

Commentary: Open Your Mind to Open Chest Management

Myeong Su Kim, M.D.¹, Suk-Won Song, M.D., Ph.D.²

¹Department of Thoracic and Cardiovascular Surgery, Yeungnam University Medical Center, Yeungnam University College of Medicine, Daegu; ²Department of Cardiovascular Surgery, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea

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Corresponding author

Suk-Won Song

Tel 82-2-2019-3384

Fax 82-2-3461-8282

E-mail sevraphd@yuhs.ac

ORCID

<https://orcid.org/0000-0002-9850-9707>

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Myeong Su Kim, M.D.



Suk-Won Song, M.D., Ph.D.

Delayed sternal closure (DSC) was first described in 1975 by Riahi et al. [1] to prevent “tight mediastinal syndrome,” which refers to hemodynamic compromise resulting from sternal closure. Other common reasons for DSC are low cardiac output syndrome (sometimes requiring central mechanical circulatory support), bleeding, arrhythmias, and myocardial edema [1]. In this study by Lim et al. [2], published in this issue of *Journal of Chest Surgery*, DSC using a vacuum-assisted closure (VAC) system was performed in 33 out of 353 cardiac surgery patients. This corresponds to 9.3% of patients, indicating that the rate of open chest management (OCM) is very high compared to the 1.1%–4.2% of patients who underwent DSC in other studies [3-5].

Three large observational studies of DSC reported that low cardiac output occurred in 58% of cases, hemodynamic instability in 20%, bleeding in 10%, arrhythmia in 7%, and myocardial edema in 5% [3,6,7]. However, in this study, intractable bleeding was the most common indication for DSC, in 75% of cases. The authors explained that the reason for this was that patients with a high risk of bleeding, such as emergency cases, redo cases, and reoperations due to postoperative bleeding, were included. Additionally, in cases of high bleeding risk, the authors adopted a strategy of prophylactically applying an open sternum even for moderate bleeding that might be controllable for a

safer postoperative course, rather than repeating bleeding control for a long time. Although it would be difficult to establish numerical criteria for indications such as intraoperative bleeding, it seems necessary to reconsider the overall indications of DSC.

Surgeons are concerned that DSC increases the risk of sternal wound infection (SWI), which has a mortality rate of up to 70% if it progresses to mediastinitis. The risk of SWI in patients with DSC is 2%–5%, whereas it is 1%–2% in patients with primary chest closure [7]. It is unclear whether DSC is an independent risk factor for SWI because patients who require DSC have multiple risk factors for sternal complications. Unfortunately, there are currently no recommendations to guide the management of antibiotic prophylaxis in patients with an open chest following cardiothoracic surgery. In 2018, a study was published on antibiotic prophylaxis in patients with OCM with DSC [8]. The researchers concluded that broad-spectrum antibiotic use was not associated with a decrease in sternal surgical site infections, but may be associated with an increase in *Clostridium difficile* infections. Similarly, an extended duration of prophylactic antibiotics was not associated with a decreased incidence of SWI.

In DSC, a widely used technique is to stent open the sternal bone with plastic syringe struts and cover the wound with an adhesive drape film, although there are several

variations [9]. Balasubramanian and Bhama [9] described a technique for DSC in which the subcutaneous tissues and skin are closed, while the sternal bone is bridged open with an orthopedic plate. They proposed that creating a biological tissue barrier over the mediastinum provides superior immune protection in closure using an Esmarch barrier and Ioban drape (3M, St. Paul, MN, USA). In their 29-patient series, there were no cases of sternal wounds or mediastinal infections. In another study, Bakaeen et al. [10] randomly assigned 452 patients to standard DSC or VAC dressing. They reported SWI rates of 5% in the control group but only 2% in the intervention group, indicating that the risk of SWI was reduced to match that of patients with primary sternal closure. Direct skin approximation and closure is a logical approach, but it is often not possible. Using an adhesive drape film might not completely seal the wound and is easily detached by active bleeding. Covering the open mediastinum with a latex membrane sewn to the skin edges carries the disadvantages of damaging the skin through repeated re-explorations, revisions, and loss of sterility. Sterility is lost when dressings leak from ongoing bleeding, raising concerns about infectious complications when the chest is left open for prolonged periods. Airtight sealing of the wound in VAC actively prevents contamination [11].

In this study, both mediastinal pleurae were opened, drainage catheters were placed, the pericardium was reconstructed after gauze packing, and VAC was applied. The procedure was simplified, effective drainage was possible, and irritation of the heart surface due to sternal edges was likely to be avoided. However, it is questionable whether an appropriate degree of sternal opening can be maintained, and the presence of compression of the right ventricle should be checked during gauze packing. As various methods for OCM are introduced, the outcomes are improving, and it is thought that surgeons' threshold for this procedure is decreasing. A randomized trial according to the presence or absence of skin approximation would seem to be an interesting future research topic, and other variables such as microbiology, the negative pressure setting, the frequency of dressing changes, and the total period of VAC will also need to be studied.

Article information

ORCID

Myeong Su Kim: <https://orcid.org/0000-0002-1435-6441>

Suk-Won Song: <https://orcid.org/0000-0002-9850-9707>

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