

What Every Radiologist Should Know about Endoscopic Retrograde Cholangiopancreatography: A Pictorial Review

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INTRODUCTION

Endoscopic retrograde cholangiopancreatography (ERCP) is a procedure that uses endoscopy and most commonly fluoroscopy to primarily treat and also to diagnose disease processes associated with the biliary and pancreatic ductal system. With its dependence on real-time image guidance, it brings the inherent risk of radiation exposure to patients. Therefore, it is crucial that radiologists be aware of the technique, indications, and complications of ERCP, which will be discussed in this poster presentation.

CLINICAL INDICATION

According to the American Society of Gastrointestinal Endoscopy (ASGE), indications for ERCP include:

- Jaundice thought to be the result of biliary obstruction
- Clinical and biochemical or imaging data suggestive of pancreatic or biliary tract disease
- Signs or symptoms suggesting pancreatic malignancy when direct imaging results are equivocal or normal
- Pancreatitis of unknown etiology
- Preoperative evaluation of chronic pancreatitis or pancreatic pseudocyst
- Sphincter of Oddi manometry
- Endoscopic sphincterotomy
- Stent placement across benign or malignant strictures, fistulae, postoperative bile leak, or large common bile duct stones
- Balloon dilatation of ductal strictures
- Nasobiliary drain placement
- Pseudocyst drainage in appropriate cases
- Tissue sampling from pancreatic or bile ducts
- Pancreatic therapeutics
- Access to the bile duct to recover migrated stents, facilitate combined endoscopic-radiologic procedures, investigate (and

ERCP is not indicated when abdominal pain does not specifically indicate biliary or pancreatic disease and MRCP and EUS are safe alternative diagnostic procedures, in gallbladder disease without signs of biliary obstruction, or to evaluate proven pancreatic malignancy with no anticipated change in course.

EVALUATION OF PATIENT

- History and physical examination
- Laboratory testing: Chemistry panel, coagulation panel, chest radiograph, and pregnancy test when appropriate, and ECG
- Review of imaging studies

PERI-OPERATIVE PATIENT PREPARATION

- Informed consent
- Patient must be NPO for at least 6-8 hours
- Perioperative antibiotics is recommended for the following clinical scenarios:
 - Predicted incomplete biliary drainage (e.g., Klatskin tumor or primary sclerosing cholangitis)
 - Actual incomplete biliary drainage
 - Immunosuppression, particularly post liver transplantation
 - Communicating pancreatic pseudocyst
 - Transenteric pseudocyst drainage
- Anticoagulants should be held while other medications may be taken with a sip of water per normal routine.
- Patients on insulin will need proper dose adjustment to reflect duration of time without meals.

ERCP TECHNIQUE

- Prior to initiating the procedure sedation medication (usually moderate) will be given.
- The patient is then typically placed in either prone or left lateral decubitus position and may be adjusted throughout the procedure to facilitate passage of the endoscope.
- Next the endoscopist must decide which type of endoscope to use. For ERCP the most commonly used endoscope is the duodenoscope which has a side viewing capability that facilitates visualization within the more vertically oriented 2nd portion of the duodenum.
- Within the duodenum the major and minor papilla need to be identified to determine the best technique for ductal cannulation as well as extent of sphincterotomy if one is to be performed. If the papilla are not readily identified a number of endoscopic maneuvers as well as glucagon (decreases duodenal motility) may be used to facilitate identification.
- To achieve access to and throughout the biliary/pancreatic ductal system a number of options are available to the endoscopist including cannulation devices, guidewires, and sphincterotomes (used to incise sphincter).
- Following cannulation of the ducts, contrast (usually non-ionic low osmolarity) is administered under fluoroscopy. If obstruction/stricture is encountered then stone retrieval devices, balloon dilation, stents, and/or drains may be used. Tissue and fluid sampling may also be performed when concerned for neoplastic or infectious process.

A myriad of difficulties are often encountered from passage of the endoscope, cannulation of the ampulla and ultimately therapeutic intervention. In addition, variability in patient anatomy must be anticipated. Prior gastrointestinal surgical history is of great significance and must be obtained to help guide appropriate technique and facilitate procedural success.

ERCP TECHNIQUE (CONT)

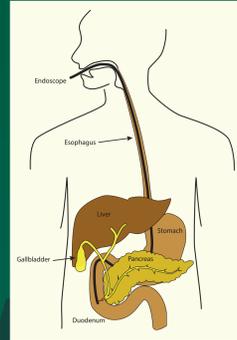


Figure illustrates the endoscope inserted through the mouth, past the esophagus and stomach into the second portion of the duodenum. The catheter or guidewire inside the lumen of the endoscope then can be used for cannulation of the biliary tract

COMPLICATIONS

The most common specific complications of ERCP include:

- Pancreatitis: Pancreatitis is the most common serious complication; rates of post-ERCP pancreatitis are roughly 3.5%.
- Hemorrhage (most commonly related to sphincterotomy)
- Perforation of viscus
- Infection including cholangitis and cholecystitis.
- Cardiopulmonary complications such as aspiration, arrhythmia, and hypoxemia are rare.

RADIATION SAFETY ASPECT OF ERCP

Real-time image guidance for ERCP is most commonly provided by fluoroscopy. Although the risk radiation injury is low, deterministic effects (including skin burns and cataract formation) and stochastic effects (increased risk of cancer) are possible. Therefore appropriate education in radiation protection is necessary to avoid unnecessary exposure to patients and personnel. Here are a list of guidelines designed to reduce radiation exposure:

- Limiting fluoroscopy time is the most direct dose reduction technique. Fluoroscopy should never be activated unless the operator is looking at the image display.
- Low dose rate fluoroscopy modes should be used whenever possible. A pulsed fluoroscopy mode with a low frame rate is generally the best selection for dose reduction.
- The location of the patient relative to the x-ray tube and image receptor also affects radiation dose levels. Therefore providers should place the patient as far away as possible from x-ray tube and as close as possible to image receptor.
- Use the collimator to include only the area of interest.
- Use magnification modes sparingly, since increase in magnification will increase the dose rate.
- Always monitor patient's cumulative radiation dose during ERCP and record in patient medical record.

CASE 1: INTRADUCTAL PAPILLARY MUCINOUS NEOPLASM (IPMN)

Intraductal papillary mucinous neoplasm (IPMN) is defined as an intraductal proliferation of mucin-producing neoplastic cells arranged in papillary formations. Duct dilatation is the key macroscopic feature of IPMN; however, this can vary significantly, depending on the degree of mucin production and papillary tumor formation. IPMN is considered a cystic tumor of the pancreas. The etiology is unknown. At the time of diagnosis, it may be benign, with or without dysplasia, or frankly malignant with an invasive carcinoma. Tumors arising from the main pancreatic duct are termed main-duct IPMNs, those involving the branch ducts, branch-duct IPMNs. In general, small branch-duct IPMNs are benign, particularly in asymptomatic patients, and can be safely followed. In contrast, main-duct tumors should be surgically resected and examined carefully for an invasive component. CECT or MR should be used as initial noninvasive modalities to assess for malignant characteristics. If high risk features are detected, subsequent EUS/ERCP should be performed with cyst aspiration



Figure 1.1: CT Abdomen with IV and oral contrast shows mild dilatation of the main pancreatic duct (red arrow)

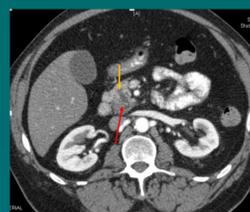


Figure 1.2: CT Abdomen with IV contrast reveals dilated main pancreatic duct within the pancreatic head/uncinate process (yellow arrow). There is also an ill-defined cystic lesion in close vicinity (red arrow)



Figure 1.3: ERCP image shows dilated main pancreatic duct (red arrow) and focal dilatation of a side branch (yellow arrow)

CASE 2: CAROLI DISEASE

Caroli disease is a congenital disorder characterized by multifocal, segmental dilatation of large intrahepatic bile ducts. Pathogenesis not completely understood but likely due to arrest or derangement in remodeling of ductal plate. Inheritance is typically autosomal recessive. The condition is usually associated with renal cystic disease of varying severity. There are two variants, Caroli disease is the less common form and is characterized by bile duct ectasia without other apparent hepatic abnormalities. The more common variant is Caroli syndrome in which bile duct dilatation is associated with congenital hepatic fibrosis. The diagnosis of Caroli disease and Caroli syndrome is established by imaging studies that demonstrate bile duct ectasia and irregular, cystic dilation of the large proximal intrahepatic bile ducts with a normal common bile duct. Treatment is largely supportive, although biliary decompression and surgery is warranted for select patients.



Figure 2.1: CT Abdomen with IV contrast shows sacular dilatation of the intrahepatic biliary system (red arrow). Note the internal soft tissue density representing portal radicles (yellow arrow)



Figure 2.2: CT Abdomen with IV contrast in coronal reformats shows sacular dilatation of the intrahepatic ducts (red arrow) and borderline size common bile duct (yellow arrow)

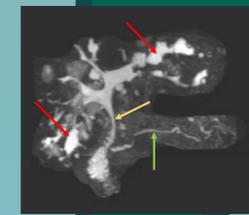


Figure 2.3: MRCP shows sacular dilatation of the intrahepatic ducts (red arrow). The common bile duct (yellow arrow) and the main pancreatic duct (green arrow) are normal in size



Figure 2.4: ERCP image demonstrates sacular dilatation of the intrahepatic ducts. The common bile duct is borderline in size (white arrow)

CASE 3: CHOLEDOCHOLITHIASIS

Cholelithiasis refers to the presence of gallstones within the common bile duct. It has been estimated that 5 to 20 percent of patients with gallstones will have choledocholithiasis at the time of cholecystectomy, with the incidence increasing with age. Symptoms associated with choledocholithiasis include right upper quadrant or epigastric pain, nausea, and vomiting. The pain is often more prolonged than is seen with typical biliary colic. Complications of choledocholithiasis include acute pancreatitis and acute cholangitis. Patients with chronic disease are believed to increase the risk of cholangiocarcinoma. Transabdominal imaging is first-line imaging modality. Patients at high risk for having common bile duct stones and with intact gallbladder generally proceed to ERCP which is the "gold standard" for diagnosis and therapeutic with stone removal.



Figure 3.1: CT Abdomen with IV contrast shows diffuse dilatation of the intrahepatic ducts



Figure 3.2: CT Abdomen with IV contrast, coronal reformats shows diffuse dilatation of the common bile duct (red arrow)

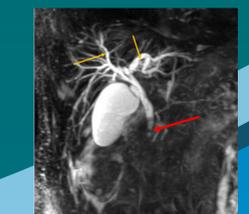


Figure 3.3: MRCP image shows diffuse dilatation of the common bile duct with a small round signal void representing a stone (red arrow). Diffuse intrahepatic ductal dilatation is also noted (yellow arrow)

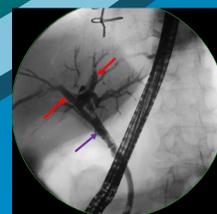


Figure 3.4: ERCP image shows diffuse intrahepatic ductal dilatation (red arrow) and common bile duct dilatation (purple arrow)

CASE 4: PANCREATIC ADENOCARCINOMA

Pancreatic adenocarcinoma is a malignant tumor derived from ductal epithelia. Pancreatic carcinoma is the fourth leading cause of cancer-related death in the United States with pancreatic ductal adenocarcinoma representing 90% of all pancreatic neoplasms. Individuals 60-70 years of age are most commonly affected. Typical presentation includes pain, jaundice and weight loss. Unfortunately, the presentation is often late in the disease course resulting in a poor prognosis. Surgical resection is the only potentially curative treatment with five year survival rates of 25-30% for node-negative and 10% for node-positive disease. Best initial workup includes multiphase CECT, multiphase MR + MRCP, or EUS/ERCP to determine potential resection.



Figure 4.1: CT Abdomen with IV oral contrast shows dilatation of the common bile duct (red arrow) and main pancreatic duct (yellow arrow), compatible with "double duct" sign



Figure 4.2: CT image shows an ill-defined hypo-enhancing mass within the pancreatic head (red arrow). The mass was proven to be pancreatic carcinoma by surgical resection

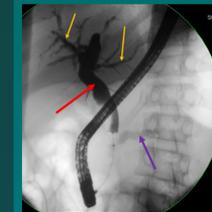


Figure 4.3: ERCP image shows diffuse intrahepatic ductal dilatation (yellow arrow) and common bile duct dilatation (red arrow). Diffuse dilatation of the main pancreatic duct is also seen (purple arrow). The image was acquired with balloon occlusion past the point of stricture in order to obtain adequate distension of the biliary system

TAKE-HOME POINTS

- ERCP is now a primarily therapeutic procedure for the management of pancreatic-biliary disorders
- Critical questioning the strength of the indication for ERCP is the first step in planning for the procedure
- The endoscopist must be properly trained in ERCP
- Review of other imaging studies is often helpful in planning the case
- The risk for clinically relevant bleeding at ERCP is almost entirely derived from performance of endoscopic sphincterotomy
- Major adverse effects of ERCP include: Pancreatitis, hemorrhage, perforation, cholangitis, cholecystitis, and stent-related adverse event
- The endoscopist should be aware of radiation dose effects on the patient and personnel working in the fluoroscopic suite

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