Colorectal endoscopic submucosal dissection with use of a bipolar and insulated tip knife

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The bipolar needle-knife (B-knife) was originally developed by Doi et al in collaboration with the Zeon Medical Company (Tokyo, Japan) in 2002. The main advantage of the B-knife is safety. The electric current is limited to the needle, and the highest density of current stays near the sheath pole. The risks of both perforation and coagulation effect to the muscle layer are, therefore, significantly reduced.[1,2] Several clinical studies have demonstrated the safety of the B-knife.[3,4]

The first-generation B-knife was a needle-only model without a water jet function. Saito et al[3] and Sano et al[1] pioneered the use of the B-knife for colorectal endoscopic submucosal dissection (ESD). The B-knife was generally safe and effective for colorectal ESD. However, there were a few cases of perforation, mainly resulting from the sharpness of the B-knife tip. With further modification as requested by Saito, a newer model of the B-knife with a spherical needle-tip was developed. The benefits of the ball-tip B-knife are these:

1. The risk of perforation is reduced because of the round shape of the needle-tip.
2. Hooking the tissue becomes easier with use of the ball-tip.

The newer ball-tip B-knife is also equipped with a water jet function (Fig. 1).

The IT nano knife was developed by Ono and Saito et al with the Olympus Company for esophageal and colorectal ESD. The insulated tip is smaller compared with the IT knife 2, allowing it to slip into the narrower submucosal (SM) layer of the esophagus and colon (Fig. 1). It has a longer knife blade compared with the B-knife, making ESD dissection faster and more efficient because one can grab more tissue at once. In colorectal ESD, the initial marginal incision and SM dissection is made by the B-knife, and the IT knife nano is used in the latter part of ESD when the SM layer is well expanded.

INDICATIONS

Endoscopic resection is indicated for superficial colorectal neoplasms that are associated with a negligible risk of lymph-node metastases. Lesions characterized by well-differentiated histologic features, tumor budding grade 1, SM invasion up to 1 mm, and no lymphovascular invasion are associated with a very low risk of lymph-node metastases and may be cured with endoscopic resection.[5,6]

Although the vast majority of colorectal lesions may be resected by EMR, ESD should be considered when the likelihood of carcinoma is high, including tumors with superficial SM invasion and intramucosal cancer. This is because ESD achieves a superior rate of en-bloc resection, which enables accurate histologic staging and a higher chance of curative resection.[7] In contrast, when EMR is performed piecemeal, the quality and reliability of histopathologic assessment is reduced, especially in terms of the lateral and vertical resection margins.[8] Despite infrequent incidence of distant metastasis, piecemeal EMR is also associated with distant metastatic risk when attempted for carcinoma.[3] In addition, EMR may not be technically feasible in nonlifting lesions with underlying fibrosis.

CONTRAINDICATIONS

ESD is contraindicated in deep SM invasive cancers. Therefore, endoscopic evaluation with image-enhanced endoscopic magnified narrow-band imaging (NBI) and pit pattern diagnosis with the use of dye-based chromoscopy is essential.[7-9]

EQUIPMENT AND PREPARATION

It is important to prepare certain devices for colorectal ESD to keep the procedures safe (Fig. 1).[10,11] The main devices for colorectal ESD are the B-knife for marginal incision and the IT knife nano for SM dissection. In case of massive bleeding, bipolar coagulation forceps such as Tighturn (Zeon Medical Inc, Tokyo, Japan) or hemostat-Y (Pentax Medical, Tokyo, Japan) are recommended to reduce the coagulation effect to the muscle layer. The short-type small-caliber tip hood was developed by Saito et al[10-12] with the Fujifilm Medical Company (Tokyo, Japan). It has a shorter and a more tapered tip compared with the hood originally developed by Yamamoto et al.[13] This allows easier entry into the narrower SM layer compared with a conventional distal attachment. It is important to use the short-type ST hood to visualize the SM layer directly to reduce the risk of perforation.

Figure 1. Equipment and preparation for colorectal endoscopic submucosal dissection (ESD).

CO_2 insufflation is fundamental to reduce patients' abdominal discomfort and to prevent severe adverse events such as pneumoperitoneum and pneumothorax.[14] Hyaluronic acid solution[13] is injected into the SM layer, after confirmation of good SM elevation first with injection of saline solution or glycerol. A well-bending colonoscope with water jet function is routinely used for colorectal ESD because the procedure is frequently performed with the patient in the retroflexed position.

GENERATOR SETTING

VIO 300D setting 1a

The same generator setting is used for the B-knife and the IT knife nano. Dry cut E3, 100W, is used for the marginal incision, and spray-coag E2, 50W is used for SM dissection.

VIO 300D setting 1b

When vessels are detected, precoagulation is applied at a low voltage of E1, 10W.[15] The coagulated vessel can then be dissected safely without bleeding. For thicker vessels or arteries, we precoagulate using a bipolar coagulation forceps at a current of 30W, E3.

CASE PRESENTATION

Preoperative diagnosis and histologic assessment

White-light endoscopy demonstrated a shallow, depressed lesion with marginal elevation and prominent fold stretching, spanning 3 cm in the ascending colon (Fig 2A). Macroscopically, this lesion was a type 0-IIa+IIc lateral spreading tumor, nongranular, pseudodepressed type (LST-NG [PD]). Narrow-band imaging revealed a clear tumor margin (Fig. 2B). After indigo carmine dye spraying, the tumor margin became more obvious. A slight reddish depression was prominent in the center of the lesion (Figs. 2C and D). Magnified NBI revealed Japan NBI Expert Team (JNET) type 2A[16] (regular vessels and regular surface patterns) in the slightly elevated area that suggested low-grade intramucosal neoplasia (Fig. 2E). Magnified NBI also revealed JNET type 2B (irregular vessels and irregular surface patterns) in the depressed area that suggested high-grade intramucosal neoplasia or submucosal superficial cancer (Fig. 2F). Magnification and indigo carmine dye revealed a IIIL pit or type VI (low-grade, noninvasive) pit pattern in the depressed component (Fig. 2G). Crystal-violet staining revealed type VI (low-grade, noninvasive) pit pattern that suggested intramucosal neoplasia or submucosal superficial cancer (Fig. 2H). The preoperative endoscopic diagnosis was type 0-IIa+IIc LST-NG (PD), Tis-T1a, 30 mm. ESD was performed, and en-bloc resection was achieved (Fig. 3A and Fig. 3B). The resected specimen had well-differentiated tubular adenocarcinoma with low-grade and high-grade atypia. The tumor had invaded the submucosa (100 μm from the muscularis mucosa) but without lymphovascular invasion. The vertical and lateral margins were clear (Figs. 4A and B).

COLORECTAL ESD PROCEDURE

Good bowel preparation is essential. Changing the patient's body position to locate the tumor opposite the

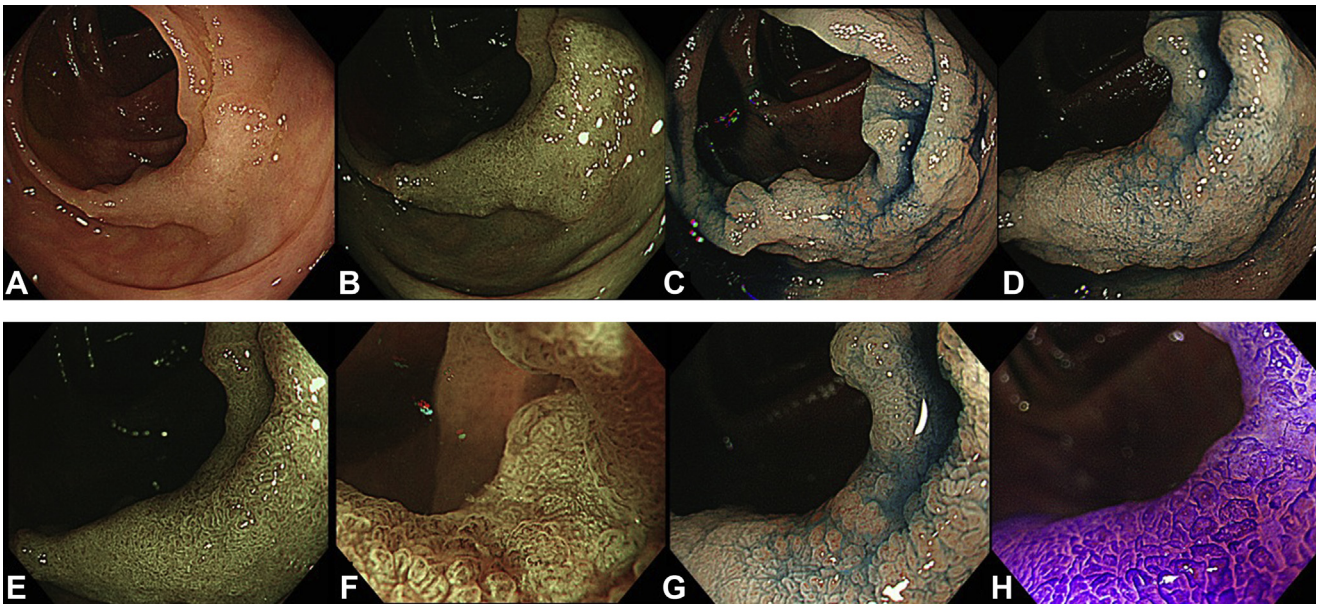

Figure 2. A, Lateral spreading tumor, nongranular type pseudodepressed type, 0-IIa+IIc located in ascending colon. Tumor was 3 cm in diameter with prominent fold stretching. **B,** Narrow-band image (NBI) revealing a clear tumor margin. **C,** After indigo carmine dye spraying margin of tumor became clearer, and a slight reddened depression was prominent in the center. **D,** Close-up view with indigo carmine dye. **E,** Magnified NBI revealing Japan NBI Expert Team (JNET) type 2A (regular vessel and regular surface patterns) in slightly elevated area suggesting low-grade intramucosal neoplasia. **F,** Magnified NBI revealing JNET type 2B (irregular vessel and irregular surface patterns) in depressed area suggesting high-grade intramucosal neoplasia or submucosal superficial cancer. **G,** Magnified view with indigo carmine dye revealing IIIL pit or VI (low-grade) (noninvasive) pit pattern in the depressed component. **H,** Crystal violet stain revealing type VI (low-grade) (noninvasive) pit pattern suggesting intramucosal neoplasia or submucosal superficial cancer.

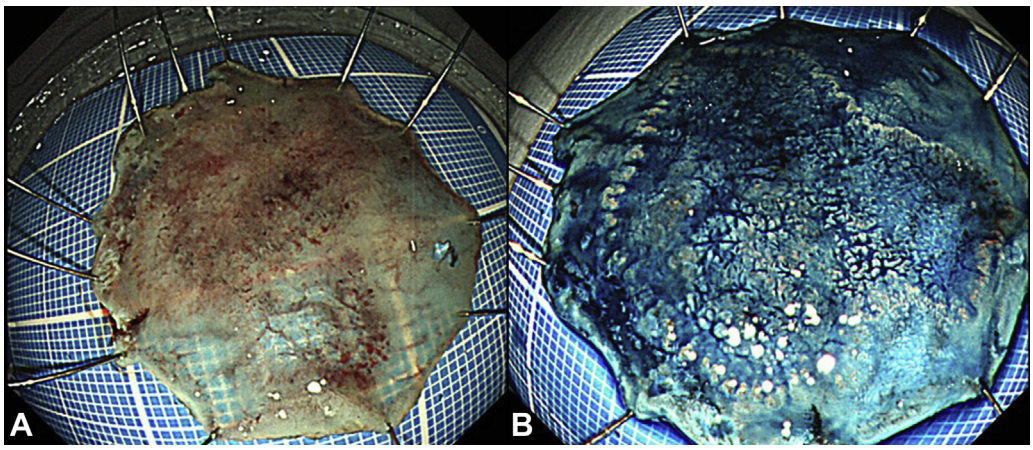

Figure 3. A, Resected specimen stretched with care on a measuring board with small pins. **B,** Indigo carmine dye sprayed on the resected specimen to enable visualization of the cut margin.

side of gravity (where no liquid is pooled) is the first step of ESD. The basic steps of ESD consist of the following: injecting fluid into the submucosa to elevate the tumor, making an incision in the surrounding mucosa to gain access to the submucosa, and dissecting the submucosa beneath the tumor to achieve tumor resection. The procedure is initiated with the patient in the retroflexed position, if possible, allowing for better control of the endoscope and improved ease of accessing the SM layer horizontally. The conventional ESD method comprises the following steps:

1. Image-enhanced endoscopic diagnosis
2. Submucosal injection under the surrounding normal mucosa
3. An initial partial mucosal incision (ie, 2-3 cm in length)
4. Submucosal dissection beneath the incision
5. Repeated partial mucosal incision and dissection in a segmental fashion
6. Completion of the en-bloc resection.

In cases of fibrosis or suspected submucosal invasion, the initial mucosal incision should be started farther away from the tumor compared with standard ESD, including

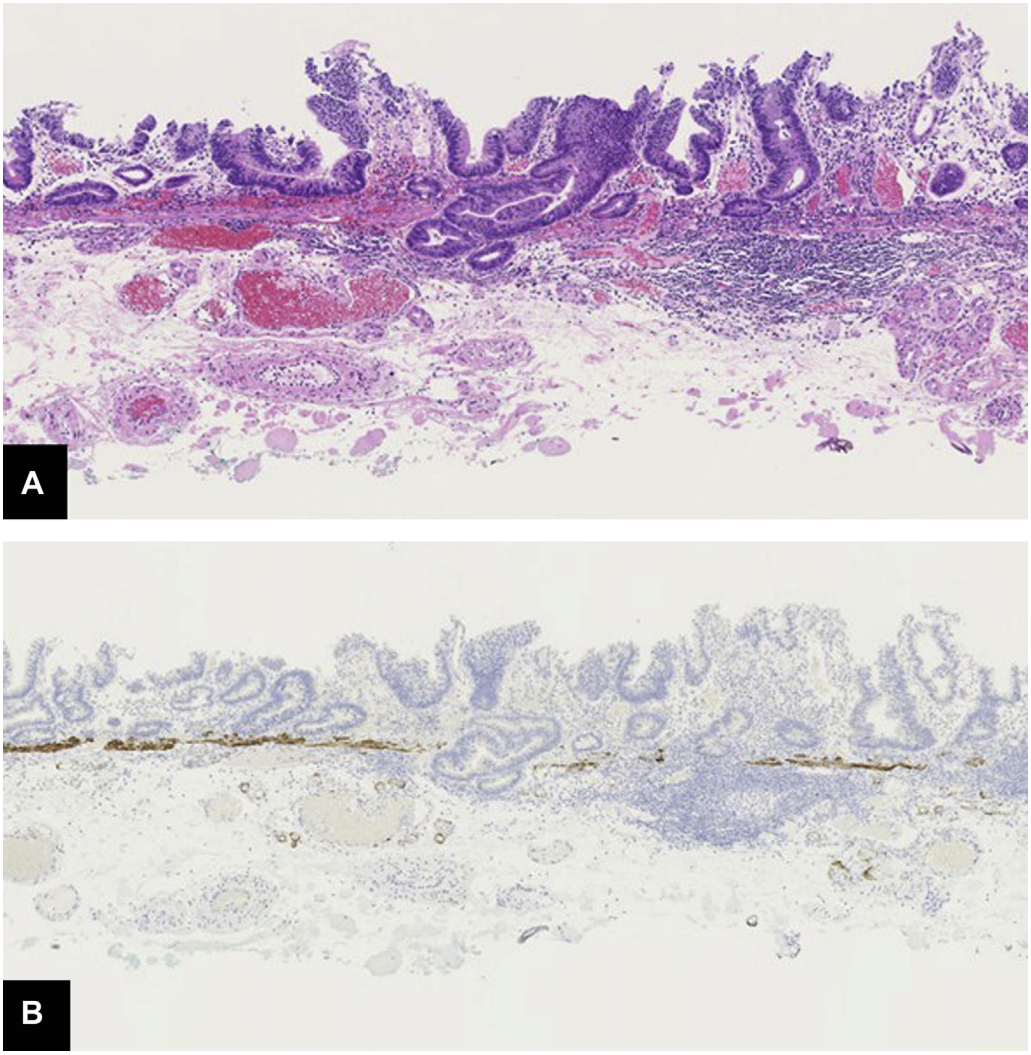

Figure 4. A, Resected specimen showing histopathologic diagnosis of well-differentiated tubular adenocarcinoma, low-grade and high-grade atypia (H&E, orig. mag. × 50). **B,** Resected specimen with desmin staining, which is routinely conducted for the diagnosis of submucosal invasive cancer, showing slight submucosal invasion (orig. mag. × 50).

a 1-cm margin of normal mucosa instead of 0.5 cm. This facilitates a safer procedure because dissection occurs with a buffer of normal tissue before the anticipated difficult areas beneath the scar or tumor are reached.

ADVERSE EVENTS

The risk of intraprocedural perforation during colorectal ESD at the National Cancer Center Hospital (NCCH) is 2% or less, and known risk factors for perforation are fibrosis in the submucosal layer and poor control of the endoscope.[10-12,17,18] The risk of delayed perforation after colorectal ESD at the NCCH is 0.2% or less, and that for delayed bleeding is approximately 2%.[12,17,18] Therefore, routine defect closure after ESD is not performed. A defect is closed only in high-risk patients who are taking anticoagulant therapy or when muscle injury is suspected.[12,18]

Troubleshooting

When perforation occurs, it is important to continue the dissection to make enough space for clipping. Usually, 1 or 2 conventional clips are adequate for colorectal ESD perforation. Several days of fasting and antibiotic therapy are recommended after complete endoscopic defect closure. Unless closure is successful, surgery is recommended.[12,18]

SUMMARY

To ensure safe and successful ESD, the essential preparation for colorectal ESD includes CO_2 insufflation, therapeutic colonoscope with water-jet function, hyaluronic acid solution, and short-type ST hood. When both a Jet B-knife and an IT knife nano are used, en-bloc resection can be achieved and favorable long-term outcome for early colorectal neoplasias obtained[19] (Video 1, available online at www.VideoGIE.org).

DISCLOSURE

All authors disclosed no financial relationships relevant to this publication.

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Abbreviations: LST-NG [PD], lateral spreading tumor; nongranular, pseudodepressed type; NBI, narrow-band imaging; SM, submucosal.

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