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Case Report / Olgu Sunumu

Negative pressure wound closure system for giant thoracic defect closure in a patient with completely visible pericardium: A case report

Dışarıdan tamamen görülebilen perikardiyumu olan bir hastada dev torasik defektin kapanması için negatif basınçlı yara kapama sistemi: Olgu sunumu

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ABSTRACT

Negative pressure wound closure system facilitates wound closure via wound contraction. In this article, we report a successful application of thoracic negative pressure wound closure system to fill the thoracic defect, control infection, and expand the lung in a 35-year-old male patient with three-rib defect, lung parenchyma injury, empyema, left complete pneumothorax, and visible pericardium after gunshot injury. The excellent result obtained in our patient demonstrates that negative pressure wound closure system is a good choice for treating high-energy thoracic injuries by reducing wound infection and enabling early wound closure.

Keywords: Negative pressure wound therapies; vacuum assisted closure; wound care.

ÖZ

Negatif basınçlı yara kapama sistemi yara kontraksiyonu yoluyla yara kapanmasını kolaylaştırır. Bu yazıda, ateşli silahla yaralanma sonrası üç kaburga defekti, akciğer parankim yaralanması, ampiyemi, sol komplet pnömotoraksı ve dışarıdan görülebilir perikardiyumu olan 35 yaşında bir erkek hastada torasik defektin doldurulması, enfeksiyonun kontrol edilmesi ve akciğerin genişletilmesi için negatif basınçlı yara kapama sisteminin başarıyla uygulanışı bildirildi. Hastamızda ulaşılan mükemmel sonuç negatif basınçlı yara kapama sisteminin yara enfeksiyonunu azaltarak ve erken yara kapanmasını sağlayarak yüksek enerjili toraks yaralanmalarının tedavisinde iyi bir seçenek olduğunu göstermektedir.

Anahtar sözcükler: Negatif basınçlı yara tedavileri; vakum yardımlı kapama; yara bakımı.

The negative pressure wound closure system (NPWCS) is currently used often in almost all areas of medical practice, particularly in general surgery. Application of NPWCS is growing in frequency because it allows a reduced number of daily dressing changes, enables the disposal of purulent substances and inflammatory mediators and cytokines, diminishes the development of tissue edema, promotes neovascularization, tissue oxygenation and healthy granulation formation, and facilitates wound closure via wound contraction.[1-3]

Negative pressure wound closure system is useful for managing large, problematic wounds that are almost totally open, filling tissue defects in patients with Fournier's gangrene, managing open abdomen after gunshot injury, allowing transient closure of the abdomen during care of abdominal compartment syndrome, and facilitating the management of diabetic foot complications.[3-6] In this article, we report a successful application of thoracic NPWCS to fill a thoracic defect, control infection, and expand the lung in a patient with three-rib defect, lung parenchyma

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injury, empyema, left complete pneumothorax, and visible pericardium after a gunshot injury.

CASE REPORT

A 35-year-old male patient wounded himself with a shotgun with the aim of suicide. After urgent partial lung resection, empyema occurred together with bronchopleural fistula and complete lung collapse due to open thorax. The patient was referred to our hospital for open thoracic wound management on postoperative day 27. On physical examination, the patient had a 15×20 cm thoracic wall defect (cavity) at the anterior and mid-axillary lines in the left thoracic region, a few lung parenchyma air leakage orifices, purulent fluid in thoracic cavity, visible heartbeat because the medial portion of this area was adjacent to the pericardium, and total collapse of the ipsilateral lung (Figure 1). We accepted this patient with these signs. Because all of his culture specimens and some results were positive, we changed his antibiotic therapy. Plans were made to use NPWCS. During this period, the patient received a tracheostomy and was connected to mechanical ventilation. He suffered from sepsis, his general condition was poor, and he was uncooperative and disoriented. A written informed consent was obtained from the patient.

Initially, we applied NPWCS every other day and then once every four days according to the condition of his wound: a total of 23 times (Figure 2). We achieved control of the infection, expansion of the lung, and diminishment of the wound via improved granulation tissue on the thoracic wall by reduced number of sponges with every other dressing change.

We used the abdominal type of NPWCS, which has a tissue protective layer, because of the patient's visible subclavian artery and vein around the adjacent pericardium and the lung apex at the time of initial NPWCS application. In addition, we wanted to avoid contact of the sponges with the pericardium. The pericardium, artery and vein were protected from contact with the sponges via the tissue protective layer of the abdominal type of NPWCS. Downsizing of the wound was achieved in three months (Figure 3).

Figure 1. Thoracic defect.

Figure 2. Application of negative pressure wound closure system.

Figure 3. Diminished thoracic defect.

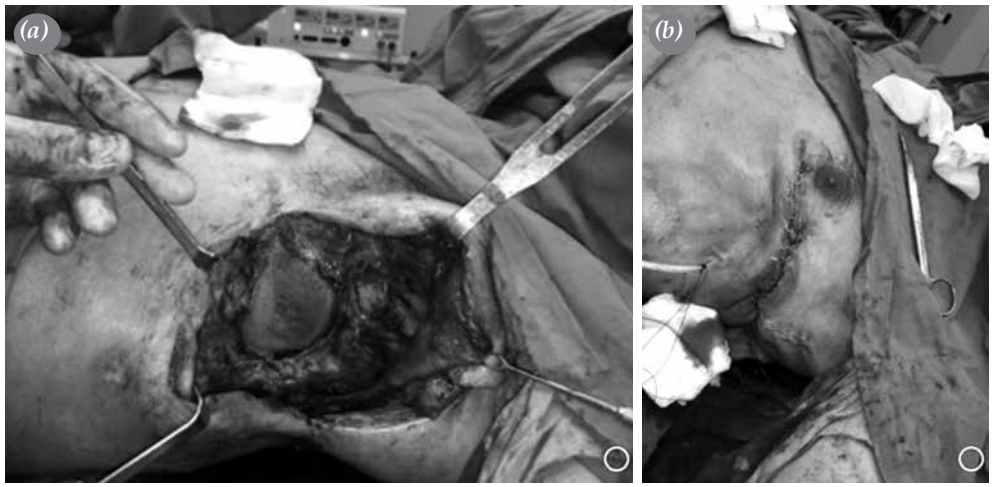

Figure 4. (a) Before and **(b)** after closure of thoracic wound.

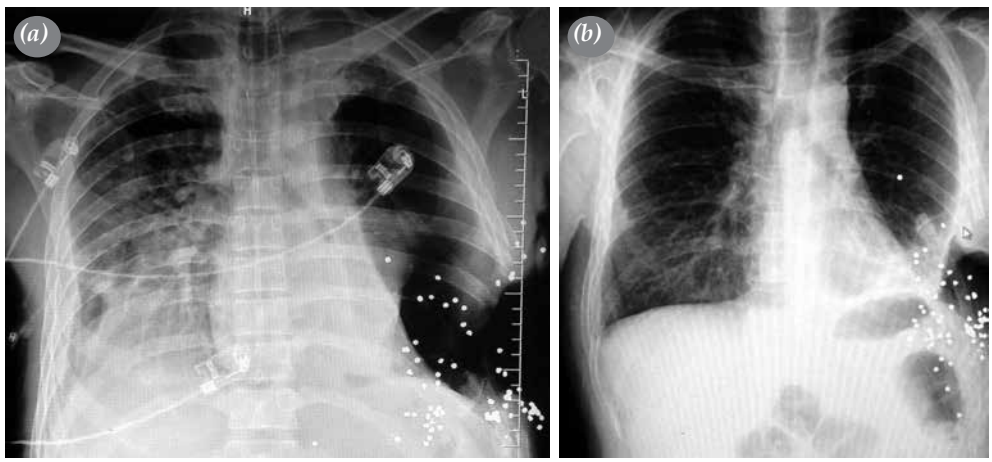

Figure 5. Lung X-rays of the patient **(a)** at first admission and **(b)** at discharge.

No enlargement occurred in the air leakage areas of the lung parenchyma. Air leakage was precluded by Vicryl sutures with pledgets at the beginning of the patient's hospitalization. We applied a small dressing with antibiotic pomades to preclude the loss of negative pressure over two reactivated air leakage areas. After the 10th application of NPWCS, we discontinued use of the abdominal type of NPWCS; we changed to the standard NPWCS because the lung expanded, the artery and vein became invisible, and granulation tissue on the lung improved. The sepsis totally resolved after the 12th dressing change. The patient was removed from ventilation and had spontaneous respiration. After the 19th dressing change, the lung was totally expanded and filled the thoracic cavity. Dressing changes thereafter were applied for the purpose of reducing the thoracic defect. Air leakage from the lung stopped when the thoracic defect decreased to 4×4 cm. After that, the skin underwent primary suturing after release from the two sides of the wound lips (Figure 4a, b). The silicon drain under the skin closure was removed on the fifth day after suturation. The patient was discharged after suture removal. The difference could be seen comparing the lung X-ray at the time of first admission and the lung X-ray at discharge (Figure 5a, b). The first X-ray revealed that the lung was totally collapsed, and the last X-ray demonstrated that the lung had expanded and totally filled the thoracic space.

DISCUSSION

Negative pressure wound closure system has been successfully used not only for chronic wounds with open fractures, but also for temporary wound closure of complicated acute injuries.[7-9] Negative pressure wound

closure system therapy provides temporary protection of soft tissue defects by means of polyurethane foam, which is sealed airtight by a polyvinyl foil. A negative topical pressure gradient is generated by the NPWCS unit.[1] In clinical practice, NPWCS therapy increases the formation of granulation tissue on the wound surface, both quantitatively and qualitatively.[1,10-12] It was well-documented that four days of NPWCS therapy produces significantly improved microperfusion, increased partial oxygen pressure in the tissue, and reduction in bacterial colonization (bacterial clearance). In the meantime, NPWCS eliminates inflammatory agents such as cytokines and leukotrienes as soon as they are produced so that these products have less opportunity to join the systemic circulation and the patients experience less suffering from the effects of multiple organ dysfunction syndrome and systemic inflammatory response syndrome (SIRS).[1,10-13] Increased microvessel density, which develops with time, results in improved granulation formation and speeds wound healing.[1] Negative pressure wound closure system offers a rapid treatment for complex pleural empyema and the opportunity for a primary closure of the empyema cavity.[14,15]

Upon admission, the patient's left lung was totally collapsed and it had thick fibrotic pleura such that expansion of the lung was not possible. In order to expand the lung at that time, it needed decortication, but the patient was suffering from SIRS and septic shock. We predicted that the lung could be expanded slowly by application of NPWCS to the thoracic space. The accuracy of our prediction may be seen by comparing the lung X-ray at the time of first admission and the lung X-ray at discharge. The first X-ray revealed that the lung was totally collapsed, and the last X-ray demonstrated that the lung had expanded and totally filled the thoracic space. Because of these features, we decided to use the NPWCS for our patient.

We focused on resolving regional edema, reducing bacterial colonization, and re-expanding the lung. Initially, we used the abdominal type of NPWCS because this type has an organ-preserving layer. We covered the sponge with organ preserving film-layer to avoid organ or vascular damage. This placement of the sponges prevents fistulization and major bleeding. We started with a -75 mmHg negative pressure level. When we observed sufficient granulation tissue on the lung after the fourth dressing change, we increased the pressure to 125 mmHg. After the 10th dressing change, we observed that there was sufficient granulation tissue, and we discontinued using the organ-preserving layer and started using the standard dressing style. We reduced the size of the sponge when we saw lung expansion. We believe that the NPWCS played a prominent role in the rapid successful healing of the large wound of our patient.

In conclusion, negative pressure wound closure system may be used to prevent high mortality and morbidity from a high-energy gunshot injury that produces a huge thoracic defect and open thorax with empyema, particularly if the patient has total lung collapse, fibrotic and thickened pleura and impossible decortication. However, caution is needed during the procedure; the pericardium and major vascular structures must be well-protected, and care must be taken to avoid possible complications. Multiple sessions of debridement and surgery are required, and the injury site(s) must be protected with appropriate and frequent dressing changes. The use of negative pressure wound closure system therapy to treat such patients facilitates recovery, and offers a "civilized," cost-effective treatment.[16] The excellent result obtained in our patient demonstrates that the negative pressure wound closure system is a good choice for treating high-energy thoracic injuries by reducing wound infection, increasing wound neovascularization and oxygenation, enhancing wound healing, and enabling early wound closure.

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