Aortoesophageal fistula, a life-threatening disease

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Summary

Aortoesophageal fistula (AEF) is a rare complication associated with high morbidity and mortality. Primary fistulas are rare, usually occurring after endovascular stent graft reconstruction with secondary presentation. It is rarely recognised in time and therapy is often unsuccessful.

We describe in detail the treatment of two patients diagnosed with AEF, with photo documentation. Unfortunately, both of our patients died.

Based on a review of the literature and our own cases, we conclude that endovascular therapy in the acute haemorrhagic phase of AEF is a reasonable approach, but resection of the aorta and eroded oesophagus should be performed early to avoid serious complications. In patients who refuse surgery, vacuum therapy and the use of fibrin glue may be effective in milder cases.

Keywords: aortoesophageal fistula, fibrin glue, stent graft, aortic resection, esophagus resection

Aorto-oesophagealis fisztula, egy életveszélyes betegség

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Összefoglalás

Az aorto-oesophagealis fisztula rendkívül ritka szövődmény, amely a sebészeti kezelés ellenére magas morbiditással és mortalitással jár. A primer sipolyok ritkák, döntően másodlagos megjelenésűek (mellkasi aorta aneurizma endovaszkuláris stentgraft-rekonstrukcióját (TEVAR) követően, idegentest, tüdő-, nyelőcsőtumor, Boerhaave szindróma, tbc-s vagy szifiliszes aortagyulladás okozza). A diagnózist ritkán állapítják meg a halál beállta előtt, és a terápia gyakran sikertelen.

Első betegünk egy 63 éves nő, akinél egy hete tartó 8/10 mellkasi fájdalom és vérhányás miatt készült CT-angiográfia álaneurizmát igazolt az aortaív-descendens határon. Sürgős TEVAR-t végeztünk. Egy hónap múlva a kontroll-CTA megerősítette az álaneurizma progresszióját. Ezért aorto-bicaroticus és bal oldali carotico-subclavia bypass műtétet és stentgraft kiegészítést végeztünk. Progrediáló szepszis miatt multidiszciplináris aorta team a nyelőcső sztent behelyezés és homografttal aortaív-rekonstrukció mellett döntött. A szepszis antibiotikumos kezelés ellenére fennállt, a beteg elhunyt.

Második betegünk egy 60 éves nő, akinél két hónapos hátfájdalom miatt készült CTA. Aorta descendens penetráló aorta fekély miatt TEVAR-t végeztünk. Progresszió, aorto-oesophagealis fisztula miatt nyelőcsőstentelést végeztünk. Emelkedő szeptikus paraméterek miatt végzett CTA tályogot, I.a endoleak-et, tartott aortarupturát igazolt. Multidiszciplináris team döntés alapján aorta exstrirpáció, szarvasmarha pericardium protézissel mellkasi aorta rekonstrukció, nyelőcső extirpáció, nyálsipoly és tápláló jejunostoma kialakítás történt. A beteg bronchocutan sipoly és a hörgők elhalása miatt szeptikus állapotban meghalt.

Az irodalom és saját esetünk áttekintése után arra a következtetésre jutottunk, hogy az aorto-oesophagealis fisztula akut vérzéses fázisában az endovaszkuláris terápia ésszerű megközelítés, de az aorta és az erodált nyelőcső reszekcióját minél hamarabb el kell végezni a fertőzés, illetve egyéb súlyos szövődmények elkerülése érdekében. Műtétet nem vállaló betegeknél, enyhébb esetekben a negatívnyomású sebkezelés és a fibrinragasztó használata eredményes lehet.

Kulcsszavak: aorta-oesophagealis fisztula, fibrinragasztó, stent graft, aorta reszekció, nyelőcső reszekció

INTRODUCTION

Although the disease was first reported in 1818 by Gabriel Jouveau-Dubreuil *(1818),* and its characteristic clinical presentation was described by Hans Chiari *(1914)* the diagnosis is rarely made before death. Aortoesophageal fistula (AEF) is an extremely rare complication (annual incidence of 0.007 per million *(Beuran et al. 2016)*) with high morbidity and mortality despite surgical treatment. Its incidence is not known precisely. Primary AEF is rare (in autopsy series of 0.04% to 0.07% *(Taheri et al. 1991)*), most of them develop because of a thoracic aortic aneurysm (0.1% to 0.8% *(Sweeney–Gadacz 1984)*), foreign body ingestion or malignant neoplasm of the lungs and esophagus, Boerhaave syndrome, aortitis (due to tuberculosis, syphilis). The more common secondary AEF after aortic endovascular stent graft reconstruction occurs in 0.3-1.6% of patients *(Champion et al. 1982; Bunt 1983)*. Even when a correct diagnosis is made, therapy is often unsuccessful.

The primary aim is to support circulation until surgery, for example with inotropic treatment, volume replacement and correction of electrolyte and blood clotting abnormalities. Furthermore, administration of broad-spectrum antibiotics to prevent esophageal sepsis is a crucial part of adequate therapy. Conventional treatment of secondary AEF consists of appropriate debridement, resection of the infected esophagus and aortic segment, ligation of the proximal and distal ends of the thoracic aorta and graft removal. This is followed by esophageal reconstruction with replacement, aortic bypass surgery including replacement of the ascending aorta and debranching of the aortic arch branches. This technique is associated with a surgical mortality rate of 25–90% *(Bunt 1983; Peck–Eidemiller 1992)* and an aortic rupture rate of 10–50%. The average perioperative mortality rate for in situ reconstruction (with allograft) is 27–30%. Esophagectomy significantly improves prognosis. For many years, no patient has survived this catastrophic condition without undergoing thoracic surgery for correction. Since 1996, transluminal stent-graft prostheses have been available as an alternative for bypass surgery.

In this paper, we would like to present a case to illustrate the importance of this life-threatening clinical scenario.

CASE REPORT-1

A 63-year-old female patient with no history of any significant disease presented in April 2022 at our Emergency Department with an 8/10 chest pain after one week. CT scan revealed a suspected esophageal tumour based on mediastinal tissue proliferation. Gastroscopy was performed. A 5 mm esophageal ulcer was confirmed, and histological samples were taken from a

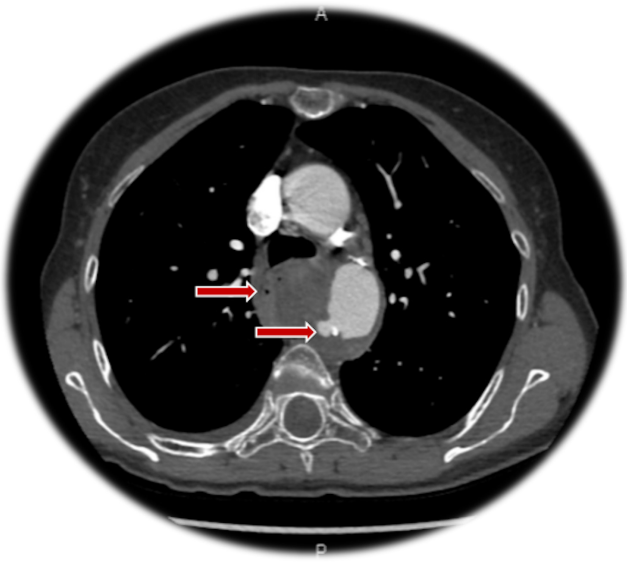

Figure 1 The CTA image shows the pseudoaneurysm at the aortic arch – descending aortic border, arrows indicate thoracic aortic contrast leakage and mediastinal air leakage

Source: Own photo

35×30 mm mass at 27 cm using endoscopic ultrasound, but no tumour was confirmed.

The next day, a control gastroscopy for haematemesis confirmed esophageal haemorrhage. CT angiography (CTA) showed a pseudoaneurysm at the aortic arch-descending border (thoracic aortic contrast agent leakage and mediastinal air trapping) *(Figure 1)*. After preliminary planning, TEVAR was performed. Postoperative control CTA confirmed correct positioning. Naso-jejunal feeding was initiated, which was changed to per os feeding based on esophageal surgery consultation. Iv antibiotic treatment was administered from the start of the treatment.

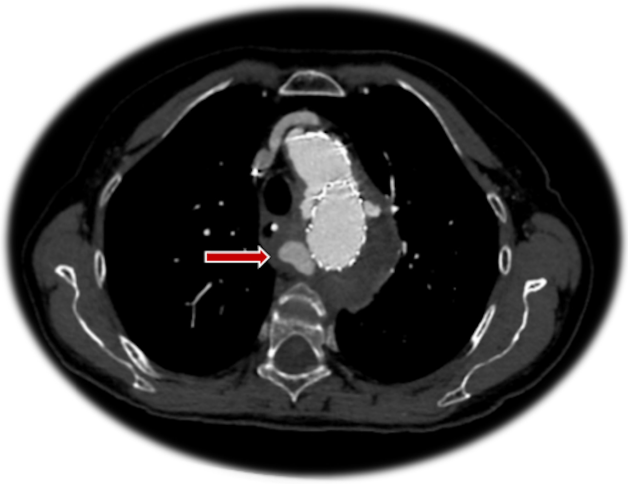

Figure 2 The CTA image shows an enlarged infective pseudoaneurysm

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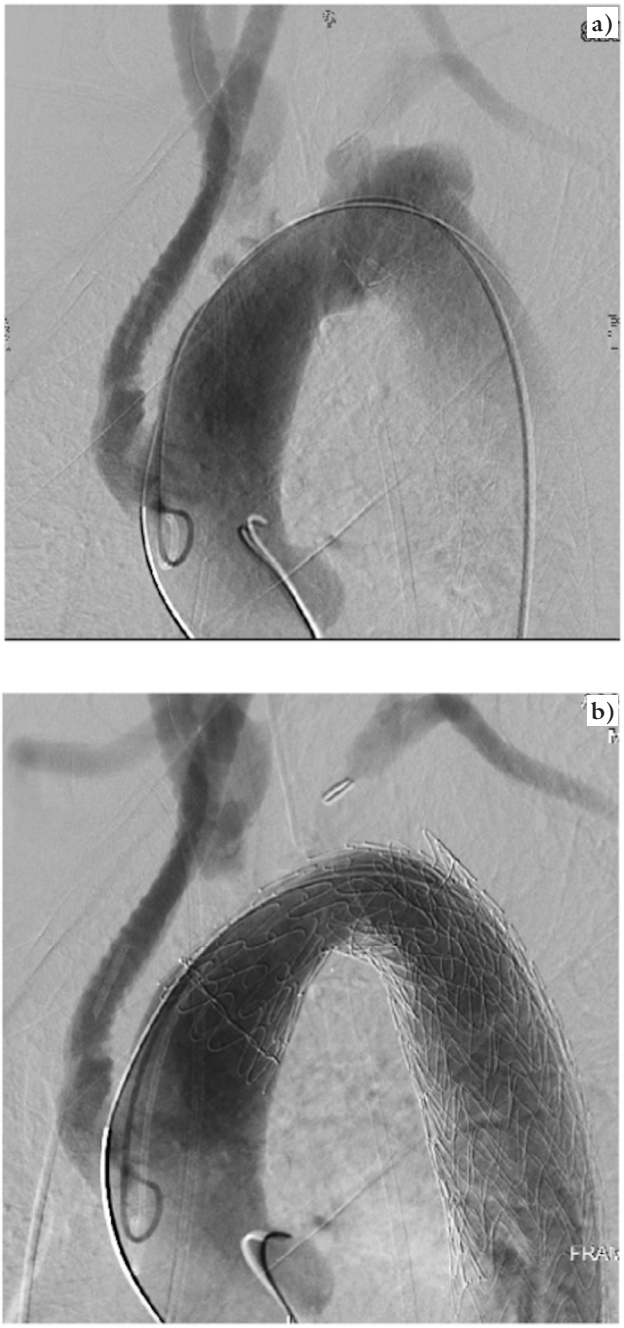

Figure 3 The figures show intraoperative angiographies taken during TEVAR surgery after debranching. a) Baseline. b) State after opening the positioned stent graft

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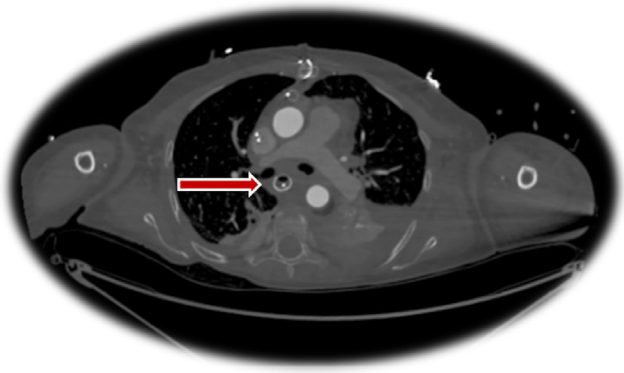

Figure 4 On the CTA taken after the third operation, an arrow shows the esophageal stent inserted at the beginning of the operation to cover the two perforations in the esophagus

Source: Own photo

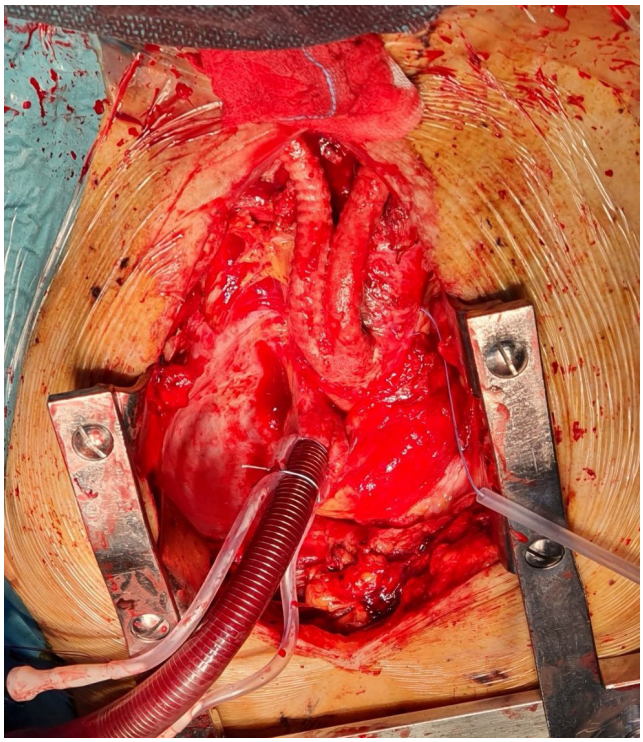

Figure 5 Photo taken at the beginning of the operation shows the aortic-bicarotid graft

Source: Own photo

On the postoperative day 40, haemoptysis returned, and CTA showed an infectious pseudoaneurysm *(Figure 2)*. An urgent second operation became indicated, which involved aortic debranching (aorto-bicarotic bypass, left carotid-subclavian bypass due to dominant left vertebral artery) and stent-graft completion *(Figure 3)*. During prolonged intensive care unit treatment, despite targeted treatment, her septic condition persisted. Therefore, a multidisciplinary (cardiac surgeon, vascular surgeon, gastroenterologist, anaesthesiologist, infectologist) decision was made to perform aortic arch replacement with a homograft.

At the beginning of the third operation, via gastroscopy an esophageal stent *(Figure 4)* was inserted due to two esophageal perforations. *Figure 5* shows the aortic-bicarotid graft at the beginning of surgery. The fistula hole was found in the aorta at the level of the diaphragm *(Figures 6–7)*. The affected aortic segment was then resected, along with the stent graft *(Figure 8)* and aortic-bicarotid graft and an aortic arch reconstruction was

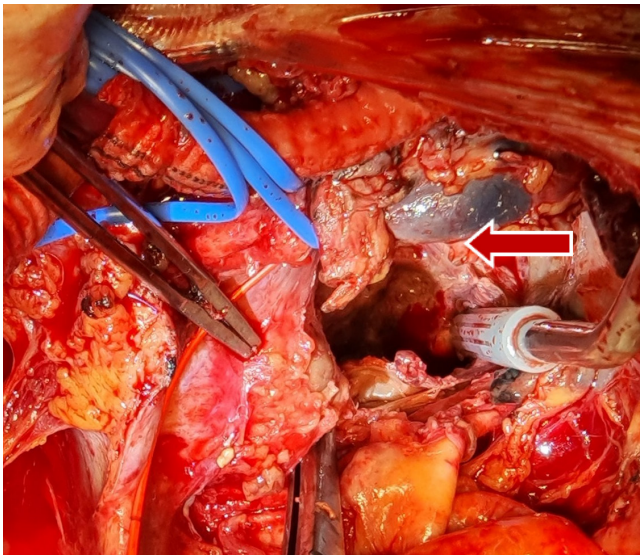

Figure 6 The arrow shows the fistula hole in the aorta at the level of the diaphragm, intraoperatively

Source: Own photo

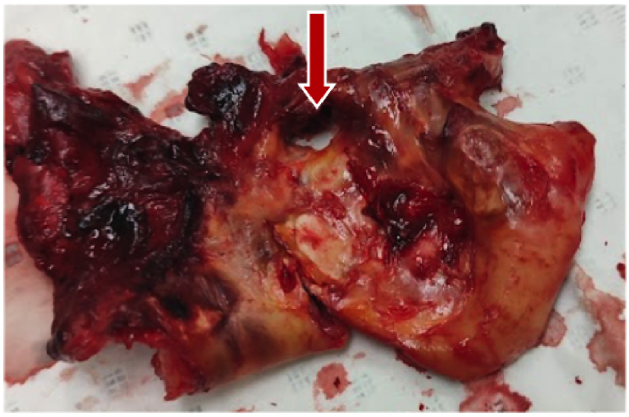

Figure 7 The arrow shows the fistula hole in the aorta, ex vivo

Source: Own photo

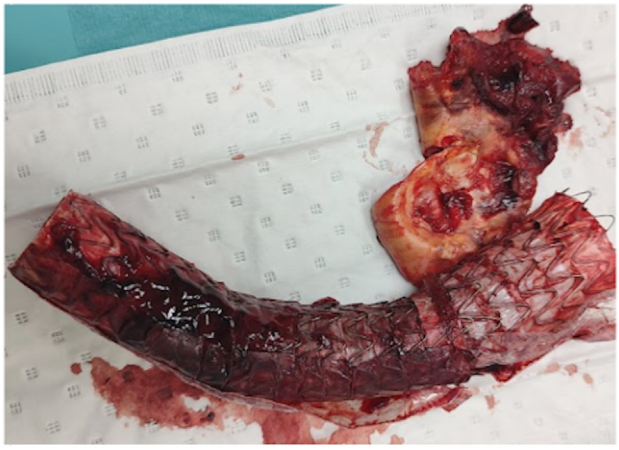

Figure 8 The stent graft removed during the 63-year-old woman's third operation

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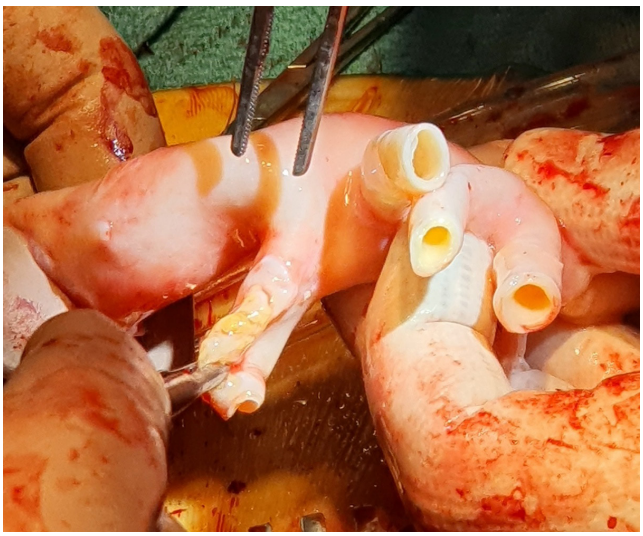

Figure 9 Figure shows the homograft used in the third operation of the 63-year-old woman for total aortic reconstruction

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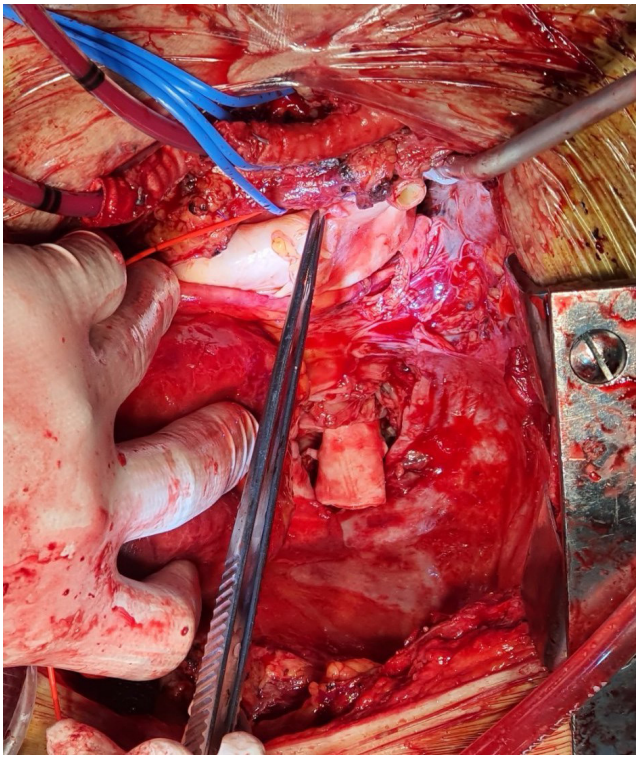

Figure 10 The intraoperative photo shows the aortic homograft inserted but not yet sutured at the level of the diaphragm

Source: Own photo

made with a homograft *(Figures 9–11)*. On the first day after the definitive, third surgery, a right lower limb critical ischaemia required an iliofemoral thromboendarterectomy, and limb circulation normalised afterwards. The patient received prolonged combination antibiotic treatment and was fed parenterally. Her condition steadily, slowly improved. Her consciousness returned but flaccid

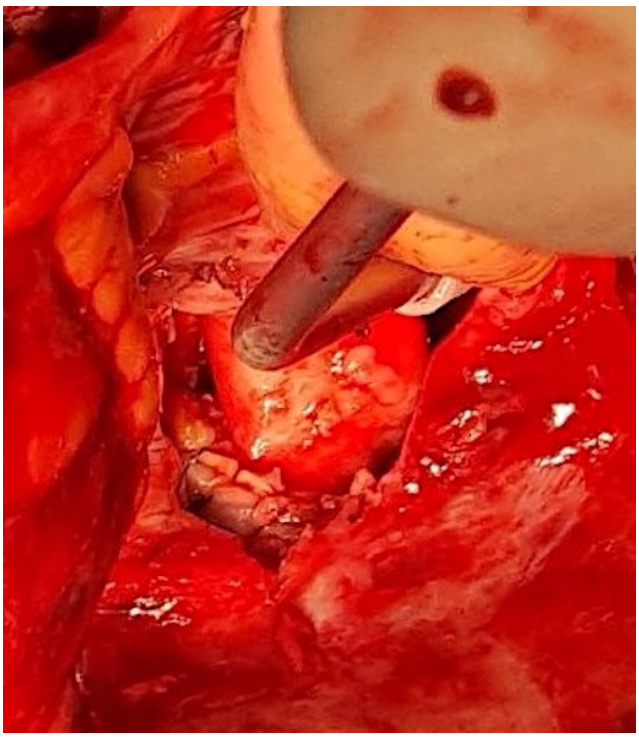

Figure 11 The intraoperative photo shows the completed distal anastomosis

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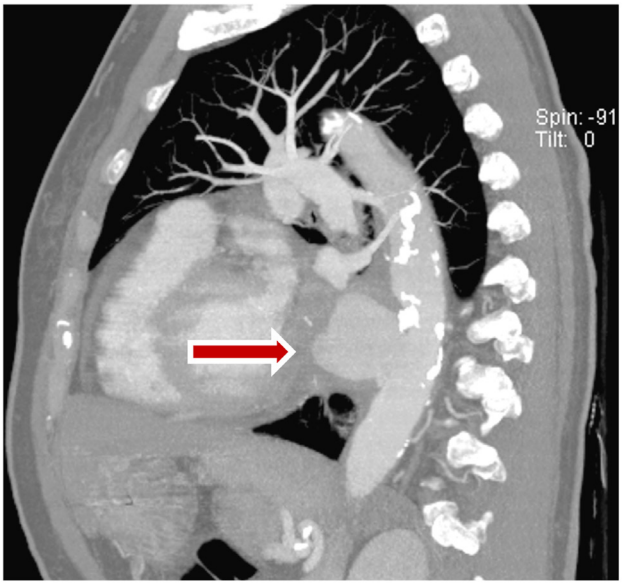
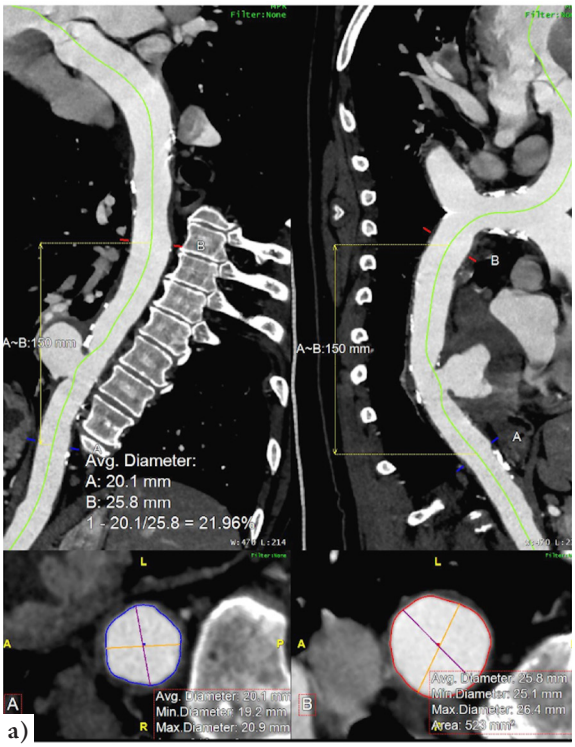


Figure 12 The CTA depicts a penetrating aortic ulcer (arrow) in the descending aorta without contrast extravasation

Source: Own photo

plegia persisted. Neurological consultation suggested myo-neuropathy of organic origin behind those symptoms. No structural abnormalities could be seen on MRI. Later pneumonia developed due to uncontrolled sepsis and the patient died on the 92nd day of her treatment.



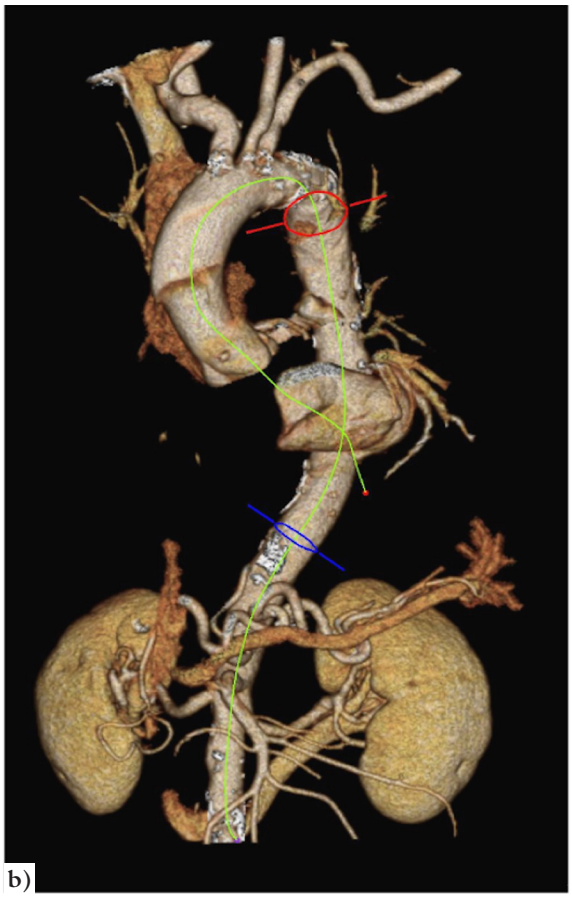


Figure 13 a) The image shows the TEVAR planning. b) The 3D reconstruction preoperative image with PAU

Source: Own photo

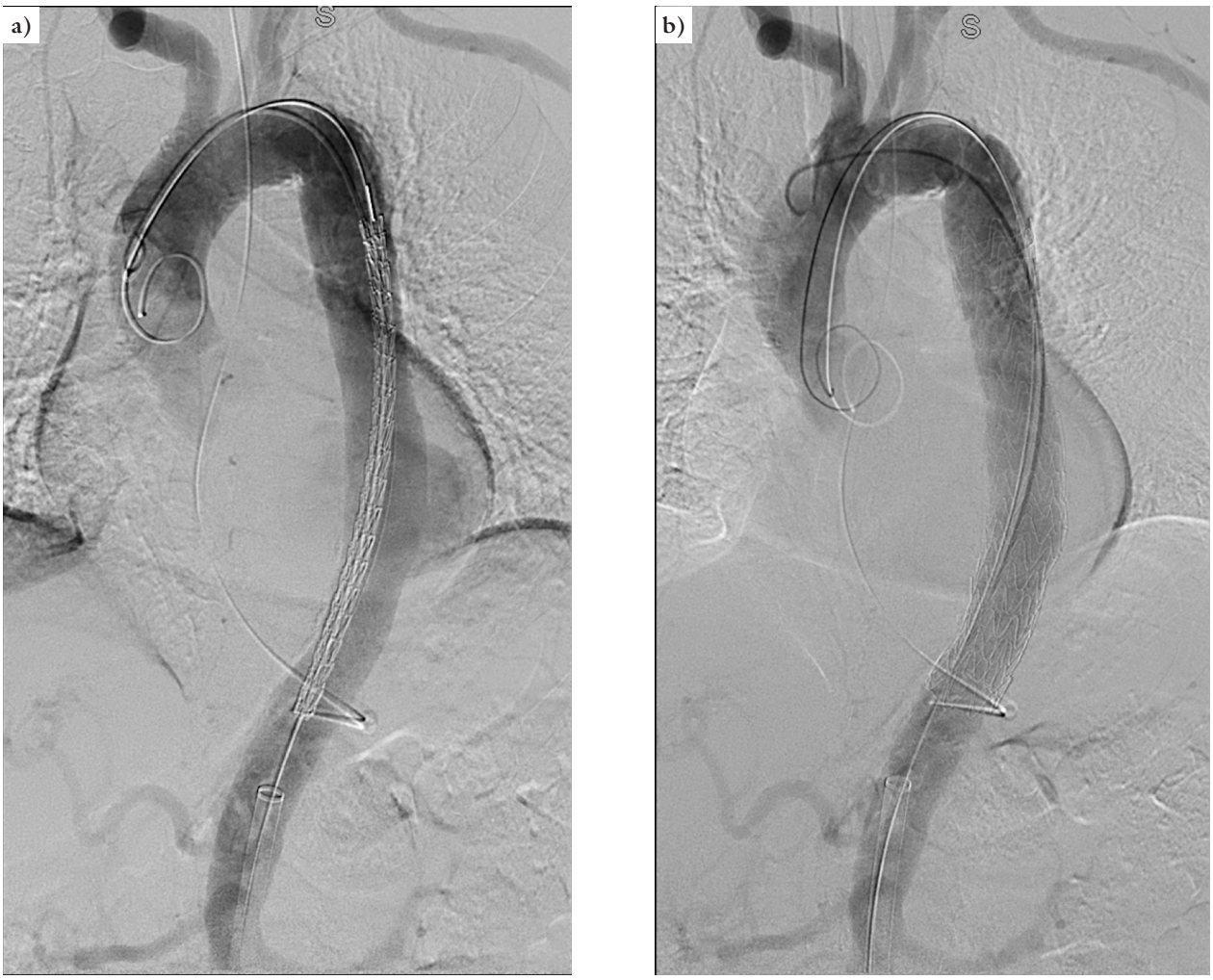


Figure 14 Angiography taken during TEVAR. a) PAU still visible after stent graft deployment, before opening. b) PAU no more visible on angiography after opening of the positioned stent graft

Source: Own photo

CASE REPORT-2

A 60-year-old woman with no prior medical history presented with two months of back pain and one week of vomiting, dysphagia at the emergency department. CTA depicted a penetrating aortic ulcer (PAU) in the descending aorta without contrast agent extravasation *(Figure 12)*. TEVAR and controlled hypotension until surgery were planned *(Figure 13)*. During TEVAR, the stent graft was fixed in good position and the PAU was not visualized *(Figure 14)*.

One week after surgery, acid hematin was excreted through a nasogastric tube during gastroscopy and an aortoesophageal fistula (esophageal diverticulum, with a perforated, impacted edge of food debris at the base of the aorta) was confirmed. A stent was inserted into the leaking esophagus, followed by stent repositioning and fixation.

Due to fever, elevated septic parameters, haemoculture positivity (Enterobacter cloacae, Veillonella parvula), targeted antibiotic treatment (imipenem/cilastin) was initiated. A mediastinal abscess (air opacity in mediastinum) was observed on CTA. The patient was referred to a surgical clinic for esophageal resection. In preparation for surgery, a CTA check one week later showed I.a endoleak and suspected rupture. Therefore, the surgical plan was modified. With the involvement of our multidisciplinary team (anaesthesiologist, cardio technologist, surgeon, thoracic surgeon, cardiac surgeon, vascular surgeon), a complete thoracic aortic reconstruction with a tube prosthesis made from 2×10×16cm bovine pericardium was performed using cardiopulmonary bypass with lower limb extracorporeal circulation, via left thoracolaparotomy. This was followed by esophageal extirpation, salivary fistula, and formation of a feeding jejunostoma.

After the stressful surgery, high spinal cord ischaemia and paraplegia (Th3-10 ischaemic myelon on MR imaging) developed. The consciousness of the patient remained preserved, upper limb muscle strength was weak. After two weeks, she was admitted to the regional inten-

sive care unit, where multidrug-resistant Pseudomonas was cultured from the trachea. Complications included subcutaneous emphysema, thoracolaparotomy for scar dissection and bronchocutaneous fistula, but stenting was not recommended for the latter. The patient survived the last surgery for 5 weeks and died on 61st day of her treatment.

DISCUSSION

Aortoesophageal fistulae (AEF) are pathologic communications between the aorta and esophagus and result in life-threatening upper gastrointestinal haemorrhage. They are fatal in the absence of prompt management. Aortoesophageal fistulas are scarce entities that account for approximately 10% of all aortoenteric fistulae and have an estimated frequency of less than 0.5% in patients admitted with upper gastrointestinal haemorrhage *(Uno 2017; Hollander-Quick 1991; Kieffer-Chiche-Gomes 2003)*. The main etiologic factors of AEF include aneurysm (54.2%), foreign body ingestion (19.2%) and esophageal cancer (17%) *(Hollander-Quick 1991)*. An incidence of 1.7% to 1.9% has been reported in the setting of thoracic endovascular aortic repair (TEVAR) *(Uno 2017)*. It has been commonly associated with rupture of the descending thoracic aorta due to aortic aneurysm, aortic dissection, foreign body, malignancy, infection, radiotherapy, endovascular stent erosion, aortic graft infection *(Uno et al. 2017; Hollander–Quick 1991; Kieffer–Chiche–Gomes 2003; Heckstall–Hollander 1998; Gulati et al. 2021; Zhong–Li 2022)*. The most common location is the descending thoracic aorta, but the aortic arch and ascending aorta can also be affected *(Hollander–Quick 1991)*. The diagnosis of AEF should be considered in all patients with mid-thoracic pain, haematemesis, symptoms of esophageal obstruction and a history of TAA, foreign body ingestion or esophageal cancer.

Non-surgical methods such as Sengstaken-Blakemore tube and percutaneous embolization are used only as temporary control methods *(Hollander–Quick 1991)*. Ronald H. Yonago and his colleagues reported the first successful AEF repair in the English literature in 1969. They performed primary esophageal repair, aortic resection and aortic continuity restoration by use of a graft *(Yonago–Iben–Mark 1969)*. The patient's history included a left ligamentum arteriosum transection due to esophageal obstruction and a suture due to a diverticulum artificial injury of the ectatic ductus arteriosus. Between 1975 and 1991, only eight survivors were reported, always after resection of the esophageal lesion, with continuity with the stomach or intestines restored, combined with Dacron graft interposition following proximal and distal ligation of the aorta *(Hollander–Quick 1991)*.

According to William M. Bogey and his colleagues, it must be very important that the bed in which the graft is placed be as clean as possible, so all devitalized tissue should be resected and the chest should be adequately flushed after esophageal repair. The placement of the aortic graft outside the aneurysm (e.g. wrapped in a parietal pleural flap) is equally important. The duration of antibiotic, antifungal treatment ranged from a few days to indefinite ones *(Bogey–Thomas–Hermreck 1992)*. For extra-anatomical or in situ reconstruction, a wide range of graft materials are available, including homograft, biological or biosynthetic materials and antibiotic-impregnated grafts.

Katsuhiro Yamanaka and colleagues have shown that the anterolateral thoracotomy with a partial sternotomy (ALPS) approach allows protection of multiple organs and provides satisfactory exploration from the aortic root to the descending aorta. Although the in-hospital mortality rate remained high, there were no late aortic-related deaths and no recurrent infections *(Yamanaka et al. 2024)*.

The question occurs, what should we do if the patient refuses the operation? German authors reported a case of AEF following TEVAR surgery for PAU due to giant cell arteritis. The patient refused open surgery for AEF and after serial endoscopic vacuum treatment of the esophagus, the fistula was successfully closed endoscopically through the esophagus using 1 ml of fibrin glue *(Halloum et al. 2023)*. Oliva et al. *(1997)* implanted first a Palmaz stent in the aorta for AEF and mediastinal abscess to cover the fistula orifice and followed up the stent graft implantation by intravascular ultrasound (IVUS). Endovascular options may be considered as a bridge to open surgery in the case of hemodynamic instability or inoperable patients *(Li-Chan-Cheng 2018; Carrel-Englberger-Schmidli 2019; Somers et al. 2023; Al-Thani et al. 2021; Takeno et al. 2020)*. Differences in efficacy and complications were found between prophylactic and salvage TEVAR. The 90-day mortality of salvage(S) TEVAR and prophylactic(P) procedure TEVAR was 40% (95% CI 23-60, I2 = 36%) and 8% (95% CI 3-17, I2 = 0%), respectively. Post-S-TEVAR haemorrhagic and infectious complications were 17% (95% CI 3-57, I2 = 71%) and 20% (95% CI 5-57, I2 = 66%), respectively. Post-P-TEVAR haemorrhagic and infectious complications were 2% (95% CI 0-10, I2 = 0%) and 3% (95% CI 1-12, I2 = 0%), respectively *(Sakai et al. 2024)*. If there is suspicion of infection or signs of imminent infections (like in bronchopleural fistula or esophageal perforation) omental flap technique is a good way to improve the overall outcome *(Somers et al. 2023)*. Once the patient is hemodynamically stable, a definitive surgical repair is beneficial. Takeno et al. *(2020)* showed that the combination of graft replacement and esophagectomy improved prognosis provided long-term broad-spectrum antibiotics were used. In general, avoiding graft infection seems to be the main concern in long term, and some authors recommend lifelong antibiotic therapy. However, this concern can be potentially eliminated using homograft or bovine grafts *(Kotelis-Gombert-Jacobs 2018)*. Al-Thani et al. *(2021)* and colleagues were the

first to use bovine pericardium for aortic reconstruction of an aortoesophageal fistula.

After comparing the literature and our own cases, we conclude that endovascular therapy is a necessary treatment in the acute bleeding phase of aortoesophageal fistulas, but aortic reconstruction (with removal of the stent graft) and early resection of the eroded esophagus are necessary for a positive outcome.

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