



## Utility of multi-detector computed tomography scans after colorectal endoscopic submucosal dissection: a prospective study

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**Background and Aims:** Several reports have described major adverse events after endoscopic submucosal dissection (ESD), such as perforation or bleeding. However, few studies have discussed the occurrence of post-ESD electrocoagulation syndrome (PEECS) after colorectal ESD. In addition, the occurrence of fever without abdominal pain in patients requires postoperative management similar to that required for PEECS. Therefore, we have defined post-ESD inflammatory syndrome (PEIS) composed of both PEECS and fever without abdominal pain. This study aimed to evaluate the correlation between the findings of multi-detector computed tomography (MDCT) imaging and PEIS in patients.

**Methods:** Between January 2015 and October 2015, we performed colorectal ESD in 100 patients; after this, all patients underwent abdominal examinations by MDCT scans. Nine patients who experienced intraoperative perforations or penetrations were excluded; 91 patients were enrolled in our prospective study. MDCT findings in patients were classified according to the amount of extraluminal gas. The patients were divided into 2 groups based on the presence or absence of extraluminal gas and were assessed for co-occurring PEIS.

**Results:** Among the 91 patients, extraluminal gas was observed in 31 (34%); of these, PEIS occurred in 14 (15%) patients. Patients with extraluminal gas had increased incidence of PEIS compared with patients without extraluminal gas (29% vs 8%,  $P = .014$ ).

**Conclusions:** Extraluminal gas was detected by MDCT in many cases and significantly correlated with the occurrence of PEIS, even in cases without obvious intraoperative perforation or penetration. MDCT findings after ESD may be useful for predicting PEIS and appropriate perioperative management. (Gastrointest Endosc 2018;87:818-26.)

## INTRODUCTION

In recent years, endoscopic submucosal dissection (ESD) for superficial colorectal tumors has evolved remarkably, and many preliminary studies have shown the advantages

of ESD over conventional EMR.<sup>1,2</sup> However, because of the inherent technical difficulties and the occurrence of severe adverse events, colorectal ESD is not widely used as a standard endoscopic treatment worldwide. Particularly, common severe adverse events, such as perforation or

*Abbreviations:* ESD, endoscopic submucosal dissection; IRB, Institutional Review Board; MDCT, multi-detector computed tomography; PEECS, post-ESD electrocoagulation syndrome; PEIS, post-ESD inflammatory syndrome; POD, postoperative day; PPCS, postpolypectomy coagulation syndrome.

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bleeding, have been reported in 1.4% to 10% and 1.0% to 2.0% of cases, respectively.<sup>3-6</sup>

The occurrence of other notable adverse events after ESD, namely postpolypectomy coagulation syndrome (PPCS) and post-ESD electrocoagulation syndrome (PEECS), have also been reported recently.<sup>7-11</sup> The term PPCS was originally proposed by Waye in 1981,<sup>12</sup> and refers to the development of abdominal pain, fever, leukocytosis, and peritoneal inflammation, in the absence of frank perforation, after endoscopic treatment with electrocoagulation. PPCS is believed to be caused by an electrical current extending into the muscularis propria and the serosa, resulting in a transmural burn at the site of endoscopic treatment.<sup>13-15</sup> PEECS may occur more often after colorectal ESD than after conventional polypectomy or EMR because colorectal ESD requires more electrocautery, resulting in a larger area of exposed propria muscle layer. Previous studies reported that PEECS occurred in 9% to 40% of patients, and most patients were managed conservatively, with or without antibiotics, and did not need surgical intervention.<sup>7-11</sup> However, some studies have reported that PEECS may eventually result in delayed perforation.<sup>11,16</sup> Thus, it is necessary to elucidate the clinical course of PEECS after colorectal ESD. Recently, studies have reported the features and treatments for PEECS after colorectal ESD. In addition, clinical experiences of fever without abdominal pain have also been reported.<sup>9</sup> However, few studies have been conducted on the prediction of the occurrence of PEECS or fever.

To clarify the cause of PEECS or fever, before planning the present study, 50 consecutive patients who underwent colorectal ESD were examined by multi-detector computed tomography (MDCT). Extraluminal gas was unexpectedly observed in 26% of cases without intraoperative perforation.

After this clinical experience, we designed a prospective study to examine the relationship between the findings of MDCT after colorectal ESD and the occurrence of PEECS or fever to assess whether the MDCT findings can predict these outcomes.

## PATIENTS AND METHODS

### Enrollment of patients and ethical approval

From January 2015 to October 2015, we prospectively included 114 colorectal superficial neoplasms from 107 patients who were treated with ESD at the Yokohama City University Medical Center. Patients who underwent multiple colorectal ESDs were excluded. Age, sex, and comorbidities were not considered exclusion criteria. All patients provided informed consent before enrollment. The study protocol was approved by the Institutional Review Board (IRB) in our center and is in accordance with the ethical guidelines of the Helsinki Declaration (no. D1412006). After IRB approval, this study was

registered as University Hospital Medical Information Network (UMIN) ID 000017776.

### Indication of ESD for colorectal tumors

ESD for colorectal lesions was performed in accordance with the Japan Gastroenterological Endoscopy Society guidelines for colorectal ESD or EMR.<sup>17</sup> Briefly, lesions in which endoscopic en bloc resection with snare EMR is difficult to perform, such as non-granular lateral spreading tumors, lesions showing a Vi-type pit pattern per Kudo's classification,<sup>18</sup> suspected carcinomas with shallow submucosal invasion, large depressed-type tumors, and large protruded-type lesions suspected to be carcinomas were included. Lesions that were suspected to have deep submucosal cancer invasion were not included.

### ESD procedure

Bowel preparation was performed by the ingestion of 2 to 4 L of polyethylene glycol solution (Niflec; Ajinomoto Pharmaceuticals, Tokyo, Japan). ESD was performed in an endoscopy room with patients under conscious sedation using intravenous injections of midazolam (0.05\_0.1mg/kg) initially, with pentazocine (15 mg/body) added in the case of insufficient sedation (in 36 patients). An additional 2 mg of midazolam was administered if necessary at the discretion of the endoscopist. Cardiorespiratory function was monitored during the procedure.

ESD was performed by 3 experienced GI endoscopists (K.H., R.K., H.K.) who have performed more than 200 gastric ESDs. A colonic endoscope furnished with a water-jet system (PCF-TYPE Q260AZI; Olympus, Tokyo, Japan), a 4-mm transparent hood (D-201-11804; Olympus, Tokyo, Japan) mounted on the tip of the endoscope, and a Dual knife (KD-650L/Q; Olympus, Tokyo, Japan) was used. Hyaluronic acid was used as a submucosal injection agent. For intraoperative bleeding, a Coagrasper (FD-411QR, Olympus, Tokyo, Japan) was used for endoscopic hemostasis. The electrosurgical unit was an ICC200 (ERBE, Tübingen, Germany). We used 2 modes, namely, the "endocut" mode (60 W, effect 3) and the "forced coagulation" effect (40 W). Carbon dioxide was used for insufflation in all cases.

### Definitions

MDCT imaging was conducted on 5-mm slices (Fig. 1).

Parenteral gas findings on MDCT after ESD were classified as follows: grade 0, no extraluminal gas; grade 1, intramural or subserosal bubbles; grade 2, a cluster of gas around the treatment area; grade 3, gas extended beyond the treated bowels (includes free air).

Perforation and penetration: intraoperative perforation was defined as the finding of extraluminal content outside the intestinal tract through a hole; delayed perforation, as new parenteral gas (free or retroperitoneal) observed on abdominal MDCT scans at least 12 hours after the procedure; and intraoperative penetration, as adipose tissue in

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