Use of Vacuum Assisted Closure System in Management of Sternal Wound Infection

Thesis submitted in partial fulfillment of the master degree in Cardiothoracic Surgery

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"At first, I thank God; the most gracious and merciful"

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List of Abbreviations

AVR	Aortic Valve Replacement
CABG	Coronary Artery Bypass Graft
CBC	Center for Disease Control and Prevention
CoNS	Coagulase Negative Staphylococci
CPB	Cardio-Pulmonary Bypass
COPD	Chronic Obstructive Lung Disease
CRF	Chronic Renal Failure
CT	Computerized Tomography
DSWI	Deep Sternal Wound Infection
ESAAS	Electrolyzed Strong Acid Aqueous Solution
HBO	Hyperbaric Oxygen
ICU	Intensive Care Unit
IMA	Internal Mammary Artery
MRI	Magnetic Resonance Image
MRSA	Methicillin Resistant Staph Aureus
MVR	Mitral Valve Replacement
NPWT	Negative pressure Wound Therapy
PAE	Post Antibiotic Effect
PALE	Post Antibiotic Leukocyte Enhancement
PFD	Polyurethane Foam Dressing
S.Aureus	Staphilococcus Aureus

S/I	Sternal Intercostal
TLC	Total Leucocytic Count
VAC	Vacuum Assisted Closure

ABSTRACT

Objectives: Vacuum-assisted closure (VAC) was primarily designed for the treatment of pressure ulcers or chronic, debilitating wounds. Recently, VAC has become an encouraging treatment modality for sternal wound infection after cardiac surgery, providing excellent results.

Methods: This was a prospective, randomized, descriptive study that enrolled a total of 20 patients with superficial and deep sternal wound infections under usage of VAC system as modality of treatment of sternal wound infection or preparing for conventional methods (omental flap or Myocutaneous flap) in the period between March 2013 till March 2014.

Results: Ninteen patients (95 %) were treated successfully. One patient (5 %) died. The overall length of hospitalization was 30.4 days (range 16 to 49). The median number of dressing changes was 6.1 (range 3 to 10). The median VAC treatment time until surgical closure 25.9 days (range 14 to 45 days) .VAC therapy was used as definitive therapy also as a bridge to conventional methods.

Conclusion: VAC therapy is a safe and reliable option in the treatment of sternal wound infection in cardiac surgery. VAC therapy should be considered as an effective primary modality of treatment of sternal wound infections and also effective adjunct to conventional treatment modalities for the treatment of extensive and life-threatening wound infections following cardiac surgery, particularly in the presence of risk factors.

Chapter 1

Introduction

Chapter 1

Introduction

The median sternotomy incision was first described for use in cardiac surgery by ***Julian et al. in 1957.*** Julian and colleagues demonstrated discrete advantages of the median sternotomy incision for cardiac surgery, particularly improved surgical efficiency, excellent exposure of the heart, great vessels, and pulmonary hila, and reduced pulmonary trauma, was a convincing argument for median sternotomy as the incision of choice for cardiac surgical procedures.

It is the most commonly used incision in cardiac surgery, providing access for most operations involving the heart and the great vessels (***Chikwe et al., 2006***).

An incision extending from the midpoint between the angle of Louis and the sternal notch to below the xiphoid process is made in the skin with a scalpel (Figure 1). This is followed by a diathermy incision through the subcutaneous tissue down to the sternum, which is divided using a standard pneumatic sternal saw (Figure 1).

Initial acceptance of this approach was hampered by reports of 5% infection rates, which invariably led to sternal dehiscence, often associated with cardiac exposure. Infection with sternal dehiscence was associated with 50% mortality in early series. Early treatment protocols used open packing of the

debrided wound and required months to achieve a healed wound if the patient did not die of cardiac or vein graft rupture in the interim. Subsequent treatment focused on the use of debridement coupled with antibiotic irrigation administered through closed indwelling catheter

systems. This technique, still in use, was a major advance and reduced the mortality to 20%. Problems of bypass graft desiccation, even in this apparently moist environment, can lead to an unacceptably high incidence of graft rupture and death. Hospital stay and morbidity is inordinately prolonged, however, with some patients spending as long as 6 months receiving treatment.

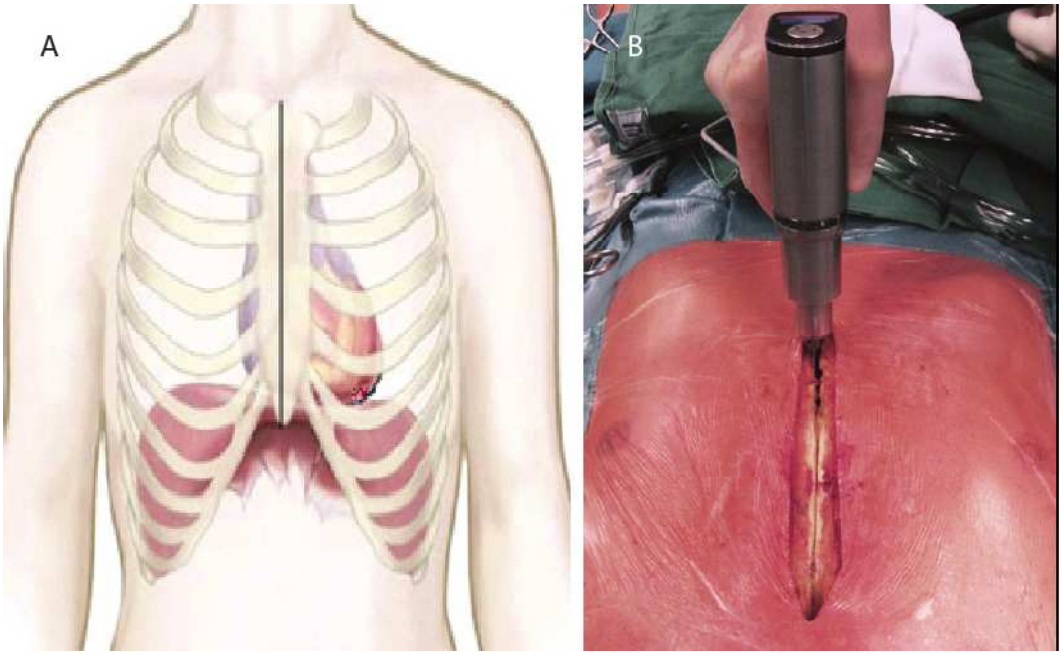

Figure 1: (A). The incision made for a median sternotomy (B). Median sternotomy being performed with a sternum saw. (***Petzina R., 2009***)

The mortality associated with suppurative mediastinitis in the absence of treatment is reported to be nearly 100% (***Baskett et al., 1999***).

In spite of this, the key factor in preventing sternal dehiscence and sternal wound infection is a stable sternal approximation. Careful attention to hemostasis and meticulous urgical technique remain the mainstays of prevention and must include precise sternal alignment and stable closure ***(Schimmer et al., 2008).***

The treatment of mediastinitis after cardiac surgery has evolved over the past 35 years. The classic surgical therapy consisted of surgical debridement followed by open wound drainage. However, this technique was associated with high failure and mortality rates and has progressively been abandoned.

In 1963, Shumaker and Coworkers described a technique of wound debridement, primary sternal closure, and continuous mediastinal irrigation ***(Shumaker and Mandlbaum., 1963).***

In 1989, Durandy and colleagues proposed a simple primary closed drainage technique using Redon catheters. The basis of this technique is, after meticulous wound debridement, to drain all infected areas with small catheters connected to bottles inside of which a strong negative pressure is created (Redon drainage device) ***(Durandy et al., 2002).*** Studies have reported significantly reduced failure and 30-day mortality rates in patients treated with this technique in comparison to patients treated with the closed continuous irrigation technique ***(Calvat et al., 1996).***

Evidence of antibiotic or iodine toxicity and poor results in earlier studies have stimulated the development of several plastic surgical procedures as alternatives to closed mediastinal irrigation ***(Milano et al, 1999).***

Thus, primary or delayed mediastinal closure using muscle flaps or the greater omentum have gained wide acceptance for the treatment of mediastinitis after cardiac surgery (***Gottlieb et al., 1996*).**

Yasuura and Colleagues in 1998 reported successful treatment of mediastinits by means of primary omentoplasty **(*Yasuura et al., 1998*).**

Muscles used as flaps for the treatment of mediastinits include pectoralis major, Rectus abdominis and latissimus dorsi muscles ***(Thomas et al., 2001).***

The vacuum-assisted closure (VAC) technique is a relatively new modality in wound-healing management. Local application of negative pressure to a wound results in improved tissue blood flow and increased granulation tissue formation ***(Sjogren et al., 2005).***

Aim of Work

Is to evaluate VAC system as an effective and safe method in management of superficial and deep sternal wound infections as primary therapy or as abridge for other reconstructive techniques.

Key words

- Sternal wound infections
- Vacuum assisted closure system

Chapter 2

Review of Literature

Chapter 2

Review of Literature

2.1. Anatomy of the sternum

The sternum (breast boric) is an elongated flat bone, resembling a short broad sword or dagger, which forms the middle part of the anterior wall of the thorax. The sternum consists of three parts. Manubrium, body, and xiphoid process (Figure 2). The sternum is covered anteriorly only by skin, superficial fascia, and periosteum, except where the pectoralis major muscle and sternal head of sternocleidomastoid muscle arise from it ***(El-Rakhawy, 1996).***

2.1.1 The Manubrium Sterni

The manubrium, or superior part of the sternum, is wider and thicker than its inferior two parts (body and xiphoid process). Although generally quadrilateral, the narrow inferior end of the manubrium gives it a triangular shape. Broad and thick superiorly, the manubrium slopes inferiorly and anteriorly. The superior surface of the manubrium is indented by an articular facet, called the clavicular notch, for articulation with the medial end of the clavicle. Just inferior to the clavicular notch, the costal cartilage of the first rib is fused with the lateral margin of the manubrium. This is a flexible but strong primary cartilaginous joint (synchondrosis) where the costal cartilage unites with the manubrium ***(Sinnatamby, 1999)***.

The inferior border of the manubrium is oval and rough where it articulates with the body of the sternum at the manubriosternal joint. This is a secondary cartilaginous joint where fibro cartilage and ligaments join the bones. This articulation is often ossified in older persons.