Brief communication - Vascular thoracic
An effective vacuum-assisted closure treatment for mediastinitis with aortic arch replacement

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Abstract

Little experience exists with the vacuum-assisted closure (VAC) therapy in the high-risk group of patients with perigraft abscess containing a large amount of prosthetic vascular grafts. We report our experience in the VAC therapy for patients with mediastinitis after aortic arch replacement. Between February 2003 and December 2006, five patients with a mean age of 72.2 years developed postoperative mediastinitis after aortic arch replacement, and were treated with the VAC system. In all the patients the mediastinal fluid and tissue examinations turned out to be negative for microbiological cultures, and successful closure of the midline incision was achieved with concomitant omental transfer after a mean duration of 22.6 days of VAC treatment. Four of the five patients survived to discharge and have been free from recurrent sign of mediastinal or graft infection at long-term follow-up. Our study indicates that the VAC treatment may reduce early mortality of life-threatening deep sternal wound infection complicated by a prior aortic arch replacement and become a preferred therapeutic option for the patients to whom another replacement is too risky.

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1. Introduction

Early mortality among the patients who had aortic arch replacement that resulted in mediastinitis is high [1]. Common treatments for them include surgical debridement, drainage, irrigation, and replacement of the prosthetic graft with an omental or a pectoral muscle flap. The graft, a foreign object, makes the infection management a challenge. A safe effective treatment for their mediastinitis has been sought.

The vacuum-assisted wound closure (VAC) system, commonly adopted for the treatment of pressure ulcers and other chronic wounds [2], is a relatively new non-invasive treatment that promotes granulation. It was previously described for the treatment of osteomyelitis and originally applied to mediastinal infection by Durandy et al. as early as in 1984 [3]. Its application has been steadily expanding and constitutes presently the treatment of choice in many institutes for post-sternotomy mediastinitis. However, its application to mediastinitis of patients who had aortic arch replacement is not yet widely known. The standard protocol for such mediastinitis at our facility has been a complete replacement of the infected graft with a homograft or xenograft. This option, however, is of great burden and unsuitable for severely infected patients.

The authors attempted to manage mediastinitis where a large amount of graft is used with the VAC system.

2. Patients and method

Between February 2003 and December 2006, five patients with aortic arch replacement who developed mediastinitis were treated with the VAC system. The patients’ demographics and history are summarized in Table 1. In terms of the predisposing factors to mediastinitis, all the five except for patient no. 4 were septuagenarians. Early postoperative course in patient no. 1 was complicated with pneumonia and sepsis. Patient no. 2 underwent re-do aortic root replacement for prosthetic valve endocarditis with aortic annular abscess. Patient no. 3 had undergone multiple mediastinal exposure for delayed mediastinal bleeding due to coagulopathy associated with thoraco-abdominal aortic aneurysm. Bacterial translocation was suspected in patients no. 4 and 5 when mediastinitis was diagnosed. Patient no. 4 had developed brain abscess with methicillin-sensitive Staphylococcus aureus. Her CT-scan revealed mediastinitis with perigraft abscess (Fig. 1a,b).

2.1. Installation of the VAC system

The VAC system components:

• polyurethane foam (Hydrosite®, Smith & Nephew Inc., Florida, FL),
• non-collapsible chest tube (BLAKE Drains®, Ethicon Inc., San Angio, TX),
• vacuum pump (HAMA Servo drain, Hama Medical Industrial Co. Ltd., Tokyo)
• LAP sponge™ (Kawamoto Co. Ltd., Osaka).
• 3M™ Ioban™ 2 antimicrobial incise drape (3M Health Care Inc., St. Paul, MN).

When a CT-scan confirmed mediastinitis, mediastinum of each patient was explored under general anesthesia in the operating room. Precise debridement and wound excision were followed by copious irrigation with warm saline. The deep sternal wound was then dressed with the VAC system that provided continuous pressure of 99 mmHg. A BLAKE Drain was placed in the middle of the incision and the incision perimeter was covered with LAP sponges. The wound was then covered with a 3M Ioban 2 antimicrobial incise drape. The mediastinum and the prosthetic grafts were observed everyday while the patient was sedated. Pyoktanin was applied for gram-positive micrococci, amply around the prosthetic grafts [4] (Fig. 1e).

2.2. Timing of sternal closure
When mediastinal tissue or gauze cultures became negative on multiple consecutive tests, the chest was closed transferring omentum or major pectoral muscle (Fig. 1c, 1d).

3. Results
Mediastinitis was healed in all five patients (see Table 1). Four patients survived to discharge and have been free from recurrent infections of the lesion. Patient no. 3 died from rupture of the thoracoabdominal aortic aneurysm 16 months after chest closure. But his postmortem graft examination showed no signs of infection (Fig. 1f).

4. Discussion
Despite the condition of the five patients in this study being too severe for the standard protocol, VAC therapy was effective in such high-risk patients in managing mediastinal infection even with the presence of the prosthesis. The effectiveness of the VAC system on microcirculation and promotion of tissue granulation was also confirmed.

Removal of exudate from the mediastinal cavity and of the vascular graft surface also contributed to the successful infection management. Slime protects bacteria from antibiotics [5]. Extracellular glycolalx slime is known as a virulence factor of many pathogenic bacteria, especially in the presence of biomaterial. Cytokines, radicals and nitrogen species secreted from blood monocytes and macrophages that are stimulated by cleavage products of gram positive bacteria, cause oxidative-inflammatory damage [6]. Strong vacuum of the VAC was effective for elimination of slime ameliorating virulent local infection.

The negative pressure of the VAC system, much higher than that of a conventional drain, caused no adverse events such as anastomotic rupture and bleeding. The VAC imposed no pressure difference between prosthetic graft and the native aorta, and no suture lines were pulled apart. The
VAC had no impact on hemodynamics and respiratory function either.

The VAC therapy can, by and large, eliminate the need for omentopexy or pectral muscle transfer in some mediastinal infections, since a strong negative pressure per se can enhance neovascularization in the mediastinal tissue. However, the presence of a large amount of prosthetic material limits the granulation around the prosthetic grafts. We believe that supplemental treatment using an omental or a pectral muscle flap is essential in the management of graft infection.

The VAC therapy augmented by pyoktanin and omentopexy as well as pectral muscle transfer was effective to treat mediastinitis that developed after aortic arch replacement. The successful VAC therapy may eliminate the need for high-risk replacement of prosthetic graft.

References