ADVANCES IN ENDOSCOPY

Current Developments in Diagnostic and Therapeutic Endoscopy

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Nonradiation, Endoscopic Ultrasound–Based Endoscopic Retrograde Cholangiopancreatography

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G&H Why is nonradiation, endoscopic ultrasound–based endoscopic retrograde cholangiopancreatography an important topic?

KB Over the past several decades, there has been a significant increase in the per capita ionizing radiation dose from medical procedures. Among gastrointestinal endoscopic procedures, endoscopic retrograde cholangiopancreatography (ERCP) carries the highest radiation exposure to patients and endoscopy staff. Nonradiation, or nonfluoroscopy, endoscopic ultrasound (EUS)-based ERCP provides a method of performing ERCP without radiation exposure. This is of particular relevance to pregnant women, in whom any radiation exposure should be avoided because of the high risk of fetal developmental malformations.

G&H How is nonradiation, EUS-based ERCP performed?

KB When patients undergo standard ERCP, the bile duct is injected with contrast to visualize the duct under fluoroscopic guidance. Fluoroscopy is also used to guide the passage of instruments into the bile duct. Many endoscopists favor using a guidewire to access the bile duct, which requires fluoroscopy to see if the guidewire is entering the bile duct. A stone, if found, is removed from the bile duct with an extraction device (eg, a basket or balloon) under fluoroscopic guidance.

Nonradiation, EUS-based ERCP begins with an EUS examination, which replaces the need for an initial diagnostic ERCP. An endoscopist employs an echoendoscope with a miniature transducer on the tip to see the bile duct with high-resolution ultrasound and to gather diagnostic information regarding the location, number, and size of the stones (Figure 1). If a stone is found, the echoendoscope is switched out for a duodenoscope, used for ERCP. An endoscopist selectively cannulates the bile duct with a catheter or sphincterotome. Entry into the bile duct is confirmed by aspiration of bile, which appears yellow or orange, in contrast to the clear appearance of pancreatic juice (Figure 2). A sphincterotomy is performed, and the stone is removed with a basket. The size and number of stones removed are matched with what was seen on EUS (Figure 3). A dry sweep across the sphincterotomized papilla is usually adequate to confirm ductal clearance; however, there is always the option of passing a cholangioscope into the duct for direct visualization. Additionally, an intraductal ultrasound probe can be passed into the duct to confirm stone clearance.

G&H How significant is the learning curve to perform nonradiation, EUS-based ERCP?

KB There are 2 components to the learning curve. The first component is being skilled in performing EUS as a diagnostic modality. An endoscopist should be able to identify the bile duct and stones in the duct, and be able to measure the size and number of stones and know their location. The second aspect to the learning curve regards ERCP. It takes experience to be able to selectively cannulate the bile duct; thus, someone new to this technique

Figure 1. Endoscopic ultrasound is used to identify the location, number, and size of stones in the bile duct prior to performing endoscopic retrograde cholangiopancreatography.

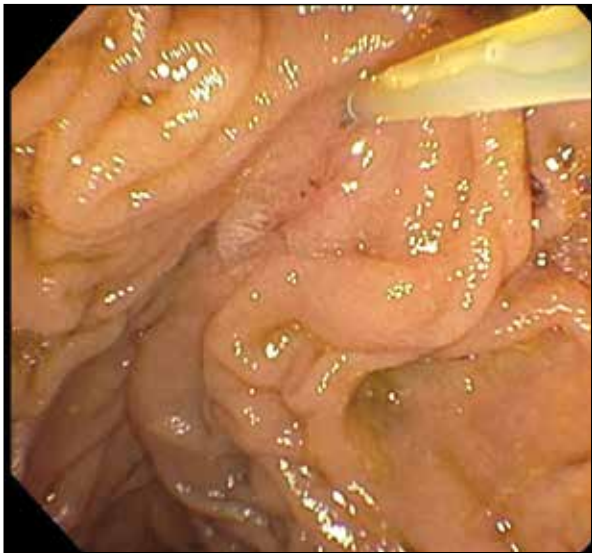

Figure 2. Visible bile in the catheter, appearing yellow, confirms access to the bile duct following nonradiation selective cannulation.

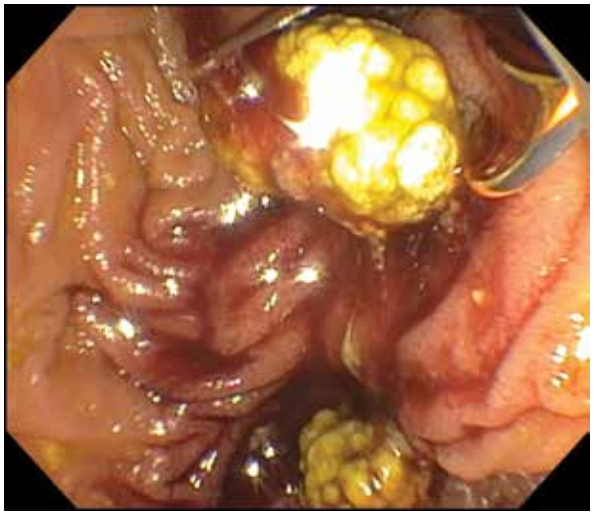

Figure 3. The extracted stones are compared to the diagnostic information provided by endoscopic ultrasound.

will be less skilled. Ideally, training programs should train endoscopists in both modalities so that they can perform single-session, single-operator, EUS-based ERCP.

G&H What are the main advantages and disadvantages of nonradiation ERCP vs standard ERCP?

KB The main advantage of nonradiation ERCP is that the patient and endoscopy staff are spared radiation exposure. The primary disadvantage is that there is a lack of a gold standard for confirming that all stones have been cleared from the bile duct, which is typically confirmed by radiologic contrast filling of the bile duct. However, cholangioscopy or intraductal ultrasound can provide this confirmation.

G&H What adverse events are associated with this procedure?

KB The main adverse event that is associated with nonradiation, EUS-based ERCP relates to misinterpretation of the EUS findings. An endoscopist may see a single stone in the bile duct on an EUS examination when there

are actually multiple stones, and subsequently may remove only 1 stone, believing clearance to be complete. A residual stone may then lead to recurrent obstruction and cholangitis. Likewise, an endoscopist who is not adequately skilled in performing an EUS could miss a stone altogether, in which case the patient risks harm from not being appropriately treated with ERCP.

G&H How does EUS compare to cholangiography?

KB Cholangiography, considered to be the gold standard, is a radiographic examination of the bile ducts using injected contrast. Studies comparing EUS and cholangiography have reported that EUS is more sensitive and more specific for detecting bile duct stones, as cholangiography can provide false positives (eg, an air bubble that looks like a stone) as well as false negatives (eg, a small stone that has a similar density as the contrast and is missed on fluoroscopic examination).

G&H What were the design and key findings of your study on the feasibility of nonradiation, EUS-based ERCP?

KB Over a period of 1 year, my colleagues and I accepted consecutive adult patients with suspected bile duct stones (based upon their clinical presentation, laboratory tests, elevated liver enzymes, abnormal imaging, and other factors) and who were referred to us for ERCP. Any patient with altered duodenal anatomy (eg, prior Whipple operation), prior intervention of the papillary or bile duct (eg, sphincterotomy, stent), or cholangitis were excluded from the study. Additional exclusion criteria were based upon an EUS examination; patients with a large stone burden (>3), stones larger than 12 mm requiring lithotripsy, intrahepatic or cystic duct stones, or a stone impacted at the papilla were not included.

Following EUS examination, patients underwent biliary cannulation without fluoroscopy, which we limited to 10 minutes in order to minimize the risk of pancreatitis (as the risk is proportionate to the number of attempts at cannulation). Within this time frame, selective cannulation was successful in 26 out of 31 patients, or 84%. It is important to note that the cases in which we could not selectively access the bile duct were due to the time limit; after 10 minutes, the risk of pancreatitis starts to potentially outweigh the benefit of avoiding fluoroscopy, and we allowed the endoscopist to resort to using fluoroscopy to assist cannulation of the bile duct, such as with wire-guided cannulation.

Sphincterotomy was then performed to remove the stones. After the endoscopist declared the ducts clear, every patient underwent a cholangiogram with contrast to confirm stone clearance. The cholangiogram confirmed that the duct was clear in all cases, which suggests that nonradiation, EUS-based ERCP is a successful and safe method for stone removal.

G&H What were the limitations of your study?

KB The success of this approach requires a single session, as EUS provides real-time information that is needed immediately prior to ERCP. A single operator is not as necessary; one operator could perform the EUS on the bile duct, and another operator could perform ERCP. However, the operators need to have adequate training and skill sets in EUS and ERCP, respectively. Our study was conducted by highly skilled single operators in a high-volume ERCP-referral center, and, thus, our results are only applicable to such centers.

G&H How can endoscopists reduce the radiation exposure from ERCP in clinical settings?

KB Most patients who present with a suspected bile duct stone undergo ERCP directly without a prior magnetic resonance cholangiopancreatography or EUS, both of which can provide important diagnostic information without radiation. When possible, endoscopists should perform EUS prior to an ERCP procedure as a replacement for diagnostic ERCP. For difficult cannulation cases, it is my personal preference to perform a precut before resorting to using a guidewire to access the bile duct, in part because the precut does not require fluoroscopy. Radiation exposure can be minimized with pulsed fluoroscopy and collimation, and medical personnel should adhere to appropriate shielding practices. Ultimately, awareness is key, on both the part of patients and clinicians.

G&H Are there any patients in whom this procedure should be avoided?

KB The prerequisite for nonradiation ERCP is adequate EUS visualization of the bile duct. The same patient populations that were excluded from our study may, therefore, not be candidates. EUS examination of the bile duct is limited in a patient with prior gastric bypass or Roux-en-Y surgery. A prior sphincterotomy or placement of a bile duct stent may create an artifact, from air or the stent itself, that limits ultrasound visualization of the bile duct.

G&H Has there been any research on the use of nonradiation ERCP in procedures other than choledocholithiasis?

KB My colleagues and I are currently evaluating nonradiologic, EUS-guided choledochoduodenostomy for the management of malignant distal bile duct obstruction using a lumen-apposing metal stent (AXIOS, Boston Scientific). This translumenal stent was developed to create an anastomotic connection between 2 neighboring lumens, in this case the upstream bile duct and the duodenal lumen, under EUS guidance. Currently, strictures are managed by placing a stent across the stricture with ERCP under fluoroscopic guidance. EUS-guided choledochoduodenostomy bypasses the stricture and thereby eliminates the need for retrograde access provided by the ERCP to the bile duct. This has theoretical advantages of easier bile duct access and eliminating the risk of post-ERCP pancreatitis. Bile duct access and stent deployment can be performed under EUS guidance alone, avoiding fluoroscopy. More research on this technique is needed.

Dr Binmoeller is the inventor of the AXIOS lumen-apposing metal stent and founder of Xlumena Inc, acquired by Boston Scientific.

Suggested Reading

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