Prevention of Sternal Wound Infections by use of a Surgical Incision Management System: First Reported Australian Case Series

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Background	Sternal wound infections are considered a costly and potentially devastating consequence of the median sternotomy in cardiothoracic surgery. Surgical incision management employs the technique of applying a closed, negative pressure vacuum dressing to a closed wound. Several studies have demonstrated a reduction in sternal wound infections using this system.
Methods	A retrospective audit of cases receiving surgical incision management demonstrated a statistically significant reduction in sternal wound infections against a predicted rate.
Results	Of the 62 patients identified, only one was complicated by a sternal wound infection with the greatest reduction seen in the high-risk infection group.
Conclusions	Although smaller in size, the results compared well to trials conducted in larger European and US centres. Although not advocating surgical incision management for routine use, it should be considered on patients considered high-risk for sternal wound infection, such as diabetics, the elderly and the obese.
Keywords	Sternal wound infection • Incision management system • Sternotomy • Obese • Diabetics • Elderly

Introduction

Cardiac surgery, although considered a clean surgery, does not mean that infections do not occur. One serious complication is that of a sternal wound infection (SWI). Sternal wound infections occur at a rate between 1-10%, depending on definition employed [1]. The rate of SWIs in any particular unit often serve as the major benchmark of overall performance. Sternal wound infections are potentially fatal and at the very least costly, requiring additional antibiotics, surgery or both [2]. This results in a prolonged length of stay postoperatively and predisposes patients to further complications. For example, 4000-6000 patients undergo surgical revision of SWIs a year in Germany. This cost has been estimated at approximately €60-90,000,000 (AUD86-129,000,000) annually [3]. A conservative estimate of the cost of SWI is to triple the cost of the original coronary artery bypass graft (CABG) procedure. Additionally, SWIs increase the risk of mortality in the first year following infection significantly [1].

The direct clinical cause of SWIs has been linked to suture breakdown, with ensuing Gram-positive bacterial invasion. Gram-positive bacteria are present in >80% of deep SWIs

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[3,4]. Sternal wound infections have been analysed in numerous studies with emphasis on identifying risk factors and possible methods of prevention. A few studies have focussed on developing a predictive model for those at high risk of serious infection, including SWIs post-cardiac surgery. One validated scoring system was developed by Fowler et al. after analysing a large cohort of patients (>300,000) from the Society of Thoracic Surgeons National Cardiac Database in the United States [2]. The objective, to identify the frequency of major infection following CABG to create a bedside scoring system to predict an individual patient's risk of serious infection post-CABG [2]. Predictive variables were based on previous literature and clinical acumen. Primary end-point was major infection with predictive variables anaylsed by multivariate logistic regression with significant variables displayed in Table 1.

From this a score can be can be calculated corresponding to a predicted rate of infection. For example, a Fowler's score of 17 would correlate to a predicted risk of infection of 7.4% using pre-operative variable or 7.6% using combined variable calculations [2]. The predictive ability of this model showed good agreement when compared to validated c-index.

Given the ability to predict which patients will be susceptible to major infections, including SWIs the best way to prevent complications is by early intervention. Surgical Incision Management (SIM) is a novel Negative Pressure Wound Therapy (NPWT) system that differs from the traditional NPWT in current practice. Conventional NPWT such as VAC therapy has long been used with unclosed wounds. However, SIM is the use of NPWT device over an already closed wound, commonly that of skin closed in subcuticular fashion with an appropriate absorbable suture. The SIM employed at our institution is the KCI-manufactured Prevena™. Prevena™ generates pressures down to negative 125 mmHg and is constructed with a polyurethane coated, polyester fabric interface layer with 0.019% ionic silver impregnated, wicking fluid from the skin surface [5]. This dressing remains in-situ for up to seven days and is connected to the single-use, self-contained suction unit with a 45 ml fluid canister (Figure 1).

In vivo studies have demonstrated several benefits to SIMs such as Prevena™. Surgical Incision Managements have demonstrated improved fluid flow over clean, closed incisions. This improved flow significantly reduces haematoma and seroma levels in the porcine model [6–8]. This would be of considerable benefit in the post-sternotomy patient. Wound dehiscence was also less likely with Prevena™ as lateral stresses on the incision margins were decreased by approximately 50% [6–8]. The stressors subsequently distributed to the more lateral, intact aspect of the incision. Fifty per cent more force was thus required to dehisce the wound [6–8]. The use of SIM has already shown benefit in other fields such as orthopaedic surgery.

A German study of approximately 3700 patients conducted in 2014, consisted of two groups, the study group that received Prevena™ post-median sternotomy and a control group receiving conventional dressings. After 30 days, the Prevena™ group had a significantly lower rate of sternal wound infections compared to the control group, 1.3% to

Table 1   Infection Risk Scores for Major Infection after CABG.

Pre-operative Variables	Pre-op Only	Combined
Age (for each 5 years over 55)	1 point	1 point
BMI 30 - 40kg/m^2	4 points	3 points
BMI 40kg/m^2	9 points	8 points
Diabetes	3 points	3 points
Renal failure	4 points	4 points
Congestive heart failure	3 points	3 points
Peripheral vascular disease	2 points	2 points
Female gender	2 points	2 points
Chronic lung disease	2 points	3 points
Cardiogenic shock	6 points	-
Myocardial infarction	2 points	-
Concomitant surgery	4 points	-
Intra-operative Variables		
Perfusion time 100 to 200 minutes	-	3 points
Perfusion time 200 to 300 minutes	-	7 points
Intra-aortic balloon pump	-	5 points
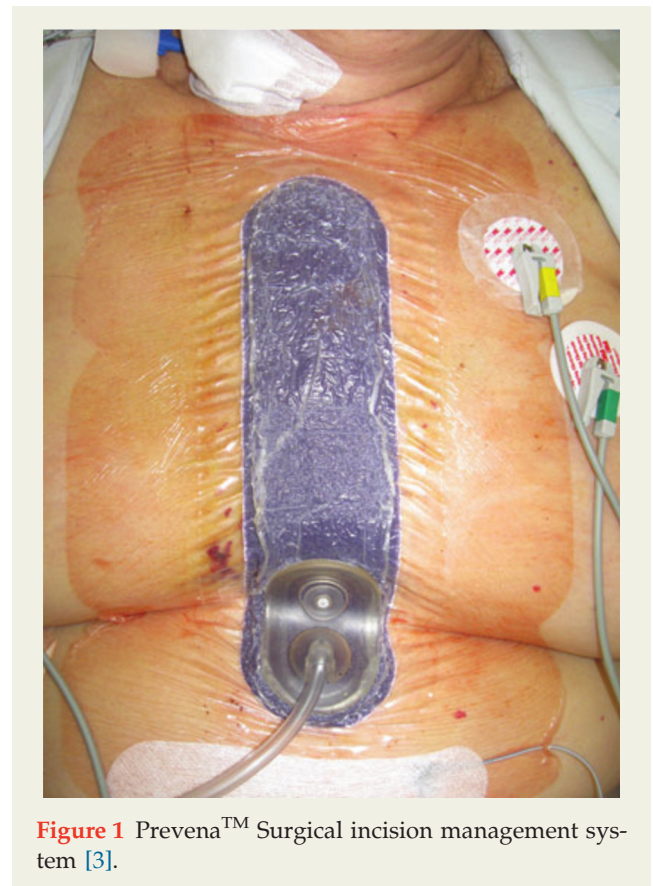
Figure 1 Prevena™ Surgical incision management system [3].