J Anesth (2014) 28:456–459
DOI 10.1007/s00540-013-1735-0

CLINICAL REPORT

Anesthetic management of peroral endoscopic myotomy for esophageal achalasia: a retrospective case series

Eriko Tanaka · Hiroaki Murata · Hitomi Minami · Koji Sumikawa

Received: 24 July 2013 / Accepted: 14 October 2013 / Published online: 2 November 2013

Abstract Peroral endoscopic myotomy (POEM) is a newly developed, less invasive treatment for esophageal achalasia that requires general anesthesia under positive pressure ventilation. In this retrospective case series, we describe the anesthetic management of 28 consecutive patients who underwent POEM for esophageal achalasia. Anesthesia was maintained with sevoflurane and remifentanil under positive pressure ventilation through a tracheal tube. Retained contents in the esophagus were evacuated just before anesthesia induction to prevent regurgitation into the trachea. The POEM procedure was performed using an orally inserted flexible fiberscope. Elevation of end-tidal carbon dioxide after initiating esophageal carbon dioxide insufflation was observed in all patients and was treated by minute adjustments to the ventilation volume. Scopolamine butylbromide-induced tachycardia in one patient was treated with landiolol hydrochloride, which is a short-acting beta 1-selective blocker. Minor subcutaneous emphysema around the neck was observed in one patient. POEM was successfully completed, and tracheas were extubated immediately after the procedure in all patients. Our findings suggest that prevention of aspiration pneumonia during anesthesia induction, preparation for carbon dioxide insufflation-related complications, and treatment of scopolamine butylbromide-induced tachycardia play important roles in safe anesthesia management of POEM for esophageal achalasia.

Keywords Peroral endoscopic myotomy · Esophageal achalasia · Anesthetic management · Retrospective case series

Introduction

Esophageal achalasia is a disorder characterized by a lack of peristalsis of the esophagus, incomplete lower esophageal sphincter relaxation, and increased tone [1]. Main clinical symptoms include dysphagia, regurgitation, and chest pain [2]. Peroral endoscopic myotomy (POEM) has been developed as an incisionless, minimally invasive endoscopic treatment intended to correct esophageal achalasia by a natural orifice transmural endoscopic surgery (NOTES)-related procedure [3, 4]. Although less invasive, POEM requires general anesthesia under positive pressure ventilation [5–7]. We describe the anesthetic management of 28 consecutive patients who underwent POEM for esophageal achalasia as a retrospective case series.

Case series

After obtaining Institutional Review Board approval, we performed a retrospective chart review for all patients who underwent POEM for esophageal achalasia at Nagasaki University Hospital from August 2010 to August 2012. No written informed consent was required. Table 1 shows the demographic characteristics and clinical features of the 28 consecutive patients who were identified.

E. Tanaka · H. Murata (✉) · K. Sumikawa
Department of Anesthesiology, Nagasaki University School of Medicine, 1-7-1 Sakamoto, Nagasaki 852-8501, Japan
e-mail: h-murata@nagasaki-u.ac.jp

H. Minami
Department of Gastroenterology and Hepatology, Nagasaki University School of Medicine, Nagasaki, Japan

Table 1 Demographic characteristics and clinical features of 28 consecutive patients who underwent peroral endoscopic myotomy for esophageal achalasia

Demographic characteristics/clinical features	Values
Male/female	10/18
Age (year)	52 (19–84)
Duration of symptoms (year)	11 (1–55)
Type of achalasia	
Non-sigmoid	22
Sigmoid	6
Degree of dilatation (diameter of esophageal lumen: *d*)	
Grade I ($d < 35$ mm)	13 (46.4 %)
Grade II (35 mm $< d <$ 60 mm)	12 (42.9 %)
Grade III (60 mm $< d$)	3 (10.7 %)

Data are presented as the mean with the range in parenthesis for continuous variables and as the number (*n*) with the percentage for categorical variables

Patients were withheld oral intake (nil per os) for 24 h before POEM. An esophagoscopy using a large channel endoscope was performed within a few hours prior to anesthesia induction to ensure complete evacuation of the esophageal contents. The nature and volume of the esophageal remnants varied among patients. Of the 27 patients whose pre-anesthetic esophagoscopic findings were available, solid food remained in ten patients (37.0 %) and only liquid was observed in four patients (14.8 %). Of the remaining 13 patients (48.1 %), a very little amount of frothy discharge was observed in five patients (18.5 %), and no remnants were found in eight patients (29.6 %). In either case, all of the esophageal contents were completely evacuated. The patients did not receive premedication before anesthesia induction. Anesthesia was induced with propofol, 1 mg/kg, under continuous intravenous infusion of remifentanil at 0.25–0.5 mcg/kg/min. In some cases, the anesthesiologist in charge of the patient decided to apply cricoid pressure. Rocuronium bromide 0.6 mg/kg was administered to facilitate orotracheal intubation with a cuffed tube. Anesthesia was maintained with sevoflurane, 1.0–1.5 % end-tidal, in oxygen 40 % with air, with continuous intravenous infusion of remifentanil under positive pressure ventilation through the tracheal tube.

For the POEM procedure [5, 8], patients were positioned supine with the upper abdomen exposed. This enabled assessment of apparent pneumoperitoneum that could occur during the procedure as POEM was performed under carbon dioxide insufflation through esophagoscopy at a constant rate of 1.2 L/min [5–8]. A 2-cm longitudinal incision was made on the esophageal mucosal surface at the level of the mid esophagus, followed by creation of a submucosal tunnel downwards, passing the gastroesophageal junction into the proximal stomach. Endoscopic myotomy was started 2 cm distal to the mucosal entry point to approximately 2–3 cm beyond the gastroesophageal junction. The inner circular muscle layer of the esophagus was the sole target of the endoscopic myotomy. Smooth passage of an endoscopy through the gastroesophageal junction into the stomach was confirmed after the myotomy was completed. The mucosal entry site was closed with hemostatic clips at the end of the procedure.

Mean duration of anesthesia and surgery were 138 and 99 min, respectively (Table 2). No regurgitation or aspiration into the trachea was observed during anesthesia induction. Endoscopic observation of the esophagus at the initiation of POEM revealed no remaining contents in any patient. End-tidal carbon dioxide elevation was observed in all patients after the initiation of carbon dioxide insufflation through the esophageal endoscope, which was controlled by increasing minute ventilation volume. No apparent change in the respiratory mechanics, such as elevation of inspiratory pressure during positive pressure mechanical ventilation, was observed in any patient. Based on the data from the electrically recorded anesthetic chart, the highest end-tidal carbon dioxide value after initiation of the esophageal carbon dioxide insufflation was <50 mmHg except for one case. The POEM procedure was completed successfully, and tracheas were extubated in the operating room in all of the patients. Postoperatively, some patients complained about epigastric pain. A diclofenac sodium suppository 25 mg was given to 20 of the 28 patients within first 24 h postoperatively, and three of these 20 patients were also administered pentazocine 15 mg intramuscularly. Metoclopramide 10 mg was used to treat postoperative nausea and vomiting in nine of the 28 patients.

The single case of sudden increase in end-tidal carbon dioxide, which reached 55 mmHg, was accompanied by a small amount of subcutaneous emphysema around the neck. Because the POEM procedure was almost completed at the time of this event, exacerbation of subcutaneous emphysema was not observed. The subcutaneous

Table 2 Anesthesia and surgical events in 28 consecutive patients who underwent peroral endoscopic myotomy for esophageal achalasia

Anesthesia and surgical events	Values
Duration of anesthesia (min)	138 (98–204)
Duration of operation (min)	99 (61–160)
Elevation of end-tidal carbon dioxide tension after esophageal carbon dioxide insufflation	28 (100 %)
Subcutaneous emphysema	1 (3.6 %)
Use of scopolamine butylbromide	4 (14.3 %)

Data are mean (range) for continuous variables; n (%) for categorical variables

emphysema subsided spontaneously in a few days. No clinically apparent adverse events, such as pneumoperitoneum, pneumomediastinum, or pneumothorax were observed during anesthesia.

Intravenous scopolamine butylbromide was administered to four patients to facilitate the POEM procedure by inhibiting abnormal spastic contraction of the esophagus. An increase in heart rate from 60 to 140 beats per min was observed in one patient, who was treated with 20 mg scopolamine butylbromide. Randiolol hydrochloride, a short-acting beta1-adrenergic antagonist, was continuously infused intravenously at a rate of 5 mcg/kg/min for about 50 min to decrease the heart rate. The remaining three patients (two received 20 mg and one received 10 mg of scopolamine butylbromide intravenously) showed a slight increase in heart rate, which lasted about 30 min, but did not require any treatment to control their heart rate.

The POEM procedure achieved the decrease in lower esophageal sphincter pressure in each patient. Mean lower esophageal pressure was decreased from 71.2 to 21.0 mmHg.

Discussion

Aspiration pneumonia caused by residual contents within the esophagus in patients with esophageal achalasia should be avoided during anesthesia induction [9]. Prior endoscopic clearance of the esophageal contents is beneficial in preventing regurgitation during anesthesia induction [6]. In our case series, all patients underwent a pre-anesthetic endoscopic procedure to guarantee esophageal emptiness. We applied cricoid pressure during anesthesia induction in some cases as a further preventative measure. However, esophagoscopy performed after anesthesia induction revealed that no contents remained in the esophagus of any patient. Thus, cricoid pressure might not be necessary during anesthesia induction when pre-anesthetic esophageal emptiness is confirmed by prior endoscopic observation. Both sevoflurane [10] and propofol [11] do not significantly influence esophageal sphincter pressure in healthy individuals. The effect of these agents on esophageal tone in patients with esophageal achalasia has not been well studied; however, information on clinical importance of the selection of anesthetics (e.g., inhalational anesthetic or total intravenous anesthesia) is not available.

Possible complications related to esophageal insufflation during the POEM procedure include pneumomediastinum, pneumoperitoneum, subcutaneous emphysema, and pneumothorax [5–7, 12–14]. General anesthesia with positive pressure ventilation is recommended during the POEM procedure to minimize the risk for pneumomediastinum [5, 6]. In two separate studies, post-procedural computed tomography [5] and chest X-ray film [13] revealed a small amount of carbon dioxide deposition in the mediastinum, although no treatment was required in either study. The reported incidence of pneumomediastinum ranges widely from 0 to 100 % [5, 12–14], possibly due to differences in method of detection in these studies. The reported incidence of pneumoperitoneum ranges from 39.5 to 60 % [7, 12, 13]. Needle placement through the abdominal wall to decrease intra-abdominal pressure, which was not indicated in the our case series, might be used when necessary [5, 7, 12], based on assessment of the abdominal wall upon clinical palpation [12].

The reported incidence of subcutaneous emphysema ranges from 0 to 55.5 %, with most cases resolved through conservative treatment [13]. Similar to laparoscopic surgery [15], a sudden increase in end-tidal carbon dioxide tension during carbon dioxide insufflation into the esophagus might be a sign of extensive subcutaneous emphysema. The use of carbon dioxide to insufflate the esophagus has been recommended, taking into account the higher incidence of subcutaneous emphysema, mediastinal emphysema, pneumothorax, and pneumoperitoneum associated with air insufflation into the esophagus [13].

About 10–20 mg of scopolamine butylbromide is usually injected intravenously during gastrointestinal endoscopic examination. However, scopolamine butylbromide induces tachycardia because of its anticholinergic action [16]. Simultaneous treatment of a beta 1-selective adrenergic antagonist is useful in keeping the heart rate stable [17]. Thus, a short-acting beta 1-selective adrenergic antagonist should be considered when scopolamine butylbromide is used during POEM for esophageal achalasia, especially for elderly patients or those with cardiac complications. Glucagon, which does not influence autonomic nervous activity, might be an option to inhibit gastric peristalsis [18].

In conclusion, prevention of aspiration pneumonia during anesthesia induction, preparation for carbon dioxide insufflation-related complications, and heart rate control against scopolamine-induced tachycardia appear to be important preventative factors for the anesthesia management of POEM for esophageal achalasia.

References

1. Ferguson MK. Achalasia: current evaluation and therapy. Ann Thorac Surg. 1991;52:336–42.
2. Bedgood R, Sadurski R, Schade RR. The use of the internet in data assimilation in rare diseases. Dig Dis Sci. 2007;52:307–12.
3. Bello B, Herbella FA, Patti MG. Evolution of the minimally invasive treatment of esophageal achalasia. World J Surg. 2011;35:1442–6.
4. Kalloo AN, Singh VK, Jagannath SB, Niiyama H, Hill SL, Vaughn CA, Magee CA, Kantsevoy SV. Flexible transgastric

peritoneoscopy: a novel approach to diagnostic and therapeutic interventions in the peritoneal cavity. Gastrointest Endosc. 2004;60:114–7.
5. Inoue H, Minami H, Kobayashi Y, Sato Y, Kaga M, Suzuki M, Satodate H, Odaka N, Itoh H, Kudo S. Peroral endoscopic myotomy (POEM) for esophageal achalasia. Endoscopy. 2010;42:265–71.
6. Inoue H, Tianle KM, Ikeda H, Hosoya T, Onimaru M, Yoshida A, Minami H, Kudo SE. Peroral endoscopic myotomy for esophageal achalasia: technique, indication, and outcomes. Thorac Surg Clin. 2011;21:519–25.
7. von Renteln D, Inoue H, Minami H, Werner YB, Pace A, Kersten JF, Much CC, Schachschal G, Mann O, Keller J, Fuchs KH, Rosch T. Peroral endoscopic myotomy for the treatment of achalasia: a prospective single center study. Am J Gastroenterol. 2012;107:411–7.
8. Minami H, Isomoto H, Yamaguchi N, Matsushima K, Akazawa Y, Ohnita K, Takeshima F, Inoue H, Nakao K. Peroral endoscopic myotomy for esophageal achalasia: Clinical impact of 28 cases. Dig Endosc 2013. doi:10.1111/den.12086
9. Khandelwal M, Krueger C. Diaphragmatic hernia after laparoscopic esophagomyotomy for esophageal achalasia in pregnancy. ISRN Gastroenterol 2011;2011:871958. doi:10.5402/2011/871958
10. Kohjitani A, Shirakawa J, Satoh E, Kagawa T, Nakajima M, Obara H. Effects of sevoflurane and enflurane on lower esophageal sphincter pressure and gastroesophageal pressure gradient in children. J Anesth. 1999;13:1–7.
11. Turan A, Wo J, Kasuya Y, Govinda R, Akca O, Dalton JE, Sessler DI, Rauch S. Effects of dexmedetomidine and propofol on lower esophageal sphincter and gastroesophageal pressure gradient in healthy volunteers. Anesthesiology. 2010;112:19–24.
12. Swanstrom LL, Rieder E, Dunst CM. A stepwise approach and early clinical experience in peroral endoscopic myotomy for the treatment of achalasia and esophageal motility disorders. J Am Coll Surg 2011;213:751–56.
13. Ren Z, Zhong Y, Zhou P, Xu M, Cai M, Li L, Shi Q, Yao L. Perioperative management and treatment for complications during and after peroral endoscopic myotomy (POEM) for esophageal achalasia (EA) (data from 119 cases). Surg Endosc 2012;26:3267–72.
14. Costamagna G, Marchese M, Familiari P, Tringali A, Inoue H, Perri V. Peroral endoscopic myotomy (POEM) for oesophageal achalasia: Preliminary results in humans. Dig Liver Dis 2012;4:827–32.
15. Lindsey S. Subcutaneous carbon dioxide emphysema following laparoscopic salpingo-oophorectomy: a case report. AANA J. 2008;76:282–5.
16. Grainger SL, Smith SE. Dose-response relationships of intravenous hyoscine butylbromide and atropine sulphate on heart rate in healthy volunteers. Br J Clin Pharmacol. 1983;16:623–6.
17. Suzuki S, Nonaka A, Abe F. Effect of esmolol on cardiovascular responses induced by scopolamine butylbromide. Masui. 2005;54:1277–81.
18. Katoh K, Nomura M, Iga A, Hiasa A, Uehara K, Harada K, Nakaya Y, Ito S. Comparison of gastric peristalsis inhibition by scopolamine butylbromide and glucagon: evaluation by electrogastrography and analysis of heart rate variability. J Gastroenterol. 2003;38:629–35.