

## Usefulness of the HyperEye Medical System in Obstructive Colitis Proximal to Colon Carcinoma

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Obstructive colitis (OC) is a nonspecific inflammatory condition that occurs at the proximal side of a completely or partially stenotic lesion typically caused by colorectal cancer. Impaired blood flow caused by these stenotic changes in the colon or rectum results in this condition. During surgery for sigmoid colon carcinoma with OC, complete surgical removal of the OC lesions is required. However, it is difficult to anticipate the range of OC before surgery. Diagnosing the potential ischemia during surgery would decrease the need for re-operation. This is the first report of HyperEye Medical System (HEMS) angiography for surgery of colon cancer with OC. We report a case of sigmoid colon carcinoma in which HEMS angiography was used and found to be useful for real-time detection of the OC lesion. (J Nippon Med Sch 2019; 86: 131–134)

**Key words:** indocyanine green, obstructive colitis, blood flow assessment, sigmoid colon carcinoma

### Introduction

Obstructive colitis (OC) is a nonspecific inflammatory condition that occurs in the colon proximal to a completely or partially stenosed lesion<sup>1</sup>. It is the result of impaired blood flow secondary to colorectal cancer. OC occurs in 0.3% to 7% of all colorectal cancers<sup>2–4</sup>. In the operation for sigmoid colon carcinoma with OC, complete surgical removal of the nonspecific inflammatory lesions of the colon is required. However, nonspecific inflammatory lesions are difficult to distinguish from normal colon. There have been no reports of angiographic studies of OC during surgery.

Indocyanine green (ICG) is a hydrophilic tricarbocyanine dye with peak spectral absorption at approximately 800 nm. ICG binds tightly to plasma proteins and is excreted in bile<sup>5</sup>. ICG emits fluorescence with a peak wavelength of 830 nm after illumination by near-infrared light. ICG fluorescence has been reported for intestinal blood flow<sup>6,7</sup>, whereas regional intestinal blood flow in

colitis using near infrared imaging systems has not been previously demonstrated. An accurate method for detecting the ischemic lesions of obstructive colitis is needed.

The HyperEye Medical System (HEMS: Mizuho Ika kogyo Co., Ltd, Tokyo, Japan) provides a clear view of the blood flow and ischemic area with color graphics. The chief advantage of HEMS over the conventional ICG imaging system is that it can be used under room light.

To date, no study has investigated the use of HEMS angiography for the assessment of blood flow in patients with OC. The HEMS was used in a case of OC and was found to be useful for determining the proper resection line.

### Case Report

A 72-year-old Japanese man with OC secondary to sigmoid colon carcinoma was admitted to our hospital. His co-existing conditions included hypertension, cerebral infarction, and chronic obstructive pulmonary disease.

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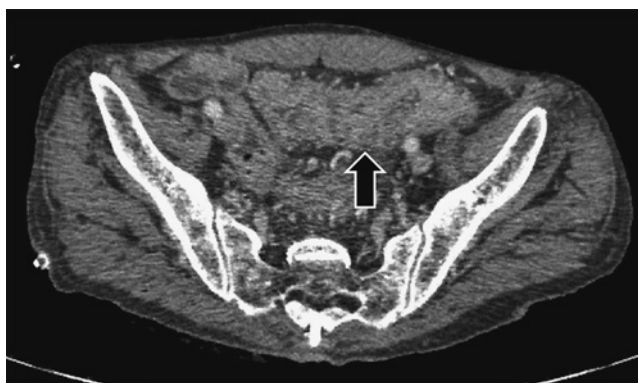


Fig. 1 Abdominal CT findings

Wall thickening is observed on the oral side of the tumor (arrow).

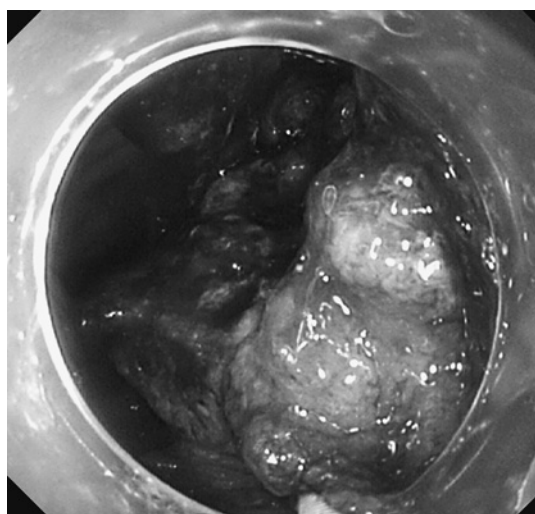


Fig. 2 Endoscopic findings

Colonoscopy shows an obstructing sigmoid colon carcinoma.



Fig. 3 Intraoperative findings

Fluorescence is observed in the colon (arrow). The extent of resection has been determined (dotted line).

Physical examination showed a blood pressure of 137/75 mmHg and a heart rate of 79 beats per minute. Serum laboratory values were unremarkable with the exception of C-reactive protein of 1.68 mg/dL (normal <0.14 mg/dL) and CA19-9 of 195 U/mL (normal <37 U/mL). Contrast-enhanced computed tomography (CT) performed on admission and the day before surgery (Fig. 1) showed obstruction of the sigmoid colon. The patient underwent preoperative colonoscopy on the day before the planned sigmoid resection (Fig. 2).

At laparoscopic surgery, a sigmoidectomy with a lymphadenectomy along the inferior mesenteric artery was performed. A resection of the anal-sided colon was performed using an Echelon Endopath Stapler (Ethicon Endo-Surgery, Johnson & Johnson, Tokyo, Japan), and the tumor was removed from a 5-cm abdominal wound. ICG

was then injected intravenously (2 mL of 2.5 mg/mL ICG). The HEMS was used to detect ICG-derived fluorescence. The ICG-derived fluorescence signals were transmitted to a digital video processor and displayed on a monitor in real time. Real-time intraoperative blood flow assessment with HEMS angiography was feasible. HEMS angiography enabled visualization of real-time blood flow in the colon (Fig. 3). After HEMS angiography, the extent of colon resection was carefully determined. HEMS angiography facilitated the identification of unexpected ischemic lesions of OC requiring re-resection. The ischemic region in the colon was identified from 8 to 25

cm proximal to the sigmoid colon carcinoma (Fig. 4). Therefore, the surgical procedure was converted from an anastomosis to a Hartmann's operation. The pathological examination revealed loss of normal mucosa (Fig. 5). Surgery was completed without any complications, and the patient had an uneventful and good postoperative recovery. The patient gave consent for publication of this case. The use of ICG was approved by the institutional review board of Ehime University School of Medicine.

### Discussion

This is the first report of the use of HEMS angiography

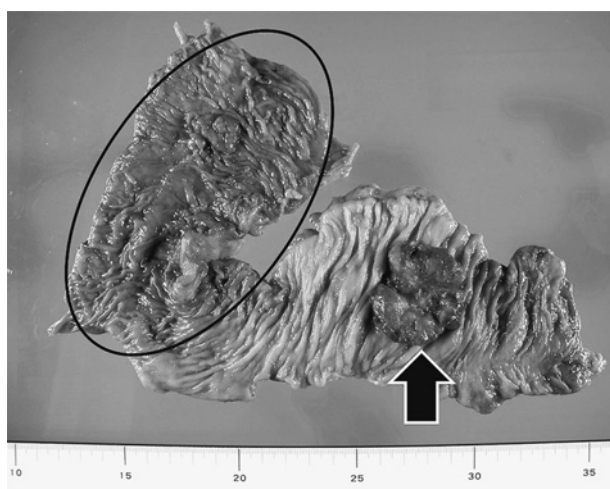


Fig. 4 Postoperative specimen of colon after resection. On the left, the obstructive colitis is seen. The arrow indicates the obstructing colon carcinoma.

to determine the appropriate demarcation line in OC. Although OC is a recognized entity in the literature, it remains an uncommon and troublesome disease<sup>8</sup>. The features of OC are as follows: (1) an ulceroinflammatory lesion is present on the oral side of the obstruction site; (2) the anal side of the obstructive site is macroscopically and histologically normal; and (3) normal mucosa is present between the obstruction and the ulceration, and its border is clear<sup>9</sup>. The findings of the present case were consistent with these criteria. OC may be substantially more frequent than previously reported because it is difficult to diagnose OC intraoperatively, since the surface of the large bowel may appear normal. Before surgery, CT can help with visualization of the tumor, but it is difficult to establish the degree of OC and the extent of necrosis<sup>10,11</sup>. Furthermore, OC may decrease the possibility of detecting a synchronous proximal colonic lesion on positron emission tomography/CT<sup>12</sup>.

Recently, ICG angiography was used for the intraoperative assessment of bowel blood flow<sup>13</sup>. Assessment of blood flow with ICG angiography is clinically useful in neurosurgery<sup>14</sup> and cardiovascular surgery<sup>15</sup>, but there are no reports of its use in OC secondary to sigmoid colon carcinoma. Extended sigmoid resection is needed if irreversible ischemic injury develops. However, identification of the area of potential ischemia is difficult. The unique advantage of HEMS is that blood flow can be visually detected in a well-lit operating room. HEMS angiography has been successfully used in imaging of the coronary ar-

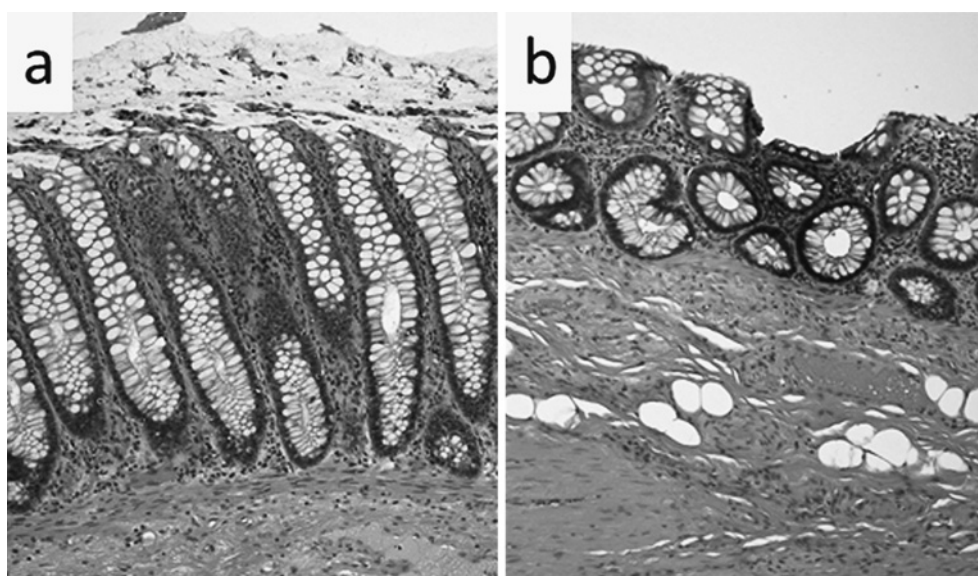


Fig. 5 Microscopic findings of obstructive colitis

(a) Normal colonic mucosa (H&E stain;  $\times 100$ ).

(b) Obstructive colitis showing features of mucosal damage (crypt loss and villous atrophy) (H&E stain;  $\times 100$ ).

teries and facilitates the identification of the demarcation line of necrosis. In the present case, CT was performed for preoperative diagnosis of sigmoid colon carcinoma. HEMS angiography is useful for real-time intraoperative detection of ischemic injury in gastrointestinal surgery.

This is the first report of HEMS angiography for surgery in OC secondary to sigmoid colon carcinoma. HEMS angiography is useful for distinguishing the ischemic segment. The aim of this case report was to call attention to the possible usefulness of HEMS angiography for OC secondary to sigmoid colon carcinoma.

There are certain limitations regarding this case report that should be noted. Assessment of blood flow with HEMS angiography is qualitative. The subjective evaluation of fluorescence intensity based on the surgeon's experience is a known limitation. This case report confirms that HEMS angiography may be useful for identification of the area of potential ischemia during laparoscopic-assisted endoscopic resection for OC secondary to sigmoid colon carcinoma. The results of this case report are encouraging and warrant further investigation.

**Conflict of Interest:** The authors declare no conflicts of interest associated with this article.

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