Caveats in using vacuum-assisted closure for post-pneumonectomy empyema

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Received 27 August 2011; received in revised form 27 September 2011; accepted 29 September 2011

Abstract

OBJECTIVES: Vacuum-assisted closure (VAC) of chronic empyemas can potentially set challenging patients free of prolonged hospitalization by warranting outpatient care. We wanted to test this concept in post-pneumonectomy empyema patients.

METHODS: Three patients with post-pneumonectomy bronchopleural fistula were subjected to open window thoracostomy (OWT) and subsequently to VAC. The BPFs were closed by endobronchial stents in 2 of the patients. The VAC system was applied at a median time of 35 days (range, 23–113) after pneumonectomy. The patients were scheduled for outpatient visits every three days with complete change of the VAC sponges.

RESULTS: Hypotension and acute thoracic pain despite minimal suction applied to the VAC sponges were observed during treatment and eventually caused VAC discontinuation. In one patient, the sponges of the VAC system could not be directly removed through the OWT and careful dissection through VATS under deep sedation was needed.

CONCLUSIONS: VAC can be of help to obliterate the post-pneumonectomy empyema cavity but its use can trigger clinically significant complications. Cautious monitoring of the VAC system must be exercised in the early period prior to discharging patients to the outpatient clinic.

Keywords: Vacuum assisted closure • Pneumonectomy • Empyema • Bronchopleural fistula

INTRODUCTION

Vacuum assisted closure (VAC) has been introduced as a treatment for the pleural empyema aimed at shrinking the pleural cavity to eventually obliterate it with viable tissue [1]. Appropriateness, efficacy and cost-effectiveness of VAC in chronic post-pneumonectomy spaces remain to be clarified [1–3]. In this setting, we recently observed possible caveats in the use of VAC.

MATERIALS AND METHODS

We have used VAC in the management of the right post-pneumonectomy spaces in three patients with manifestation of the patent bronchial stump at a median time of 35 days after surgery (range, 23–113; Table 1). Two patients had locally advanced lung cancer for which they had received chemotherapy in the neoadjuvant or adjuvant setting. In all instances, pneumonectomy was performed via a totally muscle sparing, limited thoracotomy in the auscultatory triangle; as a routine, the bronchial stump had been covered by an intercostal muscle flap. After open window thoracostomy (OWT), several options for bronchial stump closure and obliteration of the pleural cavity were pursued, including muscle flaps, omentum and, more recently, endobronchial stenting concomitant to suturing of an acellular collagen matrix to the bronchopleural fistula (BPF). In spite of the absence of an obvious air leak, the production of mucoid secretions after covered stent placement in two patients contraindicated the closure of the OWT. Gauze dressing had been applied for at least 2 week, twice a day on the first week and once a day on the second. Subsequently, VAC was instituted immediately after gauze dressing in order to fast track the patient towards home dismissal. We used a technique similar to what described by Aru et al. in 2010 [1] who also reported the intrathoracic placement of tailored oval sponges (2 × 6 × 10 cm in our experience) which are counted when inserted and removed from the pleural cavity. All patients were scheduled to be seen in the outpatient clinic once every 3 days. Common complaints after VAC use were deeply located, intolerable pleurogenic pain, leading to discontinuation of VAC in two patients, and weakness associated with hypotension while VAC was functioning in one. This latter patient was a 64-year old male who developed a large bore bronchopleural fistula 7 weeks following a right
intrapericardial pneumonectomy for a T4N0M0 adenocarcinoma and subsequent adjuvant chemotherapy. An OWT was immediately created and the chest cavity debrided. A latissimus dorsi flap was transposed and sutured over the bronchial stump but failed to completely close the BPF. At this point, an endobronchial prosthesis was placed to occlude the right main stem stump into the left main stem bronchus in order to control the fistula. The VAC system was applied with a continuous suction of 50 mmHg to help stimulating granulation and therefore obliterate the space [1]. The patient was discharged home and the VAC sponges were completely renewed every 3 days in an outpatient setting. As described by other authors [2], care was taken at loosely filling the space with sponges. Nevertheless, at day 22 from the beginning of VAC therapy, part of the sponges could not be removed from the apex of the chest despite generous irrigation of the pneumonectomy space. Under deep sedation, the cavity was then explored by video-assisted thoracoscopy and the foreign body carefully removed using endoscopic instruments (Fig. 1, Supplementary Video S1) after having noted tenacious entrapment within the diffusely inflamed parietal pleura. Final histology on randomly distributed pleural biopsies of scattered pleural nodules was negative for tumour. In the subsequent weeks, the pleural cavity did slowly reduce in size with gauze packing.

**DISCUSSION**

Basic tenets in the management of the post-pneumonectomy space include the closure of bronchopleural fistula, optimal drainage of the cavity and its subsequent obliteration [4]. OWT is considered an important step for successful closure [4]. Recently, Schneiter et al. [5] have proposed an accelerated method for treating post-pneumonectomy empyemas which can be seen as a precursor of VAC therapy. In fact, suction is applied through a chest drain left in place after careful debridement and packing of the pleural cavity. Unlike the Clagett procedure, the original thoracotomy is closed between dressings which are performed under general anaesthesia and double-lumen intubation [5]. Whatever the approach, when feasible, simultaneous resuturing of the bronchial stump or closure by the transposition of viable tissues is advocated [4, 5]. In addition, stenting of the residual main stem bronchus to exclude the bronchopleural fistula has been described [6, 7]. Nevertheless, the chest cavity is usually left open to facilitate mechanical debridement and cleansing through daily changes of dressings, often carried out under general anaesthesia to avoid the procedure-related elicited pain. In our experience, the application of VAC, even at the lowest possible suction levels, has led to significant pleuritic pain necessitating continuous increasing pain control regimens. Intolerable thoracic pain and disturbing asthenia associated with hypotension, possibly due to both fluid depletion and minimal mediastinal shift, were the reason for VAC discontinuation in two patients. Another factor in producing hypotension could be vagal stimulation. However, we believe that dressing of the post-pneumonectomy pleural space by the VAC system should be by no means comparable with gauze dressing during the Clagett procedure. In fact, tight packing is to be avoided because sponges can be trapped in the growing granulation tissue making it difficult to remove during routine ambulatory dressing changes. Moreover, with the progressive reduction in the diameter of the thoracotomy due to the peristomal healing, the ability to reach the most secluded recesses of the chest cavity may be impaired. On the other hand, the interposition of materials between the sponge and the chest wall (i.e. gauzes) may affect the efficacy of vacuum primarily aimed at enhancing granulation. The suggestion to suture, on the pleural side of the sponges, thin hyaluronic acid gauzes to prevent the entrapment may be helpful but is not of proven benefit. In our case, dressing changes at 2–3-day intervals may have contributed to sponge entrapment; however, more frequent ambulatory visits could have failed the purpose of reducing patient's

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**Table 1: Clinical features of post-pneumonectomy patients treated with VAC therapy**

<table>
<thead>
<tr>
<th>Patient (age)</th>
<th>Side and stage</th>
<th>Time to BPF (days)</th>
<th>Previous attempts at closure of BPF</th>
<th>Survival from pneumonectomy</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (53)</td>
<td>R and IV (ipsilateral axillary nodes)</td>
<td>23</td>
<td>SS, CS</td>
<td>11 months deceased MET</td>
<td>Neoadjuvant chemotherapy</td>
</tr>
<tr>
<td>2 (62)</td>
<td>R and IIB</td>
<td>35</td>
<td>IMF, OFT, RR, SS, CS, ACEL, AMP</td>
<td>25 months NED</td>
<td>PE/MV</td>
</tr>
<tr>
<td>3 (64)</td>
<td>R and IIB</td>
<td>113</td>
<td>IMF, CS</td>
<td>14 months deceased MET</td>
<td>Concurrent metastatic papillary thyroid cancer Adjuvant chemotherapy</td>
</tr>
</tbody>
</table>

IMF: Intrathoracic muscle flap; OFT: Omental flap transposition; CS: Covered stent; RR: Rib resection; SS: Surgical sealant; ACEL: Acellular matrix patch bronchial closure; AMP: Amplatzer device; MET: Metastatic disease; PE: pulmonary embolism; MV: Mechanical ventilation; NED: No evidence of disease.

**Figure 1:** Thoracoscopic evidence of the entrapment of VAC system sponges into the right apex.
independence from the hospital environment. In conclusion, VAC of the pneumonectomy space is to be contemplated among the options to facilitate the obliteration of the pleural cavity. As with other treatments, there is a learning curve also for VAC in post-pneumonectomy empyemas. Entrapment of the sponge gauze into the chronically inflamed chest wall can become an untoward and bothersome complication. Careful application and monitoring of VAC to treat post-pneumonectomy empyemas is of paramount importance to ensure smooth outpatient management.

SUPPLEMENTARY MATERIAL

Supplementary material (Video 1) is available at EJCTS online.

Conflict of interest: none declared.

REFERENCES