Turk J Gastroenterol *2016; 27: 97-102*

Early diagnosis and management of esophageal leakage after peroral endoscopic myotomy for achalasia

ESOPHAGUS

Yi-Qun Zhang, Li-Qing Yao, Mei-Dong Xu, Quan-Lin Li, Wei-Feng Chen, Jian-Wei Hu, Ming-Yan Cai, Wen-Zheng Qin, Ping-Hong Zhou

Endoscopy Center and Endoscopy Research Institute, Zhongshan Hospital, Fudan University, Shanghai, China

Original Article

ABSTRACT

Background/Aims: To improve the understanding of esophageal leakage after peroral endoscopic myotomy (POEM).

Materials and Methods: From August 2010 to April 2013, patients with postoperative esophageal leakage were identified from the database of cases with achalasia who had undergone POEM and their medical records were reviewed.

Results: Three patients (0.4%, 3/679) developed esophageal leakage after POEM. All three patients had non-severe chest or upper abdominal pain within 3 days after the procedure. Infections were observed, and computed tomography scans showed pleural effusion in all three patients. Pneumonia occurred in two of the three patients. Esophageal leakage was confirmed by gastroscopy. Incision rupture due to an early breaking-off of the clips at the tunnel entry was revealed in two cases. When detected, the entry was immediately closed using metal clips. A thoracic drain was placed in all cases. An enteric feeding tube was also placed to help correct nutrition deficiencies. Successful leakage closure was achieved in all three cases and no surgical intervention was needed.

Conclusion: Early diagnosis and treatment can improve the status of patients with esophageal leakage after POEM and can shorten the recovery time.

Keywords: Peroral endoscopic myotomy, esophageal leakage, achalasia

INTRODUCTION

Achalasia is a major primary esophageal dysmotility disorder, with dysphagia as the chief complaint. Mainly because the mechanisms underlying the loss of neurons in achalasia are not yet understood, treatment remains confined to disrupting the lower esophageal sphincter (LES) (1,2). Peroral endoscopic myotomy (POEM) has been developed as a minimally invasive endoscopic treatment and provides a curative method for esophageal achalasia. It has become widely accepted because of its general perioperative safety and excellent short-term outcomes in terms of symptom resolution and improvement in esophagogastric junction (EGJ) physiology (3-13).

Nevertheless, as with any surgical procedure, the possibility of complications occurring during and after the POEM procedure still exists. POEM-related complications include subcutaneous/mediastinal emphysema, pneumothorax, pneumoperitoneum, pleural effusion, hemorrhage, and infection (14,15). It is well known that esophageal leakage is a severe postoperative complication of esophageal surgery, with a high mortality rate. However, heretofore, it has not been reported as a complication of POEM. Although esophageal leakage has a low incidence, it can have serious conditions. Furthermore, delayed diagnosis and therapy could result in risks in morbidity and mortality. In this study, the medical records of three patients with esophageal leakage after POEM were reviewed in order to provide information regarding the mechanism, early diagnosis, and optimal management of this severe complication.

Address for Correspondence: Ping-Hong Zhou E-mail: zhou.pinghong@zs-hospital.sh.cn
Received: October 22, 2015 **Accepted:** February 14, 2016

Turk J Gastroenterol 2016; 27: 97-102

MATERIALS AND METHODS

Study design

From August 2010 to April 2013, 679 patients underwent successful POEM in our center. Patients who had esophageal leakage after the procedure were identified and their medical data were reviewed. Patients were followed up for 11–18 months, and the score of Eckardt symptoms was employed to objectively assess their symptom relief. In this study, written forms of consent to undergo POEM from the patients included were collected. The study was approved by the Institutional Research Ethics Committee.

POEM procedure

A single-channel gastroscope with a transparent cap attached to the gastroscope tip was employed (16). Other equipment and the POEM procedure have been reported in detail in previous papers (3-13). After careful hemostasis, a copious amount of saline is sprayed into the submucosal tunnel. The mucosal entry is closed by using four to six clips.

Post-procedure management

Proton pump inhibitor (PPI), antibiotic, and hemocoagulase could be used postoperatively. Symptoms, including chest/abdominal pain, hematemesis/melena, dyspnea, and abdominal distention, should be carefully observed. A chest computed tomography (CT) scan was performed on the first day after POEM in 476 of the 679 included patients (70.1%), and postoperative esophageal leakage was detected in three patients. Patients fasted in the first day after POEM, and a full liquid diet was then permitted on the second day if there were no abnormal symptoms or CT scan findings. Patients were discharged on the third day with instructions to continue the PPI and a liquid diet for 1 week, followed by a semiliquid diet for another week, before resuming a normal diet. Patients were asked to discontinue the PPI medication at 4 to 8 weeks after the POEM.

Diagnosis of esophageal leakage

The diagnosis of esophageal leakage depends on recognizing its clinical features and confirming its presence by endoscopy. Esophageal leakage is suspected if chest pain, a continuous high fever, or dyspnea occurred. However, the early signs of esophageal leakage might be nonspecific until the start of oral intake. A chest CT scan may help detect this complication if it shows a large pleural effusion, pneumonia, or segmental atelectasis of the lungs, all of which can be early signs of esophageal leakage. Emergency endoscopy was performed for confirmation in all patients suspected of esophageal leakage.

Data collection and analysis

Data on esophageal leakage after POEM were collected and analyzed. Commercial software (IBM SPSS Statistics 18; SPSS, Chicago, IL, USA) was used for the statistical analysis, and $p<0.05$ was accepted to be statistically significant.

RESULTS

Three patients developed leakage after POEM (Table 1). There were no special technical difficulties in cases 1 or 3, but difficulty creating the submucosal tunnel was noted in case 2 because of severe fibrosis in the submucosal layer from a previous laparoscopic Heller myotomy (LHM). Full-thickness myotomies of internal circular and longitudinal muscular layers were done in all three patients.

All patients with leakage reported chest or upper abdominal pain within 3 days after POEM, but it was not severe in any of these patients. Manifestations of infection, including fever and increased white blood cell counts, were observed in all three patients. CT scans on postoperative day 1 showed a pleural effusion in all three patients and pneumonia in two of the patients.

All the patients with leakage were fasted and treated with antibiotics. No other special treatment was initiated for case 1 because only a low fever and small pleural effusion were present. This patient was discharged from the hospital after tolerating a liquid oral intake for 3 days, but subsequently developed a cough, chest pain, and high fever 1 week after discharge. A chest CT at that time revealed a pulmonary abscess on the left. The patient was treated with antibiotics and nutritional support for approximately 2 months, which relieved the cough and chest pain but not the fever. Gastroscopic exploration was thus performed, which revealed a leak orifice at the tunnel entrance. An enteric feeding tube was placed into the descend-

Table 1. Patient characteristics and outcomes

Case	Age (y)	Sex	Course (y)	Eckardt score	Previous treatment	OR time (min)	Myotomy length (cm)	Early manifestations	Leakage identified by endoscopy	Closed by endoscopy	Thoracic drainage	Enteric feeding tube	Hospital stay
1	19	M	2	6	No	30	10	Chest pain on left; low fever	Yes	No	Yes	Yes	100
2	43	F	10	8	Heller	53	7	Chest pain; high fever	Yes	Yes	Yes	Yes	30
3	56	M	3	9	No	37	11	Upper abdominal pain; moderate fever	Yes	Yes	Yes	Yes	22

F: female; M: male; OR: operating room

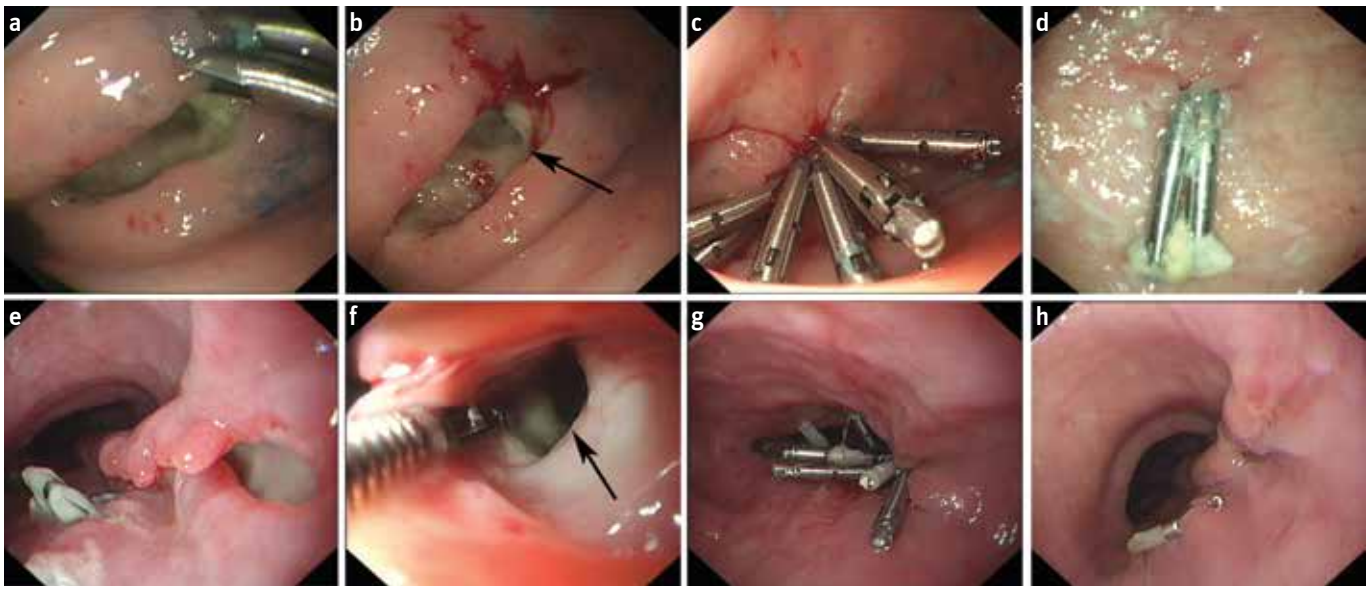

Figure 1. a-h. Esophagothoracic leakage after peroral endoscopic myotomy in two cases (#2: a-d; #3: e-h). (a, b, e, f) Metallic clips falling off the tunnel entry area and endoscopic view revealing the esophageal leak. The arrows indicate the fistula. (c, g) The fistula successfully clipped with metallic clips. (d, h) Satisfactory healing at 2-3 weeks in follow-up endoscopy.

ing duodenum. Meanwhile, a thoracic drain was placed under ultrasound guidance. The patient's temperature decreased to normal after a week, and the leak orifice was confirmed to be healing 1 month later.

In cases 2 and 3, a thoracic drain was placed immediately after the CT scans on postoperative day 1 identified the presence of possible esophageal leakage. The temperature of both patients fell after sufficient drainage, and a liquid diet was subsequently allowed. However, after oral intake resumed, the drainage changed to purulent, and a moderate fever recurred. Esophageal leakage was thus highly suspected. An esophageal X-ray with diatrizoate and oral methylene blue was performed, but no obvious esophageal leakage was detected. Both patients immediately underwent emergency gastroscopy. The clips (HX-600-135, Olympus) used to close the incision at the tunnel entry site were noted to be loose or broken off, and an orifice of leakage was detected at the tunnel entrance in both patients. When we thoroughly investigated the operation records, folding of the mucosa over the incision line after clipping was observed, indicating that the closure of the tunnel entry had been unsatisfactory. This had presumably led to dehiscence because of the relatively high tension in the area. The leakage was washed with abundant sterile saline and then closed with metal clips (Resolution™; Boston, MA, USA). A gastrointestinal decompression tube was placed near the orifice, and an enteric feeding tube was placed into the descending duodenum. The patients were restricted from oral intake and fed with a nutrient solution through the feeding tube. The body temperature, routine blood test results, and amount and character of the gastric and thoracic drainage were monitored. A PPI and antibiotics were administered to both patients, and closure of the leakage was subsequently confirmed by gastroscopy. Figure 1 shows the views during emergency endoscopy for these two patients, illustrating the diagnosis and closure of the leakage.

Table 2. Follow-up results

Case No.	Eckardt score	Endoscopy			Esophageal barium swallow	Esophageal manometry 4-s IRP, mmHg
		Cardia	Pressure	Reflux		
1	0	Open	No	No	Normal	9.1
2	1	Open	No	No	Normal	2.0
3	0	Open	No	No	Normal	8.1

IRP: integrated relaxation pressure

Complete healing of the esophageal leakage was successfully achieved in all three patients without surgical intervention. A follow-up of 11 to 18 months was taken with all three patients. The follow-up results are shown in Table 2. All the patients had continued relief of their dysphagia, and none reported gastroesophageal reflux symptoms, such as acid reflux or heartburn. The Eckardt scores decreased from pre-treatment (6, 9, and 8) to post-treatment (0, 1, and 0, respectively). At follow-up endoscopy, the endoscope passed smoothly through the esophagus to the gastric cardia in all three patients. No objective evidence of reflux was seen during endoscopy. The follow-up esophageal barium swallow and manometry showed relaxation and a normal pressure at the LES (Figure 2).

DISCUSSION

Esophageal leakage, with an incidence of 4%–30%, is one of the most serious complications of esophageal surgery (17). The rate of clinically significant esophageal perforation reported in the literature for LHM ranges from 0 to 4.6% (18). The 0.4% incidence (3/679) of esophageal leakage after POEM reported in

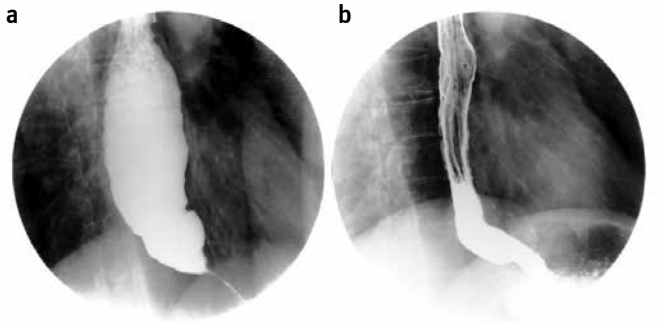

Figure 2. a, b. Esophageal barium swallow results of patient #3 pre- (a) and postoperatively (b).

the current study was much lower than that associated with esophageal surgery because the surrounding structure and blood supply of the esophagus are kept intact during the POEM procedure. It is important to maintain the integrity of the mucosal layer to allow it to cover the wound surface after myotomy, thereby avoiding the contents of esophageal leakage into the mediastinum.

In this study, all three patients who developed leakage had a long history of achalasia with severe dysphagia; this was particularly notable for case 2. Recurrent inflammation of the esophageal wall caused by frequent retention of food resulted in thickening of the mucosa and fibrosis formation in the submucosa. LHM, pneumatic dilation, or botulinum toxin injection can make this situation worse. It is difficult to create a tunnel in the submucosa in the presence of severe fibrosis. The submucosal fibrosis and mucosa thickening may increase the risk of a mucosal defect and subsequent leakage. Establishing the submucosal tunnel close to the muscle is important not only to avoid injuring the mucosal flap but also because of the lower vascularity in this area. Repeated injection of saline can be performed when the submucosal dissection plane becomes unclear; this will clear the demarcation between the mucosal layer and muscularis propria. Furthermore, the mucosal entry site should be tightly closed by metal clips after carefully washing the submucosal tunnel. However, a thick mucosa will be difficult to sew up tightly. Furthermore, endoscopic exploration in cases 2 and 3 showed that the clips used to close the tunnel entry broke off early, which was likely an important contributor to the esophageal leakage. This suggests that common clips are not powerful enough to tightly close the thick mucosal incision. Closing the tunnel entry by using Boston clips may be more effective for these types of patients and is recommended. Over-the-scope clips (OTSC) have been described as a good option for closing the mucosal incision during POEM. The use of OTSC may simplify the procedure and result in a more durable (i.e., full-thickness) closure (19). For patients with complicated situations, we also recommend extending the fasting time and placing a gastrointestinal decompression tube immediately after POEM to keep the wound surface clean to facilitate healing of the mucosal incision.

Although all three patients with leakage in our study underwent full-thickness myotomy, this is unlikely to be the cause of leakage after POEM. In our previous study (9), full-thickness myotomy was not associated with any infectious complications. These results supported the hypothesis that endoscopically performing two-level perforation of the gastrointestinal wall using the submucosal technique, even into the mediastinum, is feasible as long as the mucosal opening is sufficiently closed and ongoing spillage is avoided (20,21).

Early signs of an esophageal leak might be nonspecific and include such signs as chest pain, fever, and increased white blood cell; these occurred in all three patients in the current study. However, these nonspecific symptoms may be controlled by antibiotics if patients are fasted. Indeed, about 20% of leakages are not found and some became symptomatic only after resuming diet (22). In our experience, a change in the volume and/or characteristics of thoracic tube drainage and a slow course of recovery after oral intake might be useful hints suggesting that leakage is present.

The diagnosis of esophageal leakage is difficult, especially in the early stages of a small leak. Chest CT scans will help detect an esophageal leak, but they are less sensitive than esophageal X-ray in identifying leakage. Radiology remains the cornerstone of leakage evaluation, but they are also not completely reliable in detecting small leaks. In the current study, all leakages were detected by endoscopic exploration. Endoscopy, by providing direct vision, may be more sensitive than radiological imaging in detecting a small leakage. In the future, endoscopy may be even more useful in diagnosing a leak if it is combined with fistulography, allowing fluoroscopic imaging of the leak (23).

Furthermore, endoscopy may be the most important and effective treatment for esophageal leakage. Closure of the leakage orifice by metal clips will substantially shorten its course. The duration of healing for cases 2 and 3 was shorter than for case 1 using the same basic conservative treatment. No increase in complications was observed in cases 2 and 3 by performing an endoscopic examination in the first few postoperative days. Moreover, a gastrointestinal decompression tube and enteric feeding tube could be placed at the same time under direct vision by the endoscope, contributing to the closure of the leakage. The use of a fibrin sealant during endoscopic treatment to seal a leak or fistula has been described. Two sealant components, fibrinogen and thrombin, stimulate the coagulation cascade when sealant is placed into the fistulous tract, and the fibrin will subsequently be slowly replaced by collagen (24). Sometimes, endoscopic sealing by clips alone may not be sufficient for a large leak, so combining clipping and fibrin sealing is probably more effective in these situations. Endoscopic suturing systems have been in use for the treatment of gastroesophageal reflux disease. The same technical principle should also be suitable for closing a mucosal defect; suturing may be an interesting new method for leakage treatment by endos-

copy (25,26). OTSC, as a full-thickness clipping device, may also be used for leak closure (19). A covered retrievable stent can be another option for sealing the rupture and restoring mucosal integrity (27).

Esophageal leakage is often accompanied by malnutrition, lack of food intake, and hypercatabolism (28). Malnutrition leads to hypoproteinemia, which increases the risk of wound dehiscence, infection, and reduced fibroblastic activity, leading to failure of scar contraction and a delayed healing time (29). Nutritional problems exist in more than half of patients with leakage because of the loss of digestive fluid, especially proteins and electrolytes, which may negatively impact treatment outcome. Therefore, it is important not only to achieve closure of the esophageal leak therapeutically, but also to provide conservative treatment. The conservative management includes adequate drainage, fluid and electrolyte replacement, and nutritional support via enteral or parenteral nutrition. All three patients in this study accepted enteral nutrition with an enteric feeding tube and recovered relatively quickly. An important advantage of enteral nutrition could be the positive effect on gut barrier function (30). No malnutrition or electrolyte imbalance occurred in our patients. Enteral nutrition was thus a safe and effective treatment for patients with esophageal leakage.

Leakage of the esophagus often leads to a localized infection and systemic sepsis. Antibiotic treatment should be used in patients with systemic or local inflammation. Manifestations of infection were observed in our three patients in the first few postoperative days. They included fever, chest or upper abdominal pain, an increased white blood cell count, and pneumonia as revealed by CT scan. Patients with leakage are susceptible to infections, including pneumonia, phlebitis, and urinary tract infections, as well as infections from the incision wound and leakage area (31). Proper antibiotic therapy combined with drainage is necessary for patients with leakage in order to shorten recovery times.

Although data from long-term follow-up of patients who underwent POEM at our center were not analyzed, it appears that the effectiveness of the POEM procedure was not diminished by the development of the esophageal leakage that was adequately treated. All three patients exhibited persistent symptom relief according to the available long-term follow-up information. No morbidity was noted during follow-up.

Naturally, the current study has inherent methodological limitations, especially in view of its limited number of cases and retrospective design. Potential selection bias may have occurred since our hospital is a tertiary referral hospital and the main center with a large number of POEMs performed around the world. Thus, our results may not represent the findings in other hospitals. We recommend that POEM should be attempted in centers with experience in endoscopic resection and in the management of potential complications.

In summary, esophageal leakage is a rare complication of POEM. It is important to maintain the integrity of the mucosal layer that plays the role of the barrier between the esophageal lumen and mediastinum. Previous LHM, pneumatic dilation, and botulinum toxin injection may increase the risk of leakage by enhancing the difficulty of performing POEM. Early diagnosis is difficult because typical symptoms of esophageal leakage are often lacking before oral intake is begun. Leakage should be considered if recovery is unusual or proceeding slowly. Endoscopy is recommended as an effective and safe method to detect a small leakage and as an effective treatment for closing the leak in its early stages. Adequate nutritional support through an enteric feeding tube is another important strategy to reduce morbidity and recovery time. Patients with esophageal leakage after POEM can achieve complete recovery in a short time without surgical intervention by endoscopic closure of the leak, sufficient drainage, and optimal conservative management. The long-term effectiveness of POEM is not diminished by esophageal leakage when endoscopy is used for early detection and therapy.

Ethics Committee Approval: The study was reviewed and approved by the Institutional Review Board of Zhongshan Hospital, Fudan University.

Informed Consent: All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - Y.Q.Z., L.Q.Y., Z.P.H.; Design - Y.Q.Z., L.Q.Y., P.H.Z.; Materials - P.H.Z., Y.Q.Z., M.D.X., L.Q.L., W.F.C., J.W.H., M.Y.C., W.Z.Q.; Data Collection and/or Processing - Y.Q.Z.; Writer - Y.Q.Z., L.Q.L.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: This study was supported by grants from the Major Project of Shanghai Municipal Science and Technology Committee (13411950801), Academic Leader Training Project of Shanghai Municipal Commission of Health and Family Planning (13B038), National Natural Science Foundation of China (81201902, 81302098, 81470811, and 81401930), and Natural Science Foundation of Shanghai (13ZR1452300).

REFERENCES

1. Boeckxstaens GE, Zaninotto G, Richter JE. Achalasia. Lancet 2014; 383: 83-93. [CrossRef]
2. Eckardt AJ, Eckardt VF. Treatment and surveillance strategies in achalasia: an update. Nat Rev Gastroenterol Hepatol 2011; 8: 311-9. [CrossRef]
3. Inoue H, Minami H, Kobayashi Y, et al. Peroral endoscopic myotomy (POEM) for esophageal achalasia. Endoscopy 2010; 42: 265-71. [CrossRef]
4. NOSCAR POEM White Paper Committee, Stavropoulos SN, Desilets DJ, et al. Per-oral endoscopic myotomy white paper summary. Gastrointest Endosc 2014; 80: 1-15. [CrossRef]
5. Von Renteln D, Fuchs KH, Fockens P, et al. Peroral endoscopic myotomy for the treatment of achalasia: an international prospective multicenter study. Gastroenterology 2013; 145: 309-11. [CrossRef]
6. Familiari P, Gigante G, Marchese M, et al. Peroral endoscopic myotomy for esophageal achalasia: outcomes of the first 100 pa-

tients with short-term follow-up. Ann Surg 2014 [Epub ahead of print].
7. Swanstrom LL, Kurian A, Dunst CM, et al. Long-term outcomes of an endoscopic myotomy for achalasia: the POEM procedure. Ann Surg 2012; 256: 659-67. [CrossRef]
8. von Renteln D, Inoue H, Minami H, et al. Peroral endoscopic myotomy for the treatment of achalasia: a prospective single center study. Am J Gastroenterol 2012; 107: 411-7. [CrossRef]
9. Li QL, Chen WF, Zhou PH, et al. Peroral endoscopic myotomy for the treatment of achalasia: a clinical comparative study of endoscopic full-thickness and circular muscle myotomy. J Am Coll Surg 2013; 217: 442-51. [CrossRef]
10. Zhou PH, Li QL, Yao LQ, et al. Peroral endoscopic remyotomy for failed Heller myotomy: a prospective single-center study. Endoscopy 2013; 45: 161-6. [CrossRef]
11. Chen WF, Li QL, Zhou PH, et al. Long-term outcomes of peroral endoscopic myotomy for achalasia in pediatric patients: a prospective, single-center study. Gastrointest Endosc 2015; 81: 91-100. [CrossRef]
12. Chiu PW, Wu JC, Teoh AY, et al. Peroral endoscopic myotomy for treatment of achalasia: from bench to bedside (with video). Gastrointest Endosc 2013; 77: 29-38. [CrossRef]
13. Werner YB, Costamagna G, Swanstrom LL, et al. Clinical response to peroral endoscopic myotomy in patients with idiopathic achalasia at a minimum follow-up of 2 years. Gut 2015 [Epub ahead of print]. [CrossRef]
14. Ren Z, Zhong Y, Zhou P, et al. 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. [CrossRef]
15. Cai MY, Zhou PH, Yao LQ, et al. Thoracic CT after peroral endoscopic myotomy for the treatment of achalasia. Gastrointest Endosc 2014; 80: 1046-55. [CrossRef]
16. Tanaka E, Murata H, Minami H, et al. Anesthetic management of peroral endoscopic myotomy for esophageal achalasia: a retrospective case series. J Anesth 2014; 28: 456-9. [CrossRef]
17. Berry SM, Fischer JE. Classification and pathophysiology of enterocutaneous fistulas. Surg Clin North Am 1996; 76: 1009-18. [CrossRef]
18. Lynch KL, Pandolfino JE, Howden CW, et al. Major complications of pneumatic dilation and Heller myotomy for achalasia: single-center experience and systematic review of the literature. Am J Gastroenterol 2012; 107: 1817-25. [CrossRef]
19. Saxena P, Chavez YH, Kord Valeshabad A, et al. An alternative method for mucosal flap closure during peroral endoscopic myotomy using an over-the-scope clipping device. Endoscopy 2013; 45: 579-81. [CrossRef]
20. Willingham FF, Gee DW, Lauwers GY, et al. Natural orifice transesophageal mediastinoscopy and thoracoscopy. Surg Endosc 2008; 22: 1042-7. [CrossRef]
21. Rattner DW, Hawes R, Schwaitzberg S, et al. The Second SAGES/ASGE White Paper on natural orifice transluminal endoscopic surgery: 5 years of progress. Surg Endosc 2011; 25: 2441-8. [CrossRef]
22. Orringer MB, Marshall B, Iannettoni MD. Transhiatal esophagectomy: clinical experience and refinements. Ann Surg 1999; 230: 392-400 discussion 400-3.
23. Wong SK, Lam YH, Lau JY, et al. Diagnostic and therapeutic fistuloscopy: an adjuvant management in postoperative fistulas and abscesses after upper gastrointestinal surgery. Endoscopy 2000; 32: 311-3. [CrossRef]
24. Rabago LR, Ventosa N, Castro JL, et al. Endoscopic treatment of postoperative fistulas resistant to conservative management using biological fibrin glue. Endoscopy 2002; 34: 632-8. [CrossRef]
25. Adler DG, McAfee M, Gostout CJ. Closure of an esophagopleural fistula by using fistula tract coagulation and an endoscopic suturing device. Gastrointest Endosc 2001; 54: 652-3. [CrossRef]
26. Modayil R, Friedel D, Stavropoulos SN. Endoscopic suture repair of a large mucosal perforation during peroral endoscopic myotomy for treatment of achalasia. Gastrointest Endosc 2014; 80: 1169-70. [CrossRef]
27. Ling T, Pei Q, Pan J, et al. Successful use of a covered, retrievable stent to seal a ruptured mucosal flap safety valve during peroral endoscopic myotomy in a child with achalasia. Endoscopy 2013; 45 Suppl 2 UCTN: E63-4.
28. Messmann H, Schmidbaur W, Jäckle J, et al. Endoscopic and surgical management of leakage and mediastinitis after esophageal surgery. Best Pract Res Clin Gastroenterol 2004; 18: 809-27. [CrossRef]
29. Waitzberg DL, Plopper C, Terra RM. Postoperative total parenteral nutrition. World J Surg 1999; 23: 560-4. [CrossRef]
30. Reynolds JV, Kanvar S, Welsh FK, et al. Does the route of feeding modify gut barrier function and clinical outcome in patients after major upper gastrointestinal surgery? J Parenter Enteral Nutr 1997; 21: 196-201. [CrossRef]
31. Rolandelli R, Roslyn JJ. Surcical management and treatment of sepsis associated with gastrointestinal fistulas. Surg Clin North Am 1996; 76: 1111-22. [CrossRef]