

## THE CLINICAL PICTURE

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# Air leakage in multiple compartments after endoscopy

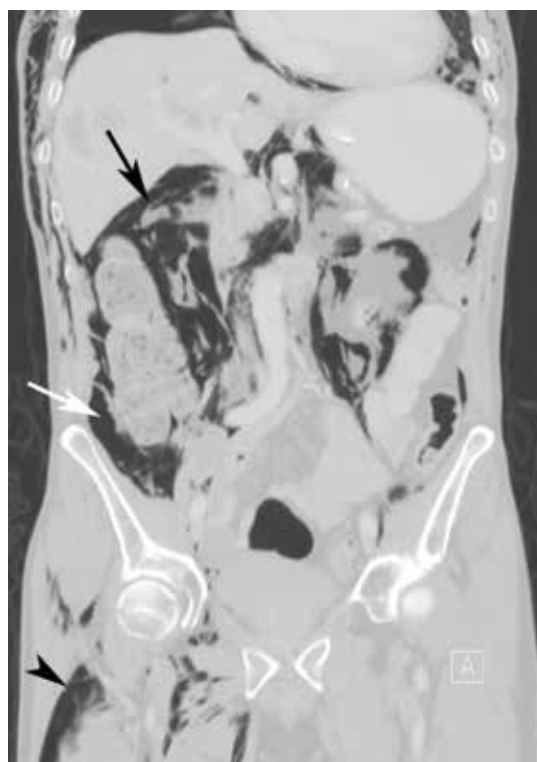
**A** 68-YEAR-OLD MAN with metastatic periampullary adenocarcinoma presented to his usual clinic for a scheduled biliary stent exchange by endoscopic retrograde cholangiopancreatography (ERCP). The stent had been placed 5 months before, and no complications had been reported during that procedure.

During the stent exchange procedure, the endoscopist advanced the scope to the second part of the duodenum, where a large, ulcerated, friable mass was visualized surrounding the ampulla, consistent with patient's known periampullary cancer. The biliary stent was removed without much difficulty. However, several attempts to cannulate the common bile duct with a preloaded guidewire failed because of extensive edema and tissue friability, and to avoid further discomfort to the patient, the procedure was aborted. No perforation was visualized during or at the end of the procedure.

During the first hour after the procedure was stopped, the patient suddenly developed abdominal pain and distention and crepitus of the right chest wall. Supine abdominal radiography showed extensive pneumoperitoneum and subcutaneous emphysema in the chest. A nasogastric tube was placed for decompression, and the patient was transferred to the surgical intensive care unit at our hospital.

## EVIDENCE OF PERFORATION NOTED

On arrival, the patient's oxygen saturation was 99% while receiving oxygen at 2 L/minute by nasal cannula. The physical examination revealed neck swelling, abdominal distention, and crepitus in the neck, abdomen, scrotum, and right lower extremity.

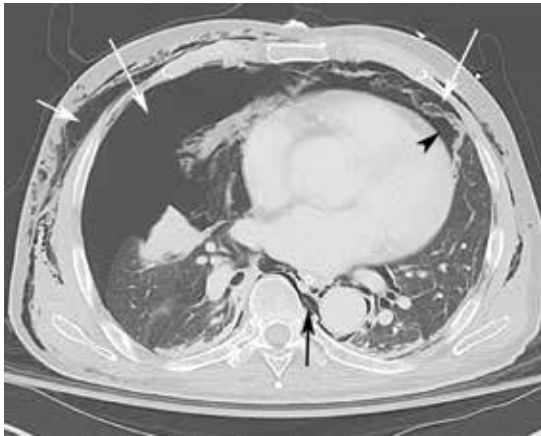


**FIGURE 1.** Computed tomography with coronal multiplanar reconstruction revealed pneumoperitoneum (black arrow), pneumoretroperitoneum (white arrow), and air along intermuscular planes in the right lower extremity (arrowhead). The image is a lung-window setting, which better demonstrates free air.

**An attempt to cannulate the common bile duct led to abdominal pain and distention and crepitus of the right chest wall**

Computed tomography (CT) of the abdomen and pelvis with oral and intravenous contrast revealed widespread pneumoretroperitoneum, pneumoperitoneum, and air along the intermuscular planes in the right lower extremity, with no evidence of extravasation of oral contrast (**Figure 1**). Also noted

doi:10.3949/ccjm.83a.15168



**FIGURE 2.** Computed tomography with axial imaging through the lungs revealed bilateral pneumothoraces (long white arrows), pneumomediastinum (black arrow), pneumopericardium (arrowhead), and subcutaneous emphysema (short white arrow).

were bilateral pneumothorax, pneumomediastinum, pneumopericardium, and extensive subcutaneous emphysema (**Figure 2**).

Despite these impressive findings, the patient remained hemodynamically stable and was managed conservatively with broad-spectrum antibiotics, gastric decompression, and bowel rest. But repeat chest radiography 5 hours after admission to the hospital revealed an enlarging right pneumothorax, which was treated with placement of a pigtail catheter. The patient continued to improve with conservative management and was discharged on the 6th day of hospitalization.

#### ■ PERFORATION DURING ERCP: INCIDENCE AND COMPLICATIONS

Although perforation is an uncommon complication of ERCP, with an incidence of 1%, mortality rates as high as 18% have been reported.<sup>1</sup> Older age, longer procedural time, anatomic variations, and diseases of the duodenum and common bile duct can increase the risk of perforation.<sup>2</sup>

#### Types of perforation

Stapfer et al<sup>1</sup> classified perforation during ERCP into four types, based on etiology and site of perforation. Type 1 is perforation of the lateral or medial duodenal wall caused by excessive pressure from the endoscope or its acute angulation. Type 2 is periampullary in-

jury, often associated with sphincterotomy or difficulty accessing the biliary tree. Type 3 is injury to the common bile duct or pancreatic duct caused by instrumentation. Type 4 is the presence of retroperitoneal free air with no evidence of actual perforation; this is usually an incidental finding and is of little or no clinical consequence.<sup>1</sup>

In 2015, a review of 18 studies described the distribution of ERCP perforation according to the Stapfer classification: 25% were type 1, 46% were type 2, and 22% were type 3.<sup>3</sup>

#### Effects of air insufflation

ERCP requires air insufflation for optimal visualization. During difficult or prolonged procedures, a larger amount of air may be insufflated to maintain bowel lumen visibility. Depending on the site and size of the defect, a variable amount of air can leak under pressure once the perforation occurs. A rapid retroperitoneal air leak can spread to multiple body compartments, including the mediastinum, pleura, neck, subcutaneous tissues, scrotum, and musculature by tracking through various fascial planes. Rarely, rapid ingress of air in these areas can lead to compartment syndrome.<sup>4</sup>

Small perforations tend to close spontaneously and may remain clinically silent, but large or persistent perforations are known to cause subcutaneous emphysema, sepsis, and respiratory failure.<sup>5</sup>

#### Our patient's type 2 perforation

We presumed that our patient had a type 2 perforation, given the finding of retroperitoneal air. Difficulty cannulating the biliary tree via the friable malignant tissue at the site of the major papilla likely caused punctate perforations, resulting in air leakage into the retroperitoneum. Punctate perforations typically do not allow contrast extravasation, explaining the absence of oral contrast leakage on CT.

#### ■ TREATMENT OF ENDOSCOPY-RELATED PERFORATION

Conventional supine and upright abdominal radiography is an appropriate initial imaging modality to confirm the diagnosis. However, CT is more sensitive and accurate, especially when air leakage is confined to the retroperitoneum. In-

Perforations are usually treated with a broad-spectrum antibiotic, bowel rest, and stomach decompression

travenous or oral contrast is not necessary but may help localize the perforation and better delineate fluid collections and abscesses.<sup>2</sup>

Once perforation is suspected, treatment with a broad-spectrum antibiotic, bowel rest, and stomach decompression is imperative.<sup>6</sup> Further management depends on the type of perforation and the overall clinical picture. Type 1 perforations usually require immediate surgical intervention. Type 2 perforations often seal spontaneously within 2 to 3 days and

thus are managed conservatively (ie, a broad-spectrum antibiotic, gastric decompression, and bowel rest), unless there is a persistent leak or a large fluid collection. Type 3 perforations rarely require surgery since most are very small and close spontaneously, and so they are managed conservatively. Type 4 perforations are the least serious. They result in retroperitoneal free air that is thought to be related to the use of compressed air for lumen patency. They require only conservative measures.<sup>1</sup> ■

## REFERENCES

1. **Stapfer M, Selby RR, Stain SC, et al.** Management of duodenal perforation after endoscopic retrograde cholangiopancreatography and sphincterotomy. *Ann Surg* 2000; 232:191–198.
2. **Enns M, Eloubeidi K, Mergener P, et al.** ERCP-related perforations: risk factors and management. *Endoscopy* 2002; 34:293–298.
3. **Vezakis A, Fragulidis G, Polydorou A.** Endoscopic retrograde cholangiopancreatography-related perforations: diagnosis and management. *World J Gastrointest Endosc* 2015; 7:1135–1341.
4. **Frias Vilaca A, Reis AM, Vidal IM.** The anatomical compartments and their connections as demonstrated by ectopic air. *Insights Imaging* 2013; 4:759–772.
5. **Machado N.** Management of duodenal perforation post-endoscopic retrograde cholangiopancreatography. When and whom to operate and what factors determine the outcome? A review article. *JOP (Online)* 2012; 13:18–25.
6. **Dubecz A, Ottmann J, Schweigert M, et al.** Management of ERCP-related small bowel perforations: the pivotal role of physical investigation. *Can J Surg* 2012; 55:99–104.

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