect of duodenal perforation after ERCP need to be confirmed by radiological imaging: Computerized Tomography (CT) has a high sensitivity for the detection of intra- and retro-peritoneal air and collections. The therapeutic approach to duodenal perforation is usually conservative, surgery is necessary in few cases. The use of carbon dioxide (CO2) insufflation can have a positive impact to reduce the entity of perforative complications.

KEY WORDS: duodenal perforation, endoscopic retrograde cholangiopancreatography (ERCP), endoscopic sphincterotomy, posterior laparostomy, carbon dioxide insufflation.

Introduction

Gastrointestinal perforations following diagnostic and therapeutic endoscopy are serious adverse events which need a prompt diagnosis and treatment (1). Endoscopic retrograde cholangiopancreatography (ERCP) is an advanced therapeutic procedure for biliary-pancreatic diseases with a low incidence of perforations (0.14-1.6%) but high related mortality (4.2-29.6%) (2). ERCP-related duodenal perforations can involve: the peritoneum, the retroperitoneum and the bile ducts (3); early diagnosis of duodenal perforation and treatment are important to prevent morbidity and mortality (4-6).

The therapeutic approach to duodenal perforation is usually conservative; the need for endoscopic or surgical treatment depends from size, location, and timing of gastrointestinal wall defect recognition. The expanding use of carbon dioxide (CO2) insufflation during interventional endoscopy can have a positive impact in reducing the entity of perforative complications (7). When surgical treatment to drain retroperitoneal collections is needed, the posterior approach by laparostomy needs to be considered (8, 9).

Endoscopic perforations

Gastrointestinal perforations may result from endoscopic or surgical procedures, or they can be spontaneous (e.g. Boerhaave syndrome) (10). Gastrointestinal perforation is defined as the presence of gas or luminal contents outside the gastrointestinal tract (11). Endoscopic perforation is a rare but severe adverse event, associated with significant morbidity and mortality and it increases during interventional procedures: ERCP, endoscopic mucosal resection (EMR), endoscopic submucosal dissection (ESD), foreign bodies removal, gastrointestinal dilations, tumor ablation, peroral endoscopic myotomy (POEM) (1).

Endoscopic perforations are likely to increase, because of the widespread implementation of endoscopic resources and the expanded indications for therapeutic endoscopy. Computerized Tomography (CT) has a high sensitivity for the detection of free air (mediastinum, peritoneum, retroperitoneum) and extraluminal fluids and collections (1, 2).
ERCP-related perforations and classification

Duodenal perforation is an uncommon complication of ERCP with a low incidence (0.14-1.6%), but a high mortality rate (4.2-29.6%) (2). The incidence of this complication may be influenced by:

- **the patient**: age, sex, history of previous post-ERCP pancreatitis, sphincter of Oddi dysfunction, dilated common bile duct, biliary strictures, congenital abnormalities or post-surgical anatomy;
- **the technique**: poor experience of the operator, difficult cannulation, longer duration of the procedure, sphincterotomy or use of the pre-cut, intramural injection of contrast medium, use of stent, balloon sphincter dilatation (12, 13).

The main reasons for post-ERCP perforations are: endoscopic sphincterotomy (56%), manipulation of the guidewire (23%), stricture dilation (4%), stent insertion or migration (3%) (1). Post-ERCP perforations can be located in the periampullary area (65%), bile ducts (25%) and pancreatic ducts (1.4%) (1).

Three classifications of post-ERCP perforations were proposed:

1) Howard et al. (1999) (5) (that considers the site of perforation and the therapeutic indications):
   - Group I: drilling for guide-wire (early detection and resolution with medical therapy);
   - Group II: periampullary perforation (early detection, responsive to medical therapy or endoscopic drainage);
   - Group III: duodenal perforation far from the papilla (late diagnosis, higher rate of mortality and morbidity, requires surgical drainage).

2) Stapfer et al. (2000) (14) (based on the mechanism, anatomical location and severity of the lesion that can predict the need for surgery):
   - Type I: traumatic (often caused by excessive pressure on the intestinal wall by the duodenoscope) on the medial or lateral wall of the duodenum, with high risk of peritonitis. If early diagnosed, endoscopic therapy can be effective. A high mortality (up to 28%) was reported (14).
   - Type II: perivaterian injury often associated with biliary or pancreatic sphincterotomy and precut; if diagnosed early, endoscopic nasobiliary drainage is effective together with medical therapy.
   - Type III: traumatic injuries of distal biliary or pancreatic duct from wires or catheters. The diagnosis is often early, endoscopic treatment with biliary or pancreatic stenting is effective.

3) Kim et al. (2011) (19) (based on the site of perforation):
   - Type I: injury by endoscope to the duodenal wall far from the papilla, with high risk of contamination.
   - Type II: injury by cannulation catheter or sphincterotomy, small hole with reduced contamination.
   - Type III: injury by guidewire to the biliary or pancreatic duct with low risk of contamination.

The Stapfer’s classification is considered more complete and is recommended from the European Society of Gastrointestinal Endoscopy (ESGE) (1).

Recognition of post-ERCP perforation

Early diagnosis of post-ERCP perforations allows to avoid surgery and improves the prognosis (1, 4, 5, 12).

Large perforations can display intra-abdominal organs through the ostium, whereas smaller perforations may show only yellowish tissue of intra/retroperitoneal fat or by bleeding from other sites, such as a lateral wall of the duodenum. Experts recommend changing the duodenoscope to a forward view gastroscope for better mucosal visualization (accurate reporting with iconographic support is recommended).

The presence of intra- or retro-peritoneal air can be seen on X-ray pictures during ERCP. Performing a plain X-ray at the beginning (Figure 1 a) and at the end (Figure 1 b) of the procedure, is suggested from our experience giving the possibility for an early suspect/diagnosis of the complication.

After ERCP the following **signs and symptoms** need to be considered as an “alarm” for perforation considering that the possible retroperitoneal nature of the injury may mask the severity.

- Suspicious or doubts about the procedure;
- Symptoms: early abdominal pain with unusual relaxing bowels, chest pain, subcutaneous em-
physema, “shortness of breath”;  
- Symptoms of drilling: new onset epigastric pain and back pain, tenderness with or without peritoneal signs, emphysema, tachycardia and fever.  
- Delayed systemic reaction: fever, increased inflammatory markers (CRP, leukocytosis), hypotension, mental confusion, signs of peritoneal irritation, peritonitis and septic shock that can occur later in most retroperitoneal perforation (2, 10, 20).

The suspect of perforation after ERCP needs to be confirmed by radiological imaging: Computerized Tomography (CT) with or without water soluble contrast medium is necessary for the diagnosis and to plan the treatment in a multidisciplinary setting (surgeon, endoscopist, radiologist, interventional radiologist) (1, 12, 20).

Following CT-scan and evidence of retroperitoneal air it is important, if the patient is stable, to repeat the exam after 48 hours to confirm the reduction of the amount of air and rule out fluid collection (16). In general, isolated retroperitoneal air is suggestive of a sphincterotomy site perforation. However, the amount of air may not correlate with the size of perforation but rather with the degree of endoscopic insufflation of air during the procedure. For that reason CO₂ insufflation during ERCP is suggested on a routine basis in the near future. Retroperitoneal or intraperitoneal fluid without air is more suggestive of acute pancreatitis than perforation, which almost always results in extraluminal gas attributable to insufflation (12).

**Management of post-ERCP perforations**

The management of post-ERCP perforations depends from its site and size, clinical signs and radiological findings. An early diagnosis with prompt treatment can improve the outcome (1, 4, 6, 8).

Some algorithms have been proposed (1, 3, 8, 17, 21) to diagnose and manage post-ERCP perforations, all using the Stapfer’s classification. According to these algorithms initial management of post-ERCP perforations is conservative and minimvasive (endoscopic clipping for Stapfer Type I, endoscopic biliopancreatic drainage for type II and III).

**Non surgical management**

- broad-spectrum antibiotics with infusion of fluids as soon as possible (12);  
- nasogastric or nasoduodenal tube decompression in order to limit intra or retroperitoneal drainage;  
- parenteral nutrition if complications impede adequate enteral feeding for at least 7 days and in undernourished patients (22).

In a recent review the non-surgical management applied in 62% of patients was effective in 92.9% of cases (12).

**Endoscopy**

Lateral duodenal perforations can be successfully managed with large diameter over-the-scope clip
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(OTSC) (23) and a combination of standard clips and fibrin glue (24). When retroperitoneal perforation is diagnosed, attempt at endoscopic or surgical repair of the sphincterotomy-related perforation are not required since the perforation is usually small and will close spontaneously in the absence of retroperitoneal infection. The efficacy of through the scope clips in closing periampullary perforations is unknown (1). An option to treat early diagnosed peri-ampullary perforations could be the placement of fully covered self-expandable metal stent (FC-SEMS).

OTSC is preferred in small-sized lesions and in perforation caused by the endoscope (25). Indication criteria for cSEMS vs OTSC vary and might impede design of randomized studies.

Interventional radiology and surgery

Retroperitoneal perforation need follow-up CT scan to detect the development and progress of retroperitoneal collections, which may require percutaneous or surgical drain (12). Since the majority of post-ERCP perforations are in the retroperitoneal duodenum, percutaneous drainage (PCD) could also be useful (Figure 2). Obviously patients with peritonitis and severe sepsis need surgery, but surgery for this complication has been associated with high mortality, of up to 50% in older series. Few data are available on the selection criteria for surgery or PCD.

A small series included 14 patients treated by surgery or PCD: 7 patients with localized collections and no or minimal contrast leak underwent PCD and 7 underwent surgery. None of our patients

Figure 2 - Retroperitoneal collection (arrow) following sphincterotomy related perforation (a); resolution of the collection (arrow) after percutaneous drainage (b).
treated with PCD needed surgical drainage and resolution of the collections was observed in all the cases. The mean duration of percutaneous drainage was 31 (range 14-90) days. Selected patients with localized collections and minimal contrast leak on CT scan can be managed successfully with PCD (26).

In the last 10 years surgical indication to ERCP-related perforations has changed radically. Duodenal perforation passed from a surgical complication (27) to a medical disease and surgery is necessary only in 6% of cases.

Surgery is indicated in case of (12, 15): major contrast leak on CT scan; severe sepsis, peritonitis, all cases of intraperitoneal fluid collections on CT scan not amenable to endoscopic or percutaneous drainage; perforation in the presence of common bile duct stones or retained hardware (ex. Dormia basket); failure of non-surgical treatment. In major periamplullary or ductal contrast leakage, immediate surgical intervention is needed to reduce morbidity and mortality (12).

In a recent review of retrospective studies (1) based on 115,747 ERCPs, 390 Stapfer type II, III and IV perforations were reported, and only 63 (18.8%) were managed surgically. Non-surgical therapy was effective in 92.9% of the cases.

**ERCP-related perforation: something new?**

*Surgical retroperitoneal laparostomy*

Drainage of the retroperitoneum can be achieved through a posterior laparostomy (8, 9). The technique of posterior laparostomy through the bed of the 12th rib provided adequate debridement and drainage of upper and lower parts of the retroperitoneal space (Figure 3) involved by infection following periamplullary duodenal perforation. At the end of the procedure, three or more “in-and-out” drainage tubes were left in the retroperitoneal space. The laparostomy was packed with gauze and left open for spontaneous healing.

The main advantages of this approach are: creation of a wide and open cavity with gravitational drainage, avoiding septic contamination of the peritoneal cavity; easier removal of infected collections and repeated dressings and washing during cleaning of the wound in the recovery unit. Retroperitoneal laparostomy allowed, in small series (8, 9), a good control of sepsis and duodenal secretions avoiding more invasive abdominal surgical procedures. Closure of the duodenal leak was obtained after a mean of 14.5 days in 6 reported cases (9) without mortality or major complications.

**Carbon dioxide insufflation**

Air injection is essential during endoscopic procedures but it is not absorbed by the bowel and must be passed from the gastrointestinal tract, which may lead to post-ERCP abdominal pain and discomfort. Recently, carbon dioxide (CO2) has been introduced as an alternative to air for insufflation. CO2 is rapidly absorbed from the bowel and is delivered directly to the lungs by the circulation. CO2 can reduce abdominal pain and discomfort after
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ERCP. The role of CO₂ insufflation during ERCP is not yet established (7), but can theoretically reduce the amount and duration of retroperitoneal gas in case of ERCP-related perforations. However, the CO₂ absorption can cause hypercapnia and acidosis, which must be prevented through hyperventilation.

To date, randomized controlled trials with higher number of patients are needed to better assess the role of CO₂ during ERCP (7).

Conclusions

Intestinal perforation is widely recognized as an uncommon endoscopic complication, but one of the most serious. It increases during interventional procedures such as ERCP.

Post-ERCP duodenal perforations can be caused by the duodenoscope, a sphincterotomy and extra-mural passage of guidewires or migration of stents (3).

Over the years, different classifications of post-ERCP duodenal perforations have been proposed, but today the most used is the Stapfer’s classification (12).

Early diagnosis and prompt treatment of post-ERCP duodenal perforations is essential for a better outcome and prognosis (1, 4, 5, 12). CT scan has a key to diagnose the perforation and drive subsequent management (1, 12, 16, 20).

Post-ERCP duodenal perforations become mainly a medical disease (26), amenable to mini-invasive endoscopic approach (clips, stent).

Drainage of retroperitoneal collections can be performed by interventional radiology and surgery is only necessary in 6% of the cases (12).

There is an unanimous consensus (1, 12, 13) on the initial conservative management of post-ERCP duodenal perforation limited to the papilla of Vater or biliary ducts.

References

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