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Efficacy of a novel strategy for poststernotomy deep sternal infection after thoracic aorta replacement using a prosthetic graft

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KEYWORDS

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Summary Background: Poststernotomy deep sternal wound infections are persistent and occasionally fatal, especially in cases involving prosthetic grafts, because of their complicated structure and virtual impossibility of removal. We aimed to verify the influence of cooperation with plastic surgeons and our novel strategy for treating deep sternal wound infection after aortic replacement on cardiovascular surgery outcomes.

Patients and Methods: Nine hundred eighty-three consecutive patients were divided into two groups: an early group (2012–2013) and a late group (2014–2015). The late group had received cooperatively improved perioperative wound management: our novel strategy of deep sternal infection based on radical debridement and immediate reconstruction decided by reference to severities of the patient's general condition and widespread infection by early intervention of plastic surgeons. The groups were analysed retrospectively. Binary variables were analysed statistically with the Fisher exact test and continuous variables with the Mann-Whitney U test. Inter-group differences were assessed with the chi-square test.

Results: Twenty of 390 cases in the early group and 13 of 593 cases in the late group were associated with deep sternal infection. Morbidity rates of deep sternal wound infection and associated mortality rates 1 year after reconstruction surgery were significantly less ($p < 0.05$ for both) in the late group.

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Conclusions: Intervention by plastic surgeons improved perioperative wound management outcomes. Our treatment strategy for deep sternal wound infection also reduced associated mortality rates. Facilities should consider the early inclusion of plastic surgeons in the treatment of patients undergoing aortic replacement to facilitate better outcomes.

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Introduction

Deep sternal wound infections (DSWIs) such as sternal osteomyelitis (SO) and mediastinitis (MS) are severe, and occasionally fatal complications occur following cardiovascular surgery using median sternotomy, with an incidence rate of 0.4–5%^{1,2} and an associated mortality rate of 10–25%.^{1,2} The use of prosthetic grafts makes infection control difficult after aortic surgery. The gold standard treatment for DSWI is complete excision of the infected foreign material with debridement of the peripheral tissue and repair of vascular continuity. Moreover, revision surgery on prosthetic grafts is associated with high risks such as severe operative stress, technical difficulties and reinfection. The number of patients with risk factors for sternal instability, such as insulin-dependent diabetes mellitus, obesity, immunosuppression, chronic obstructive pulmonary disease, osteoporosis and renal failure, has increased in the past few decades.^{3,4} In such cases, poor wound healing results in several postsurgical complications.

The Aortic Center of Kawasaki Saiwai Hospital is one of the leading centres in Japan for aortic diseases including aortic aneurysms and/or dissections. This centre was established in 2011 because of an increase in the number of patients with aortic disease. With the sharp increase in aortic surgeries, DSWI cases have also increased.

In 2014, cardiovascular surgeons discussed strategies to promote better wound healing after aortic surgery with plastic surgeons. Consequently, a new collaborative strategy for DSWI was developed. This study aimed to verify the effect of this strategy for DSWI after aortic surgeries using a median sternotomy approach.

Patients and methods

Study design and setting

This was a retrospective case series study. The ethical review board of Kawasaki Saiwai Hospital approved this study (study approval no.: 28-28). Individual consent was waived. Results of the research were made available to the public by posting them in our hospital and releasing them on the website (<http://www.saiwaihp.jp>).

Patient selection and study protocol

All patients who underwent aortic surgery using the median sternotomy approach at the Aortic Center of Kawasaki Saiwai Hospital between January 2012 and December 2015 were included. Patients who underwent cardiovascular surgeries using other approaches for descending and abdominal aortic

aneurysms, those with non-aortic disease such as coronary diseases and valve disorder and those for whom prosthetic grafts were not used were excluded.

The patients were divided into two groups according to the date of aortic surgery: an early group (2012–2013) and a late group (2014–2015). All DSWIs were treated by cardiovascular surgeons in the early group, whereas immediate intervention was performed by plastic surgeons using the new DSWI strategy in the late group.

Patient data including patient characteristics, details of aortic surgery, incidence of and treatment methods for DSWI and outcomes in cases of DSWI were obtained retrospectively. Follow-up for the early and late groups ended in December 2014 and December 2016, respectively. A flow-chart of the inclusion process is shown in [Figure 1](#).

Surgical procedure improvement

From January 2014, cardiovascular and plastic surgeons reviewed the aortic surgery procedure in an attempt to reduce the mortality rates associated with DSWI. The need to prevent thermal damage by electrocautery scalpel and crush injury by retractors was reaffirmed. We changed from running sutures to interrupted suture to close the median sternal wounds, and we placed a continuous suction drainage tube subcutaneously in cases with obesity.

In the early group, when the surgical site infection was diagnosed as DSWI, several treatment methods such as debridement, wound irrigation by saline, negative-pressure wound therapy (NPWT) and reconstructive surgeries using an omental flap and/or pectoralis major muscle flap were selected depending on the preference of the cardiovascular surgeon ([Figure 2](#)), creating a minor inconsistency in treatment policy. In the late group, plastic surgeons intervened immediately after confirming DSWI, and cardiovascular surgeons treated DSWI according to the strategy described below.

Our DSWI treatment strategy

When surgical site infection after median sternotomy was confirmed, clinical signs such as chest pain, fever (body temperature >38 °C), increases in white blood cell counts and C-reactive protein levels, red and inflamed chest skin, pus discharge and sternal instability were carefully observed. If these changes were observed, we opened the wound at bedside, and tests such as blood examination, wound and blood bacteriological cultures and diagnostic imaging were performed ([Figure 3a-d](#)). Because inflammatory chest skin does not always appear in cases of MS without SO, computed tomography (CT) is indispensable if only to determine the condition of the mediastinum and sternum.

The diagnosis of DSWI was initially classified as either SO or MS. In the case of MS, CT scans show sternal disruption

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