See Article page 77.

Commentary: Delayed sternal closure—an open and not-so-shut case

Rachel Eikelboom, MD, and
Michael H. Yamashita, MDCM, MPH

Rachel Eikelboom, MD (*left*), and Michael H. Yamashita, MDCM, MPH (*right*).

CENTRAL MESSAGE

A randomized study is required to determine whether closing the skin and soft tissues over an open sternum reduces the risk of sternal wound infection in these critically ill cardiac surgery patients.

Of the 300,000 patients who undergo cardiac surgery each year in North America,[1] as many as 12,000 (4%) leave the operating room with an open sternum.[2] Delayed sternal closure (DSC) was first described in 1975 by Riahi and colleagues[3] to prevent "tight mediastinal syndrome," which is 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. The relative incidences of each, as reported in 3 large observational studies of DSC, are summarized in Table 1.[4-6]

Surgeons remain concerned that DSC increases the risk of sternal wound infection (SWI), which has a mortality of 10% to 14% if it progresses to mediastinitis.[1] The risk of SWI in patients with DSC is 2% to 5%, compared with 1% to 2% in patients with primary chest closure.[5] Whether DSC is an independent risk factor for SWI is unclear, because patients requiring DSC are critically ill and have multiple risk factors for sternal complications.

Surgical technique and prophylactic antibiotic regimen may affect infection risk in patients with DSC. A widely used technique is to stent open the sternal bone with syringes and cover the wound with an Esmarch patch and an Ioban antimicrobial drape (3M, St Paul, Minn), although there are several variations. Antibiotic use in DSC varies from standard surgical prophylaxis for the first 48 hours to broad-spectrum antibiotics for several days after sternal closure.[7]

In this issue of the *Journal*, Balasubramanian and Bhama[8] describe a technique for DSC in which the subcutaneous tissues and skin are closed, while the sternal bone is bridged open with an orthopedic plate. Balasubramanian and Bhama[8] propose that creating a biologic tissue barrier over the mediastinum provides superior immune protection to an Esmarch and Ioban closure. In their 29-patient series, there were no cases of sternal wound or mediastinal infection. A similar approach to DSC was published in *The Journal of Thoracic and Cardiovascular Surgery* in 2014, with similarly small sample size and low infection rates.[9]

Balasubramanian and Bhama[8] demonstrate that this approach to DSC is feasible and safe, but the impact on

TABLE 1. Indications for delayed sternal closure

Indication	No. of patients	%
Hemodynamic instability	92	20
Low cardiac output state	266	58
Myocardial edema	24	5
Bleeding	46	10
Arrhythmia	33	7

From the Department of Surgery, Max Rady College of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada; and the Cardiac Sciences Program, St Boniface Hospital, Winnipeg, Manitoba, Canada.

Disclosures: The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication Feb 14, 2020; revisions received Feb 14, 2020; accepted for publication Feb 20, 2020; available ahead of print March 5, 2020.

Address for reprints: Michael H. Yamashita, MDCM, MPH, FRCSC, Y3519–409 Tache Ave, Winnipeg, MB R2H 2A6, Canada (E-mail: myamashita@sbgh.mb.ca).

JTCVS Techniques 2020;2:80-1
2666-2507

https://doi.org/10.1016/j.xjtc.2020.02.024

clinical outcomes remains unclear. The sample size is small, and there is no comparison group. The theory that infection risk is reduced with a biologic tissue barrier is plausible, but it remains unsubstantiated by this series or previous literature.

A recent randomized trial reported reduced SWI rates with the application of a negative-pressure dressing to an open sternum. Bakaeen and colleagues[2] randomly assigned 452 patients to standard DSC or negative pressure dressing. They reported SWI rates of 5% in the control group but only 2% in the intervention group, thus reducing the risk of SWI to match that of patients with primary sternal closure.[2] A randomized trial should be performed for the technique described by Balasubramanian and Bhama[8] to clarify whether a biologic barrier provides superior protection from SWI. Choice and duration of antibiotics should also be studied in a randomized fashion. Patients requiring DSC are at high risk of surgical complications, and clarifying the safest methods for DSC through randomized trials may significantly affect outcomes.

References

1. Abu-Omar Y, Kocher GJ, Bosco P, Barbero C, Waller D, Gudbjartsson T, et al. European Association for Cardio-Thoracic Surgery expert consensus statement on the prevention and management of mediastinitis. *Eur J Cardiothorac Surg*. 2017;51:10-29.
2. Bakaeen FG, Haddad O, Ibrahim M, Pasadyn SR, Germano E, Mok S, et al. Advances in managing the noninfected open chest after cardiac surgery: negative-pressure wound therapy. *J Thorac Cardiovasc Surg*. 2019;157:1891-903.e9.
3. Riahi M, Tomatis LA, Schlosser RJ, Bertolozzi E, Johnston DW. Cardiac compression due to closure of the median sternotomy in open heart surgery. *Chest*. 1975; 67:113-4.
4. Furnary AP, Magovern JA, Simpson KA, Magovern GJ. Prolonged open sternotomy and delayed sternal closure after cardiac operations. *Ann Thorac Surg*. 1992;54:233-9.
5. Boeken U, Assmann A, Mehdiani A, Akhyari P, Lichtenberg A. Open chest management after cardiac operations: outcome and timing of delayed sternal closure. *Eur J Cardiothorac Surg*. 2011;40:1146-50.
6. Christenson JT, Maurice J, Simonet F, Velebit V, Schmuziger M. Open chest and delayed sternal closure after cardiac surgery. *Eur J Cardiothorac Surg*. 1996;10: 305-11.
7. Eckardt JL, Wanek MR, Udeh CI, Neuner EA, Fraser TG, Attia T, et al. Evaluation of prophylactic antibiotic use for delayed sternal closure after cardiothoracic operation. *Ann Thorac Surg*. 2018;105:1365-9.
8. Balasubramanian V, Bhama JK. Technique for ''open sternal'' chest closure in patients with assist devices and transplant recipients. *J Thorac Cardiovasc Surg Tech*. 2020;2:77-9.
9. Rajakaruna C, Rodriguez GM, Rajbanshi BG, Ziganshin BA, Elefteriades JA. Novel technique for delayed sternal closure: soft tissue approximation with substernal bridge. *J Thorac Cardiovasc Surg*. 2014;148:2427-9.