

# Management of Sternal Wound Infections in Patients with Congenital Heart Disease Undergoing Cardiac Surgery

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## ABSTRACT

**Background:** Post sternotomy sternal wound infection is a difficult problem to manage and carries significant morbidity and mortality. Multiple different management strategies are considered acceptable depending on the severity of the infection and underlying patient factors. Risk factors in adults differ significantly from those in children. The role of vacuum assisted closure has been studied in adults, however data on patients with congenital heart disease (CHD) undergoing surgery is limited.

We present our experience with sternal wound infections in patients with CHD.

**Methods:** From 2012 to 2019 a total of 10,054 patients underwent median sternotomy for congenital heart disease (CHD) surgery. Of these 14 developed a sternal wound infection. The infections were classified as superficial (SSWI), deep (DSWI) or deep sternal wound infection with mediastinitis (DSWI-M). Management strategy was standardized and after local wound cultures had been taken, antibiotics initiated, and the patient was taken to the operating room for initial debridement and vacuum assist closure device (VAC) application. Once the wound was clean and the granulation tissue was flourishing the wound was closed secondarily; either directly or with a myocutaneous flap closure.

**Results:** 14 patients (5 male and 9 female) presented with a sternal wound infection. The mean age was 31 months (ranging from 3-168 months). The median weight was 9.8 kg (3.9-27 kg). Mean presentation with wound infection symptoms was 11.6 days (5- 28 days) after initial surgery. There was one mortality (1/14) 7.1% that was due to systemic sepsis. Superficial sternal wound infections SSWI occurred in 3 patients, while 9 had deep sternal wound infections, and 2 patients had a DSWI-M. Average hospital stay was 29.1 days (9-148 days) and the number of VAC changes per patient averaged to 3.8 (2-7). Nine patients had a delayed secondary closure, while 4 required a local (pectoralis major) myo-cutaneous advancement flap closure after VAC treatments.

**Conclusions:** Sternal wound infections remain a postoperative problem with significant morbidity, prolonged hospitalization, and cost. VAC assisted closure is a successful strategy that leads to good control of local wound sepsis as well as deep mediastinitis, post cardiac surgery in patients with CHD. It shortens hospital stay, decreases morbidity and mortality and successful delayed secondary closure can then be done using either a direct closure or more complex closure depending on the degree of sternal breakdown from the infection.

**Keywords:** Vacuum assisted closure, myocutaneous flap, CHD, sterna wound infection

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## INTRODUCTION

In patients with congenital heart disease (CHD) sternal wound infections are a rare but important complication that is associated with significant morbidity and mortality. The reported incidence is usually less than 1-2% of all cardiac surgeries. The severity of postoperative wound infection is variable. They are usually categorized as a superficial sternal wound infection (SSWI involving only the skin or subcutaneous tissue), deep sternal wound infections (DSWI), to DSWI with sternal dehiscence, osteomyelitis, and sub sternal mediastinal tissue involvement (DSWI-M).

Despite the frequency with which the median sternotomy incision is used in pediatric cardiovascular surgery, few reports have discussed the diagnosis, management, and treatment strategy of mediastinitis in children.

Patient related risk factors are different in the pediatric/congenital patient sub-group as compared to adult patients. Despite the frequency with which the median sternotomy incision is used in pediatric cardiovascular

surgery, few reports have discussed the diagnosis, management, and treatment strategy of mediastinitis in children. The purpose of our study was to evaluate the patient demographics, clinical presentation, bacteriologic spectrum, and evolving management strategy for pediatric postoperative cardiac surgery patients who have been diagnosed with a sternal wound infection after median sternotomy.

## MATERIALS AND METHODS

**Patient Selection:** We retrospectively reviewed the congenital cardiac surgical records of two of the hospitals where our group practiced. The data search showed that from June 2012 to December 2019 a total of 10,054 congenital heart disease patients had undergone a median sternotomy. Out of this 14 (0.17%) had presented with a sternal wound infection requiring re admission to the hospital. Patients with a fever, wound cellulitis and discharge were admitted to the hospital as a superficial sternal wound infection (SSWI) or as a deep sternal wound infection (DSWI) if there was sternal dehiscence. Sternal dehiscence with deep organ space infection or a computed

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tomography showing a substernal abscess were categorized as DSWI with mediastinitis (DSWIM).

**Data Collection:** The data was collected on patient demographics, cardiac diagnosis, initial and subsequent surgical procedures, postoperative complications, time to re presentation, nature of wound infection, cultures, clinical course, and management strategies. The data was organized into a structured Microsoft Excel database.

**Surgical Management Strategies:** The patients were admitted, and baseline labs were drawn. Wound and systemic cultures were taken, and they were then started on intravenous (IV) antibiotics.

Patients were then taken to the operating room and after debridement and washout we employed a strategy of applying a local vacuum assisted closure (VAC) device in the operating room. The VAC was applied to all 14 of the patients in this study. The vacuum device consisted of a sterile sponge that was cut to appropriate size and fitted into the wound. The sponge was impaled with a multiperforated Jackson Pratt (JP) drain. One the sponge with drain assembly was placed on the infected wound, this was then covered with a sterile see through impermeable dressing, such as Op Site. The suction catheter was then hooked to a wall suction and was set to suction at 50 mm Hg to 100 mm Hg for 30 minutes; and would then be turned off for a 15-minute break. The VAC system was changed every three to four days.

If there was complete sternal dehiscence the wires were removed. However, if the wires were visible but the sternum intact and not mobile then they were left in place and VAC dressing were changed as described. A Plastic surgical consultation was obtained and once wound healing with granulation tissue was seen and a negative culture was obtained the VAC was terminated and the wound was closed either primarily or by local pectoralis major myo-cutaneous advancement flaps; especially when there was extensive sternal dehiscence with DSWI or mediastinitis. This worked well except in one case where an initial pectoralis major flap failed and then a rectus abdominis myo-cutaneous rotational flap needed to be employed.

## RESULTS

The database showed that from June 2012 to December 2019 a total of 10,054 congenital heart disease patients had undergone a median sternotomy. A total of 14 (0.17%) patients had presented with a sternal wound infection requiring re-admission to the hospital. There were 14 patients (5 male and 9 female) with sternal wound infections. The mean age was 31 months (ranging from 3-168 months). The median weight was 9.8 kg (3.9-27 kg). Mean presentation with wound infection symptoms was 11.4 days (5- 24 days) after initial surgery. There was one mortality (1/14) 7.1% that was due to systemic sepsis. Superficial sternal wound infections SSWI occurred in 3 patients, while 9 had deep sternal wound infections, and 2 patients had a DSWIM. Nine patients had acyanotic CHD while 5 patients had underlying cyanotic CHD. Thirteen patients had two ventricle anatomy and one patient had single ventricle anatomy. Average hospital stay was 28.7 days (6-148 days) and the number of VAC changes per patient averaged to 3.8 (2-7). The wound cultures failed to

grow anything in 8 patients while showed 4 patients grew out methicillin-resistant staphylococcus aureus (MRSA) and 4 patients had gram negative rods species such as Acinetobacter and Pseudomonas in cultures. Nine patients had a delayed secondary closure, while 4 required a local (pectoralis major) myo-cutaneous advancement flap closure after VAC treatments and 1 patient needed a rotational myo-cutaneous advancement flap after a failed local myo-cutaneous flap.

## DISCUSSION

Sternal wound infections after cardiac surgery carry significant morbidity and mortality<sup>1</sup>. In patients with congenital heart disease requiring a median sternotomy the risk factors are different from adults. The nature of the problem ranges from superficial sternal wound infections (SSWI) to a deep sternal wound infections (DSWI) and deep sternal wound infection with mediastinitis<sup>2</sup>.

Definitions of sternal wound infections are standardized. A deep sternal wound infection was defined according to the Centers for Disease Control and Prevention guidelines. Superficial surgical site infections (SSI) or superficial sternal wound infection (SSWI) was defined as that involving only the skin or subcutaneous tissues, deep sternal wound infections DSWIs involve deep soft tissues (fascial and muscular layers), and postoperative mediastinitis was defined as a DSWI with sternal disunion, underlying organ space infection/sub sternal abscess. Presence of a sternal "click" or sternal instability was defined as evidence of sternal dis or non-union but without any purulence, cellulitis, or disunion of the skin. Sternal dehiscence was defined as evidence of sternal incision disunion with sternal bone disunion and was considered to be similar to a DSWI<sup>3</sup>.

Management strategies are variable and the optimal treatment strategy for more complicated deeper infections remain controversial<sup>1</sup>. Strategies vary from debridement with antibiotic irrigation and sternal rewiring and closure; use of negative pressure/vacuum assist devices; or the use of omental flaps or rotational/advancement pectoralis and rectus abdominis muscle or myo-cutaneous flaps<sup>2,4,5,6,7,8</sup>.

We have incorporated a surgical strategy of early surgical washout and local debridement with application of a VAC device, followed by closure either directly or with pectoralis major muscle flaps, or rectus abdominis muscle flap. We began using this vacuum assisted wound management protocol from 2011.

Predisposing risk factors have been extensively described in adults, such as diabetes, use of bilateral mammary arteries, previous radiation, morbid obesity. Risk factors in pediatric patients with CHD undergoing sternotomy is limited. Children with asplenia syndrome or those who have undergone a cardiac transplantation have been reported to be at increased risk of infectious complications<sup>2</sup>.

Working in a low to middle income country and possibility of less than optimal sterile technique procedures lead to the adoption of a two antibiotic regimen perioperative regimen; the duration of which was variable and varied from surgeon to surgeon. The microbiology of sternal wound infections is variable. The organism are usually a staphylococcus or a gram-negative species<sup>1,9</sup>.

TVAC therapy has gained popularity since its introduction in 1997. Studies have shown this modality to be significantly beneficial in its use in the treatment of sternal wound infections, both with and without mediastinitis. It has been shown to decrease the number of dressing changes, reduce the time between surgical debridement and definitive closure, and reduces the hospital stay and overall cost. The therapy is used both as a bridge between debridement and definitive closure and as a catalyst to secondary sternal-wound healing<sup>10</sup>. Quality of life has been shown to be better among patients with secondary VAC than among patients with musculocutaneous flap<sup>11</sup>. Early diagnosis, aggressive surgical treatment with the use of a VAC system allowed us to achieve a good long-term result.

Data has shown it to be specially beneficial in patients with sternal osteomyelitis however is still unclear whether it should be considered as standard of care for all sternal wound infections<sup>12</sup>.

In our experience initial treatment with a sterile VAC system leads to successful and earlier closure than traditional debridement and multiple dressing changes. Also, the requirement for more complex reconstructions is decreased and this is an important consideration in small babies who do not have bulky omentum or well-developed rectus muscles.

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