ORIGINAL ARTICLE

Endoscopic debridement of paraesophageal, mediastinal abscesses: a prospective case series

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Background: Mediastinal abscesses after esophageal perforation or postoperative leakage nearly always require surgical intervention.

Methods: Patients with paraesophageal abscesses were treated with EUS-guided or endoscopic mediastinal puncture if the abscess was >2 cm and sepsis was present. Abscess cavities were entered with a 9.5-mm endoscope after balloon dilation to allow irrigation and drainage. Debris was removed with a Dormia basket. Concomitant pleural effusions were treated with transthoracic drains. Patients received intravenous antibiotics and enteral/parenteral nutrition.

Results: Twenty patients fulfilled the entry criteria. Simple drainage was sufficient in 4 cases, and puncture was impossible in one case. Of the 15 treated patients (age 39-76 years, 5 women) the etiology of perforation was Boerhaave's syndrome (n = 8), anastomotic leak (n = 3), and iatrogenic perforation (n = 4). Debridement was successful in all cases and required a median of 5 daily sessions (range 3-10). All patients became apyrexial, with a C-reactive protein < 5 mg/L within a median of 4 days (range 2-8 days). Esophageal defects were closed with endoclips (n = 7), fibrin glue (n = 4), metal stents (n = 1), or spontaneously healed (n = 3). One patient died from a massive pulmonary embolism one day after successful debridement (mortality 7%). No other complications were seen. Median follow-up was 12 months (range 3-40 months).

Conclusions: Nonoperative endoscopic transesophageal debridement of mediastinal abscesses appears safe and effective. (Gastrointest Endosc 2005;62:344-9.)

Esophageal perforation as well as postoperative, intrathoracic anastomotic insufficiency are feared conditions and continue to carry a high morbidity and mortality, ranging from 10% to 35%.[1] Factors that influence outcome are the location and the etiology of the perforation.[2] Timing of medical or surgical treatment appears to be the most important predictor of mortality.[3,4] Contained esophageal perforation and leakage can be treated conservatively.[5] However, once mediastinal abscesses have formed, the clinical course often is complicated, and prolonged hospital admissions are often necessary. Surgical intervention is invariably necessary to debride and clean the abscess cavity, to generate a controlled fistula, and to repair the esophageal defect.[6,7] Surgical treatment algorithms of mediastinal abscesses after esophageal perforation remain controversial and need to be tailored to the etiology of the perforation, the site of the perforation, and the presence or the absence of mediastinal abscess formation. Alternatively, percutaneous CT-guided thoracocentesis with catheter drainage has been described.[8-11]

Recent developments in endoscopic techniques and the invention of EUS have made an endoscopic approach for treatment of paraesophageal abscesses possible. Under direct endoscopic vision or by EUS-guided puncture, drainage of paraesophageal fluid collections can be achieved by insertion of nasocystic catheters or stents.[12-14] Usually, spontaneous closure of the puncture site can be expected. In case of a larger esophageal perforation or an anastomotic leak, endoscopic clip application, closure with fibrin glue, or placement of covered metal stents can be used to seal the defect.[15,16]

However, if a larger abscess that contains debris and necrotic material is present, drainage via small-caliber stents or catheter drains (usually 7F-10F drains) may not be sufficient. The recently described successful endoscopic management of larger retroperitoneal abscesses when

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using EUS-guided puncture, dilation of the posterior gastric wall, and debridement under direct endoscopic intubation[17-19] stimulated us to use this technique in patients with larger paraesophageal abscesses after esophageal perforation.

Capsule Summary

What is already known on this topic

- Esophageal perforation and mediastinal abscess formation have a high morbidity and a mortality of 10-35%.
- Mediastinal abscesses traditionally require surgical drainage.
- Endoscopic transesophageal debridement and drainage of such abscesses maybe feasible and safe.

What this study adds to our knowledge

- In a single-center, prospective, feasibility study, patients with paraesophageal abscesses were safely and effectively drained by EUS-guided or endoscopic mediastinal puncture and debridement.

PATIENTS AND METHODS

During a 4-year study period, patients were entered in this study if they had sustained an esophageal rupture (because of perforation or intrathoracic anastomotic leakage) and fulfilled the entry criteria. These were signs of sepsis (body temperature $\geq$ 38.5°C and a C-reactive protein [CRP] level $>$ 7 mg/dL) and a paraesophageal abscess formation of $>$ 2 cm (at the largest diameter) on cross-sectional imaging when using multislice CT and additional EUS in selected cases. All patients initially had been treated conservatively with intravenous antibiotics and parenteral nutrition. The research was carried out in accordance with the Helsinki Declaration as revised in 1989. All patients gave written informed consent before each intervention.

During index endoscopy, the abscess cavity was punctured either by using linear EUS (GF-UCT 140; Olympus Optical Co [Europa], Hamburg, Germany) or was directly entered transendoscopically via the preexisting perforation with the aid of a hydrophilic guidewire (Jagwire; Boston Scientific Corp, Siegen, Germany). Patients were routinely sedated with intravenous propofol by using the bolus technique.[20] A 7F catheter was introduced over the guidewire (under fluoroscopic guidance) into the abscess cavity, and pus was aspirated. This was send for culture and antibiotic sensitivity analysis to guide concomitant antibiotic treatment. In patients where larger amounts of pus ($>$50 mL) could be aspirated without difficulty by this technique or a free flow of pus alongside the drain into the esophageal lumen was observed, a 8.5F stent was placed, and the patient was excluded from the study. In those patients where this simple drainage of pus was not possible, the initial access point was dilated over a guidewire to 15 mm by using a transendoscopic balloon dilator (CRE balloon; Boston Scientific) whenever necessary. The abscess cavity was then entered with a standard 9.5-mm videoendoscope (GIF Q 145; Olympus), and the cavity was carefully inspected under direct endoscopic vision (Fig. 1A). Generous lavage was undertaken (through the working channel of the endoscope, occasionally by using a dedicated pump system [Endo Water Jet; Pauldrach, Garbsen, Germany]) with 300 to 500 mL of 0.9% sterile saline solution. In addition, debris and necrotic material was carefully removed with Dormia baskets (FG-22Q-1; Olympus). Coexisting larger pleural effusions (detected by chest radiograph or thoracic CT) were treated with a large-caliber transthoracic chest drain (usually 16F), which was placed under fluoroscopic guidance.

The transendoscopic lavage and debridement was repeated daily until the abscess cavity looked clean and no further pus or debris was present (Fig. 1A to F). Before each endoscopy, each patient was asked to wash his mouth with a disinfection solution (Hexoral; Pfizer GmbH, Karlsruhe, Germany) for 5 minutes potentially to reduce the bacterial contamination of the endoscope during the transoral route. All patients were kept nil by mouth (except for tap water) during the treatment period. The decision to use enteral or parenteral nutrition was left to the clinical team who was looking after the patient. When necessary, a PEG with duodenal extension or a direct percutaneous enterojejunostomy (PEJ) was used to enable enteral feeding.

The percutaneous chest drain was removed once drainage had reduced to $\leq$50 mL per day. When the clinical signs of sepsis were no longer present and endoscopic inspection documented a clean abscess cavity, endoscopic treatment was terminated. Spontaneous closure of the endoscopic access site was awaited over 48 hours, if clinically reasonable. Otherwise, the esophageal defect was closed endoscopically with hemoclips (HX-600-090L; Olympus), fibrin glue (Beriplast P Combiset; Aventis Pharma GmbH, Marburg, Germany), or by placement of a covered esophageal metal stent (Ultraflex; Boston Scientific). After this, oral nutrition was carefully started. Before discharge, resolution of the mediastinal abscess was documented by repeat thoracic CTs.

Statistics

All data were given as mean (standard deviation) and ranges. Written informed consent was obtained from all patients after a detailed discussion about the available treatment options in close collaboration with colleagues from the departments of surgery, pulmonology, and

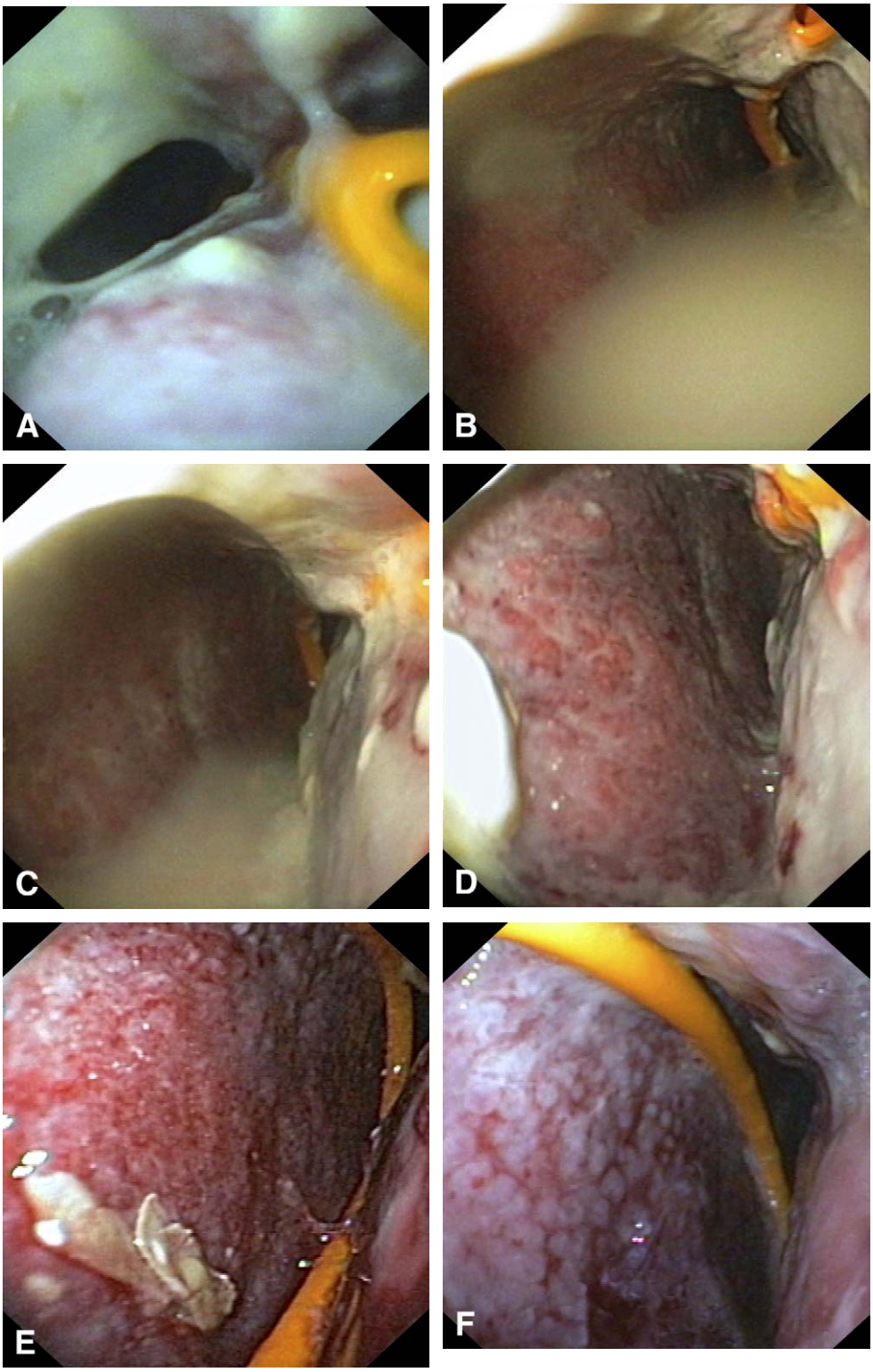

Figure 1. A to F, Series of transesophageal endoscopic approaches to the abscess cavity in one patient, showing progress of debridement over 6 days. A transthoracic chest drain is seen placed in the abscess cavity to aid drainage of irrigation fluid, pus, and air. The lung is seen on the left in all pictures.

radiology. The work was performed according to the principles of the Declaration from Helsinki. Formal institutional review board approval was not necessary according to German medical law (because this was not a randomized study and no novel pharmacologic agents or technical devices were investigated).

TABLE 1. Demographic and clinical characteristics of consecutive patients treated with transesophageal endoscopic debridement (N = 15)*

Mean age, y	60 ± 13 (39-76)
Gender	5 women, 10 men
Mean temperature, °C	38.8 ± 0.6 (38.5-40.2)
Mean C-reactive protein, mg/dL	11.9 ± 4.6 (8-22)
Boerhaave's syndrome	8
Postoperative anastomotic leak	3
Iatrogenic perforation	4

*All data are given as mean with standard deviation and range.

TABLE 2. Clinical course and outcome of 15 patients treated with transesophageal endoscopic debridement*

Mean no. performed endoscopic procedures	7.4 ± 3.0 (5-16)
Mean no. daily endoscopic debridements	5.0 ± 2.3 (3-10)
Mean time to normalization of temperature and C-reactive protein, d	4.5 ± 2.2 (2-8)
Mean days of inpatient stay	14.5 ± 5.6 (9-22)
Patients with resolution of abscess on CT, N	15/15
Procedure-related morbidity, N	0/15
Mortality, N	1/15 (6.7%)

*Data are given as mean with standard deviation and range.

RESULTS

During the 4-year study period, 20 consecutive patients fulfilled the clinical entry criteria. In several of the patients, the diagnosis of esophageal perforation had initially been missed, and all had been treated conservatively. They were referred to our unit when a mediastinal abscess became apparent. In 4 of the patients, large amounts of pus could be easily aspirated during the initial puncture when the first endoscopic evaluation was carried out in our department. In these patients, simple transesophageal drainage with an 8.5F, double-pigtail stent was sufficient to achieve satisfactory drainage and resolution of the abscess. In one further patient, transesophageal access to the abscess failed because of technical problems, and the patient, therefore, underwent surgery.

Altogether, 15 consecutive patients underwent drainage according to the above-mentioned treatment algorithm, with daily endoscopic mediastinal debridement. The demographic and the clinical data of these patients are given in Table 1. The mean abscess diameter on CT was 50 mm (18 mm; range 28-73 mm). The iatrogenic perforations were caused by pneumatic dilation for achalasia in 3 cases and by dilation of a peptic stricture in one patient. Nutrition was provided by total parenteral nutrition in 6 patients, by PEG with duodenal extension in 5 patients, and by PEJ in 4 patients.

The results of the endoscopic and clinical follow-up are presented in Table 2. We observed a tendency for spontaneous closure of the created esophageal access point, which made several redilations necessary in 7/15 patients. Overall, the 15 patients were hospitalized for a mean stay of 15 days (5 days; range 9-22 days). The endoscopic treatment was technically and clinically successful in all patients. There was no morbidity associated with this approach, but, unfortunately, one patient died from a fulminant pulmonary artery embolism 1 day after completion of the successful debridement (overall mortality 6.7%). An autopsy revealed a thrombosis of the right iliac and femoral veins, which had been clinically inapparent. The patient had received concomitant prophylaxis with subcutaneous heparin.

Closure of the esophageal defect occurred spontaneously in 3 patients. Hemoclips were used in 7 patients, and fibrin glue was used in 4 patients. A partially covered metal stent was placed across a large anastomotic leak in one patient.

At discharge, resolution of the abscess cavity and the radiologic features of mediastinitis were observed in all patients. No recurrence of any form of mediastinitis was observed during a median follow-up of 12 months (range 3-40 months).

DISCUSSION

We present the first large series that suggests that endoscopic debridement of mediastinal abscesses after esophageal rupture represents a feasible therapeutic alternative to thoracoscopic or open surgical treatment. The morbidity and the mortality of our patients treated with transesophageal endoscopic debridement (6.7%) compares favorable with published data, in particular, of patients with Boerhaave's syndrome, where the mortality rate of surgical treatment lies between 13% and 66%.[20-23] Other surgical approaches, in particular, the use of T tubes to create a controlled fistula, carry mortalities between 36% and 50%.[6] Radiologic-guided thoracentesis or modern video-assisted thoracic surgery of mediastinal abscesses may be associated with a lower morbidity. However, until now the experience with these techniques was limited, because only case reports have been published.[8-11]

The first report of using endoscopic access to treat a mediastinal collection was made by Kanschin and

Pogodina[13] in 1983, who described the successful endoscopic transesophageal insertion of a nasomediastinal drain. This technique was later complemented by Abe et al,[12] who described the successful nasomediastinal drain insertion and the closure of the esophageal perforation after foreign-body ingestion and development of mediastinitis.

The invention of EUS has led to the ability to characterize mediastinal lesions and to insert catheters and stents under EUS guidance. To the best of our knowledge, there are 3 patients described so far in whom mediastinal abscesses were successfully managed by EUS-guided drainage.[14,24]

However, solid debris will not be evacuated by placement of endoscopic drains alone, and, also, irrigation of the abscess cavity via nasocystic catheters placed alongside a stent will, at the most, result in a very slow resolution of solid necrosis and debris. A more aggressive approach, therefore, may be justified.

We have expanded the reported endoscopic and EUS-guided interventions to not only insert mediastinal pigtail drains and/or transnasal irrigation catheters but to manage patients with direct endoscopic debridement and lavage in cases where endoscopic drainage alone seems to be difficult. Our treatment approach follows well-known surgical principles of trying to remove pus when present and then to repair the underlying defect (if necessary). We used the strategies developed for the aggressive management of infected peripancreatic necrosis by performing transgastric retroperitoneal endoscopy and debridement.[17,18] Similar to the experience with endoscopic retroperitoneal debridement, repeated interventions were necessary to clean the mediastinal abscess cavity, but, finally, resolution of the life-threatening condition was achieved. Therefore, our results should further stimulate the development of endoscopic techniques that manage transmural endoscopy beyond the GI lumen.[25] Especially, a refinement of the necrosectomy technique used in our trial is urgently awaited, because Dormia baskets (and vigorous irrigation with the aid of a dedicated water pump) do not appear be very suitable for this purpose. A more effective method of debridement would avoid the substantial number of repeated interventions and may shorten the hospital stay.

Our favorable results that use the daily repeated endoscopic debridement required sophisticated technology and, more importantly, extensively trained medical personnel. The daily interventions had to be scheduled ahead to allow enough time for the careful debridement of the abscess cavity and do require considerable commitment both of the staff and the endoscopists. All operators had to be familiar with the techniques of advanced interventional endoscopy, which is necessary to allow success in this difficult group of patients. We would recommend that this approach should only be undertaken in centers with extensive experience in EUS and interventional endoscopy. It was recently shown that the outcome of endoscopic interventions for the management of peripancreatic fluid collections was related to the individual experience of the performing endoscopist.[19] A multidisciplinary approach (e.g., together with pneumonology and thoracic surgery) is mandatory for the management of patients with complex mediastinits.

Our entry criteria could be an explanation for the good clinical outcome, because we entered patients with small to very large abscesses (ranging from 28-73 mm in diameter). However, none of our patients had responded to conservative management, which, by definition, is an indication for surgery by traditional standards. The uniformly good outcome, apart from one nonprocedure-related death from a fulminant pulmonary embolus, therefore, appears to be genuine. Only randomized controlled trials comparing different treatment options would allow a direct comparison but sadly are difficult to conduct.

Because of our therapeutic algorithm, we were not able to differentiate if endoscopic drainage alone (without debridement) may have been sufficient enough to treat some of our patients. However, we feel that our inclusion criteria and treatment algorithm for those patients, where spontaneous drainage of pus and debris was difficult, were robust. They allowed us to select patients likely to benefit from daily endoscopic debridement.

In conclusion, we believe that our data from a larger cohort of patients presents good evidence that the transesophageal endoscopic approach for debridement of mediastinal abscesses is a promising alternative to surgical treatment.

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REFERENCES

1. Zwischenberger JB, Alpard SK, Orringer MB. Esophagus. In: Townsend CM Jr, editor. Sabiston textbook of surgery. 16th ed. Philadelphia: WB Saunders; 2001. p. 723-7.
2. Dolgin SR, Wykoff TW, Kumar NR, Maniglia AJ. Conservative medical management of traumatic pharyngeoesophageal perforations. Ann Otol Rhinol Laryngol 1992;101:209-15.
3. White RK, Morris DM. Diagnosis and management of esophageal perforations. Am Surg 1992;58:112-9.
4. Muir AD, White J, McGuigan JA, McManus KG, Graham AN. Treatment and outcomes of oesophageal perforation in a tertiary referral centre. Eur J Cardiothorac Surg 2003;23:799-804.
5. Cameron JL, Kieffer RF, Hendrix TR, Mehigan DR, Baker RR. Selective nonoperative management of contained intrathoracic esophageal disruptions. Ann Thorac Surg 1979;27:404-8.

6. Urschel HCJ, Razzuk MA, Wood RE, Galbraith N, Pockey M, Paulson DL. Improved management of esophageal perforation: exclusion and diversion in continuity. Ann Surg 1974;179:587-91.
7. Butkin BL, Miller JI Jr, Mansour KA. Esophageal perforation: emphasis on management. Ann Thorac Surg 1996;61:1447-52.
8. White CS, Meyer CA, Templeton PA. CT fluoroscopy for thoracic interventional procedures. Radiol Clin North Am 2000;38:303-22.
9. Petrakis I, Katsamouris A, Drossitis I, Bouros D, Chalkiadakis G. Usefulness of thoracoscopic surgery in the diagnosis and management of thoracic diseases. J Cardiovasc Surg (Torino) 2000;41:767-71.
10. Chung DA, Ritchie AJ. Videothoracoscopic drainage of mediastinal abscess: an alternative to thoracotomy. Ann Thorac Surg 2000;69:1573-4.
11. Tanaka T, Inaba Y, Arai Y, Matsueda K, Aramaki T, Dendo S. Mediastinal abscess successfully treated by percutaneous drainage using a unified CT and fluoroscopy system. Br J Radiol 2002;75:470-3.
12. Abe M, Sugiyama M, Hashimoto Y, Itho N, Nakaura H, Izumisato Y, et al. Endoscopic nasomediastinal drainage followed by clip application for treatment of delayed esophageal perforation with mediastinitis. Gastrointest Endosc 2001;54:646-8.
13. Kanschin NN, Pogodina AN. Transesophageal drainage of the mediastinum in perforating mediastinitis. Vestn Khir Im Grek 1983;130:24-7.
14. Kahaleh M, Yoshida C, Kane L, Yeaton P. EUS drainage of a mediastinal abscess. Gastrointest Endosc 2004;60:158-60.
15. Rodella L, Laterza E, De Manzoni G, King R, Lombardo F, Catalano R, et al. Endoscopic clipping of anastomotic leakings in esophagogastric surgery. Endoscopy 1998;30:452-6.
16. Eubanks PJ, Hu E, Nguyen D, Procaccino F, Eysselein VE, Klein SR. Case of Boerhaave's syndrome successfully treated with a self-expandable metallic stent. Gastrointest Endosc 1999;49:780-3.
17. Seifert H, Wehrmann T, Schmitt T, Zeuzem S, Caspary WF. Retroperitoneal endoscopic debridement for infected peripancreatic necrosis. Lancet 2000;356:653-5.
18. Baron TH. Endoscopic drainage of pancreatic fluid collections and pancreatic necrosis. Gastrointest Endosc Clin N Am 2003;13:743-64.
19. Harewood GC, Wright CA, Baron TH. Impact on patient outcomes of experience in the performance of endoscopic pancreatic fluid collections drainage. Gastrointest Endosc 2003;58:230-5.
20. Seifert H, Schmitt TH, Gultekin T, Caspary WF, Wehrmann T. Sedation with propofol plus midazolam versus propofol alone for interventional endoscopic procedures: a prospective, randomized study. Aliment Pharmacol Ther 2000;14:1207-14.
21. Bladegroen MR, Lowe JE, Postlethwait RW. Diagnosis and recommended management of esophageal perforation and rupture. Ann Thorac Surg 1986;42:235-6.
22. Salo JA, Isolauri JO, Heikkila LJ, Markkula HT, Heikkinen LO, Kivilaakso EO, et al. Management of delayed esophageal perforation with mediastinal sepsis: esophagectomy or primary repair? J Thorac Cardiovasc Surg 1993;106:1088-91.
23. Orringer MB, Striling MC. Esophagectomy for esophageal disruption. Ann Thorac Surg 1990;49:35-43.
24. Fritscher-Ravens A, Siriam PV, Pothman WP, Fullekrug B, Jäckle S, Thonke F, et al. Bedside endosonography and endosonographically-guided fine-needle aspiration in critically ill patients: a way out of the deadlock. Endoscopy 2000;32:425-7.
25. Kalloo AN, Singh VK, Jagannath SB, Niiyama H, Hill SL, Vaughn CA, et al. Flexible transgastric peritoneoscopy: a novel approach to diagnostic and therapeutic interventions in the peritoneal cavity. Gastrointest Endosc 2004;60:114-7.

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