

ADVANCES IN ENDOSCOPY

Current Developments in Diagnostic and Therapeutic Endoscopy

Section Editor: Klaus Mergener, MD, PhD, MBA

Endoscopic Approach to Biliary Strictures



Steven Edmundowicz, MD
Professor of Medicine
University of Colorado School of Medicine
Medical Director for Endoscopy
Digestive Health Center
University of Colorado Hospital
Aurora, Colorado

G&H What are the main indications for performing cholangioscopy in the evaluation of biliary strictures?

SE There are a few indications for performing cholangioscopy in biliary strictures in a patient. These are primarily to identify the location and visual characteristics of the stricture and to obtain tissue from the stricture using biopsy forceps or brushes. Typically, a stricture can be brushed without cholangioscopy; however, cholangioscopy allows endoscopists to visualize the stricture and to sample the areas of the stricture that appear most likely to be malignant. Cholangioscopy can also be useful in complex bifurcation strictures to visualize the right and left main duct orifices and selectively place guidewires into the desired segments of the liver for access or stenting.

G&H What are some of the recent technological advances and choices in cholangioscopes for assessing biliary strictures?

SE Regarding the advances in cholangioscopy, there has been a continuous evolution from reusable dual-operator cholangioscopes to disposable single-operator cholangioscopes that use high-quality optical sensor cameras to provide higher resolution images. The problem with the reusable cholangioscopes is that they often become damaged during the procedure (eg, as a result of acute angulations or because they are so thin and fragile). Almost all centers have switched over to the disposable single-operator cholangioscopes. Initially, these were fiber-optic

devices that had 4-way tip deflection and a reusable visualization fiber inside a flexible plastic insertion tube with irrigation and suction channels. The insertion tube of the cholangioscope was passed into the operating channel of a therapeutic duodenoscope to be passed into the biliary tree while the control head was attached to the duodenoscope's handle, allowing one physician to operate both instruments. Manufacturers later developed digital cholangioscopes with various chip cameras that improved the imaging. Now, the second generation of digital cholangioscopes with even better optical systems are available. Additional device companies are bringing single-use cholangioscopes to the market. Three different companies are providing cholangioscopes to the US market right now. These devices are similar in that they all have a small insertion tube that goes through the typical duodenoscope into the bile duct and a mechanism for tip deflection as well as irrigation and suction. The current cholangioscopes, or miniscopes, also have an operating channel to pass a small biopsy forceps, a basket, guidewire, snare, or lithotripsy probes. The cholangioscopes can be used to obtain tissue, remove migrated stents, selectively place guidewires, and treat stones in both the biliary tree and the pancreatic duct.

G&H When inspecting an indeterminate stricture with cholangioscopy, what are the macroscopic signs that predict a malignancy?

SE Typically, the endoscopist would see an irregularity in the mucosal surface of the bile duct that would be raised,

polypoid, or mass-like. Occasionally, there may only be stenosis but with mucosal vessels that are prominent or dilated (often called tumor vessels) surrounding the area.

G&H Is there a diagnostic algorithm that you follow for determining when and how to sample a stricture?

SE The decision of when to biopsy or brush a stricture is individualized based on the center and whether the endoscopist is performing the first endoscopic retrograde cholangiopancreatography (ERCP) or whether someone else has already performed an ERCP and perhaps placed a biliary stent for a patient who presents with obstructive jaundice. It also depends in part on where the stricture is located. Strictures in the mid- and upper common bile

Using fluoroscopy at the same time as cholangioscopy is often very helpful to see which ductal segment one is entering.

duct are easiest to access by cholangioscopy; those that are very distal in the bile duct (near the ampulla of Vater) are a little more challenging; and those that are upstream in the liver may be difficult to reach because the diameter of the bile duct may not be large enough to accommodate the cholangioscope. The strategy often taken is to perform initial sampling after an endoscopic ultrasound is completed to determine if there is a mass that could be sampled. If there is a mass outside the liver, we would typically sample that by fine-needle biopsy and then perform an ERCP for decompression, and we would not use cholangioscopes or sample the stricture.

On the other hand, if there is no mass on endoscopic ultrasound, an ERCP would be performed to localize and then visualize the stricture, typically by performing cholangioscopy in that first procedure to identify the area that is abnormal and biopsy it with the forceps that go through the cholangioscope. Occasionally, we will not perform cholangioscopy because of time constraints or other issues, and simply perform a regular ERCP and brush the stricture first, obtaining cytology from the stricture. Cytology is not as accurate as cholangioscopic biopsies. However, cytology can often yield a positive diagnosis in tumors that are invading the bile duct, and

this method is much easier to perform and much less expensive than cholangioscopy. A second ERCP with cholangioscopy can be completed later if a diagnosis is not made on the first procedure. These options are discussed in the American Society for Gastrointestinal Endoscopy 2023 guideline on the evaluation of the indeterminate biliary stricture.

G&H What are the potential pitfalls of cholangioscopy and the main mistakes to avoid?

SE There are reports of cholangitis developing after cholangioscopy, especially if obstructed segments of the liver do not have adequate drainage at the end of the procedure. Intravenous antibiotics with biliary coverage should be given if cholangioscopy is undertaken. There are also challenges with inserting the cholangioscope into the bile duct in some patients, depending on their anatomy. It can be very difficult to advance the cholangioscope, particularly if the bile ducts are narrowed. If the bile duct is narrower than the cholangioscope diameter, which is typically 3.9 mm, when the endoscopist pushes the cholangioscope forward, it will impact and push the duodenoscope back into the stomach. Other challenges are limited mobility of the cholangioscope in bile duct–strictured areas. If the bile duct is very fixed, turning the duodenoscope left, right, up, or down is impossible because the duct is encased by the stricture; it becomes difficult if not impossible to target biopsies or pass guidewires effectively.

G&H Could you share a few tricks to better maneuver the cholangioscope inside difficult bile ducts?

SE Typically, endoscopists use the up/down/left/right control of the cholangioscope. One of the newer cholangioscopes has just a one-direction bending section, but it can be rotated, allowing the endoscopist to move the biopsy channel around the circumference of the bile ducts and to better target with it. There are issues with getting the initial introduction of the cholangioscope into the bile duct in some cases owing to the position and the size of the cholangioscope. If there is a challenging cannulation, a guidewire can be left in the bile duct and the cholangioscope passed over the guidewire to facilitate entrance into the biliary tree.

It is also possible to put a short guidewire into the cholangioscope and then aim the cholangioscope toward the bile duct, using the wire through the cholangioscope to access the bile duct and follow that wire up into the biliary tree with the cholangioscope. Often, manipulating the cholangioscope in the bile ducts requires a combination of manipulating the duodenoscope (the large scope

that is holding the cholangioscope) vs manipulating the cholangioscope itself with its up/down/left/right controls. Often the cholangioscope can be moved up and down in the biliary tree just by moving the duodenoscope tip up toward the ampulla or away from the ampulla. Using fluoroscopy at the same time as cholangioscopy is often very helpful to see which ductal segment one is entering. If

... anyone who performs complex ERCP (ie, more than just placing a stent or pulling a stone out) can and should learn how to perform cholangioscopy.

the goal is to get to a specific stricture (perhaps the right hepatic ducts), fluoroscopy can be used to guide the cholangioscope in that general direction and then advance it slowly through the ductal system. It can also be helpful to pass an angled short guidewire through the cholangioscope, and utilizing the torque vise, advance the cholangioscope over the wire and into the targeted liver area.

G&H Are there additional indications for the use of cholangioscopes in gastrointestinal endoscopy?

SE Cholangioscopes can be useful for a number of things. They can go through very small lumens that typically cannot be accessed with larger endoscopes. Sometimes, they are used to examine fistulas in the gastrointestinal tract. They can be advanced through the skin to manage cutaneous fistulas. They are used quite frequently in the biliary tree and the pancreatic ducts to perform lithotripsy with either electrohydraulic lithotripsy or laser lithotripsy to break or fragment stones. Endoscopists have used the laser through the cholangioscope to treat strictures. This is performed by cutting through the stricture with a laser and allowing the stricture to heal faster than just by dilating it or putting a stent across it. In the operating room, surgeons can use cholangioscopes to pass through the cystic duct into the bile duct, allowing them to perform cholangioscopy to see whether a stone is impacted or stuck in the biliary tree.

G&H How should endoscopists be trained in cholangioscopy?

SE In one multicenter study of advanced endoscopy training, fellows reported that they do not receive much experience in cholangioscopy but that they obtain enough to know how to insert and use the cholangioscope. They will gain more experience with it as they go through their practice. The manufacturers of cholangioscopes often have courses or hands-on sessions where individuals can learn the techniques to help utilize the device—how to manipulate it and how to pass the biopsy forceps, baskets, and guidewires. I think anyone who performs complex ERCP (ie, more than just placing a stent or pulling a stone out) can and should learn how to perform cholangioscopy. The procedure can be a very useful adjunct to their practice.

G&H What innovations need to occur to further improve the utility of current cholangioscopes?

SE There are some things in progress now that will be very exciting. The first that is obvious is the incorporation of artificial intelligence in the image interpretation of these miniscopes. This will allow for quick identification of lesions that have the characteristics typical of malignancy, and this may even be able to help the operator by directing where the biopsies should be taken to identify malignant cells. Expansion of the operating channel in some of the cholangioscopes can allow the accessories (eg, biopsy forceps) to be passed through without having concerns about resistance or kinking that could prevent their deployment. Smaller-diameter cholangioscopes have become available. One manufacturer had a cholangioscope as small as 3.2 mm in diameter, which when compared with the typical larger cholangioscopes of 3.9 mm in diameter may not seem significant; however, in the biliary tree and when working with tight strictures, even a small reduction can make a big difference.

Disclosures

Dr Edmundowicz is a consultant for Boston Scientific, Dragonfly Endoscopy, and Olympus, and a cofounder of Aspero Medical.

Suggested Reading

Fujii-Lau L, Thosani NC, Al-Haddad M, et al. American Society for Gastrointestinal Endoscopy guideline on role of endoscopy in the diagnosis of malignancy in biliary strictures of undetermined etiology: methodology and review of evidence. *Gastrointest Endosc*. 2023;98(5):694-712.e8.

Sethi A, Chen YK, Austin GL, et al. ERCP with cholangiopancreatography may be associated with higher rates of complications than ERCP alone: a single-center experience. *Gastrointest Endosc*. 2011;73(2):251-256.

Wani S, Keswani RN, Han S, et al. Competence in endoscopic ultrasound and endoscopic retrograde cholangiopancreatography, from training through independent practice. *Gastroenterology*. 2018;155(5):1483-1494.e7.