REVIEW ARTICLE

Endoscopic Resection Techniques for Duodenal and Ampullary Adenomas

Grace E. Kim, MD,[1] Uzma D. Siddiqui, MD[2]

Background and Aims: Duodenal polyps have a reported incidence of 0.3% to 4.6%. Sporadic, nonampullary duodenal adenomas (SNDAs) comprise less than 10% of all duodenal polyps, and ampullary adenomas are even less common. Nonetheless, the incidence continues to rise because of widespread endoscopy use. Duodenal polyps with villous features or those that are larger than 10 mm may raise concern for malignancy and require removal. We demonstrate endoscopic resection of SNDAs and ampullary adenomas using some of our preferred techniques.

Methods: The duodenum has several components that can make EMR of duodenal polyps technically challenging. Not only does the duodenum have a thin muscle layer, but it is also highly mobile and vascular, which may explain higher rates of perforation and bleeding of duodenal EMR reported in the literature compared with colon EMR. A standard adult gastroscope with a distal cap is commonly used for duodenal EMRs. Based on the location, however, side-viewing duodenoscopes or pediatric colonoscopes may be used. To prepare for EMR, a submucosal injection is performed for an adequate lift. The polyp is then resected via stiff monofilament snares and subsequently closed with hemostatic clips if feasible. The ampullectomy technique differs slightly from duodenal EMRs and carries the additional risk of pancreatitis. Submucosal injection in the ampulla may not lift well; thus, its utility is debatable. Biliary sphincterotomy should be performed, and based on endoscopist preference, the pancreatic duct (PD) guidewire can be left during resection to maintain access. After resection, a PD stent is placed to minimize pancreatitis risk.

Results: The video shows the aforementioned duodenal EMR techniques. Two clips of ampullectomy are also shown in the video.

Conclusions: A few common techniques used to perform duodenal EMR and ampullectomy are highlighted in the video. It is important to understand and manage adverse events associated with these procedures and to have established surveillance plans. (VideoGIE 2023;8:330-5.)

Duodenal polyps are rare, with incidence rates of 0.3% to 4.6%.[1] The 3 major types of duodenal adenomas are sporadic, nonampullary duodenal adenomas (SNDAs), ampullary adenomas, and adenomas in familial adenomatous polyposis (FAP) syndrome.

The prevalence of SNDAs ranges from 0.03%[2] to 6.9%[3] of all duodenal polyps, with increased incidence given more frequent use of endoscopy. Located most commonly in the second portion of the duodenum, it carries as much as 85% of malignant potential and requires active surveillance.[4] Unfortunately, most of the studies on SNDAs are small series, and there are no consensus guidelines. Villous features, high-grade dysplasia, and those more than 20 mm significantly increase malignancy risk; thus, resection of SNDAs is advised.[5-10] In one multicenter study in Japan evaluating almost 400 duodenal SNDAs, tumor diameter greater than just 5 mm was significantly associated with high-grade dysplasia or superficial adenocarcinomas.[11] Up to 72% of patients with SNDAs also have been shown to have colon polyps[12] with significantly increased odds ratio of 7.8 for advanced colorectal adenoma and 3.6 for colorectal neoplasia,[13] prompting up-to-date colonoscopy for colon cancer screening in these patients.

Ampullary adenomas are far less common with autopsy studies showing rates of 0.04% to 0.12% for villous ampullary adenoma.[14] While most of ampullary adenomas (80%) tend to be benign, up to half may be associated with FAP and carry higher malignant potential.[15,16] Those greater than 10 mm or with villous features raise concerns for

Abbreviations: ESD, endoscopic submucosal dissection; FAP, familial adenomatous polyposis; PD, pancreatic duct; SNDA, sporadic nonampullary duodenal adenoma.

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Section of Gastroenterology, Hepatology, and Nutrition, Department of Internal Medicine, University of Chicago, Chicago, Illinois (1), Center for Endoscopic Research and Therapeutics, University of Chicago, Chicago, Illinois (2).

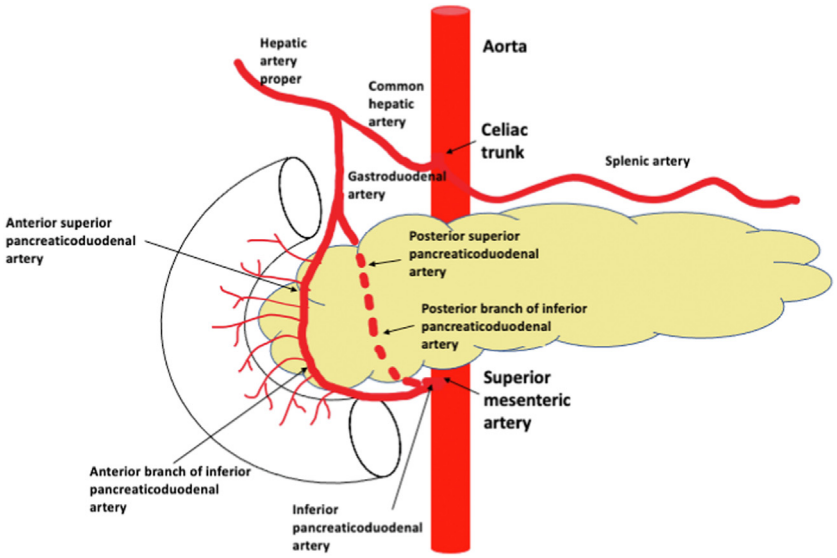

Figure 1. Vascular supply of the duodenum.

malignancy, and up to half have been shown to harbor a small focus of adenocarcinoma.[17,18] While the management of ampullary adenomas had traditionally been surgical (ie, pancreaticoduodenectomy), endoluminal surgeries carry high morbidity and mortality; thus, endoscopic management is increasingly preferred.[16,19] Ampullary adenomas require ERCP to better visualize the ampulla using a side-viewing duodenoscope and for pancreatic duct access during ampullectomy. For the purposes of this video, we will focus on commonly used and our center's preferred techniques for endoscopic resection of SNDAs and ampullary adenomas (Video 1, available online at www.videogie.org).

The duodenum is dually supplied by the gastroduodenal artery from the celiac branch and the inferior pancreaticoduodenal artery from the superior mesenteric artery, as shown in Figure 1. The duodenum has several components that can make EMR of duodenal polyps technically challenging. Not only does the duodenum have a thin muscle layer, but it is also highly mobile and vascular, which may explain higher rates of perforation and bleeding of duodenal EMR reported in the literature compared with colon EMR.

A standard adult gastroscope with a distal cap is commonly used for duodenal EMRs. Based on the location, however, side-viewing duodenoscopes or pediatric colonoscopes may be used. For example, ampullary adenomas require a side-viewing duodenoscope for a better field of vision. A side-viewing duodenoscope may also be used for better identification of the ampulla for SNDAs, as it is extremely important to identify the relationship of the polyp to the ampulla prior to EMR.

Once a detailed examination of the duodenal polyp has been completed, showing its size, location, and position relative to the ampulla, a dye solution is injected submucosally to achieve adequate lift. Then a stiff monofilament snare is used to resect the lesion; we advise using snares less than 2 cm in diameter to minimize perforation risk. The cold-snare technique for EMRs in the colorectum has been shown to have the fewest adverse events and highest en bloc resection rates with less procedure time when compared to hot snares.[20,21] It has been suggested that cold-snare EMR reduces risk of bleeding and perforation, and although a recent article showed reduced intraprocedural and postprocedural bleeding, it did report 2 perforations in the cold-snare group that were treated with clips for duodenal adenomas greater than 15 mm.[22] For smaller lesions, cold snares are shown to be safe and effective with near zero perforation rates and are recommended by the European Society of Gastrointestinal Endoscopy.[23] For diathermy (eg, coagulation versus cutting), there currently are no data to favor one over the other based on the outcomes and adverse event rates; nonetheless, our center prefers the current cutting technique to minimize thermal energy delivery to the muscle layer to minimize perforation risks in the thin duodenal wall.

If the resection base is narrow enough, hemostatic clips are used to close the resection site. Nonetheless, the increased motility of the duodenum often dislodges clips, and its use in preventing delayed adverse events may not be as effective as it is in the colon. There are newly Food and Drug Administration–approved hemostatic agents in powder and gel forms that are being used to prevent delayed bleeding. However, no comparative data to clips or between hemostatic agents currently exist. As opposed to the older-generation powders that are opaque and have a tendency to prematurely form into a thin gel, the newer transparent self-assembling matrix-forming hemostatic gel

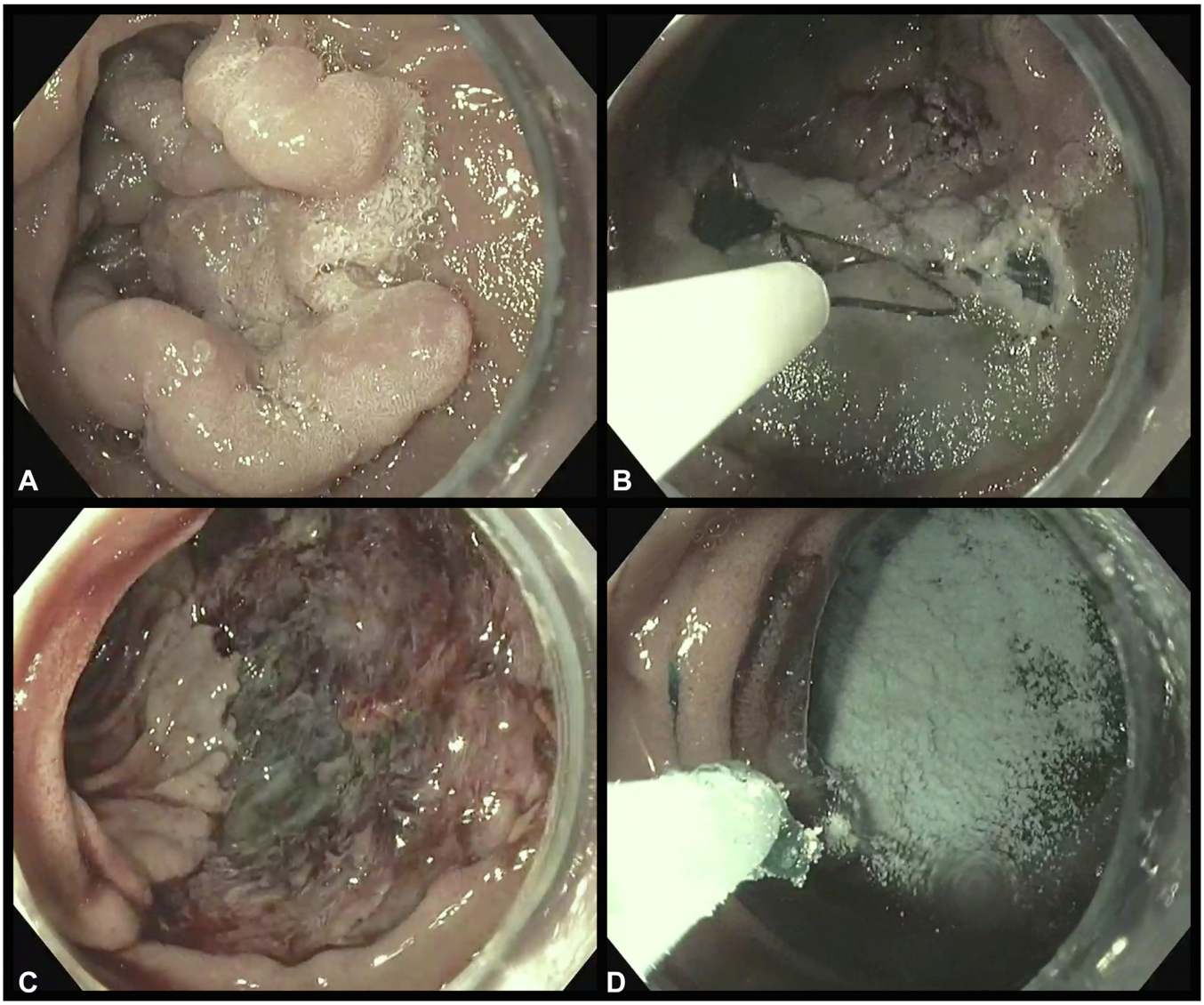

Figure 2. Duodenal adenomas before (**A** and **B**) and after (**C** and **D**) EMR in piecemeal fashion with hemostatic powder applied at the end.

forms a clear viscous coating once applied to the lesion resulting in rapid hemostasis.[24,25] An increasing number of studies have reported success with treatment of GI bleeding, including EMR and endoscopic submucosal dissection (ESD) bleeds to prevent post-procedural bleeding.[26-28] In one recent randomized controlled trial evaluating 101 patients undergoing ESDs, the use of self-assembling peptide gel to control bleeding during ESD reduced the need for diathermy and had higher rates of complete wound healing compared to those who used heat therapy to control bleeding.[29] Another new hemostatic adhesive hydrogel powder has also shown promising rates of hemostasis for upper GI bleeding and is used as a monotherapy with a 96% immediate hemostasis rate and a 3.7% re-bleeding rate at 30 days.[30] Thus, these agents could be considered prophylactic to decrease post-procedural bleeding instead of or in conjunction with clipping. In our center, suturing is not typically done for closure of large duodenal resection sites because of reduced lumen circumference.

If there is an immediate adverse event such as intraprocedural bleeding, using coagulation graspers on a soft-coagulation setting is the preferred method of treatment. Typically, the soft coagulation setting used is 70 W at hemostatic effect 4, as was used in this video. Bipolar electrocoagulation or argon plasma coagulation are generally avoided as they are associated with higher rates of adverse events. Some examples of duodenal adenomas resected via EMR are shown in Figure 2 as well as in the video.

Underwater EMR without using a submucosal injection is an increasingly used technique first described by Binmoeller et al[31] in 2013 for duodenal adenomas. In this

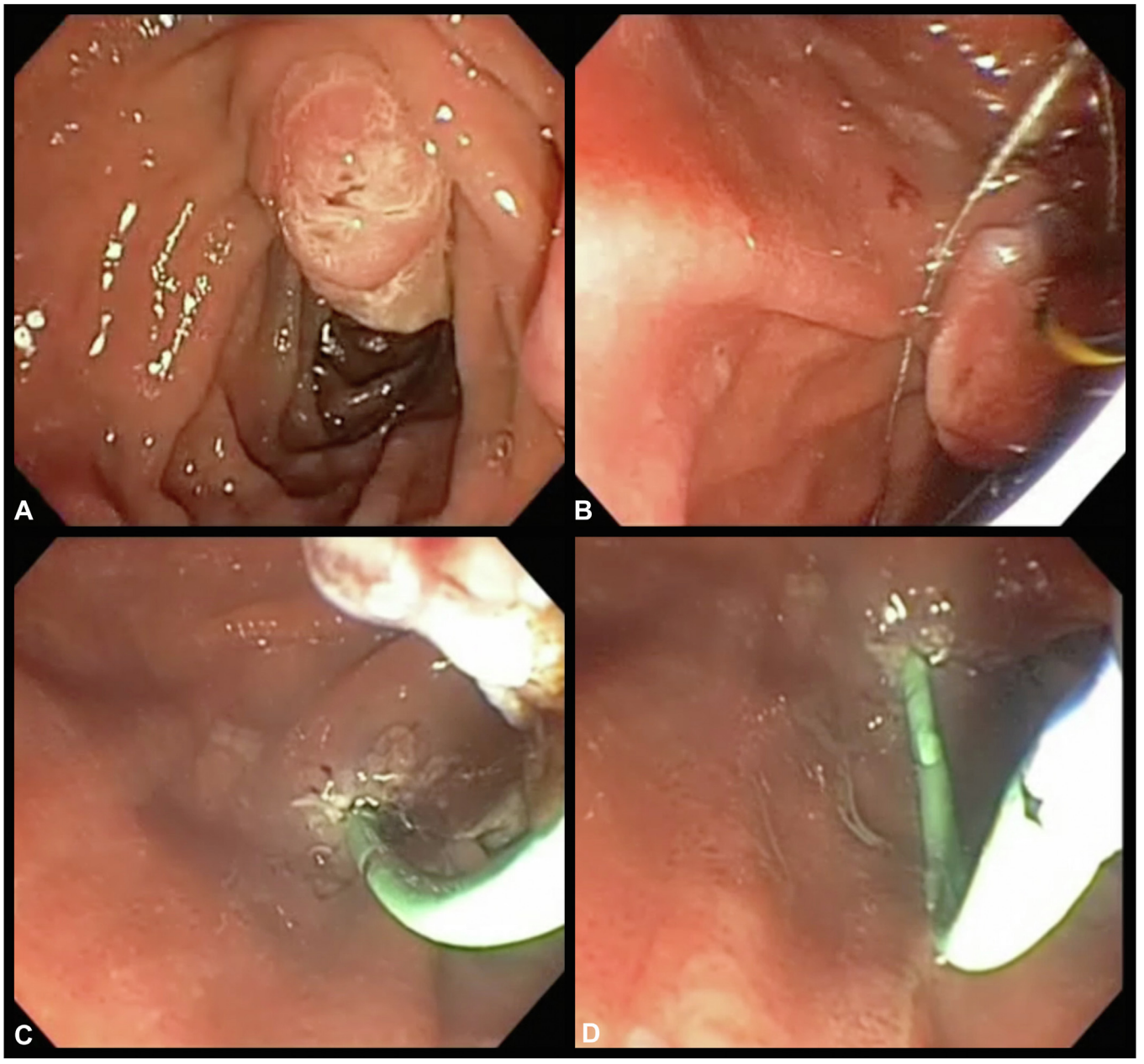

Figure 3. Ampullary adenoma before (**A** and **B**) and after (**C** and **D**) ERCP with ampullectomy and pancreatic duct stent placement. Note the pancreatic duct wire in place as the snare wraps around the adenoma.

method, the lumen is completely deflated and filled with water using a water jet, which enables the lesion to float upward; this then is snared and removed.[32] This technique is advantageous in that only the superficial layers float, limiting deeper mucosal damage and thus perforation; especially for smaller duodenal lesions less than 20 mm, underwater EMR carries a high safety profile.[33] When compared to conventional EMR, underwater EMR was reported to have higher en bloc resection rates and lower bleeding rates.[34] A recent meta-analysis evaluating 258 duodenal lesions undergoing underwater EMR reported a pooled rate of adverse events at 6.9% with the majority being bleeding with no perforation.[35] Nonetheless, another meta-analysis evaluating 635 duodenal lesions less than 20 mm reported that, while underwater EMRs had a pooled rate of higher en bloc resection rate compared to that of conventional EMR with an odds ratio of 1.78 (1.17-2.71, $P = .0007$), there was no difference in R0 resection rate or recurrence rate between the 2 methods.[36] Other endoscopic techniques include a combination of partial submucosal injection with underwater EMR[37] and a gel immersion EMR,[38] both of which were described in Japan and remain

to be studied further. ESD is another option for SNDAs as they have high en bloc resection rates; however, they are less favored because of significant adverse events with perforation up to 39%.[39-41] For the purposes of this video, the traditional EMR techniques are shown.

The ampullectomy technique differs slightly from duodenal EMRs and carries the additional risk of pancreatitis.[42,43] The ampulla does not lift well with submucosal injection; thus, its use is debatable. In our opinion, there is low yield for injection, which would just distort views. If there is a laterally spreading component extending onto the duodenal wall, however, submucosal injection would be useful as seen in the video. There are many ways to perform ampullectomy; the video provides suggested techniques as there are no reported differences in outcomes for different techniques. Generally, ERCP is performed to inject contrast in both the common bile duct and the pancreatic duct (PD). We opacify the PD to ensure that the wire is in the main PD and not perforated through the side branch prior to placing the stent (which has been reported when PD was not opacified). However, some centers do not inject any contrast and there are no data to suggest one technique is better than the other.

Biliary sphincterotomy is typically performed prior to ampullectomy; since our preference is to leave a pancreatic duct wire in place and then pass the snare over the wire to do the ampullectomy polyp resection, the biliary sphincterotomy allows the specimen to fall off the wire before placing the PD stent and then retrieve the specimen right away afterward. Furthermore, biliary sphincterotomy may minimize any subsequent obstruction from edema or clot, but this is not performed by every endoscopist. Based on our preference, a PD guidewire can also be left in the duct to maintain access after resection. The guidewire technique has the advantage of continual PD access for an easier subsequent PD stent placement. When opening the snare, it should correspond to the long axis of the mound. The snare tip should initially be anchored above the apex of the papilla and slowly opened and drawn down over the papilla. Whether or not the guidewire technique is used, a PD stent must be placed after the ampullectomy to minimize pancreatitis risk.[44] An example of an ampullary adenoma undergoing EMR and a PD stent placement is shown in Figure 3 and in Video 1.

For both SNDAs and ampullary adenomas, recurrence can be quite high with reports up to 39%.[45-48] While histology and size have been associated with recurrence, en bloc resection was not.[45,49] En bloc resection, however, has been shown to decrease risks of intraprocedural bleeding, which has been reported in as high as 43% of duodenal resections.[50] Other risk factors for bleeding include size and procedure time.[50] Additionally, the duodenum is unique in that it is constantly exposed to the caustic agents of the pancreaticobiliary juice with bile and proteolytic enzymes that can cause mucosal injury when there is a pre-existing mucosal disruption (ie, after EMR).[51] This can subsequently lead to increased bleeding and delayed perforations; hence, SNDAs located distal to the ampulla on its ipsilateral side are especially prone to such adverse events. Because of high recurrence rates, the American Society for Gastrointestinal Endoscopy guidelines recommend frequent follow-ups for duodenal lesions, initially starting at 3- to 6-month intervals then 6- to 12-month intervals for 2 to 5 years thereafter.[19]

Ascertaining the specific type of duodenal adenoma when a duodenal polyp is detected facilitates further management. This video highlights some of commonly used techniques for duodenal EMR and ampullectomy. The risks of perforation should be carefully weighed against the benefits of en bloc resection given that most of the duodenal lesions are benign. Hence piecemeal EMR is the preferred technique for duodenal EMRs, but it is also essential to have an established surveillance plan for SNDAs and ampullary adenomas given the risk of recurrence. Understanding the risks of adverse events and having prompt recognition and management of such events is highly important in duodenal polyp management.

DISCLOSURE

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