Endoscopic biliary sphincterotomy

AUTHOR: Priya Jamidar, MD, FACG, FASGE
SECTION EDITOR: Douglas G Adler, MD, FACG, AGAF, FASGE
DEPUTY EDITOR: Kristen M Robson, MD, MBA, FACG

All topics are updated as new evidence becomes available and our peer review process is complete.

Literature review current through: **Sep 2023.**
This topic last updated: **Apr 19, 2022.**

INTRODUCTION

Endoscopic biliary sphincterotomy refers to the transection of the biliary sphincter within the ampulla of Vater (also referred to as the papilla or the major duodenal papilla of Vater). Cannulation of the bile duct is followed by high frequency current applied with a special knife (sphincterotome) to incise the circumferential muscle within sphincter of Oddi. Sphincterotomy is a technically complex procedure that is performed under direct endoscopic visualization and fluoroscopic guidance.

Biliary sphincterotomy is typically performed during endoscopic retrograde cholangiopancreatography (ERCP) to facilitate subsequent interventions (eg, stone removal) or as primary treatment for conditions such as bile leak.

This topic will discuss the indications, technical aspects, and adverse events related to biliary sphincterotomy. For patients in whom cannulation of the bile duct is difficult, an alternative method such as precut (access) sphincterotomy may be utilized, and these techniques are discussed separately. (See "Precut (access) papillotomy" and "Precut sphincterotomy: Another perspective on indications and techniques" and "Precut sphincterotomy: Another perspective on efficacy and complications".)

An overview of ERCP is presented separately. (See "Overview of endoscopic retrograde cholangiopancreatography (ERCP) in adults".)

Evaluation and management of complications related to ERCP are discussed separately:

- (See "Post-endoscopic retrograde cholangiopancreatography (ERCP) pancreatitis".)
- (See "Post-endoscopic retrograde cholangiopancreatography (ERCP) bleeding".)
- (See "Infectious adverse events related to endoscopic retrograde cholangiopancreatography (ERCP)".)

PATIENT SELECTION

Clinical applications — Biliary sphincterotomy is performed to facilitate endoscopic interventions or as primary endotherapy in the following conditions:

- Postsurgical biliary complications (eg, bile leak). (See "Endoscopic management of postcholecystectomy biliary complications" and "Liver transplantation in adults: Endoscopic management of biliary adverse events".)
- Sphincter of Oddi dysfunction.
- Choledocholithiasis. (See "Choledocholithiasis: Clinical manifestations, diagnosis, and management".)
- Biliary strictures (eg, primary sclerosing cholangitis, malignant biliary stricture related to pancreaticobiliary cancer). (See "Primary sclerosing cholangitis in adults: Management" and "Endoscopic stenting for malignant biliary obstruction".)

Contraindications — Endoscopic biliary sphincterotomy is usually contraindicated in conditions where the risk of complications is higher than the potential benefits of the procedure. Endoscopic sphincterotomy is a procedure with a higher bleeding risk (table 1), and it is relatively contraindicated in patients with untreated hemostatic disorders who are deemed to be at high risk for bleeding by the advanced endoscopist.

PATIENT PREPARATION

The preprocedure preparation for patients undergoing biliary sphincterotomy is similar to that described for patients undergoing endoscopic retrograde cholangiopancreatography (ERCP). (See "Overview of endoscopic retrograde cholangiopancreatography (ERCP) in adults", section on 'Patient preparation'.)

Most patients do not need to discontinue aspirin or nonsteroidal anti-inflammatories when undergoing ERCP with biliary sphincterotomy. However, for patients on anticoagulants and/or nonaspirin antiplatelet agents who undergo endoscopic sphincterotomy, the procedure-related bleeding risk is higher. The management of antiplatelet and anticoagulant therapy in patients undergoing endoscopic sphincterotomy is typically individualized, managed in conjunction with the prescribing specialist, and is discussed separately. (See "Management of antiplatelet agents in patients undergoing endoscopic procedures" and "Management of anticoagulants in patients undergoing endoscopic procedures".)

EQUIPMENT

Sphincterotomes — A sphincterotome (also referred to as a papillotome) is a catheter with a cutting wire at its distal end, and sphincterotomes are available with varying configurations, cutting wire length, outer diameter, and other features (eg, rotational). Newer sphincterotomes may be brought to market, and availability varies by geographic area. Specific features include [1,2] (picture 1):

- **Configuration** – Sphincterotome configuration can be broadly categorized as pull-type, push-type, or needle-knife.
  - Pull-type – We typically use a pull-type sphincterotome that consists of a cutting wire partially enclosed in a polytetrafluoroethylene [PTFE or Teflon] catheter. The wire exits the catheter approximately 3 cm before its distal end and re-enters the catheter approximately 3 mm from its tip. The portion of the catheter distal to the re-entry point is referred to as the "nose." When tension is applied to the wire via the handle of the sphincterotome, the distal portion of the catheter becomes curved so that the exposed wire is brought away from the catheter. This also results in the catheter tip pointing upward, and this position facilitates cannulation of the bile duct.
  - Push-type – Push-type sphincterotomes are designed such that the cutting wire is oriented at the six o'clock position, and tightening the wire pushes it out to form a bow. Push-type sphincterotomes are useful for patients with Billroth II anatomy. (See "Endoscopic retrograde cholangiopancreatography (ERCP) after Billroth II reconstruction", section on 'Endoscopic sphincterotomy'.)
  - Needle-knife – A needle-knife sphincterotome has a cutting wire ranging in length from 3 to 5 mm that can be retracted into an outer Teflon sheath (figure 1). Needle-knife sphincterotomes are typically used if initial cannulation methods are unsuccessful. (See "Precut (access) papillotomy".)
- **Cutting wire** – A sphincterotome has an electrosurgical cutting wire at the distal tip of the catheter. The sphincterotome is connected to an electrosurgical generator by an electrode

connector located at the handle. The cutting wire functions as a knife when electrical current is applied. The length of the cutting wire ranges from 15 to 40 mm, while the most commonly used wires range in length from 20 to 30 mm. Devices with longer wires follow the natural curve of the side-viewing endoscope and its elevator and are more likely to enter the papilla in the correct orientation, leading to successful bile duct cannulation. However, the longer wire length may not always be an advantage since the transfer of energy is optimized when a shorter segment of cutting wire is applied to sphincter tissue. Longer cutting wires allow the sphincterotome to bend more deeply but need to be extended further out from the endoscope tip to function properly. Shorter cutting wires facilitate bending the sphincterotome when less of the device has been extended from the endoscope tip, which provides an advantage during bile duct cannulation.

To limit contact of the cutting wire with overlying tissue, some sphincterotomes have an insulating coating on the proximal one-half of the wire (ie, the portion that is closer to the duodenoscope). Most cutting wires are available in a monofilament configuration [3].

- **Number of lumens** – Multi-lumen sphincterotomes are widely available and are commonly used. With a double-lumen sphincterotome, one lumen contains the cutting wire, while the other is used for the guidewire or contrast injection (after removing the guidewire). With a triple-lumen sphincterotome, there is an additional lumen dedicated for contrast injection, and thus, guidewire removal is not necessary (picture 1).

- **Other features** – Sphincterotomes that can rotate are available, and these devices may facilitate optimal sphincterotome and cutting wire orientation.

  Pull-type sphincterotomes are available with short or long noses. We typically use short-nosed devices because based on clinical experience, they are more responsive to bending, provide more control during sphincterotomy, and often do not require deep cannulation before the cutting wire exits the endoscope. In contrast to long-nosed devices, short-nosed devices may be more likely to become inadvertently dislodged from the bile duct, but this risk is mitigated by using a multi-lumen sphincterotome for over-the-wire sphincterotomies. Thus, long-nosed devices are rarely used.

Guidewires — Guidewires used for sphincterotomy consist of a monofilament core (usually nitinol) and outer coating of polytetrafluoroethylene [PTFE, or Teflon] [4,5]. The distal tip of the guidewire is usually hydrophilic and can be straight or angled to facilitate cannulation of the left or right biliary system. Guidewires must be electrically nonconductive. Guidewires for endoscopic retrograde cholangiopancreatography (ERCP) are available in various diameters, typically ranging from 0.018 to 0.035 inches.

Electrosurgical devices

General principles — Electrical current is applied to the cutting wire via an electrosurgical generator. Sphincterotomes are usually monopolar devices, thereby requiring grounding pads to complete the electrical circuit. High frequency electrical current can be applied either as pure-cut, pure-coagulation, or a blend of the two currents, and current settings are based on endoscopist preference.

Most endoscopists use blended (or mixed) current consisting of both cut and coagulation for sphincterotomy because it has been associated with lower risk of bleeding. In a meta-analysis of four trials including over 800 patients who had endoscopic sphincterotomy, rates of post-sphincterotomy bleeding of any severity were lower with use of mixed current compared with pure-cut current (9 versus 29 percent), but there were no significant differences in the rates of pancreatitis between the groups [6].

Electrosurgical devices that use either constant wattage or constant voltage regulation are available. In the United States, most advanced endoscopists use generators with constant voltage regulation for sphincterotomy. (See 'Conventional electrosurgical generators' below and 'Microprocessor-controlled generators (ERBE generator)' below.)

Conventional electrosurgical generators — High frequency current is required for sphincterotomy. Conventional electrosurgical generators deliver thermal energy by using constant wattage. A potential problem with these devices may occur from variations in voltage, which cause changes in thermal effects. As the wire coagulates tissue, electrical resistance rises. It is important to appreciate that voltage is the primary determinant of thermal damage. From Ohm's law:

P = V x C (power = voltage x current)

C = V/r (current = voltage/resistance)

Thus P = V x V/r, or r x P = V(2) (resistance x power =voltage squared)

These equations illustrate that with conventional generators, as resistance rises, so does voltage. These generators deliver low voltage at low resistance (such as during the start of the cut or open-air activation), and high voltage at high resistance. This explains how a sudden, uncontrolled incision (also referred to as "zipper cut") may occur. Resistance continues to rise at a local point in contact with the wire. The conventional generator delivers higher amounts of voltage while tension is applied to the cutting wire by bending the sphincterotome. When the wire breaks through the tissue, there is a very short period when the wire is cutting through low resistance tissue at high voltage, potentially leading to an uncontrolled (zipper) cut.

These principles also illustrate how excessive thermal injury may occur. Current is equal to the voltage divided by the resistance, so resistance is inversely proportional to current, while voltage is directly proportional. If voltage is constant, then as resistance rises, current falls off. The current level must be high at the start of the cut to establish the electrical arcs needed to cut tissue. As the cut proceeds, the current should decrease. However, with conventional generators, the voltage variation that accompanies these factors can cause excessive coagulation leading to thermal injury. The risk of thermal injury increases at higher voltages with conventional generators.

Microprocessor-controlled generators (ERBE generator) — The ERBE generator (manufactured by ERBE USA Inc.) delivers electrical current by constant voltage regulation [7]. Unlike conventional electrosurgical generators, the ERBE generator does not permit voltage to wax and wane in response to changes in tissue impedance (ie, resistance). The wattage is automatically and frequently adjusted. Since voltage is the primary determinant of thermal injury during sphincterotomy, the ERBE generator delivers more predictable and reproducible cutting effects and less overall thermal injury. (See 'Conventional electrosurgical generators' above.)

The "Endocut" mode, which is widely utilized for sphincterotomy, delivers energy with fractionated, intermittent pulses of current, resulting in cutting with hemostasis. The generator automatically turns on and off so that the cut takes place in short stages. It has been hypothesized that the continuous, controlled interchange between precise cutting and coagulation may decrease the incidence of bleeding, since overly rapid cutting does not take place. Although a similar process can be achieved by intermittently pressing the foot pedal to deliver thermal energy, this method provides relatively little control over the length and effectiveness of cutting [8].

Data have suggested possible benefits of using ERBE generator [9,10]. In a study including 2711 sphincterotomies (biliary or pancreatic), use of the ERBE generator was associated with lower rates of endoscopically observed bleeding compared with conventional electrosurgical generators (5.5 versus 1.2 percent) [10]. However, there were no significant differences in rates of clinically significant bleeding or pancreatitis between the two groups.

TECHNIQUE

Standard sphincterotomy — The technique for standard biliary sphincterotomy involves cannulating the bile duct, performing cholangiogram, positioning the sphincterotome within the papillary orifice, and incising the papilla.

The steps are summarized as follows:

- Cannulate the bile duct – Before standard sphincterotomy, cannulation of the bile duct is performed with a sphincterotome (picture 1).

  For patients in whom selective cannulation of the bile duct is challenging or unsuccessful, precut sphincterotomy may be required to gain access to the biliary tree. Precut sphincterotomy can be performed by using one of several techniques (eg, needle-knife fistulotomy), and these are discussed separately. (See "Precut (access) papillotomy" and "Precut sphincterotomy: Another perspective on indications and techniques".)

- Perform a cholangiogram – A cholangiogram is performed to evaluate for biliary abnormalities (eg, stricture, stone).

- Withdraw the sphincterotome within the papillary orifice – The sphincterotome is withdrawn into the papillary orifice such that approximately one-half to three-quarters of the cutting wire is visible in the duodenum.

- Maintain the duodenoscope position – Sphincterotomy is commonly performed with the endoscope in the short-scope position where the duodenoscope is straight with no gastric loop and is typically inserted 50 to 70 cm from the incisor teeth. In the short position, the tip of the duodenoscope is positioned below the papilla [11]. However, some advanced endoscopists prefer the long-scope position where a gastric loop is left in the stomach so that the duodenoscope is inserted beyond 70 cm.

- Position the cutting wire – To position the cutting wire in contact with the roof of the papilla between 11 and 1 o'clock, tension is applied at the handle of the sphincterotome such that the tip becomes curved and separated from the wire. This maneuver directs the cutting wire upward and toward the roof of the papilla. If the wire is not oriented between 11 and 1 o'clock, the tip of the duodenoscope is adjusted to reposition the wire. As an example, if the wire is oriented at the two o'clock position, this can be corrected by adjusting the left/right duodenoscope knobs and twisting or torquing the scope to the left while advancing the duodenoscope to a long-scope position.

- Incise the papilla – Immediately prior to starting the sphincterotomy, the position of the cutting wire is confirmed to be oriented between 11 and one o'clock with direct visualization. The papilla is incised with the cutting wire while applying electrocautery. (See 'Electrosurgical devices' above.)

The length of sphincterotomy is determined by the indication for sphincterotomy, common bile duct size, and anatomic factors. The incision should be directed along the longitudinal axis of the intramural segment of the common bile duct and should, in general, not be continued beyond the junction of the intramural segment of the bile duct and the duodenal wall. This landmark is identified by locating where the superior margin of the bulging impression of the intramural bile duct meets the duodenal wall. Relying on the horizontal fold to denote this landmark may be inaccurate, and these folds can often be transected without consequence. If an adequate sphincterotomy has been performed, a fully-curved sphincterotome should be able to move easily in and out of the papillary orifice.

Modifications for anatomic variations

Periampullary diverticulum — Patients with periampullary diverticulum may have increased risk for developing bile duct stones [12]. However, biliary sphincterotomy may be challenging in such patients because the length and direction of the incision may be difficult to assess. Periampullary diverticula can be classified as follows (picture 2) [13]:

- Type I, papilla located inside the diverticulum
- Type II, papilla located at the margin of the diverticulum
- Type III, papilla located outside but close to the diverticulum

The approach to cannulating the bile duct and performing sphincterotomy in patients with periampullary diverticulum is guided by patient anatomy and endoscopist preference [14-16]. Several techniques for sphincterotomy in this setting have been described including needle-knife fistulotomy or pancreatic stent placement followed by precut sphincterotomy [17]. The sphincterotomy incision can usually be continued to the edge of the diverticulum, while the sphincterotomy length may be limited in patients in whom it is difficult to visualize the incision. (See "Precut (access) papillotomy" and "Precut sphincterotomy: Another perspective on indications and techniques", section on 'Needle knife techniques'.)

Periampullary diverticulum may be a risk factor for post-sphincterotomy bleeding, although data are mixed. In a study including nearly 3000 patients who had endoscopic retrograde cholangiopancreatography (ERCP), periampullary diverticulum was associated with higher rates of post-sphincterotomy bleeding compared with no diverticulum (9 versus 5 percent) [15]. In a subsequent study including 700 patients who had ERCP, rates of post-sphincterotomy bleeding were not significantly different for patients with periampullary diverticulum compared with no diverticulum [18].

Surgically altered anatomy (Billroth II) — For patients who have undergone a partial gastrectomy with Billroth II anastomosis, sphincterotomy poses a special challenge but can often be accomplished by experienced advanced endoscopists using technique modifications [19]. The main technical issue is that the papilla appears to be upside down because the endoscope approaches the papilla from a distal location (ie, afferent limb) rather than from the typical proximal direction. For patients with Billroth II anatomy, cannulation of the bile duct is performed in a reverse position with the bile duct oriented at the six o'clock position (rather than the 12 o'clock position).

Several techniques for performing biliary sphincterotomy in patients with Billroth II anatomy have been described [20-22]:

- Needle-knife papillotomy either with free-hand technique or after placing a stent in the bile duct. The incision is continued along the stent towards the junction of the intramural segment and the duodenal wall (in the six o'clock position). We typically use the freehand technique.
- A reverse or inverted sphincterotome may facilitate the procedure. These sigmoid loop sphincterotomes are designed so that the cutting wire is oriented towards the six o'clock rather than the 12 o'clock position (picture 3) [23]. However, in practice, reverse sphincterotomes often do not orient correctly.
- Use of a rotatable sphincterotome [24].

Issues related to performing ERCP in patients with Billroth II anastomosis including cannulating the bile duct and performing sphincterotomy are discussed in more detail separately. (See "Endoscopic retrograde cholangiopancreatography (ERCP) after Billroth II reconstruction".)

COMPLICATIONS

The reported overall incidence of complications associated with endoscopic retrograde cholangiopancreatography (ERCP) and biliary sphincterotomy has ranged from 3 to 12 percent [1]. However, other interventions that are performed during ERCP (eg, stone extraction, biliary stent placement) may have contributed to the overall complication rates.

The risk of mortality related to ERCP with sphincterotomy appears to be very low, with reported rates ranging from zero to 0.6 percent [25-27].

Complications related to ERCP with sphincterotomy may be classified by time of onset:

- Early complications – Early complications (ie, ≤30 days after the procedure) that have been associated with sphincterotomy include [25-33]:
  - Pancreatitis, 0.8 to 5 percent. (See "Post-endoscopic retrograde cholangiopancreatography (ERCP) pancreatitis".)
  - Bleeding, 0 to 3 percent. (See "Post-endoscopic retrograde cholangiopancreatography (ERCP) bleeding".)
  - Perforation, 0 to 2 percent. (See "Post-ERCP perforation".)
  - Cholangitis/sepsis, 0 to 8 percent. (See "Infectious adverse events related to endoscopic retrograde cholangiopancreatography (ERCP)".)
- Late complications – Late complications of sphincterotomy (ie, >30 days after the procedure) include papillary stenosis [34,35]. However, limited data suggest that papillary stenosis is uncommon. In a study including 156 patients who had endoscopic sphincterotomy for bile duct stones, papillary stenosis was reported in three patients (2 percent) after a mean follow up of nearly 10 years [35]. Papillary stenosis can be managed endoscopically with repeat sphincterotomy, stenting, and/or balloon dilation [34].

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Endoscopic retrograde cholangiopancreatography (ERCP)".)

SUMMARY AND RECOMMENDATIONS

- **General principles** – Endoscopic biliary sphincterotomy refers to the transection of the biliary sphincter within the ampulla of Vater. Cannulation of the bile duct is followed by high frequency current applied with a special knife (sphincterotome) to incise the circumferential muscle within sphincter of Oddi. Biliary sphincterotomy is performed during endoscopic retrograde cholangiopancreatography (ERCP). (See 'Introduction' above.)
- **Clinical applications** – Biliary sphincterotomy is performed to facilitate endoscopic interventions or as primary endotherapy for the following conditions:
  - Postsurgical biliary complications (eg, bile leak). (See "Endoscopic management of postcholecystectomy biliary complications" and "Liver transplantation in adults:

Endoscopic management of biliary adverse events".)

- Sphincter of Oddi dysfunction.
- Choledocholithiasis. (See "Choledocholithiasis: Clinical manifestations, diagnosis, and management".)
- Biliary strictures. (See "Primary sclerosing cholangitis in adults: Management" and "Endoscopic stenting for malignant biliary obstruction".)

- **Patient preparation** – The preprocedure preparation for patients undergoing biliary sphincterotomy is similar to that described for patients undergoing ERCP. (See "Overview of endoscopic retrograde cholangiopancreatography (ERCP) in adults", section on 'Patient preparation'.)

- **Equipment** – Equipment needed to perform sphincterotomy includes a sphincterotome, guidewire, and an electrosurgical device, in addition to the endoscope used to perform ERCP (usually a side-viewing duodenoscope). (See 'Equipment' above.)

  A sphincterotome (also referred to as papillotome) is a catheter with a cutting wire at its distal end, and sphincterotomes are available with varying configurations, cutting wire length, and outer diameter (picture 1).

- **Technique** – The technique for performing a standard biliary sphincterotomy generally involves cannulating the bile duct, performing cholangiogram, positioning the sphincterotome within the papillary orifice, and incising the papilla by applying electrical current to the sphincterotome wire. (See 'Standard sphincterotomy' above.)

- **Complications** – The reported overall incidence of complications related to ERCP with biliary sphincterotomy has ranged from 3 to 12 percent. However, other interventions that are performed during ERCP (eg, stone extraction) may have contributed to overall complication rates. The most commonly reported serious adverse events include bleeding, pancreatitis, and cholangitis. (See 'Complications' above.)

REFERENCES

1. Ryozawa S, Itoi T, Katanuma A, et al. Japan Gastroenterological Endoscopy Society guidelines for endoscopic sphincterotomy. Dig Endosc 2018; 30:149.

2. Köksal AŞ, Eminler AT, Parlak E. Biliary endoscopic sphincterotomy: Techniques and complications. World J Clin Cases 2018; 6:1073.
3. ASGE Technology Committee, Kethu SR, Adler DG, et al. ERCP cannulation and sphincterotomy devices. Gastrointest Endosc 2010; 71:435.
4. Singhvi G, Dea SK. Guidewires in ERCP. Gastrointest Endosc 2013; 77:938.
5. Kwon CI, Koh DH, Song TJ, et al. Technical Reports of Endoscopic Retrograde Cholangiopancreatography Guidewires on the Basis of Physical Properties. Clin Endosc 2020; 53:65.
6. Verma D, Kapadia A, Adler DG. Pure versus mixed electrosurgical current for endoscopic biliary sphincterotomy: a meta-analysis of adverse outcomes. Gastrointest Endosc 2007; 66:283.
7. https://us.erbe-med.com/fileadmin/user_upload/MKT5027_VIO_300_D_2019-07.pdf (Accessed on August 23, 2021).
8. Grund KE, Farin G. New principles and application of high frequency surgery, including argon plasma coagulation. In: Annual of Gastrointestinal Endoscopy, 10th ed, Rapid Science Publishers, 1997.
9. Kohler A, Maier M, Benz C, et al. A new HF current generator with automatically controlled system (Endocut mode) for endoscopic sphincterotomy--preliminary experience. Endoscopy 1998; 30:351.
10. Perini RF, Sadurski R, Cotton PB, et al. Post-sphincterotomy bleeding after the introduction of microprocessor-controlled electrosurgery: does the new technology make the difference? Gastrointest Endosc 2005; 61:53.
11. Byrne KR, Adler DG. Cannulation of the major and minor papilla via endoscopic retrograde cholangiopancreatography: Techniques and outcomes. Techniques in Gastroinestinal Endoscopy 2012; 14:135.
12. Wijarnpreecha K, Panjawatanan P, Manatsathit W, et al. Association Between Juxtapapillary Duodenal Diverticula and Risk of Choledocholithiasis: a Systematic Review and Meta-analysis. J Gastrointest Surg 2018; 22:2167.
13. Boix J, Lorenzo-Zúñiga V, Añaños F, et al. Impact of periampullary duodenal diverticula at endoscopic retrograde cholangiopancreatography: a proposed classification of periampullary duodenal diverticula. Surg Laparosc Endosc Percutan Tech 2006; 16:208.
14. Panteris V, Vezakis A, Filippou G, et al. Influence of juxtapapillary diverticula on the success or difficulty of cannulation and complication rate. Gastrointest Endosc 2008; 68:903.

15. Zoepf T, Zoepf DS, Arnold JC, et al. The relationship between juxtapapillary duodenal diverticula and disorders of the biliopancreatic system: analysis of 350 patients. Gastrointest Endosc 2001; 54:56.
16. Egawa N, Anjiki H, Takuma K, Kamisawa T. Juxtapapillary duodenal diverticula and pancreatobiliary disease. Dig Surg 2010; 27:105.
17. Park CS, Park CH, Koh HR, et al. Needle-knife fistulotomy in patients with periampullary diverticula and difficult bile duct cannulation. J Gastroenterol Hepatol 2012; 27:1480.
18. Tyagi P, Sharma P, Sharma BC, Puri AS. Periampullary diverticula and technical success of endoscopic retrograde cholangiopancreatography. Surg Endosc 2009; 23:1342.
19. Okabe Y, Ishida Y, Kuraoka K, et al. Endoscopic bile duct and/or pancreatic duct cannulation technique for patients with surgically altered gastrointestinal anatomy. Dig Endosc 2014; 26 Suppl 2:122.
20. Ciçek B, Parlak E, Dişibeyaz S, et al. Endoscopic retrograde cholangiopancreatography in patients with Billroth II gastroenterostomy. J Gastroenterol Hepatol 2007; 22:1210.
21. Lin LF, Siauw CP, Ho KS, Tung JC. ERCP in post-Billroth II gastrectomy patients: emphasis on technique. Am J Gastroenterol 1999; 94:144.
22. Dolay K, Soylu A. Easy sphincterotomy in patients with Billroth II gastrectomy: a new technique. Turk J Gastroenterol 2008; 19:109.
23. Hintze RE, Veltzke W, Adler A, Abou-Rebyeh H. Endoscopic sphincterotomy using an S-shaped sphincterotome in patients with a Billroth II or Roux-en-Y gastrojejunostomy. Endoscopy 1997; 29:74.
24. Kim GH, Kang DH, Song GA, et al. Endoscopic removal of bile-duct stones by using a rotatable papillotome and a large-balloon dilator in patients with a Billroth II gastrectomy (with video). Gastrointest Endosc 2008; 67:1134.
25. Suissa A, Yassin K, Lavy A, et al. Outcome and early complications of ERCP: a prospective single center study. Hepatogastroenterology 2005; 52:352.
26. Disario JA, Freeman ML, Bjorkman DJ, et al. Endoscopic balloon dilation compared with sphincterotomy for extraction of bile duct stones. Gastroenterology 2004; 127:1291.
27. Fujita N, Maguchi H, Komatsu Y, et al. Endoscopic sphincterotomy and endoscopic papillary balloon dilatation for bile duct stones: A prospective randomized controlled multicenter trial. Gastrointest Endosc 2003; 57:151.
28. Jin PP, Cheng JF, Liu D, et al. Endoscopic papillary large balloon dilation vs endoscopic sphincterotomy for retrieval of common bile duct stones: a meta-analysis. World J Gastroenterol 2014; 20:5548.

29. Watanabe H, Yoneda M, Tominaga K, et al. Comparison between endoscopic papillary balloon dilatation and endoscopic sphincterotomy for the treatment of common bile duct stones. J Gastroenterol 2007; 42:56.
30. Vlavianos P, Chopra K, Mandalia S, et al. Endoscopic balloon dilatation versus endoscopic sphincterotomy for the removal of bile duct stones: a prospective randomised trial. Gut 2003; 52:1165.
31. Barthet M, Lesavre N, Desjeux A, et al. Complications of endoscopic sphincterotomy: results from a single tertiary referral center. Endoscopy 2002; 34:991.
32. Ikarashi S, Katanuma A, Kin T, et al. Factors associated with delayed hemorrhage after endoscopic sphincterotomy: Japanese large single-center experience. J Gastroenterol 2017; 52:1258.
33. Nakaji S, Hirata N, Matsui H, et al. Hemodialysis is a strong risk factor for post-endoscopic sphincterotomy bleeding in patients with choledocholithiasis. Endosc Int Open 2018; 6:E568.
34. Veldkamp MC, Rauws EA, Dijkgraaf MG, et al. Iatrogenic ampullary stenosis: history, endoscopic management, and outcome in a series of 49 patients. Gastrointest Endosc 2007; 66:708.
35. Prat F, Malak NA, Pelletier G, et al. Biliary symptoms and complications more than 8 years after endoscopic sphincterotomy for choledocholithiasis. Gastroenterology 1996; 110:894.

Topic 640 Version 17.0

GRAPHICS

Procedure-related bleeding risk from gastrointestinal procedures

Higher-risk procedures
Polypectomy*
Biliary or pancreatic sphincterotomy
Treatment of varices
PEG placement¶
Therapeutic balloon-assisted enteroscopy
EUS with FNA$^{\Delta}$
Endoscopic hemostasis

Tumor ablation
Cystgastrostomy
Ampullary resection
EMR
Endoscopic submucosal dissection
Pneumatic or bougie dilation
PEJ
Low-risk procedures
Diagnostic (EGD, colonoscopy, flexible sigmoidoscopy) including mucosal biopsy
ERCP with stent (biliary or pancreatic) placement or papillary balloon dilation without sphincterotomy
Push enteroscopy and diagnostic balloon-assisted enteroscopy
Capsule endoscopy
Enteral stent deployment (controversial)
EUS without FNA
Argon plasma coagulation
Barrett's ablation

EGD: esophagogastroduodenoscopy; ERCP: endoscopic retrograde cholangiopancreatography; PEG: percutaneous endoscopic gastrostomy; EUS: endoscopic ultrasound; FNA: fine-needle aspiration; EMR: endoscopic mucosal resection; PEJ: percutaneous endoscopic jejunostomy.

* Among patients undergoing colonic polypectomy, the size of the polyp influences the risk of bleeding, and it may be more appropriate to categorize polyps less than 1 cm in size as low risk for bleeding.

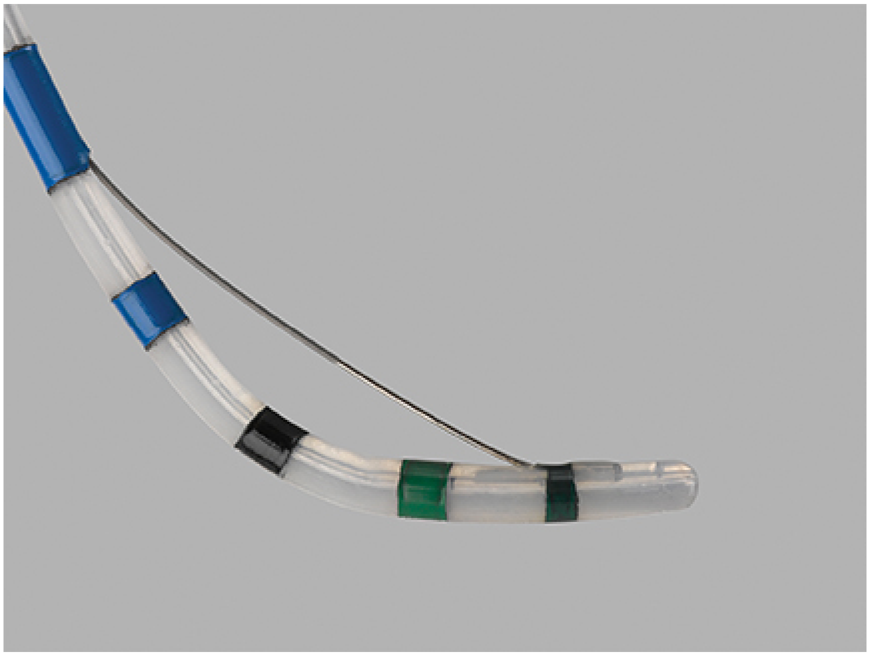
¶ PEG on aspirin or clopidogrel therapy is low risk. Does not apply to dual antiplatelet therapy.

Δ EUS-FNA of solid masses on aspirin/nonsteroidal anti-inflammatory drugs is low risk.

Reproduced from: ASGE Standards of Practice Committee, Acosta RD, Abraham NS, et al. The management of antithrombotic agents for patients undergoing GI endoscopy. Gastrointest Endosc 2016; 83:3. Table used with the permission of Elsevier Inc.

Graphic 50700 Version 8.0

Triple lumen sphincterotome

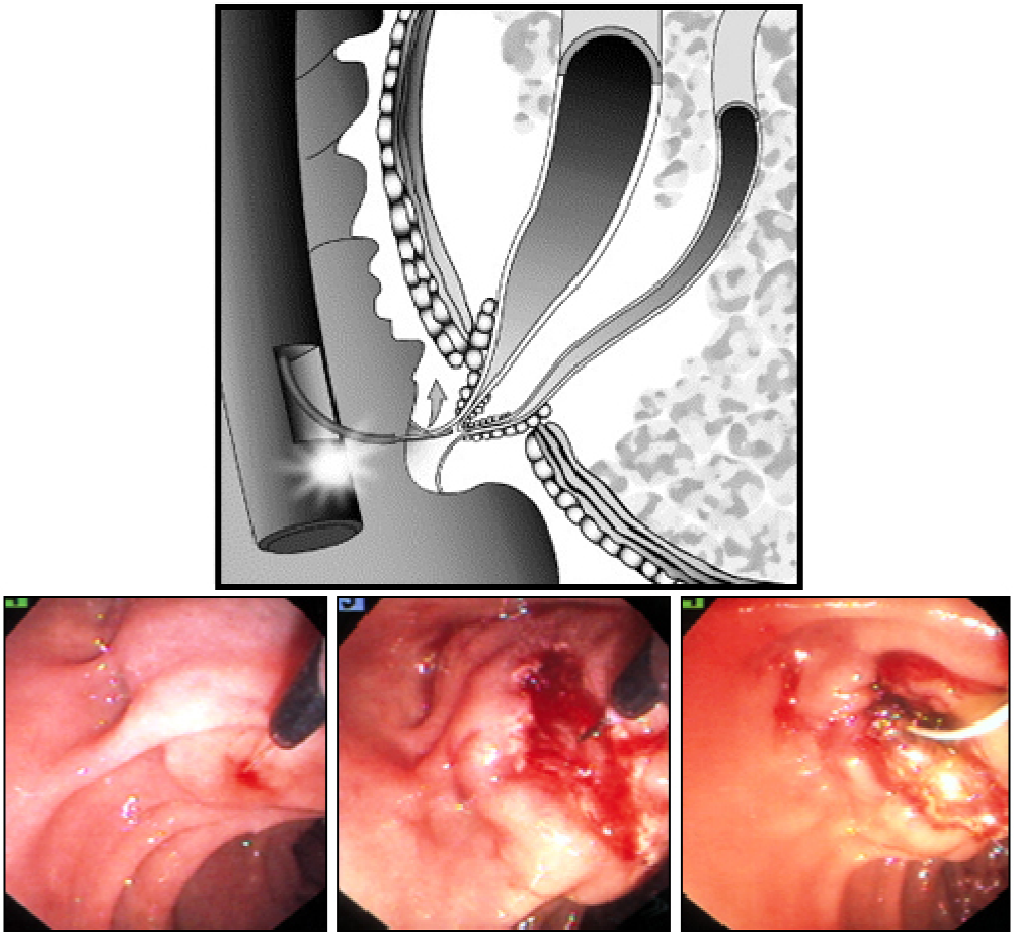


Triple lumen sphincterotome.

Courtesy of Cook Medical.

Graphic 134070 Version 1.0

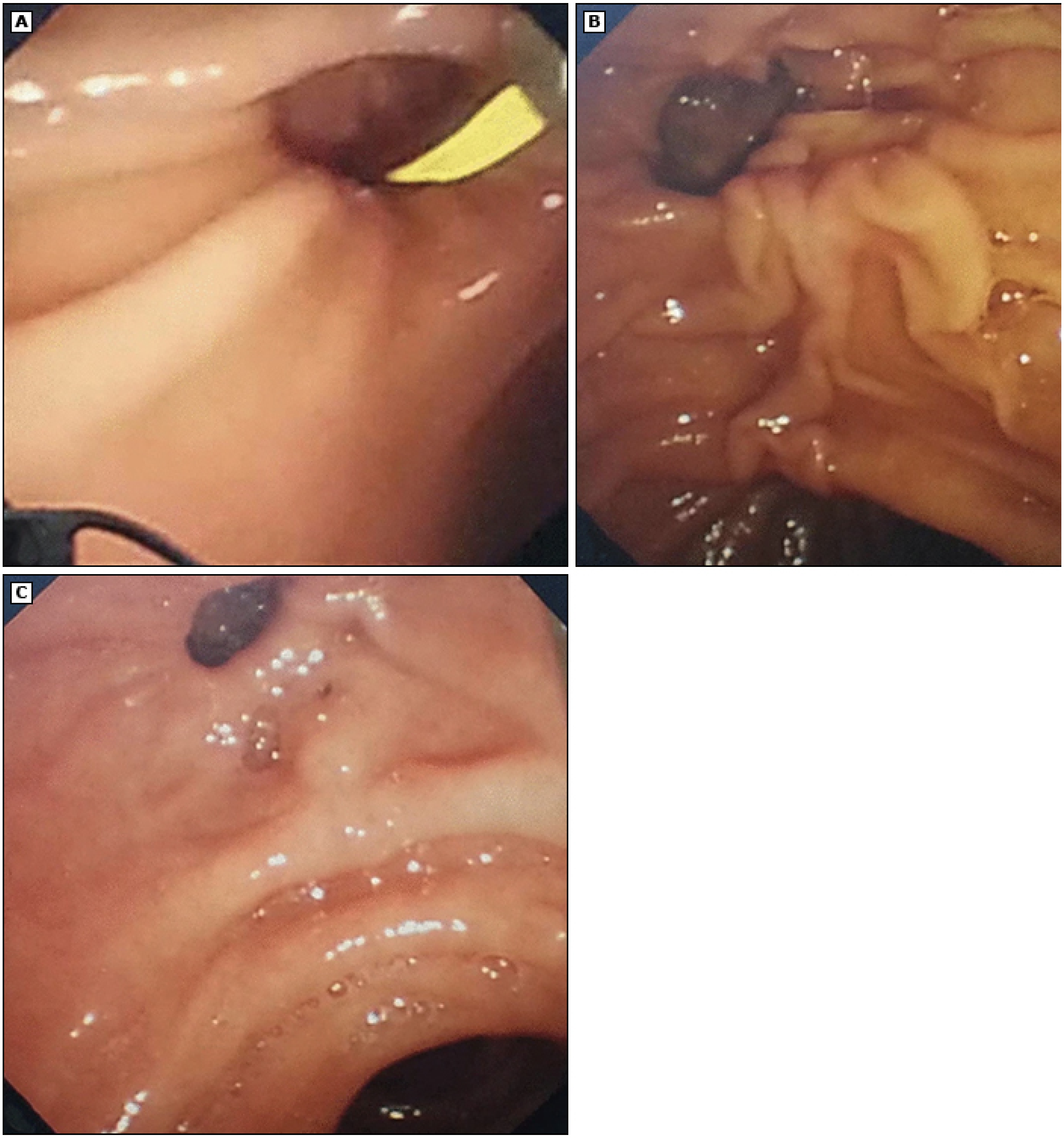
Free-hand needle-knife papillotomy



Courtesy of Martin L Freeman, MD.

Graphic 76180 Version 4.0

Major papilla with diverticulum

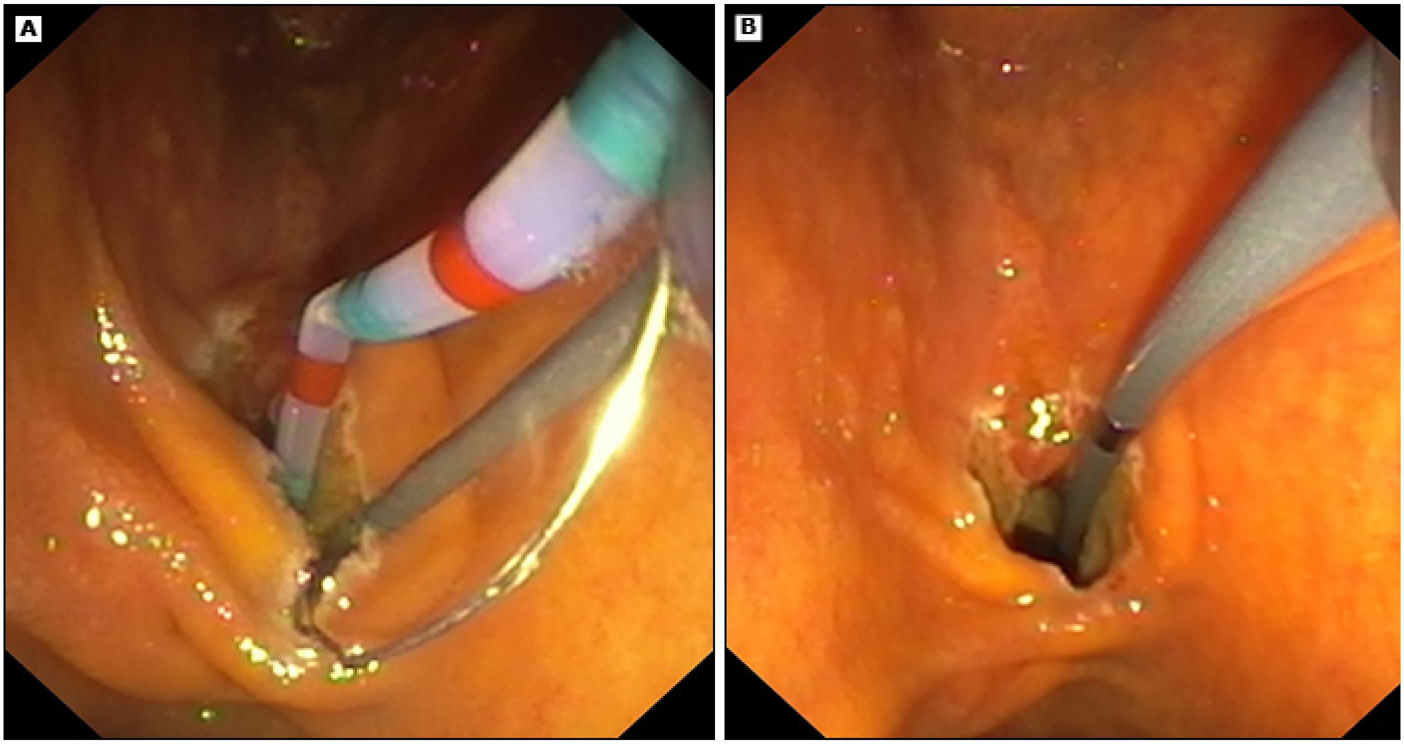


The endoscopic pictures demonstrate the position of the major papilla in relationship to a diverticulum in th second portion of the duodenum. The papilla may be located inside the diverticulum (panel A, pictured duri guidewire insertion), at the margin of the diverticulum (panel B), or outside the diverticulum (panel C).

From: Hu Y, Kou DQ, Guo SB. The influence of periampullary diverticula on ERCP for treatment of common bile duct stones. Sci Rep 20 10:11477. Copyright © 2020 The Authors. Available at: https://www.nature.com/articles/s41598-020-68471-8 (Accessed on October 1ξ

Graphic 134071 Version 3.0

Use of inverted sphincterotome for a patient with Billroth II gastrectomy



Panel A demonstrates the use of an inverted sphincterotome with a side-viewing duodenoscope for performing biliary sphincterotomy in a patient with Billroth II gastrectomy. Endoscopic view following biliary sphincterotomy is shown in panel B.

Courtesy of Digestive Endoscopy Unit, Policlinico Gemelli Foundation IRCCS Catholic University – Rome, Italy.

Graphic 130460 Version 2.0

Contributor Disclosures

Priya Jamidar, MD, FACG, FASGE Speaker's Bureau: Boston Scientific Corporation [Endoscopic retrograde cholangiopancreatography]. All of the relevant financial relationships listed have been mitigated. **Douglas G Adler, MD, FACG, AGAF, FASGE** Consultant/Advisory Boards: Abbvie [Endoscopy]; Boston Scientific [Endoscopy]; Endorotor [Endoscopy]; Merit [Endoscopy]; Olympus [Endoscopy]. Speaker's Bureau: Abbvie [Pancreatology, general GI]. All of the relevant financial relationships listed have been mitigated. **Kristen M Robson, MD, MBA, FACG** No relevant financial relationship(s) with ineligible companies to disclose.

Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

Conflict of interest policy

→