Combination of a dynamic rigidizing overtube and a novel injectable needle-type knife to facilitate colorectal endoscopic submucosal dissection

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INTRODUCTION

Endoscopic submucosal dissection (ESD) allows for the en bloc and complete endoscopic resection of superficial lesions throughout the GI tract. Although technically challenging, colorectal ESD is increasingly performed for endoscopic resection of large and difficult polyps, especially those that may harbor early malignancy or cannot be successfully removed with standard endoscopic mucosal resection.[1]

Here, we present a challenging case of a laterally spreading tumor at the hepatic flexure in a difficult and unstable colon, which was removed by ESD using a novel injectable needle-type knife and with the assistance of a novel dynamic rigidizing overtube (Video 1, available online at www.giejournal.org).

DYNAMIC RIGIDIZING OVERTUBE

A stable endoscopic position is a nonnegotiable prerequisite for safe and effective colorectal ESD. When the endoscope is in a long, looped position, paradoxical motion and unstable endoscope mechanics render ESD both unsafe and often technically impossible to complete. Furthermore, if a perforation were to occur while the endoscope is unstable, endoscopic closure may likewise be challenging or impossible. On the other hand, when the endoscope is in a short, reduced position, 1-to-1 motion is established between the operator and the endoscope, and the stable endoscope position allows ESD to be completed both safely and effectively. If a perforation were to occur while the endoscope is stable, endoscopic closure is more likely to be successful.

During colorectal ESD, the colonoscope is typically inserted in the shortest possible position, avoiding excessive air insufflation and loop formation.[2] When the lesion is reached, if there is a loop in the colonoscope, attempts are made to reduce the loop by applying manual abdominal counterpressure and performing torque-based reduction maneuvers. One-to-one colonoscope motion is confirmed before ESD is started.

Recently, a novel dynamic rigidizing overtube (Pathfinder; Neptune Medical, Burlingame, Calif, USA) was approved by the U.S. Food and Drug Administration.[3-5] The device consists of a flexible overtube that is connected to a vacuum for rigidization via an attached stopcock (Fig. 1). The overtube is soft and pliable in its flexible state. When a vacuum is applied, the overtube becomes 15 times stiffer in its rigid state. Overtube-assisted colonoscopy using this device allows straightening of the colon to decrease angulation and loop formation. The overtube is currently designed to accommodate only a pediatric colonoscope. During colonoscopy, the overtube is advanced in a fashion similar to other overtube-based procedures such as single-balloon and double-balloon enteroscopy.

INJECTABLE NEEDLE-TYPE ESD KNIFE

The fundamental technique of ESD has been serially refined over the several decades since its original development. During this time, specialized endoscopic knives have also been developed, each with advantages for various situations. The needle-type ESD knife is a fundamental tool used for both mucosal incision and submucosal dissection in ESD. Recent generations of existing knives have added an injection capability to eliminate the need for instrument exchange during submucosal dissection.

Recently, a new injectable needle-type ESD Knife (ORISE ProKnife; Boston Scientific, Marlborough, Mass, USA) was introduced (Fig. 2). The knife comes in 3 versions according to the length of the electrode shaft: a 3-mm version for peroral endoscopic myotomy, a 2-mm version for gastric ESD, and a 1.5-mm version for colorectal ESD. The electrode shaft itself is T-shaped and measures 0.5 mm in diameter, allowing high current density for precise cutting. The knife has several unique characteristics that separate it from existing injectable needle-type ESD knives. First, the injection is delivered directly through the tip of the electrode to create a sustained lift without device exchange. Second, the device contains a locking feature that secures the fixed length of the electrode in place, without requiring an assistant to hold the device in its open position. Finally, the device handle includes a

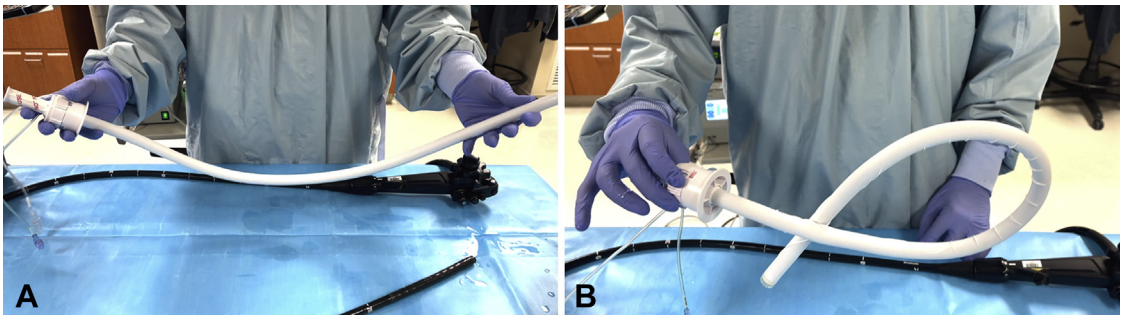

Figure 1. The rigidizing overtube, in **(A)** flexible and **(B)** rigid position.

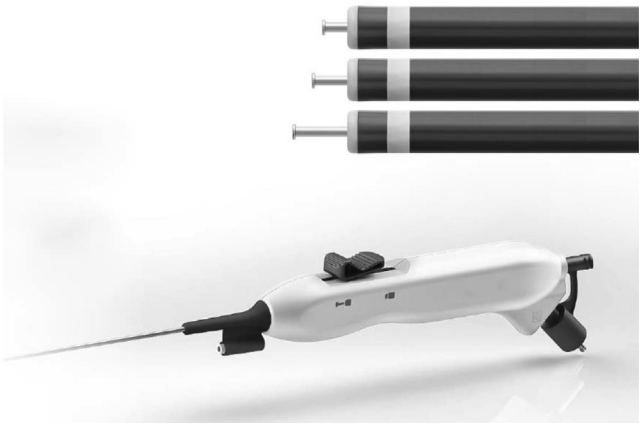

Figure 2. Novel injectable needle-type ESD knife.

cleaning tool to clear the catheter and restore injection in the event of a clog during prolonged procedures.

CASE DESCRIPTION

A 66-year-old man with coronary artery disease, hypertension, hyperlipidemia, and diabetes mellitus was found on screening colonoscopy to have a 35-mm laterally spreading tumor at the hepatic flexure (Paris IIa+Is). An attempted endoscopic mucosal resection was unsuccessful because of nonlifting of the lesion during submucosal injection; therefore, he was referred for ESD.

Given the length of the procedure and the patient's medical comorbidities, the procedure was performed under general endotracheal anesthesia. A pediatric colonoscope (PCF-H190DL, Olympus America, Center Valley, Pa, USA) with a tapered-tip distal attachment cap (ST hood, Fujifilm Medical Systems, Stamford, Conn, USA) was initially advanced to the cecum and withdrawn to the hepatic flexure. However, because of a highly redundant left colon segment, the colonoscope could not be reduced into a stable, short position for ESD despite manual abdominal counterpressure and position changes. In the looped, long position at the hepatic flexure, the endoscope was noted to be in an extremely unstable position and therefore unsafe for ESD.

The endoscope was removed, and the rigidizing overtube was introduced onto the endoscope. The endoscope with the overtube was then advanced as far as possible in the flexible state, reaching the transverse colon. The endoscope was then reduced as much as possible, and the overtube was advanced to the tip of the endoscope. The overtube was rigidized, and the endoscope was then advanced to the lesion. Another loop was encountered at the lesion, preventing 1-to-1 motion. The overtube was made flexible, and the endoscope and overtube were reduced. The overtube was again advanced to the tip of the endoscope and rigidized. At this point, the endoscope was able to access the lesion from a short, reduced position, with 1-to-1 motion. ESD could thus be safely performed (Fig. 3).

Initial submucosal lifting with a 6% hetastarch solution was performed using a standard injection needle. The injectable needle-type ESD knife was used to make a mucosal incision, and submucosal dissection was performed. Moderate submucosal fibrosis (F1) was unexpectedly encountered, which hindered visualization of the dissection plane.[6] However, the novel ESD knife was able to consistently deliver robust submucosal injection via the center of the needle tip, thus providing reliable submucosal lifting and improved visualization of the dissection plane throughout the procedure. With reliable submucosal lifting, en bloc endoscopic resection was completed without perforation in 101 minutes. The final histopathologic diagnosis was tubulovillous adenoma without high-grade dysplasia. The margins were negative, and thus complete and curative resection was obtained. The patient was discharged home after the procedure with an uncomplicated recovery course.

DISCUSSION

Successful colorectal ESD is heavily reliant on multiple factors, including a stable endoscopic position, a well-planned resection strategy, clear visualization of the

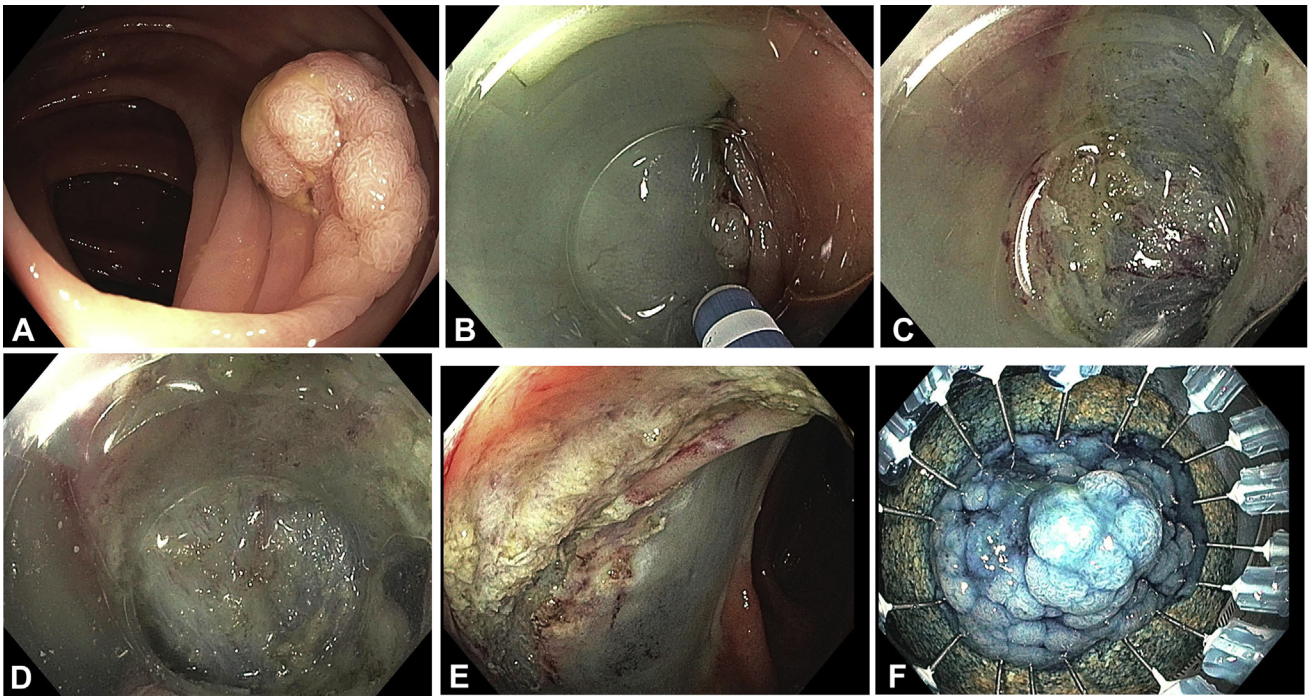

Figure 3. A, A patient was referred for resection of a 35-mm laterally spreading tumor at the hepatic flexure. **B,** An initial mucosal incision was made. **C and D,** Submucosal dissection was performed using a novel injectable needle-type ESD knife, with submucosal fibrosis noted. **E,** Endoscopic appearance of resection defect and **(F)** specimen after en bloc resection.

submucosal dissection plane, and reliable electrosurgical instruments. This video demonstrates all of the key aspects that made this resection successful.

Overtube-assisted colonoscopy allows for straightening of the colon to decrease loop formation. This has previously been described in single-balloon and double-balloon enteroscopy,[7,8] as well as with a first-generation mechanically stiffening overtube (ShapeLock, USGI Medical, San Clemente, Calif, USA) that is no longer commercially available.[9-11] In addition, overtube assistance with balloon enteroscopy,[12] as well as with a dedicated double-balloon device, has been described for stabilization of the resection field in ESD.[13,14]

Recently, a novel rigidizing overtube was introduced for colonoscope stabilization for various applications in colonoscopy and for ERCP in surgically altered anatomy.[3-5] As we demonstrated, we were able to use the rigidizing overtube for stabilization during a challenging ESD at the hepatic flexure. It is important to note that the rigidizing overtube was primarily used in this case to gain access to challenging locations in the right colon segment without loop formation. It is not designed as a technique to assist beginners in overcoming the challenges of colorectal ESD.

Aside from a stable endoscopic position, reliable visualization of the submucosal dissection plane is crucial to maintaining safety in ESD. In our case, the presence of submucosal fibrosis obscured the dissection plane. In these situations, the endoscopist depends even more on reliable submucosal injection and the overall performance of the ESD knife. Most existing injectable needle-type ESD knives are designed to inject from the base of the electrode and may thus be prone to clogging after prolonged cautery. This may result in an inconsistent or ineffective submucosal injection, potentially causing an unsafe situation during submucosal dissection. The novel ESD knife demonstrated in our case differs in that the injection is delivered via the tip of the electrode, which theoretically allows for a more powerful and focused injection. Notably, we did not encounter any clogging or ineffective submucosal injection in our case. Furthermore, the device handle includes a cleaning tool, which allows the device to be more consistently reliable throughout the duration of the procedure.

CONCLUSION

The novel dynamic rigidizing overtube allowed for a stable endoscopic position in a challenging ESD at the hepatic flexure. In addition, we demonstrated the first use of a novel injectable needle-type ESD knife, highlighting its various potential advantages in challenging colorectal ESD. Future dedicated studies are necessary to validate the usefulness of the rigidizing overtube in endoscopic resection and to compare the overall performance, reliability, and cost-effectiveness of the different injectable ESD knives.

DISCLOSURE

Dr E. Coronel is a consultant for Boston Scientific. All other authors disclosed no financial relationships.

Abbreviation: ESD, endoscopic submucosal dissection.

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