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Perforation due to ERCP

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ABSTRACT

Iatrogenic duodenal and pancreaticobiliary perforations associated with endoscopic retrograde cholangiopancreatography (ERCP) are rare but associated with a significant morbidity and mortality. Perforations can be caused by the endoscope itself, secondary to endoscopic sphincterotomy, or related to the use of accessories (guidewires and stents). There is no consensus to direct the clinician on proper management of ERCP-related perforation. Traditionally perforations were classified according to their etiology and anatomical site and managed accordingly. Recently, the time to diagnosis, clinical state of the patient, and results of imaging studies have been shown to better predict the need for surgical intervention. This review summarizes perforations related to ERCP, with an emphasis on the criteria to determine if medical or surgical intervention is the appropriate management strategy.

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1. Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) has evolved from a diagnostic procedure to a predominantly therapeutic one. As a consequence, the complexity of ERCP and the potential for complications has increased. Overall, procedure-related complications occur in 5%-10% of cases with an associated mortality of 0.1%-1% [1,2].

Perforation during ERCP may occur by several mechanisms: (1) luminal perforation by the endoscope, usually resulting in intraperitoneal injury, (2) extension of a sphincterotomy incision beyond the intramural portion of the bile or pancreatic duct with retroperitoneal leakage, and (3) extramural passage of guidewires or migration of stents [3]. Duodenal perforations from the superior duodenal angle to the descending duodenum may be complicated by leakage of bile or pancreatic enzymes, which can result in damage to abdominal organs, making duodenal perforation one of the most serious complications of ERCP.

The incidence of duodenal perforation during ERCP has decreased since its introduction in 1968, now approximately 0.08%-0.6% [4-6], most likely a result of an improvement in the experience and skill of the endoscopists. Although rare, perforations need to be diagnosed and treated promptly, as delayed diagnosis and intervention may lead to the development of sepsis and multiorgan failure, which are associated with a high mortality, ranging between 8% and 23% [7].

Surgical, endoscopic, and medical management strategies for ERCP-related perforations have been described, although there is no evidence-based strategy to guide the clinician [8]. This is likely because of the fact that perforations are rare and reported patient populations are not comparable [9-11]. Although there is likely a subset of patients for whom urgent surgical intervention is necessary for improved outcomes, the criterion to select these patients is not clearly defined [12,13]. Some experts advocate a management algorithm based on the mechanism of injury, whereas others recommend using more dynamic markers such as the patient's clinical progress and cross-sectional imaging [14,15]. This review focuses on duodenal and pancreaticobiliary perforations due to ERCP. Perforations at the esophagus, stomach, afferent limb of a Billroth II anatomy, and liver have been reported with ERCP but are not covered here [4,9,16,17].

2. Risk factors for perforation

Risk factors for perforation can be divided into those that are patient related or procedure related. Patient-related factors include suspected sphincter of Oddi dysfunction, female sex, older age, normal serum bilirubin, history of post-ERCP pancreatitis, and abnormal or distorted anatomy (ie, situs inversus or post-Billroth II gastrectomy) [10-12,18-22]. Procedure-related factors include difficult cannulation, intramural injection of contrast agent, longer duration of procedure, sphincterotomy and precut papillotomy, biliary stricture dilation, papillary balloon dilation, and procedure performed by inexperienced endoscopists [2,9-12,18-22].

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The presence of a periampullary diverticulum or roux-en-Y anatomy is a probable risk factor, although currently available data have not confirmed this [3]. A retrospective single-institution series reported that for every 10 minutes of ERCP procedure time greater than the mean, the risk of a perforation is increased by 1.26 times [9]. Recently, there has been growing evidence to support the use of limited endoscopic sphincterotomy with large papillary balloon dilation as an alternative to complete endoscopic sphincterotomy alone [23-25]. Although both are risk factors for ERCP-related perforation, there appears to be a lower rate of perforation (without an increased risk of pancreatitis) in the limited sphincterotomy with papillary balloon dilation group [23-25].

3. Classification of iatrogenic perforations

Traditionally, ERCP-related duodenal perforations have been classified according to the location or mechanism of injury for the purposes of guiding management (Table).

Stapfer et al [11] classified perforations into 4 types in decreasing order of injury severity with the purpose of correlating the mechanism of injury and the anatomical location of perforation as predictors of the need for surgical intervention. Type I perforations are injuries of the duodenal wall (usually lateral wall) caused by the endoscope itself. They often occur when too much pressure is applied to the sweep of the thin-walled duodenum and are usually recognized immediately by the endoscopist. Consequently, there is often considerable extravasation of duodenal contents retroperitoneally or intraperitoneally or both. Type II perforations are periampullary injuries of the medial wall of the duodenum. These most commonly occur during biliary or pancreatic sphincterotomy and are variable in their severity. Type III perforations are bile or pancreatic ductal injuries caused by instrumentation (guidewires), stone extraction, and stenting. They are often recognized at the time of ERCP as a blush of contrast agent outside the ductal system. Type IV perforations are minuscule retroperitoneal injuries caused by the use of excessive insufflation during endoscopy together with sphincter manipulation. These are often not considered true perforations, and it is believed that they are related to compressed gas passing through the duodenal wall into the retroperitoneum. Postprocedure retroperitoneal gas alone is not uncommon and in 1 study occurred in 29% of asymptomatic patients post-ERCP who underwent sphincterotomy. In the absence of physical findings, retroperitoneal gas alone is not a cause for alarm [26].

Howard et al [10] classified perforations into 3 groups in increasing order of severity according to the mechanism of injury. Group I refers to guidewire-induced perforations; group II are periampullary perforations due to sphincterotomy or precut papillotomy; and group III are duodenal perforations due to direct endoscope-induced trauma.

Machado [7], in a recent review of the literature of duodenal perforations due to ERCP between 2000 and 2011, reported the location of perforation due to ERCP as being the duodenal wall in 34.5%, periampullary in 31.3%, common bile duct in 23.0%, unknown in 7.9%, retroperitoneal gas only in 0.8%, and miscellaneous in 2.5% of cases. The etiology of the perforations were related to sphincterotomy in 25.9%, guidewire in 21.5%, endoscope in 14.3%, and stent placement in 8.0% of the cases and were unknown in 8.0%, other in 15.1%, and not reported in 7.2% of cases. Although perforation due to sphincterotomy is the most frequent, it can be minimized by limiting the length of cutting wire that is in contact with the tissue and performing stepwise incisions (Figure 1). To reduce the risk of guidewire perforations, it is important to monitor the wire frequently and only advance the wire under fluoroscopic guidance and without excessive force.

Recently, several publications have classified perforations based on clinical and radiologic features [8,15]. Clinical features of interest are the time to diagnosis, presence of peritoneal signs, and evidence of a systemic inflammatory response [15]. The most pertinent computed tomography (CT) findings are the presence of

Table
Classification of iatrogenic duodenal perforations during endoscopic retrograde cholangiopancreatography.

References	Type and definition
Stapfer et al [11]	Type I, lateral or medial duodenal wall perforation, endoscope related Type II, periampullary perforations, sphincterotomy related Type III, ductal or duodenal perforations due to endoscopic instruments Type IV, guidewire-related perforation with presence of retroperitoneal gas on imaging
Howard et al [10]	Group I, guidewire perforation Group II, periampullary perforation Group III, lateral duodenal wall perforation

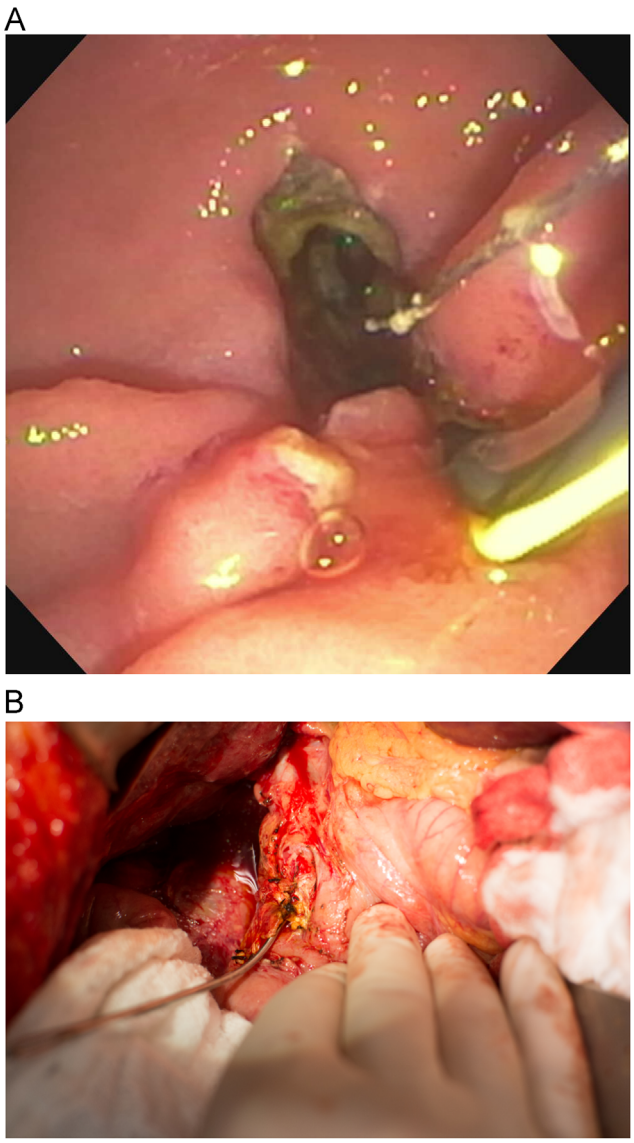

Fig. 1. A patient with periampullary perforation secondary to biliary sphincterotomy: (A) an endoscopic image revealing the excessive length of cutting wire within the bile duct and extension of the sphincterotomy beyond the transverse fold and (B) the intraoperative image after the duodenum has been subjected to the Kocher maneuver and is rotated medially. The metal probe is going through the perforation into the bile duct.

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