



Successful treatment of refractory empyema using dual sheet covering

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(Citation)

Asian Cardiovascular and Thoracic Annals, 30(3):342-344

(Issue Date)

2022-03

(Resource Type)

journal article

(Version)

Accepted Manuscript

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Uchida T, Tanaka Y, Kuroda S, Hokka D, Maniwa Y. Successful treatment of refractory empyema using dual sheet covering. Asian Cardiovascular and Thoracic Annals. 2022;30(3):342-344. © The Author(s) 2021.
doi:<https://doi.org/10.1177/02184923211015078>

(URL)

<https://hdl.handle.net/20.500.14094/0100477952>



Abstract

Managing thoracic empyema with massive air leakage can be challenging. We present a case with thoracic empyema with multiple bronchopleural fistulae and extensive lung parenchymal necrosis due to drain injury. Emergency operation was performed for respiratory distress due to massive air leakage. As direct sutures could not be achieved due to the extensive parenchymal necrosis, polyglycolic acid and oxidized regenerated cellulose sheets were packed into the lesion. Although open-window thoracostomy was required for bronchopleural fistulae, the stoma closure was achieved via vacuum-assisted closure therapy. The dual sheet coverings contributed to the successful recovery by resolving multiple bronchopleural fistulae.

Keywords: thoracic empyema, bronchopleural fistula, Polyglycolic acid sheet

Introduction

Thoracic empyema involves the administration of antibiotics and the efficient drainage of pus from the thorax to control the infection. For refractory thoracic empyema, which is sometimes accompanied by bronchopleural fistulae (BPF), open-window thoracostomy (OWT) should be offered. Although OWT is particularly effective for intrathoracic infection control, stoma closure is achieved in only 34.3% by musculoplasty. [1] Vacuum-assisted closure (VAC) therapy has been used to accelerate OWT closure for several years. We present a rare case of refractory thoracic empyema with multiple BPF and extensive lung parenchymal necrosis due to drain injury that was successfully treated by VAC therapy following OWT.

Case Report

The patient was a 70-year-old male under mechanical ventilation who had been treated for right lung abscess and sepsis due to *Pseudomonas pneumonia*. His comorbidities were severe emphysema and low cardiac function due to past myocardial rupture. In the course of mechanical ventilation, right pneumothorax occurred (Fig. 1), then a thoracic drain tube was inserted. The drain tube penetrated the lung abscess in the lower lobe, causing dyspnea, and he was transferred to our institution.

The patient presented with severe respiratory distress ($\text{PaO}_2 / \text{FiO}_2$ ratio 58) and

hemodynamic deterioration, requiring catecholamine administration. Subsequently, emergency surgery was performed for massive air leakage. After removing hematoma and pus, a 7 cm bowl-shaped parenchyma injury without visceral pleura was observed. To reduce air leakage and hemorrhage, polyglycolic acid (PGA) and oxidized regenerated cellulose (ORC) sheets were packed in layers with fibrin glue into the lesion (Fig. 2). During postoperative intensive care, differential ventilation using 2 mechanical ventilators (right; tidal volume 100 mL, positive end-expiratory pressure 3 cm H₂O, left; tidal volume 350 mL, positive end-expiratory pressure 8 cm H₂O) was adopted to decrease the pressure applied on the repaired lung. The thoracic drain was placed without suction. Although the air leakage, infection and respiratory condition improved, OWT and tracheotomy were performed on postoperative day 11 because the treatment of BPF was expected to be prolonged. Although his underlying conditions had prolonged ventilation period, the mechanical ventilator was successfully withdrawn on postoperative day 88. Although musculoplasty was considered, low cardiac function due to past myocardial rupture was judged to be at high risk for long general anesthesia. Therefore, VAC therapy was initiated on postoperative day 150 (Figure 3) to accelerate the proliferation of granulation tissue. The OWT stoma was successfully closed without musculoplasty on postoperative day 184.

Discussion

One of the biggest problems in this case was massive air leakage. As the patient's condition on admission was too severe to perform conventional treatment such as OWT, our initial intention was to decrease air leakage as much as possible to stabilize his condition by less invasive method within a short operation period. The advantage of packing PGA and ORC sheets are its simplicity and minimal invasiveness and the methods decreased air leakage effectively and allowed us to proceed with VAC therapy.

The PGA sheet functions as a scaffold for tissue regeneration, thus accelerating lung wound healing. [2] The ORC sheet thickens pleura by prompting fibroblast granulation. [3] Yamanaka et al. reported that a dual-covering method using both PGA and ORC sheets thickened pleura and prevented recurrence of primary spontaneous pneumothorax. [4] We infer that the synergic effect of the PGA and ORC sheets further strengthens pleura and accelerates fistulae closure.

Another major problem encountered was infection control. Although *Pseudomonas* empyema was difficult to manage, OWT and antibiotics have kept infection under control. Although foreign objects can be the sources of infection, both PGA and ORC sheets are absorbable, resolving over 15 weeks and 2 weeks, respectively. Previous reports [2, 5] demonstrated that both PGA and ORC sheets did not influence the occurrence of infection. Furthermore, the ORC sheet has bacteriostatic action, [6] as it keeps pH levels around 6 and

creates a hostile environment for a broad spectrum of bacteria including staphylococci, *Pseudomonas aeruginosa*, and *Acinetobacter calcoaceticus*. We believe both PGA and ORC sheets do not become the sources of infection and can be safely used in the thoracic surgery.

A third problem was closing the OWT because the patient would not tolerate long general anesthesia. Air leakage as a contraindication of VAC therapy is controversial. [4] [3] We believe that major air leakage prevents lungs from expanding, which means sufficient ventilation cannot be secured. Although our case showed massive air leakage at the time of the first surgery, dual coverings have greatly decreased this, and VAC was achieved without any worsening of respiratory status.

Conclusion

We demonstrated the successful treatment of refractory thoracic empyema with multiple BPF with a multidisciplinary treatment of dual sheet coverings, OWT, and VAC.

Acknowledgement:

Not applicable

Statement of Informed Consent:

Informed consent was obtained from the patient.

Declaration of Conflicting Interests:

The authors declare that there is no conflict of interest.

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Figure Legends

Fig. 1: Chest CT revealed right pneumothorax and extensive lung abscess in the right lower lobe.

(A: axial plane, B: coronal plane).

Fig. 2A: A 7cm bowl-shaped necrotic lung parenchyma exposed 8 bronchial fistulae (pointed by blue arrows). **Fig. 2B:** PGA sheet (light blue) and ORC sheet (white) were packed in layers to the lesion. ORC sheet was topped to cover the whole packing.

Fig. 3: Postoperative courses of open window thoracostomy (OWT) are shown. The blue arrow shows PGA used for the lesion, which was later absorbed over time. The OWT closure was successfully achieved without musculoplasty.





