

New Device for Endoscopic Vacuum-Assisted Closure (E-Vac) in Acute Mediastinitis from Esophageal Perforation

B M Ciuntu¹, C Vasiluta¹, APapancea¹, I Garleanu², S L Toma³, B F Toma^{4,*}, D Timofte^{1,*}, D Azoicai¹ and S O Georgescu¹

1 Grigore T.Popa University of Medicine and Pharmacy, Faculty of Medicine, Department of Surgery, 16 Universitatii Str., 700115, Iasi, Romania

2 Grigore T.Popa University of Medicine and Pharmacy, Faculty of Medicine, Department of Gastroenterology and Hepatology, 16 Universitatii Str., 700115, Iasi, Romania

3 “Gheorghe Asachi” Technical University from Iasi, Department IMSI, Bd. D. Mangeron, No. 64, 700050

4 Grigore T.Popa University of Medicine and Pharmacy, Faculty of Medicine, Department of Obstetric & Gynecology, 16 Universitatii Str., 700115, Iasi, Romania

5 Grigore T.Popa University of Medicine and Pharmacy, Faculty of Medicine, Department of Preventive Medicine and Interdisciplinarity, 16 Universitatii Str., 700115, Iasi, Romania

E-mail: toma.bogdanf@gmail.com, dantimofte@yahoo.com

Abstract. Acute mediastinitis is an uncommon but potentially devastating infection involving the structures of the mediastinum. The 2 most common causes of acute mediastinitis are esophageal perforation or median sternotomy. Conventional forms of treatment for acute mediastinitis usually involve surgical revision with open dressings or closed irrigation, or reconstruction with vascularized soft tissue flaps such as omentum or pectoral muscle. Vacuum-assisted closure is a treatment with a wound-healing technique based on the application of local negative pressure to a wound. We present the case of a 73 years old male patient admitted in our clinic with esophageal perforation that appeared possible after an endoscopic dilatation done for an esophageal stenosis in the inferior 1/3 part. Using a modified double-lumen naso-gastric probe adapted to the negative pressure unit and using the same principle as in the negative pressure treatment of soft tissue wounds we have achieved positive results with successful cure of esophageal perforation. The thoraco-abdominal Computer Tomography done with contrast substance confirmed the esophageal perforation, acute mediastinitis and bilateral pleuresia. The patient had a full recovery after 29 days of hospitalization with a positive check-up at one and two months after leaving our clinic.

1. Introduction

Primary cases of mediastinitis are very rare [1] but they may occur spontaneously or in connection with other inflammation of the surrounding area: epiglottitis, pharyngitis, pneumonia, pericarditis, and bronchitis [2]. The great majority of mediastinal infections are secondary, originating from many sources. Most secondary mediastinal infections are related to esophageal disruption, although not all esophageal perforations lead to mediastinitis. Puncture perforations tend to heal spontaneously, while



large tears require surgery [1]. In esophageal erosion caused by the presence of a foreign body, an inflammatory reaction occurs and invasive mediastinitis does not develop [3].

Deep sternotomy wound infection is another source of secondary mediastinitis. The sternotomy incision has been widely used in open intracardiac procedures since it was proposed by Julian in 1957 [4]. McClelland reviewed the incidence of deep sternotomy wound infection and mediastinitis between 1984 and 1996, finding a rate of 0.3% to 5% [5]. Respiratory tract infections are rarely the cause of mediastinitis, due to antibiotics and improved oral hygiene [6].

However, oropharyngeal infections, such as quinsy, Ludwig's angina, and retropharyngeal abscess, are cause for concern since they tend to spread along the fascial planes. These infections can cause morbid necrotizing mediastinitis.

At this time, metastatic infections, retroperitoneal and subphrenic infections, and osteomyelitis of the spine and ribs seldom lead to mediastinitis. However, other new sources for infection are developing. AIDS and immunosuppression are leading to new combinations of infectious processes.

Iatrogenic injuries account for up to 60% of all cases of esophageal perforation [7]. The risk of perforation increases significantly from 0.6% for purely diagnostic endoscopy to 6% for operative procedures [8]. Vacuum-assisted closure allows open drainage that continuously removes exudate with simultaneous stabilization of the chest and isolation of the wound. By maintaining a moist environment, this therapy stimulates granulation-tissue formation [9] in combination with an increased blood flow in the adjacent tissue [10,11].

Furthermore, VAC therapy approximates the wound edges and provides a mass filling effect with a low degree of surgical trauma, without establishing a new wound (e.g. abdominal wound in omental flaps). Finally, due to sternal stabilization and wound isolation, patients can be mobilized early and receive physiotherapy in order to minimize further complications.

2. Materials and methods

Required material: double-lumen naso-gastric probe, vacuum S size kit, surgical instruments for small surgery, vacuum pump;

Device preparation requires informations about the size of the defect to be explored and also provides data for endoscopic guidance in preparing contact material (foam kit) and sizing the naso-gastric tube dimensions that will be mounted on the sponge. Obtaining the necessary data for the intervention is done by performing a CT scan.

The intervention involves a mixed endoscopic-surgeon-anesthetist team and the therapeutic gesture will take place in the surgery room, patient requiring general anesthesia with oro-tracheal intubation.

Preparing the sponge according to the size of the cavity will be made respecting all three dimensions measured by the CT scan previously performed. The nazo-gastric probe is adjusted according to the length of the sponge. The holes in the naso-gastric probe should not exceed the proximal and distal edge of the future sponge sleeve.

Perforated sponge is drilled by following an imaginary line through its center along its entire length, representing the future path through which the nazo-gastric probe will be passed.

After preparing all this upper gastrointestinal endoscopy is performed with viewing the cavity of the wound, inspection and lavage.

The nazo-gastric probe is passed through the nasal orifice and exteriorized through mouth, when the previously made sponge is attached with its firm anchorage. The endoscopist takes and drives the device created to the defect by placing it inside the cavity to be drained actively. The aspect of the assembly is visualized by the retraction of the endoscope and also under visual control is initiated the aspiration with negative pressure.

The endoscope is withdrawn and the nazo-gastric probe firmly fixed to the nose wing.

3. Results and discussions

We present the case of a 73 years old male patient which is admitted in our clinic with sever retrosternal pain and heavy breathing, fever and excessive sweating. From the personal pathological

antecedents, we remember the esophageal stenosis in the inferior 1/3 median with a esophageal dilatation done in May 2017.

From the patient statement we understand that the beginning of the symptoms had begun at about 5 days after the dilatation procedure. Analyzing the clinic examination with the personal pathological antecedents we raised the suspicion of diagnosis of iatrogenic esophageal perforation. We did a toraco-abdominal Computer Tomography with contrast substance which confirms the diagnosis (Figure 1): in the posterior mediastinum collection about 60/80/127 mm, with inhomogeneous content, and a 9 mm perforation on the anterior wall of the esophagus in the 1/3 median part. Bilateral pleurisy with clotted aspect on the left side.

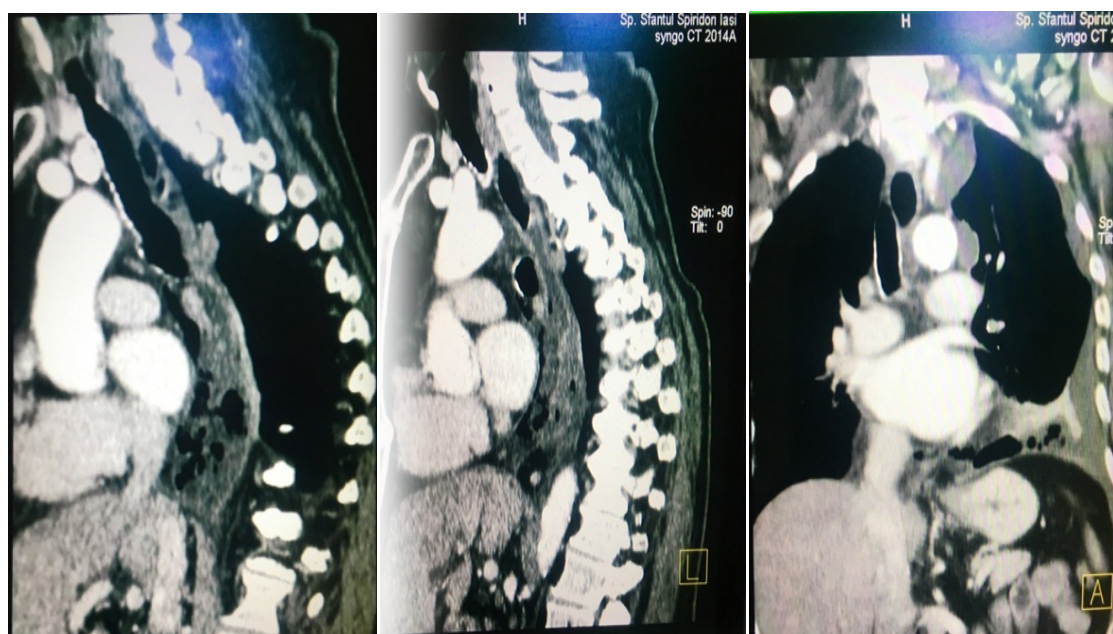


Figure 1. The posterior mediastinum with the collection and the esophageal perforation.

In a interdisciplinary discussion with the thoracic surgeon we decided to postpone the surgical intervention and to try the the endoscopic endoluminal negative pressure therapy.

On the 17.05.2017 we did a superior digestive endoscopy with the finding of the esophageal perforation (Figure 2) and the inspection of the cavity.

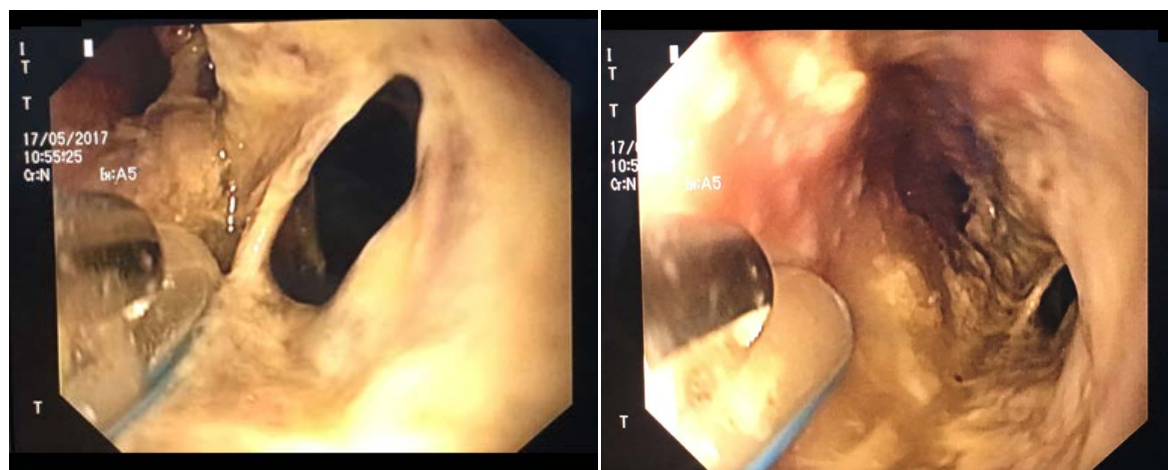


Figure 2. The initial endoscopic aspect of the esophageal perforation and the cavity.

We prepared the endoluminal vacuum kit (Figure 3) as we described in the Material and Method subchapter, with the placement of the kit in the interior of the perforation following the description of the CT examination.

We set the device at a 165 mmHg pressure. At the same time, we did a self-feeding jejunostomy. The patient was motorized in the ICU Clinic for his biological status, enteral and parenteral feeding, and the good function of the vacuum kit (the washing of the kit to avoid the clotted of the secretions in the tube system).

We performed the change of the vacuum kit in the first state at 4 days after installing it, after that at 5 days under endoscopic control, with the checkup of the cavity that was smaller every time and the general status of the patient was better.

In the 14th day post procedure we did a checkup toraco-abdominal CT that confirms the good evolution of the patient with the decreased dimension of the posterior mediastinum cavity at about 22/26/30 mm.

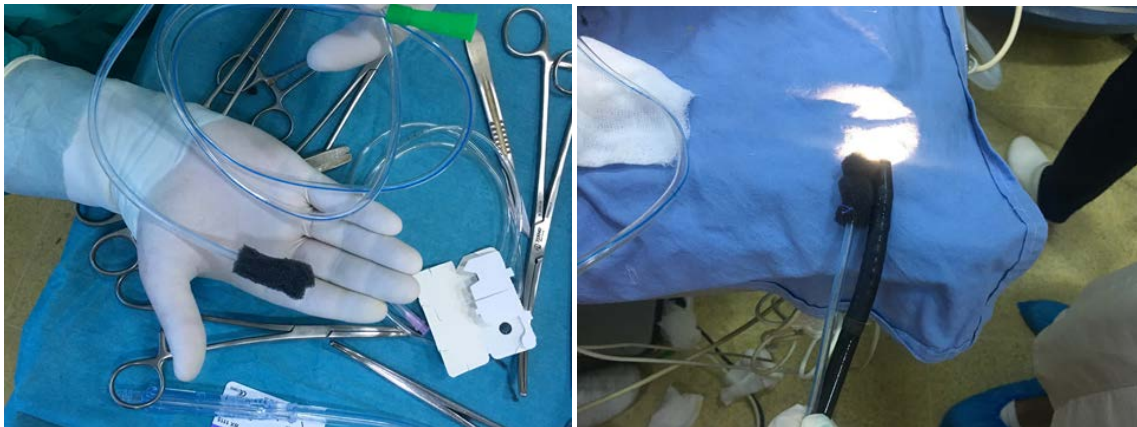


Figure 3. The endoluminal vacuum kit.

On post-operative day 29 the endoluminal vacuum kit is suppressed under endoscopic control, with complete healing (Figure 4), which is also supported by the appearance of the superior digestive examination with Gastrografin (contrast substance).

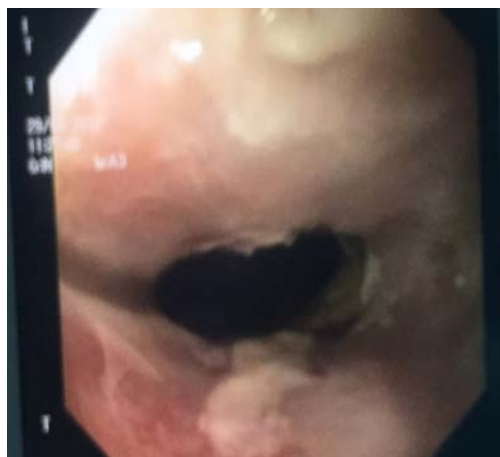


Figure 4. Final endoscopic aspect.

At the checkup after the first and second month the radiological examination with contrast substance does not reveal any pathological aspects.

4. Discussions

Anastomotic leakages and esophagus perforations remain to be severe complications of the upper gastrointestinal (GI) tract. Reported leak rates after esophagectomy vary widely from 1% to 30% [12]

The exact mechanism by which VAC exerts its wound healing mechanism is not fully understood. It has been postulated that the increased perfusion results from an increased hydrostatic pressure gradient along an arteriole, thus directly drawing blood along the vessel.

An alternative explanation is the reduction of tissue edema by removing osmotically active molecules and mediators, thus preventing capillary compromise. The tissue edema in the wound margins creates a situation similar to a localized compartment syndrome.

A complimentary mechanism aiding the healing process would be the removal of inhibitory molecules. Bennet al. reported a decrease in inflammatory phase cytokines and a simultaneous increase in stimulating cytokines. However, so far no quantitative studies have been reported supporting the theory of a reduction in interstitial fluid. Vacuumassistedclosure also approximates the wound margins, and therefore, exerts a mechanical force on the surrounding tissue. Tissue expansion is known to stimulate angiogenesis and increase the mitotic activity in skin. It has also been hypothesized that mechanical stress (transduction) caused by VAC stimulates wound healing through 'reversed' tissue expansion.

Mechanical stimulation is known to stimulate several physiological mechanisms, such as ion transport, release of second messengers, alterations in gene expression, and increased protein synthesis. Shear stress has been demonstrated to increase cell division by up-regulation of the second messengers causing phosphorylation [13].

The cleaning of the contaminated is one of the key points in the treatment of the esophageal perforations and the mediastinal abscesses and stent therapy must be combined with the mediastinal drainage in all cases with mediastinal collections.

Because many endoscopic perforations are small, well-defined, and have limited contamination, both the repair of the perforation and the diversion of luminal contents can now be accomplished via endoluminalmeans, which allows for the avoidance of surgery and its morbidity[14].

A major advantage of the negative pressure therapy is the ability to clean the perforated cavity using a minim invasive method, this way we can avoid the sepsis and the death of the patient. In our case we were able to clean even the wall of the consolidated wound, that were covered with fibrin tissue, to be able to produce granulation tissue in the first 3 days up to 5 days of treatment assisted with negative pressure.

The complexity of the proximal esophageal perforations is bigger than that of the distal ones because the procedure is more invasive, and the placement of the stent at this level may affect the air ways. This fact and the management of the sponge requires high skills of endoscopy makes this procedure available only in the big hospital centers with experience in interventional endoscopy and critical care.

The decision of treatment must be taken by an interdisciplinary team, with staff from General Surgery, Interventional Radiology, Endoscopy and Intensive Care Unit.

Endoscopically assisted negative pressure therapy proves to be an important alternative in the treatment of patients with upper gastrointestinal tract fistulae. The method was adapted from the use of the method to the skin wounds, the principle of the method being transferred to the adaptation of the device for cavity drainage. However, anastomotic fistula remains a challenge, with few treatment options available. Recently, endoscopic vacuum closure (E-VAC) has been reported as an effective treatment for closure of esophageal perforations and for upper gastrointestinal tract fistulae. [14-16]

The major upside in the evaluation of this new technique is the absence of comparative studies, because of its complexity and the high number of treatment methods, surgical interventions and all kinds of stents.

Unfortunately, clinical evidence regarding the endoluminal closure of perforations is limited to case reports and case series; there have been no randomized controlled clinical studies in this area[17].

The limits of this study includes the low number of patients, the different causes of lesions and the impossibility of comparing with other treatment methods. A multicentric study a large scale would be necessary to pass this limits because the apparition of esophageal fistulas and perforations is rare.

5. Conclusions

EVT for parietal lesions of the esophageal wall is a great procedure in the management of this pathology with a high mortality and the surgeons and gastroenterologist must have considered as a treatment option in this kind of lessons.

The prospective and comparative studies are necessary for the evaluation of this new and minim invasive procedure.

6. References

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