Endoscopic Submucosal Dissection of Early Esophageal Cancer

TSUNEO OYAMA, AKIHISA TOMORI, KINICHI HOTTA, SYUKO MORITA, KEN KOMINATO, MASAKI TANAKA, and YOSHINORI MIYATA
Department of Gastroenterology, Saku General Hospital, Minamisaku, Nagano, Japan

In Japan, the majority of esophageal cancers are squamous cell carcinomas. Because no lymph node metastasis was reported in squamous cell carcinomas limited to the intraepithelial layer (m1) or proper mucosal layer (m2), the Japanese Esophageal Association recommended endoscopic mucosal resection (EMR) as the treatment of choice for these cancers. However, these lesions often spread laterally, exceeding the limits of en bloc resectability with conventional EMR methods such as the EMR cap method. The lesions resected in piecemeal manner with conventional EMR methods are prone to recur locally. Therefore, we developed a method of mucosal resection with a hook-knife that enables endoscopic submucosal dissection safely and achieves a high rate of en bloc resection for larger lesions. The median size of the resected specimen and cancer by our method was 32 mm (range, 8–76 mm) and 28 mm (range, 4–64 mm), respectively. The en bloc resection rate was 95% (95 of 102) and the local recurrence rate was 0% (0 of 102). This procedure was safe, with only 6 cases (6%) of mediastinal emphysema, which improved with conservative treatment. Endoscopic submucosal dissection with the hook knife is a method of endoluminal surgery enabling large en bloc resections without increased surgical risks.

In Japan, the majority of esophageal cancers are squamous cell carcinomas.[1] Esophageal mucosal cancers are divided into 3 subgroups according to their depth of invasion[1]: epithelial cancer (m1) is limited to the intraepithelial layer, whereas m3 cancer involves the deep mucosal layer adjacent to the muscularis mucosa or may involve it only partly. Mucosal esophageal cancers with invasion of intermediate depth were classified as m2. According to this subclassification of superficial esophageal cancers, endoscopic mucosal resection (EMR) is indicated for esophageal cancers involving the superficial epithelial layer (m1: carcinoma in situ) or the proper mucosal layer (m2) because no lymph nodes metastasis have been reported in cancers limited to these 2 layers. In contrast, if the cancer invasion has reached the m3 layer, lymph node metastasis has been reported. Therefore, the Japanese Esophagus Association decided that the indication of EMR for early esophageal cancer should be restricted to m1 or m2.[2] The quality of life after EMR is much better than after esophagectomy. Many superficial esophageal cancers have been treated by EMR in Japan.

The specimens resected by EMR often are too small, so piece-meal resection was performed for the large lesions. Furthermore, the local recurrence rate of cases that undergo the piece-meal resection was higher than that of en bloc resected cases.[3] Therefore, we developed an endoluminal surgery method, endoscopic submucosal dissection (ESD) with the hook knife,[4,5] to enhance en bloc resections.

Patients and Methods

Procedure of Endoscopic Submucosal Dissection With the Hook Knife

The tip of the knife is bent at a right angle. The length of the hook is 1.3 mm and the length of the arm is 5 mm. The hook knife has a handle on the proximal side and the direction of the hook can be controlled via handle rotation (Figure 1*A*). It is possible to cut the mucosa, submucosal fibers, and vessels with this knife and to stop minor bleeding as well. The direction of the top of the hook knife should be controlled and kept parallel with the muscular layer to prevent perforation (Figure 1*B*).

Marks are made around the lesion with the hook knife with 40-W forced coagulation mode (VIO 300D; ERBE, Tuebingen, Germany). Glycerol is injected into the submucosal layer to separate the mucosa from the proper muscular layer. An initial mucosal cut is made by using the backside of the hook knife with the dry cut mode (60 W, effect 5). The mucosa is hooked with the hook knife from the submucosal side to the esophageal lumen and cutting is repeated. A surrounding mucosal incision also can be performed. Finally, the submucosal fibers and vessels are cut using the hook knife with the dry cut mode (60 W, effect 5) or spray coagulation mode (60 W, effect 5) from the oral side because the hook knife can be

Abbreviations used in this paper: EMR, endoscopic mucosal resection; ESD, endoscopic submucosal dissection.

1542-3565/05/$30.00
PII: 10.1053/S1542-3565(05)00291-0

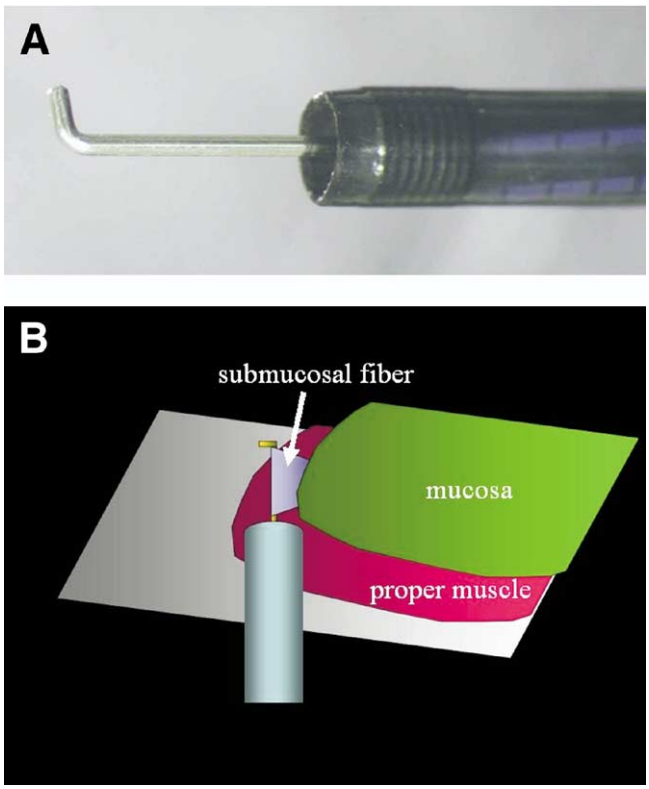

Figure 1. (*A*) The tip of the knife is bent at a right angle. The length of the hook is 1.3 mm and the length of the arm is 5 mm. The hook knife has a handle on the proximal side, and the direction of the hook can be controlled via the handle rotation. (*B*) The direction of the hook knife should be controlled parallel with the proper muscular (muscularis propria) layer to prevent perforation.

approached parallel to the muscular layer in this situation (Figure 2).

Sometimes bleeding may occur while cutting in a submucosal dissection. If the size of the vessels is 1 mm or less, the vessels can be cut without bleeding in the spray mode (60 W, effect 2). If this causes bleeding, visualization of the submucosal layer becomes difficult, so immediate hemostasis should be applied with the hook knife as follows. The tip of the hook knife should be placed in contact with the bleeding vessel and the bleeding should stop within a short time because of coagulation (60 W, effect 2). If the bleeding continues, hemostatic forceps in the soft coagulation mode is useful.

Results

A total of 102 cases of superficial esophageal squamous cell carcinomas were resected by ESD with the hook knife from January of 2000 to August of 2004. Water intake is permitted beginning on the day of the ESD procedure, and the diet is changed gradually on a daily basis from a total fluid diet to increasingly solid gruel for a week.

The median size of resected specimens and cancer was 32 mm (range, 8–76 mm) and 28 mm (range, 4–64 mm), respectively. The en bloc resection rate was 95% (95 of 102) and the local recurrence rate was 0% (0 of 102); the mean follow-up period was 21 months (range, 3–54 mo). There were no perforations, but 6 cases of mediastinal emphysema (6%) were observed. Two days of intravenous antibiotics (Flomoxef 2 g/day) and fasting with intravenous infusion were instituted to treat the patients who had mediastinal emphysema.

Seven patients needed balloon dilatation because of stenosis after ESD. The mucosa defect was four fifths or more of the circumference in these cases.

The major complication of ESD is perforation, but there were no perforations in our experience. The most important point to avoid perforation is to keep the visual field of the submucosal layer clear and to control the direction of the hook knife parallel with the muscularis propria layer.

Discussion

The Japanese Esophagus Association decided that the indication of EMR for esophageal cancer should be restricted to m1 or m2 depths, because no lymph node metastases were reported in cancers limited to these 2 layers.[2] However, if the cancer invasion has reached the m3 layer, the lymph node metastasis rate was reported as 9% and if the cancer had minutely invaded to the submucosal layer (≤200 μm below the muscularis mucosa; sml), the lymph node metastasis rate was 19%.[6] The lymph node metastasis of m3 or submucosal minute invasive cancer that had no lymph-duct involvement or scatter infiltration was 4.7%.[6] Therefore, precise pathologic examination of the resected specimen is very important to determine whether the patient needs additional treatment. A precise histologic examination may be difficult with piece-meal–resected specimens removed by EMR. Moreover, specimens resected with the EMR method sometimes are damaged by forceps or aspiration retrieval. These drawbacks led to the development of ESD with the hook knife. A large en bloc resection, 70 mm or greater in size, is possible with this ESD method, permitting more precise histologic examination of the entire lateral and vertical extension.

The needle knife, insulation tip knife (KD-610L; Olympus, Tokyo, Japan), flex knife (KD-630L; Olympus), and hook knife (KD-620LR; Olympus) have been reported as useful for gastric ESD.[7,8] The esophageal wall is thinner than that of stomach. The esophageal wall always moves with respiration and heartbeat, and the lumen is narrow. Therefore, esophageal ESD is more difficult to perform than gastric ESD. In addition, esophageal ESD with the IT knife is difficult to perform