

## Infrared endoscopic system for detection of bleeding points during endoscopic resection

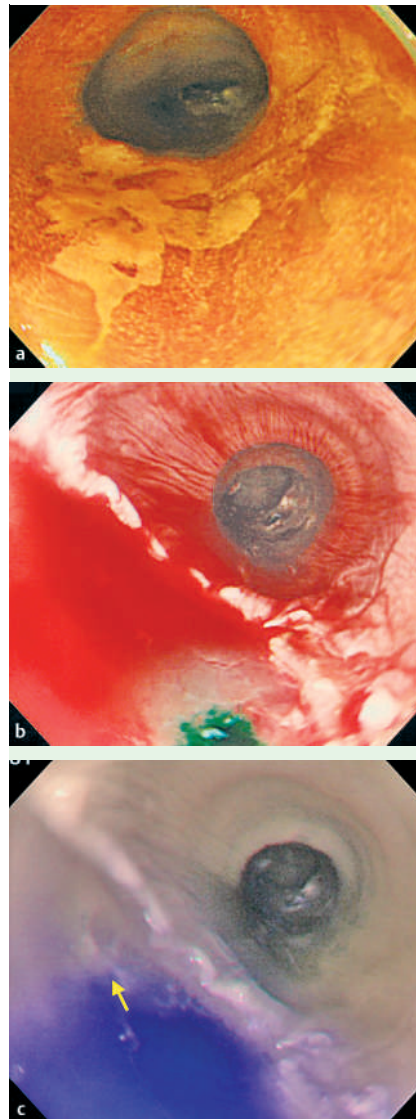
Endoscopic resection is a widely used treatment for gastrointestinal tumors. The major complications of endoscopic resection are bleeding and perforation. Bleeding during the procedure can cause technical difficulties.

Infrared electronic endoscope systems (IREESs) with intravenous injection of indocyanine green (ICG; Daiichi Pharmaceutical Co., Ltd., Tokyo, Japan) were developed for the visualization of mucosal or submucosal vessels. The usefulness of IREES in diagnosing gastric cancer or vascular lesions in the gastrointestinal tract has been reported [1–4].

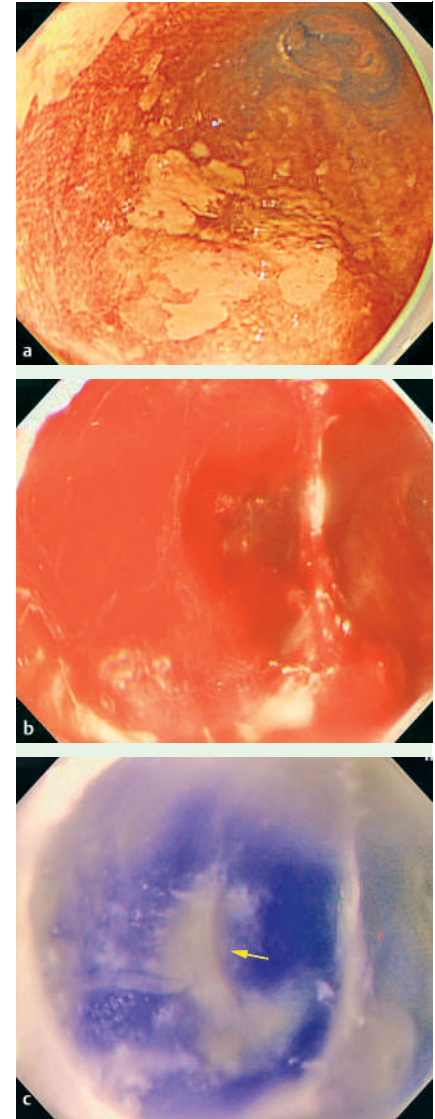
Endoscopic resection of superficial esophageal cancer and detection of bleeding points was carried out as follows: A forward-viewing endoscope (GIF-Q240 IR; Olympus Medical Systems Co., Ltd., Tokyo, Japan) was introduced. After iodine staining, several milliliters of ICG solution (0.025 mg/ml saline) were injected into the submucosal layer beneath the lesion. The lesion was resected using the EMRC method [5] and retrieved from the gastrointestinal tract soon after resection. The endoscope was introduced again and the post-resection ulcer observed by conventional and infrared endoscopic viewing.

ICG absorbs near-infrared maximally at a wavelength of about 805 nm and reflects infrared at 920–960 nm, while it is displayed in blue in IREESs [3,4]. The ulcer base after endoscopic resection, which is

played in white, whereas pooled blood is a dark lucent gray (● Fig. 1 and 2; ● Videos 1 and 2). We can therefore distinguish the bleeding point (white) clearly from the pooled blood (dark gray) without aggressive washing.



**Fig. 1** **a** Endoscopic view with iodine staining showing an unstained lesion, 15 mm in diameter, 30 cm from the incisors. **b** Conventional endoscopic view of the resection site with submucosal indocyanine green (ICG) injection. Overt bleeding occurred soon after endoscopic mucosal resection; however, the bleeding point is not clearly recognized in the pooled blood. **c** Infrared endoscopic view of the resection site with submucosal ICG injection. The bleeding point is visualized in white, while the pooled blood is displayed in a lucent gray color.



**Fig. 2** **a** Endoscopic view with iodine staining showing an unstained lesion, 15 mm in diameter, 28 cm from the incisors. **b** Conventional endoscopic view of the resection site with submucosal ICG injection. Overt bleeding occurred soon after endoscopic mucosal resection. The ulcer bed is covered with blood, and the bleeding point is not recognized. **c** Infrared endoscopic view of resection site with submucosal ICG injection. The bleeding point is displayed in white even in the pooled blood.

### Video 1

Case 1. Overt bleeding occurred soon after endoscopic resection of an esophageal cancer. Conventional and infrared endoscopic observations were performed. In the infrared electronic endoscope system (IREES), the bleeding point is more clearly visualized because the flow of the bleeding is displayed in white.

### Video 2

Case 2. Overt bleeding occurred soon after endoscopic resection of an esophageal cancer. Conventional and infrared endoscopic observations were performed. In the IREES, the bleeding point is displayed in white even in the pooled blood, and it is more clearly visualized than with the conventional system.

composed of submucosal tissue containing ICG, is displayed in blue on the monitor. If bleeding occurs during the procedure, the bleeding point is usually dis-

Using this system, we found that we could visualize bleeding points more clearly than with conventional systems. Although further investigation will be necessary to elucidate the mechanism, we demonstrated the ability of IREESs to

detect a bleeding point during endoscopic resection.

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## Bibliography

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