

Case report

Sternotomy closure using negative pressure wound therapy after heart transplantation

Modestas Gudauskas^{a,*}, Jekaterina Cvetkova^b, Vilius Janušauskas^{b,c},
Aleksejus Zorinas^{b,c}

^a Vilnius University Faculty of Medicine, Vilnius, Lithuania

^b Institute of Clinical Medicine, Faculty of Medicine, Vilnius University, Vilnius, Lithuania

^c Clinic of Cardiovascular Diseases, Institute of Clinical Medicine, Vilnius University Faculty of Medicine, Santariskiu st. 2, 08661, Vilnius, Lithuania

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Summary

Background: Deep sternal wound infection (DSWI) after orthotopic heart transplantation (OHT) is not a common but known complication and carries high mortality and morbidity rates. This report identifies a successful management strategy for recurrent DSWI, and it is a valuable addition to the medical literature supporting the management of sternal wound infections (SWI) along with negative pressure wound therapy (NPWT).

Case presentation: This report describes the successful management of recurrent DSWI after OHT in a 52-year-old patient. We performed secondary sternotomy closure along with NPWT for the immunosuppressed patient.

Conclusion: Our case demonstrates that a combination of reduced immunosuppression, adequate antimicrobial treatment, and NPWT can effectively treat complicated DSWI.

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Keywords: deep sternal wound infection, negative pressure wound therapy, heart transplantation

Background

Deep sternal wound infection (DSWI) after orthotopic heart transplantation (OHT) is not a common but known complication and carries high mortality and morbidity rates. The management of sternal wound infections (SWI) in patients after OHT is not well studied [1]. Immediate aggressive surgical management is suggested when diagnosed, but the treatment modalities differ [1–3].

Case report

A 52-year-old overweight (BMI 30.1 kg/m²) male has presented with symptoms of DSWI four months after OHT. He complained of pain in the

lower sternum, general weakness, and fever. During physical examination fluctuating lump on the lower part of the sternum has been found. From the previous medical history, it was known that the patient had mitral valve replacement for infective endocarditis, and he was on the heart transplant waiting list for decompensated congestive heart failure. The year before OHT, the patient's heart failure symptoms progressed, and he was admitted to the intensive care unit with cardiogenic shock and pulmonary oedema requiring inotropic support, intraaortic balloon pump, and pulmonary ventilation. An urgent left ventricular assist device implantation as a "bridge to heart transplantation" was performed. Twelve months later, he had received a matching donor heart and underwent OHT. After a complicated postoperative course, he was discharged home on the 90th postoperative day. During this admission, the patient was on OHT related medications along with immunosuppressants sirolimus and prednisolone. Laboratory tests showed leucocytosis ($13.68 \times 10^9/\text{ml}$) with high C-reactive protein

* Corresponding address: Modestas Gudauskas, Vilnius University Faculty of Medicine, M. K. Čiurlionio st. 21/27, LT-03101, Vilnius, Lithuania

Phone: +37052398700

E-mail: modestas.gudauskas@mf.stud.vu.lt.

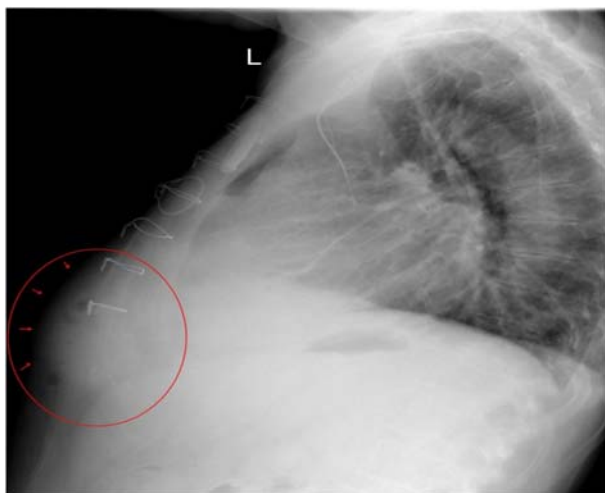


Figure 1. X-ray findings of mediastinitis after orthotopic heart transplantation. The lateral radiograph shows swelled soft tissue (circle) elevation and gas bubbles in the tissue (arrows)



Figure 2. Computed tomography findings of mediastinitis after orthotopic heart transplantation. Axial CT image shows an abscess with air at the level of 4 thoracic vertebra (circle). The infectious process has been limited to the lower part anterior mediastinum

(263 mg/l) and elevated creatinine (237 μ mol/l). The X-ray and computed tomography have confirmed our suspicion of DSWI (Figs. 1, 2). A patient was taken to the operating room, and a partial lower re sternotomy was performed. After removing steel wires, a significant amount of pus was evacuated from the mediastinum. Microbiology samples were taken, and *E. coli*, sensitive to most antibiotics, was identified. Debridement of the lower mediastinum and exposed sternal edges has been performed, and NPWT combined with antibiotic therapy, amoxicillin-clavulanate, 1000/200 mg three times a day was started. Following three weeks of NPWT patient had no signs of infection. Three consecutive wound swabs were negative, and blood results were normal. The mediastinum and sternum were cov-

ered with clean granulation tissues and looked well. The sternum was rewired and closed. Unfortunately, on the seventh postoperative day, a recurrence of DSWI was diagnosed. A microbiology result came back positive for *E. coli*, resistant to most antibiotics. Appropriate antibiotic therapy with meropenem, 1000 mg three times a day was initiated. For the second time, partial lower re sternotomy has been performed to evacuate pus and blood clots. Debridement of the wound has been performed, and NPWT has been reinitiated with changes in the immunosuppression regimen. At this time, sirolimus was switched to cyclosporine (to maintain blood levels of 100 ng/ml, dose-adjusted due to chronic renal failure). Reduction of the immunosuppression regimen resulted in two episodes of acute graft rejection. It was treated with methylprednisolone 1000 mg intravenously. On the 60th day of the NPWT, combined with an antibiotic regimen and reduced immunosuppression, the patient had no DSWI signs. Gradual reduction of the sponge size during each dressing change has allowed complete secondary closure of anterior mediastinum and approximation of the sternal edges (Fig. 3). Pectoral flaps to cover the sternotomy line were used, and skin was closed using pledged reinforced interrupted suture technique. A patient's postoperative course was uneventful, and he was discharged home. The patient was regularly monitored at the outpatient clinic for two years, no signs of recurrent SWI or heart failure symptoms were identified.

Discussion

SWI after cardiac surgery is a feared complication. Sternal wound complications, including superficial wound infections, DSWI, and sternal instability, may occur, primarily after sternotomy procedures. Many patients with DSWI are at a higher risk of repeated interventions, complex wound care, use of long-term antibiotics, extended in-hospital care, and altogether increased mortality rates.

The incidence of DSWI after OHT varies considerably due to different diagnostic criteria and patient populations. SWI after OHT is reported with an incidence of up to 8.8%. DSWI, including mediastinitis, ranges from 2.7% to 8.7% after OHT [1]. DSWI after OHT, having in mind the use of immunosuppressive therapy, is a common complication and carries high mortality and morbidity rates. Carrier et al. reported a mortality rate for DSWI after OHT of 18%, Filsoufi et al. 31%, and Wallen et al. reported a mortality rate of 30% [1–3].

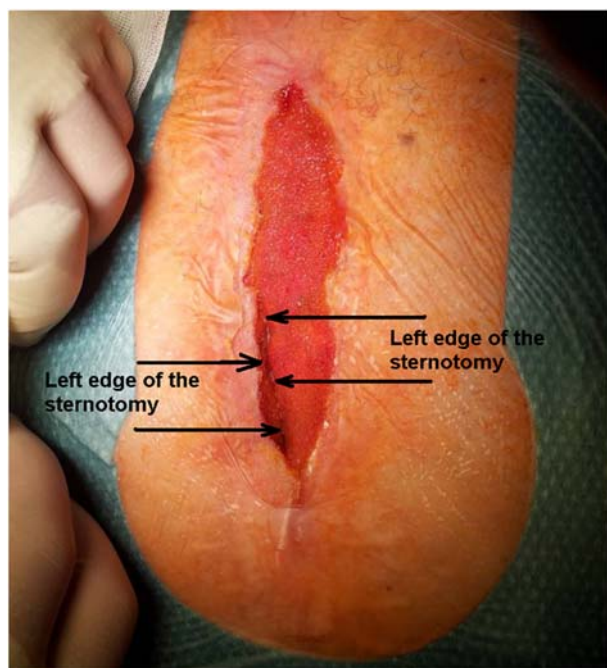


Figure 3. Anterior mediastinum closure after second negative pressure wound therapy. Gradual reduction of the size of the polyurethane sponge during each change has allowed complete closure of the anterior mediastinum and approximation of the sternal edges

According to the literature, our patient's leading risk factors were obesity (BMI > 30 kg/m²), previous heart surgeries, ventricular assistance device, and inotropic support [4,5].

The management of SWI in patients after OHT is not well studied [1]. Immediate aggressive surgical management is suggested [1–3]. Authors suggest different aggressive surgical treatment strategies. Carrier et al. reported surgical debridement, mediastinal drainage, and sternal reclosure with antibiotic treatment and omentoplasty with pectoralis muscle flaps used in 2 patients [2]. Abid et al. report early aggressive debridement followed by substernal iodine irrigation and primary sternal closure as preferred intervention, whereas Senechal et al. report best results with closed drainage without irrigation therapy [5,6]. Filsoufi et al. followed an open-chest management protocol involving aggressive debridement of necrotic tissue and NPWT accompanied by six weeks of intravenous antibiotic treatment [1]. Other authors have argued in favour of open chest management with vacuum-assisted (VAC) devices. VAC therapy allows better tissue granulation and healing, with less infectious recurrences than open or closed techniques with irrigation [7]. According to study by Baillot et al., most patients treated with VAC therapy showed decreased perioperative mortality and increased short-term survival [7].

In this clinical case, the patient was managed by debridement along with adequate an-

timicrobial treatment and NPWT/VAC. The chosen treatment initially showed promising results, and the sternum was rewired after three weeks of NPWT. Unfortunately, one week after wound closure, DSWI recurred, and NPWT was reinitiated. Postoperative complications after heart transplantation include mTOR inhibitor-related wound-healing impairment. Adverse events of sirolimus-related wound complications are reported in 8–40% of heart transplantation patients [8]. For this time, we decided to change the immunosuppression regimen from sirolimus to a low dose of cyclosporin and set the blood plasma concentration at 100 ng/mL. With a reduced immunosuppression regimen, the potential risk of graft rejection is high. Close monitoring of cardiac performance by frequent cardiac echocardiography was maintained. In the suspicion of deteriorating cardiac function, myocardial biopsies were obtained. Nevertheless, during this second course of NPWT, this patient had two episodes of acute graft rejection. Furthermore, we decided to approximate the sternum using a secondary closure technique along with NPWT, which turned out to be safe and effective. Gradual reduction of the size of the polyurethane sponge during each change has allowed complete closure of the anterior mediastinum and approximation of the sternal edges.

Conclusions

We report a case of recurrent DSWI after OHT in a 52-year-old patient. Our case demonstrates that a combination of reduced immunosuppression, adequate antimicrobial treatment, and NPWT can effectively treat complicated DSWI.

Consent

Consent was obtained from the hospital to use anonymized patient information.

Conflict of interest

The authors declare that they have no conflict of interest.

References

- [1] Filsoufi F, Rahmanian PB, Castillo JG, Pinney S, Broumand SR, Adams DH. Incidence, treatment strategies and outcome of deep sternal wound infection after orthotopic heart transplantation. *J Heart Lung Transplant* 2007;26(11):1084–90.
- [2] Carrier M, Perrault LP, Pellerin M, Marchand R, Auger P, Pelletier GB, et al. Sternal wound infection after heart transplantation: incidence and results with aggressive surgical treatment. *Ann Thorac Surg* 2001;72(3):719–23.

- [3] Wallen TJ, Habbertheuer A, Gottret JP, Kramer M, Abbas Z, Siki M, et al. Sternal wound complications in patients undergoing orthotopic heart transplantation. *J Card Surg* 2019;34(4):186–9.
- [4] Abboud CS, Wey SB, Baltar VT. Risk factors for mediastinitis after cardiac surgery. *Ann Thorac Surg* 2004;77(2):676–83.
- [5] Sénéchal M, Leprince P, Tezenas Du Montcel S, Bonnet N, Dubois M, El Serafi M, et al. Bacterial mediastinitis after heart transplantation: clinical presentation, risk factors and treatment. *J Hear Lung Transplant* 2004;23(2):165–70.
- [6] Abid Q, Nkere UU, Hasan A, Gould K, Forty J, Corris P, et al. Mediastinitis in heart and lung transplantation: 15 years experience. *Ann Thorac Surg* 2003;75(5):1565–71.
- [7] Baillet R, Cloutier D, Montalin L, Côté L, Lellouche F, Houde C, et al. Impact of deep sternal wound infection management with vacuum-assisted closure therapy followed by sternal osteosynthesis: a 15-year review of 23 499 sternotomies. *Eur J Cardio-Thoracic Surg* 2010;37(4):880–7.
- [8] Nguyen LS, Vautier M, Allenbach Y, Zahr N, Benveniste O, Funck-Brentano C, et al. Sirolimus and mTOR inhibitors: a review of side effects and specific management in solid organ transplantation. *Drug Saf* 2019;42(7):813–25.