

Retrospective Study

Efficacy and safety of endoscopic submucosal dissection under general anesthesia

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Institutional review board statement: The study was reviewed and approved by the Ethics Committee of the Fukuoka University Faculty of Medicine.

Informed consent statement: Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent.

Conflict-of-interest statement: We have no financial relationships to disclose.

Data sharing statement: No additional data are available.

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Manuscript source: Unsolicited manuscript

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Received: February 14, 2016

Peer-review started: February 15, 2016

First decision: March 23, 2016

Revised: April 21, 2016

Accepted: May 17, 2016

Article in press: May 27, 2016

Published online: July 10, 2016

Abstract

AIM: To evaluate the efficacy and safety of endoscopic submucosal dissection (ESD) under general anesthesia.

METHODS: From January 2011 to July 2014, 206 consecutive patients had undergone ESD under general anesthesia for neoplasms of the stomach, esophagus, and colorectum were enrolled in this retrospective study. The efficacy and safety of ESD under general anesthesia were assessed.

RESULTS: The *en bloc* resection rate of esophageal, gastric, and colorectal lesions was 100.0%, 98.3%, and 96.1%, respectively. The complication rate of perforation

and bleeding were 0.0% and 0.0% in esophageal ESD, 1.7% and 1.7% in gastric ESD, and 3.9% and 2.0% in colorectal ESD, respectively. No cases of aspiration pneumonia were observed. All complications were managed by conservative treatment, with no surgical intervention required.

CONCLUSION: With the cooperation of an anesthesiologist, ESD under general anesthesia appears to be a useful method, decreasing the risk of complications.

Key words: Complication; Endoscopic submucosal dissection; General anesthesia; Conscious sedation

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Core tip: Studies regarding endoscopic submucosal dissection (ESD) under general anesthesia in Japan are scarce because ESD is generally performed under conscious sedation. ESD requires minimal patient movement for optimal visualization, which may be hampered because of insufficient sedation. Thus, this retrospective study aimed to evaluate the efficacy and safety of ESD under general anesthesia in 206 consecutive patients. The complication rate was lower in our study than in previous studies. Moreover, no cases of aspiration pneumonia were observed. ESD under general anesthesia appears to be a useful method for reducing the risk of complications.

Yamashita K, Shiwaku H, Ohmiya T, Shimaoka H, Okada H, Nakashima R, Beppu R, Kato D, Sasaki T, Hoshino S, Nimura S, Yamaura K, Yamashita Y. Efficacy and safety of endoscopic submucosal dissection under general anesthesia. *World J Gastrointest Endosc* 2016; 8(13): 466-471 Available from: URL: <http://www.wjgnet.com/1948-5190/full/v8/i13/466.htm> DOI: <http://dx.doi.org/10.4253/wjge.v8.i13.466>

INTRODUCTION

Endoscopic submucosal dissection (ESD) is a well-established treatment for early-stage malignant lesions of the stomach, esophagus, and colorectum with no risk of lymphatic metastasis^[1-4]. ESD requires precise and complicated maneuvers. Minimal patient movement for maintaining good visualization is important for a successful procedure, and intraoperative management of the patient's general condition is very important for achieving safe ESD. In Japan, ESD is usually performed under conscious sedation in the endoscopy room. However, some issues are associated with this procedure, including patient movement because of insufficient effect of sedation and a risk of aspiration pneumonia. Any patient movement during the procedure can result in complications such as perforation and hemorrhage because of impaired visual control. Aspiration pneumonia can induce respiratory failure. Therefore, we perform ESD under general anesthesia with

mechanical ventilation. In this study, we retrospectively investigated the efficacy and safety of ESD under general anesthesia.

MATERIALS AND METHODS

Indications for endoscopic submucosal dissection under general anesthesia at our institution

ESD under general anesthesia is performed in cases in which the predicted procedure time is > 120 min, an insufficient effect of conscious sedation (such as that in heavy drinkers) was observed, or strict anesthetic management is required (such as that in high-risk cases affected by comorbidities).

Patients

We retrospectively enrolled consecutive 206 patients who had undergone ESD under general anesthesia for neoplasms of the stomach, esophagus, and colorectum in accordance with our indications, except for two patients who rejected the treatment for neoplasms because of their old age, at the Fukuoka University Faculty of Medicine, Department of Gastroenterological Surgery between January 2011 and July 2014. Information collected from medical records included clinical and operative data.

General anesthesia

ESD was performed under general anesthesia with endotracheal intubation by the anesthesiologist in the operation room. General anesthesia was induced with rocuronium and propofol and was maintained with propofol or sevoflurane, remifentanyl, and intermittent rocuronium administration during the procedure. After endotracheal intubation, patients were placed in the left lateral position in cases of esophageal or gastric lesions or in the supine position in cases of colorectal lesions.

Endoscopic equipment

Esophageal and gastric lesion: A gastroscope (GIF H260Z; Olympus, Tokyo, Japan) was used for marking the lesion. The lesion's circumference was marked using argon plasma coagulation (APC). ESD was conducted using a gastroscope (GIF Q260J; Olympus, Tokyo, Japan) with a distal attachment cap (DH-28GR; Fujifilm, Tokyo, Japan). Submucosal injections were performed using a 25-G needle (3 mm; Impact Flow, Top Corporation, Tokyo, Japan) for esophageal lesions, and a 25-G needle (4 mm; Impact Flow, Top Corporation) for gastric lesions. Incision and dissection were performed using two types of Flush Knife BT (2.0 and 2.5 mm, respectively, DK2618JB, Fujifilm Medical, Tokyo, Japan). An electrosurgical generator (VIO 300D; ERBE, Tübingen, Germany) was used for all ESD procedures. All visible vessels were coagulated with hemostatic forceps (Coagrasper; FD-410LR, Olympus).

Colorectal lesions: The endoscope used was a colonoscope (PCF-Q260AZI; Olympus, Tokyo, Japan) with a distal attachment cap (DH-29GR; Fujifilm, Tokyo, Japan) for

Table 1 Baseline clinical and operational characteristics of patients undergoing esophageal endoscopic submucosal dissection

Age, (yr) ¹	69.7 ± 10.0
Sex, n (%)	
Male	41 (89.1)
Female	5 (10.9)
Preoperative co-morbidities, n (%)	39 (84.8)
ASA score, n (%)	
I	8 (17.4)
II	37 (80.4)
III	1 (2.2)
Histologic type, n (%)	
Squamous cell carcinoma	53 (91.4)
Leiomyoma	2 (3.4)
Others	3 (5.2)
Mean diameter of resected specimen, (mm) ¹	32.9 ± 12.1
<i>en bloc</i> resection rate, n (%)	58 (100)
Duration of anesthesia, (min) ¹	233.6 ± 95.0
Duration of operation, (min) ¹	164.5 ± 95.1
Postoperative hospital stay (d) ¹	8.3 ± 2.3
Complication rate, n (%)	0 (0.0)
Intraoperative bleeding	0 (0.0)
Delayed bleeding	0 (0.0)
Intraoperative perforation	0 (0.0)

¹Mean ± SD. ASA: American Society of Anesthesiologists score.

marking of the lesion and ESD. The lesion's circumference was marked using APC. Submucosal injections were performed using a 25-G needle (3 mm, Impact Flow, Top Corporation, Japan). Incision and dissection were performed with a Flush Knife BT (1.5 mm, DK2618JB, Fujifilm Medical, Tokyo, Japan). An electrosurgical generator (VIO 300D; ERBE, Tübingen, Germany) was used for all ESD procedures. All visible vessels were coagulated with hemostatic forceps (Coagrasper; FD-411UR, Olympus).

All ESD procedures were performed with carbon dioxide insufflation.

Ethical considerations

The study was reviewed and approved by the Ethics Committee of the Fukuoka University Faculty of Medicine.

RESULTS

Esophageal ESD under general anesthesia

We performed esophageal ESD under general anesthesia for 58 esophageal neoplasms in 46 patients. The baseline clinical and operative characteristics of the patients are summarized in Table 1. The male:female ratio was 41:5 (89.1%/10.9%) and the mean age of the patients was 69.7 ± 10.0 years (range, 26-82 years). The number of patients who had preoperative comorbidities was 39 (84.8%). The diameter of the resected specimen was 32.9 ± 12.1 mm (range, 10-70 mm). The *en bloc* resection rate was 100.0%. The mean operating time was 164.5 ± 95.1 min (range, 40-468 min). The mean anesthesia time was 233.6 ± 95.0 min (range, 105-545 min). With regard to complications, no cases of perforation or bleeding were observed, and there was no

Table 2 Baseline clinical and operational characteristics of patients undergoing gastric endoscopic submucosal dissection

Age, (yr) ¹	70.4 ± 10.2
Sex, n (%)	
Male	79 (71.2)
Female	32 (28.8)
Preoperative co-morbidities, n (%)	91 (75.2)
ASA score, n (%)	
I	20 (18.0)
II	88 (79.3)
III	3 (2.7)
Histologic type, n (%)	
Differentiated type adenocarcinoma	102 (84.3)
Undifferentiated type adenocarcinoma	8 (6.6)
Others	10 (8.3)
Mean diameter of resected specimen (mm) ¹	39.5 ± 13.9
<i>en bloc</i> resection rate, n (%)	119 (98.3)
Duration of anesthesia, (min) ¹	254.5 ± 95.4
Duration of operation, (min) ¹	188.4 ± 91.7
Postoperative hospital stay (d) ¹	7.5 ± 2.0
Complication rate, n (%)	4 (3.3)
Intraoperative bleeding	1 (0.8)
Delayed bleeding	1 (0.8)
Intraoperative perforation	2 (1.7)

¹Mean ± SD. ASA: American Society of Anesthesiologists score.

perioperative mortality (Table 1).

Gastric ESD under general anesthesia

We performed gastric ESD under general anesthesia for 121 gastric neoplasms from 111 patients. The baseline clinical and operative characteristics of the patients are summarized in Table 2. The male:female ratio was 79:32 (71.2%/28.8%) and the patients' mean age was 70.4 ± 10.2 years (range, 44-89 years). The number of patients who had preoperative comorbidities was 91 (75.2%). The diameter of the resected specimen was 39.5 ± 13.9 mm (range, 10-80 mm). The *en bloc* resection rate was 98.3%. The mean operating time was 188.4 ± 91.7 min (range, 50-615 min), and the mean anesthesia time was 254.5 ± 95.4 min (range, 110-680 min). With regard to complications, intraoperative bleeding occurred in 1 (0.8%) patient, delayed bleeding occurred in 1 (0.8%) patient, and intraoperative perforation occurred in 2 (1.7%) patients (Table 2). In all cases of intraoperative perforation, we were able to close the hole using endoclips. All complications were managed using conservative treatment, with no surgical intervention required. No perioperative mortality was observed.

Colorectal ESD under general anesthesia

We performed colorectal ESD under general anesthesia for 51 colorectal neoplasms from 49 patients. Baseline clinical and operative characteristics of the patients are summarized in Table 3. The male:female ratio was 22:27 (44.9%/55.1%), and patient mean age was 66.7 ± 9.6 years (range, 42-87 years). The number of patients who had preoperative comorbidities was 32 (65.3%). The diameter of the resected specimen was 36.5 ± 11.3

Table 3 Baseline clinical and operational characteristics of patients undergoing colorectal endoscopic submucosal dissection

Age, (yr) ¹	66.7 ± 9.6
Sex, n (%)	
Male	22 (44.9)
Female	27 (55.1)
Preoperative comorbidities, n (%)	32 (65.3)
ASA score, n (%)	
I	14 (28.6)
II	34 (69.4)
III	1 (2.0)
Histologic type, n (%)	
Adenocarcinoma	18 (35.3)
Adenoma	29 (56.9)
Carcinoid	3 (5.9)
Mean diameter of the resected specimen (mm) ¹	36.5 ± 11.3
<i>en bloc</i> resection rate, n (%)	49 (96.1)
Duration of anesthesia, (min) ¹	262.1 ± 93.0
Duration of operation, (min) ¹	199.4 ± 82.2
Postoperative hospital stay (d) ¹	7.4 ± 1.7
Complication rate, n (%)	3 (5.9)
Intraoperative bleeding	0 (0.0)
Delayed bleeding	1 (2.0)
Intraoperative perforation	2 (3.9)

¹Mean ± SD. ASA: American Society of Anesthesiologists score.

mm (range, 10-85 mm). The *en bloc* resection rate was 96.1%. The mean operating time was 199.4 ± 82.2 min (range, 68-465 min), and the mean anesthesia time was 262.1 ± 93.0 min (range, 130-630 min). With regard to complications, delayed bleeding occurred in 1 (2.0%) patient, and intraoperative perforation occurred in 2 (3.9%) patients (Table 3). Furthermore, in all cases of intraoperative perforation, we were able to close the hole using endoclips. All complications were successfully managed using conservative treatment, with no surgical intervention required. No perioperative fatalities were observed.

DISCUSSION

In Japan, ESD is usually performed under conscious sedation in the endoscopy room. Therefore, reports regarding ESD under general anesthesia in Japan are scarce^[5,6].

ESD requires precise and complicated maneuvers with minimal patient movement for maintaining optimal visualization. However, such precise and complicated maneuvers are sometimes difficult to perform because of patient movement because of an insufficient effect of sedation. Benzodiazepines, such as diazepam and midazolam, have been used as standard sedation in patients undergoing endoscopic therapy. However, the range of effective doses of such agents considerably differs among patients; therefore, it is difficult to achieve a stable level of sedation^[7]. Moreover, the dose is often increased to suppress body movement, resulting in oversedation and potentially causing hypoxemia and decreased levels of consciousness upon the patient's return to the hospital ward^[8]. Recently, the usefulness of propofol anesthesia for

therapeutic endoscopy was reported^[7,9]; however, the safe use of propofol is limited.

The advantages of ESD under general anesthesia include optimal visualization in the absence of patient movement; the operator can concentrate on ESD maneuvers without having to attend to anesthetic management because of the assistance of an anesthesiologist; if complications, such as intraoperative perforation and bleeding occur, we can manage this with optimal visualization; there is no risk of aspiration pneumonia during the ESD procedure; and the supervisor can teach beginners without having to care regarding the patient's consciousness.

The reported rate of perforation and bleeding of ESD is 5.0% and 2.1% in esophageal ESD^[10], 0.3%-5.0% and 3.4%-5.8% in gastric ESD^[1,11-14], and 1.4%-10.4% and 0.0%-12.0% in colorectal ESD^[15-18], respectively.

However, the complication rate of perforation and bleeding in ESD under general anesthesia in our institution was 0.0% and 0.0% in esophageal ESD, 1.7% and 1.7% in gastric ESD, and 3.9% and 2.0% in colorectal ESD, respectively. Although half of ESDs were performed by an endoscopy fellow under direct supervision of an experienced endoscopist, the complication rate was lower in our study than that in previous reports.

If intraoperative perforation and bleeding occur, any patient movement during the procedure may cause difficulty in controlling the endoscope because of poor visualization. In our study, intraoperative massive bleeding occurred in only one case of gastric ESD. Furthermore we can safely and quickly control bleeding by maintaining optimal visualization. Moreover, in all cases of intraoperative perforation, we were able to close the hole using endoclips. Conservative treatment was sufficient for all complications, and no surgical intervention was required to manage any bleeding or perforation.

Aspiration pneumonia by vomiting can induce respiratory failure. Aspiration pneumonia is reported to occur in 2.2%-6.6% of patients undergoing ESD^[19-21]. Endotracheal intubation reportedly prevents aspiration, and positive pressure ventilation decreases the risk of air-related adverse events^[4,22]. Here we experienced no cases of aspiration pneumonia performing ESD under general anesthesia.

In this study, 25.5% patients of all ESD procedure under general anesthesia required strict anesthetic management because of severe heart or lung disease (data not shown). However, no complications associated with general anesthesia were observed. Strict anesthetic management by an anesthesiologist may be important in patients with severe heart or lung disease.

Postoperative hospital stay in our study may be longer than that in other advanced nations. The average number of hospitalization days is more in Japan than in other advanced nations because of difference in the medical insurance system. Therefore, the length of hospitalization days in our study was not because of general anesthesia.

The limitation of ESD under general anesthesia is that it can be performed only in a limited number of institutions because it requires the cooperation of an anesthesiologist.

With the cooperation of an anesthesiologist, ESD under general anesthesia will be a useful method for reducing ESD-related complications. Also, ESD under general anesthesia may be a favorable option for ESD beginners.

COMMENTS

Background

Studies regarding endoscopic submucosal dissection (ESD) under general anesthesia in Japan are scarce because ESD is generally performed under conscious sedation. ESD requires minimal patient movement for optimal visualization, which may be hampered because of insufficient sedation.

Research frontiers

This study aimed to evaluate the efficacy and safety of ESD under general anesthesia.

Innovations and breakthroughs

The *en bloc* resection rate of esophageal, gastric, and colorectal lesions was 100.0%, 98.3%, and 96.1%, respectively. The complication rate of perforation and bleeding were 0.0% and 0.0% in esophageal ESD, 1.7% and 1.7% in gastric ESD, and 3.9% and 2.0% in colorectal ESD, respectively. No cases of aspiration pneumonia were observed. All complications were managed by conservative treatment, with no surgical intervention required.

Applications

With the cooperation of an anesthesiologist, ESD under general anesthesia will be a useful method for reducing ESD-related complications.

Peer-review

In the article ESD under general anesthesia, authors tried to evaluate the efficacy and safety of ESD under general anesthesia in the retrospective manner.

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P- Reviewer: Kvolik S, Mentos O **S- Editor:** Qi Y **L- Editor:** A
E- Editor: Lu YJ





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