Original article

Sternal wound management in pediatric cardiac surgical patients: implementation of wound care pathways incorporating principles of wound bed preparation paradigm and early-advanced therapy

ABSTRACT

Objective The information on sternal wound management in children after cardiac surgery is limited. The authors formulated a pediatric sternal wound care schematic incorporating concepts of interprofessional wound care and the wound bed preparation paradigm including negative-pressure wound therapy (NPWT) and surgical techniques to expedite and streamline wound care in children.

Methods Authors assessed knowledge about sternal wound care among nurses, surgeons, intensivists, and physicians in a pediatric cardiac surgical unit regarding the latest concepts such as wound bed preparation, NERDS and STONEES criteria for wound infection, and early use of NPWT or surgery. Management pathways for superficial and deep sternal wounds and a wound progress chart were prepared and introduced in practice after education and training.

Results The cardiac surgical unit team members demonstrated a lack of knowledge about the current concepts of wound care, although this improved after education. The newly proposed management pathway/algorithm for superficial and deep sternal wounds and a wound progress assessment chart was introduced into practice. Results in 16 observed patients were encouraging, leading to complete healing and no mortality.

Conclusions Managing pediatric sternal wounds after cardiac surgery can be streamlined through incorporation of evidence-based current wound care concepts. In addition, the early introduction of advanced care techniques with appropriate surgical closure further improves outcomes. A management pathway for pediatric sternal wounds is beneficial.

Keywords cardiac, infection, interprofessional, management, pediatric, sternum, surgery, wound care

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INTRODUCTION

Open heart surgery is usually done through the median sternotomy. The incision is associated with exposure of the thoracic soft tissues and the sternal bone. Pediatric patients are vulnerable to postoperative incision site dehiscence or infection (deep sternal infection 0.4% to 5.1%).[1,2] The risk factors are prematurity, low weight, nutrition deficiencies, low resistance, comorbid conditions, genetic abnormalities, compromise of tissue vascularity, damage related to the surgical procedure, use of cardiopulmonary bypass, and perfusion issues. In addition, complexity of the procedures, repeat surgeries, and prolonged ventilation may delay wound healing. Wound dehiscence, infection (superficial or deep), and other related issues lead to a prolonged hospital stay, frequent dressing changes, a high cost of management, and high morbidity (50%).[1,3] Moreover, this may bring adverse psychological impact on patients and their families. Because the wounds do not always follow the expected course of healing, an early detection and aggressive management of treatable issues is the key to success.

So far, literature on post-surgical sternal wounds have described sternal wound issues mainly in adult populations.[1,3] However, in view of the lack of standardised guidelines for the management of such complications an individualised surgical approach and institutional preference is guiding the wound management.[4] The issue is complicated when surgical site infection is confused with sternal dehiscence. Dehiscence may not always be associated with infection and therefore application of concepts of wound bed preparation, NERDS (Non-healing, Exudate, Red friable tissues, Debris, Smell) and STONEES (Size increasing, Temperature, Os [probes to bone], New breakdown, Edema/erythema, Exudate, Smell) criteria and interprofessional wound care in patients with sternal wound may need to be considered.[5,6] The pediatric population with sternal wounds is a vulnerable group and therefore there is need to explore possibilities of effective and standardised wound care in children. The wound bed paradigm was described in nonsurgical adult patients but authors have attempted here to utilise the information for pediatric surgical population.

METHODS

Problem Identification

The authors' institution is a tertiary referral facility performing approximately 300 heart surgeries each year. The authors explored the available sternal wounds management guidelines and pathways in the pediatric population through a literature search. This also included assessment of local practice and knowledge of the wound care among the treating teams.

The team felt that there is a need for a wound care strategy based on the latest evidence-based information that includes components of wound care paradigm, patient centered concerns and incorporation of latest techniques that provides clear guidelines and streamline sternal wound care, uniformly.

Planning and Implementation

The planning required discussion with the surgical, nursing, and intensive care team to devise a universal pathway and management protocol so that the practice of sternal wound management could be standardised. Based on the review of literature, experience, established practices in other international centers and learning from the International Interprofessional Wound Care Course (IIWCC), the authors proposed wound assessment chart (Table 1) and two enablers depicting algorithms/pathways (Figures 1 and 2). The authors believed that the sternal wound healing process can be streamlined using algorithmic treatment method for early detection of infection, assessing depth of wound and the sternal stability in combination with early use of negative-pressure wound therapy (NPWT) and surgical intervention for a favorable outcome.

Materials and Resources

Human Resources. Each member was assigned clear roles and responsibilities emphasising strong collaboration amongst each other. As per the plan, the patients were primarily assessed by the wound care nurse. The surgeon examined the patient for debridement, NPWT or closure of the wounds. The physician was responsible for comprehensive assessment of medical comorbidities. In addition, a plan of wound care, choice of dressing, antiseptics, need for antibiotics were decided by the physician and the wound care nurse. Intensive, postoperative, and critical care was provided by the intensive care staff. The primary cardiac anomaly or issues were treated

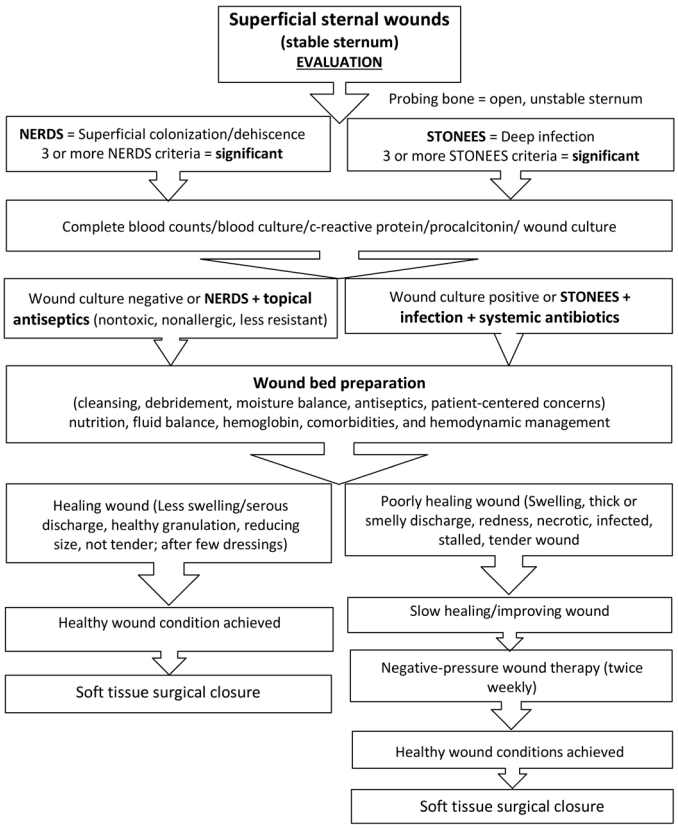

Figure 1. Superficial sternal wound management pathway

by the pediatric cardiologists. Further, a dietitian managed nutrition status. Finally, any multisystemic comorbidity was managed by the respective medical or surgical discipline as and when required.

Tools Utilised

1. Wound progress assessment chart (Table 1) and two enablers showing algorithms/pathways for wound management (Figures 1 and 2).
2. Education: presentations/discussions within the group
3. Existing medications/materials for wound care.
4. Surgical procedures/equipment.
5. Results of pre and post-implementation survey of the participating staff through questionnaire on existing and improved knowledge following education through lectures and group discussions (Supplemental Table, http://links.lww.com/NSW/A##).

Ethical Considerations

A written ethical approval of the study proposal was obtained from the Chief of the Pediatric Cardiac Surgery Department on behalf of the facility's institutional review board. In addition, each patient's parents were asked to provide written informed consents for treatment, photography, and the use of data for research and publication purposes by signing the institutional consent form, which has been kept in each patient's file as per the hospital policy for confidentiality.

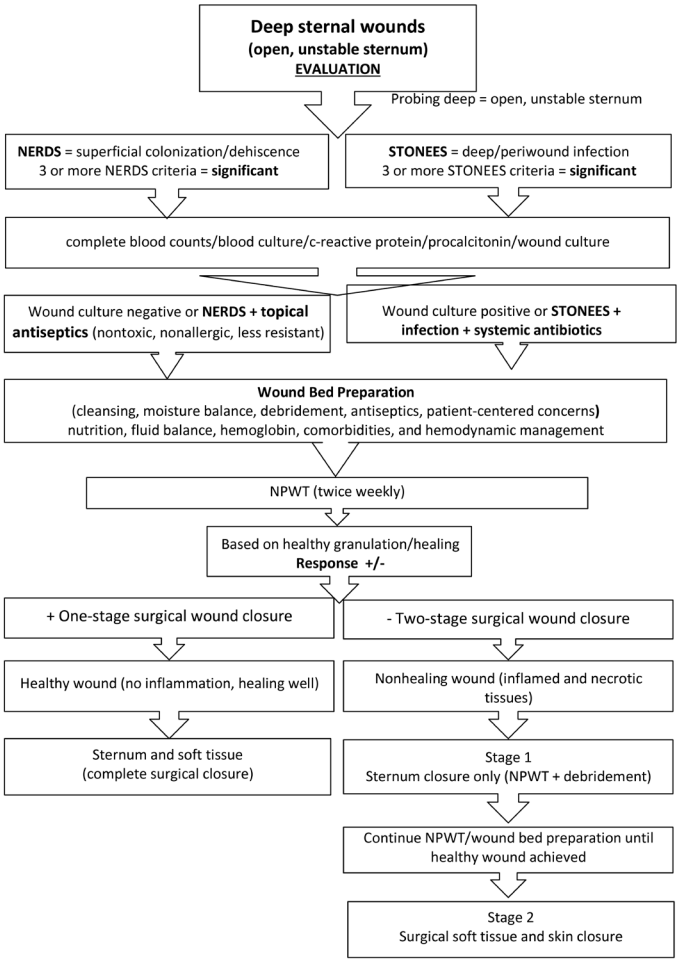

Figure 2. Deep sternal wound management pathway
Abbreviation: NPWT, negative-pressure wound therapy

Implementation

During the IIWCC first-residential education session, the authors realised that there is often a difference in the knowledge of a specialised wound care professional and a nonspecialised cardiac surgery unit personnel. The authors realised the gap in their unit's wound care practice resulted in inconsistent planning and decision making for the management of complex pediatric sternal wounds. Therefore, need for devising local standardised wound care guidelines based on latest evidence was strongly felt.

After discussions, it was decided to go ahead to print the final proposed pathways as an official document to be included for reference and practice. A review of literature on the sternal wound management was done in order to find an evidence-based practice to be implemented in the unit with special emphasis on wound bed preparation paradigm and NERDS/STONEES criteria for superficial colonisation and deep/periwound infection along with advanced wound care strategies.[5,6] Usually, the sternal wounds are classified as per the nature of infection, depth of the wound or the time of onset from the surgery.[7,8] The investigators defined the wound as superficial, if the extent of dehiscence or infection was limited to the skin or subcutaneous layer or a deep wound, where the muscle or bone was involved including mobile (unstable) sternal segments.[7,8] In the authors' opinion, the surgical management of sternal wound can be planned and managed efficiently, if the depth and the mobility of the sternum is taken into consideration early and addressed accordingly.

The wound assessment chart (Table 1) and two pathways (Figures 1 and 2) for sternal wound management were prepared. The Os (probing bone) criteria of the mnemonic STONEES was replaced by "unstable/mobile" or "completely exposed sternum" in this study. The treating unit members were assessed using a questionnaire on their existing knowledge about the wound bed preparation and pediatric sternal wound care. Education to the existing staff was provided with an emphasis on components of the wound care paradigm. A post education survey was conducted using a questionnaire to verify effectiveness and understanding of proposed wound care concepts within the team (Supplemental Table). The group started to work on the project by implementing the proposed strategies daily. Patient clinical data was recorded regularly.

RESULTS

Process Evaluation

Our project did not require many resources because all logistics and patients were in one unit. An infrared handheld thermometer was introduced into practice, which is proven to

be a cheap, easy to use, and cost effective means of detecting periwound temperature. With the available resources, it was appropriate to design a wound care assessment chart (Table 1) that incorporated NERDS/STONEES and specific clinical wound characteristics that indicate sternal wound healing progress in children.

The authors educated relevant staff about the importance of sternal wound screening as per prepared wound assessment chart and to follow the proposed superficial and deep sternal wound management pathways. With further practice and education, the whole team started following the proposed practice uniformly. A pre-implementation evaluation of existing wound care knowledge and practice was performed through a questionnaire. After education sessions, a post-implementation evaluation was performed. The evaluation results showed that majority of participants have acquired the necessary knowledge and understanding.

Once a wound dehiscence, discharge, or infection was suspected, daily progress was recorded in the wound assessment chart until a decision was made regarding type of wound care and plan to be followed as per proposed wound care algorithm.

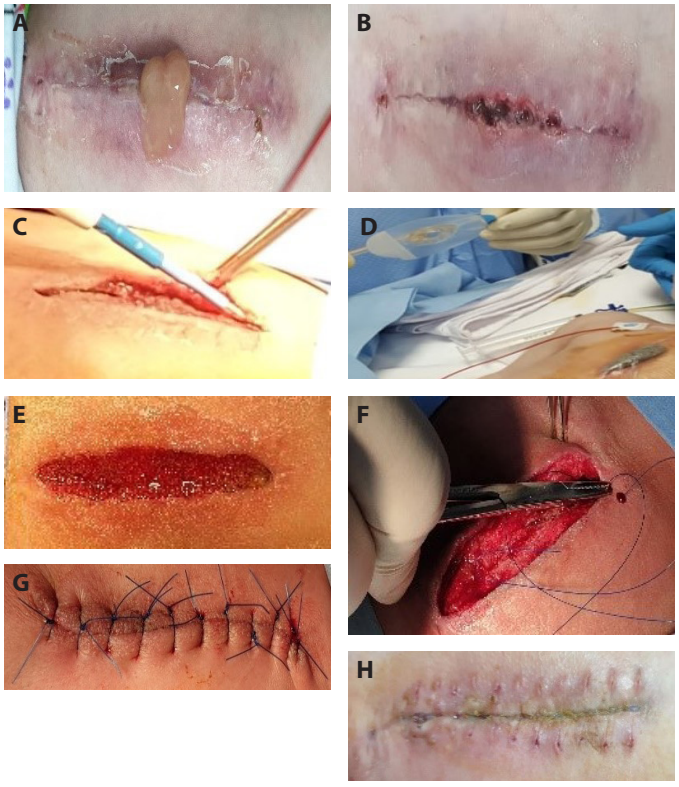

Figure 3. Superficial wound with negative-pressure wound therapy (NPWT) and one-stage wound closure

A and B, 6-month-old girl with cyanotic heart disease 5 days after open heart surgery. Incision-site inflammation and abscess. C, Drainage and debridement of sterile superficial purulent collection. D, NPWT. E, Wound with healthy granulation at day 8 after NPWT. F and G, Soft-tissue closure at day 11 after NPWT. H, Day 10 after soft tissue closure and stitch removal.

Qualitative Outcomes

- Feedback taken from the charge nurse wound care, staff nurses and wound care team including pre and postimplementation survey.
- All were satisfied with improvement in quality of wound care. However, it would require further data to show the impact of these pathways and protocol on sternal wound management over the long term.
- Patient data related to the wound management as an example from respective group of patients in the form of photograph.

Quantitative Outcomes

The authors recruited patients from June 2020 to December 2020; a total of 16 patients were evaluated for postcardiac surgical wound issues (Table 2). Of these, four had simple wound dehiscence during the first week after surgery. Wound bed preparation was started and these superficial wounds were managed with cleansing, debridement, and dressings. The soft tissue closure was achieved in all the patients by day 12 (average). There was no mortality.

There were 8 patients with superficial wounds (stable sternum group) who developed wound gapping and seropurulent discharge 4 days after surgery (average). Wounds were explored and enlarged to clean, debride, and apply NPWT. The wound culture was positive for three patients (*Staphylococcus aureus* in two and *Klebsiella* species in one) who received antibiotics accordingly. The twice- weekly regimen of dressing change and debridement was applied resulting in single-stage closure of wound in all the patients on average 13 days from onset (Figure 3). There was no mortality.

Four patients were treated for deep sternal wounds where the sternum was unstable and mobile. Two patients developed sinus and swelling over the sternum 1 month after the initial operation. The remaining two developed deep infection and wound dehiscence within the first week of surgery. The wound cultures were positive for all the patients (*Staphylococcus* in three and *Klebsiella pneumoniae* in one). The wounds were explored, debrided, and after obtaining a sample for culture, NPWT was started immediately in addition to systemic antibiotics. A twice weekly regimen of dressing change with cleansing and debridement resulted in single-stage (sternum with soft tissue) closure of the wounds in two patients by the end of 2 weeks. However, two patients with deep sternal wounds (instable sternum) had poor wound healing that required sternal closure first at the end of 2 weeks and then soft tissue closure at second stage by the end of third week, after continuation of wound care with NWPT (figure 4). *K pneumoniae* was present in one patient. There was no mortality in this group either.

All the patients were given pediatric intensive care treatment that includes daily fluid balance, care of comorbid conditions, anemia, nutrition and prevention of pressure injuries. In addition, they were given oxygen, analgesia, and general

Figure 4. Deep sternal wound with two-stage closure after negative-pressure wound therapy (NPWT)

A and B, Incision site inflammation/swelling and drainage and debridement on postoperative day 8. C, NPWT. D, Day 9 after debridement and NPWT. E, Day 15 after NPWT. F and G, Sternal closure (stage 1) on day 17 of NPWT. H, Continuation of NPWT on the superficial tissues. I, Healing with granulation on day 23 of NPWT. J, Stage 2 soft tissue closure.

anesthesia during the surgical procedures. Families were educated and counselled at all crucial times.

DISCUSSION

The best approach in dealing with sternal wound in children after cardiac surgery is prevention of infection and care of the patient as a whole, considering all clinical factors interfering with the patient care and outcomes.[2] Typically, CDC guidelines are used to diagnose sternal wound infections.[9] This includes duration of onset of the signs or symptoms after surgical procedure (within 30 days) and presence of pus or a positive microbial culture. In addition, presence of pain, tenderness, fever, or erythema is considered, if surgeon has to reopen the incision site due to a suspected infected swelling.[9] Clinicians must be aware that in pediatric populations, initially there may be only a wound dehiscence but in due course it may be complicated by other conditions. Poor skin condition, age, prematurity, chromosomal anomalies, complex surgical procedures, repeat surgeries, and poor perfusion are some of the common causes of wound dehiscence. Therefore, an evidence-based systematic approach to wound care including the principles of wound bed preparation, advanced wound care therapy, and use of appropriate surgical techniques tailored to the patients for early recovery is ideal for vulnerable populations with a dehisced sternal wound.[4]

There is a lack of information in the available literature regarding optimal sternal wound management (infected or not) in the pediatric population, especially those who undergo complex cardiac surgical procedure.[4] Therefore, these initial observations and proposed management strategy may be helpful in improving outcomes and encourage other surgical units to follow similar practice. In addition, in the absence of CDC criteria of surgical site infection, a wound assessment from the onset of tissue dehiscence as per validated NERDS and STONEES criteria will not only help in detecting local evidence of critical colonisation or deep infection early to halt the process by taking advantage of the methods applied in the wound bed preparation.

The most important factor in the management of sternal wounds is to prevent or identify infection. Infection is associated with high mortality, prolonged hospital stays, and high cost of the treatment.[1,3,10] A cross-sectional validation study of using NERDS and STONEES to assess bacterial burden in the wounds in the adult general population concluded that any three criteria were found to provide sensitive and specific information about the amount of bacteria present in the wound when used by expert clinicians.[5,6] The landmark study by Woo and Sibbald[6] validated that by collating any three clinical signs exhibited in the assessed wounds, the sensitivity for NERDS increased to 73.3% (specificity 80.5) and to 90% (specificity 69.4) for STONEES. Therefore, a knowledge of NERDS and STONEES criteria is crucial during initial assessment of any sternal wound and may help in identifying critical colonisation or local infection. This component was incorporated in the proposed wound care pathways as first step to prevent or treat it at the earliest.

The authors found deficiencies in their unit regarding wound care knowledge. The systemic antibiotics were used when blood culture was positive or three STONEES criteria were present. In addition, many patients had comorbid conditions, congenital malformations, invasive procedures, or catheters during intensive care that required systemic antibiotics.

The next step included overall wound assessment considering wound bed preparation principles including patient-centered concerns. The incorporation of debridement, cleansing, and dressing materials as per the wound condition and correction of comorbidities such as pain management was addressed. This helped to stratify wounds, evaluate response to the treatment, and further plan wound management in terms of need and timing of appropriate advanced therapies.

In the last part of management pathway, the role of advanced techniques including surgical procedures was considered and implemented, which helped expedite wound healing.

The sternal area has little muscle or soft tissue cover, and so the area does not have a generous blood supply.[1,2,4,9] In addition, the close proximity of bone to the skin facilitates entry of superficial infection to the deeper tissues. The area is under higher stress due to continuous respiratory movement.[9] All of these factors not only make sternal wounds a difficult substrate to heal but justify the early use of advanced therapy or surgery.[3] Among these strategies, NPWT has proven successful for use in pediatric cardiac surgical patients.[11]

Therefore, the proposed strategy recommends NPWT at an early stage to keep the area dry and relatively stable to

Table 1. Wound progress chart: cardiac surgery

Subject	Observation	Day 1 (from dehiscence)	Day 2	Day 3	Day 4	Day 5
Cardiac surgery	- Date of surgery - Procedure name: - Open chest (yes/no)					
Comorbidities	- Date of chest closure (if it was open chest) - Genetic anomaly/renal failure/anemia/ nutrition diff.					
Patient-centered concerns	- Pain (tenderness) (yes/no) - Fever (yes/no)					
Local wound exam	- Size (cm) - Base: Necrotic/black, slough /yellow/ unremarkable Moisture (dry/moist) - Edge: Hyperkeratotic, macerated, normal - Undermining (yes/no) - Crepitus (yes/no)					
Superficial colonisation (NERDS)	- Nonhealing - Exudate Amount (none, scant, moderate, frank) Character (serous, purulent) - Red, friable, bleeding, unhealthy granulation - Debris, necrotic - Smell					
Deep infection (STONEES)	- Size - Temperature - Os probing bone/exposed bone / sternal bone mobility - New breakdown - Exudate - Erythema - Smell					
Wound culture	- Growth: positive/negative					
Blood culture	- Growth: positive/negative					
Steroid use WBC/CRP/Procalcitonin	- Yes/no					

promote healing. NPWT stimulates blood flow, granulation tissue and reduce inflammatory response. In addition, it maintains a moisture balance by countering the effect of friction and resultant inflammation. It also helps expedite rate of healing, reduces frequency of dressing, manpower and may affect hospitalisation time and cost.[1,4,8,10,11] The twice weekly application of the NPWT was based on assumptions to keep the wound dry, evaluate the condition more frequently to intervene early debridement or closure and reduce the recovery time to achieve overall benefits related to the hospitalisation, cost, and logistics. In some situations, with deep infection or wet wounds, the need for dressing change may be variable and frequent.

In children, soft and friable tissues with future growth potential are limitations for implementation of invasive surgical options.[1,2,4] Therefore, direct soft-tissue closure with a limited pectoralis major muscle advancement and staged sternal bone closure is recommended. The role of surgery in this decision-making was dependent upon the nature of the wound bed, presence of infection, sternal mobility, and depth of the wound. In deep wounds with an unstable sternum, the sternal closure was considered one-stage (all layers closed once healthy, healable tissue achieved). However, in case of more resistant wounds, a sternal closure was attempted as a first step to protect mediastinal tissues and provide stability. Once the superficial layer was found to be healthy, a second-stage soft tissue closure was done (two-stage closure). This staging helps to reduce wall tension and risk of further dehiscence.

In all of the patients, antibiotics were used according to the culture and sensitivity, or empirically when signs of local or systemic infection were seen. In addition, care of comorbid conditions, nutrition support, and parent counseling were also provided through an interprofessional approach.

Through proposed wound care pathways and education, the investigators not only improved the knowledge but also have introduced the wound care practice in a national center of excellence. The authors incorporated a strategy to educate and inform parents about prevention, care and management of issues related to cardiac surgery in children such as incisional pain, infection, wounds, rehabilitation, and psychological support that helps in holistic care of such patients.

Limitations

This project was limited to the introduction of wound care pathways and a change in the practice only as a first step. A small number of cases were recorded as observations or case studies. Ideally, these tools should be analysed in the long-term with larger patient populations. In addition, the role of infrared thermometry was introduced but was not used uniformly because it was a novel addition to the authors' unit and it is difficult to compare two identical parts in the chest, unlike comparing limb temperatures. Therefore, authors compared the temperature over the sternal area and the abdominal wall as an alternative, but the reliability of these results was not evaluated.

CONCLUSIONS

The management of sternal wound after cardiac surgery in the pediatric population can be streamlined through incorporation of evidence-based guidelines and components of wound care

Table 2. Distribution of 16 observed cases: type of wounds and therapy

Variable	Simple Dressing Plus Closure (Superficial Wound)	NPWT Plus Single Stage Closure (Superficial Wound)	NPWT Plus Single Stage Closure (Deep Wound)	NPWT Plus Two Stage Closure (Deep Wound)
No. of patients	4	8	2	2
Sex				
Male	1	5	1	1
Female	3	3	1	1
Mean duration since index procedure (days)	4	4	15	4
Average time for closure (days)	12	13	14	21
Mean age (months)	1	15 days	1	1
Mortality	0	0	0	0
Comorbidities				
Down syndrome	1	0	0	0
DiGeorge syndrome	0	1	0	1
G6PD difficiency	0	0	1	0
Wound culture				
Staphylococcus aureus	0	2	2	1
Klebsiella	0	1	0	1

Abbreviations: G6PD, glucose-6-phosphate dehydrogenase; NPWT, negative pressure wound therapy.

paradigm through standardised management pathways based on interprofessional care concepts. This will help in avoiding individual preferences and practice in the treating units to compare the effectiveness and improvement in the long-term outcomes. In addition, early implementation of NPWT and appropriate use of surgical procedure expedite wound healing in children with postsurgical sternal wounds and that provide comprehensive benefit to the patient and the organisation. A long-term study is required to observe real impact of the proposed concepts and management pathways.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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SUPPLEMENTAL TABLE

Assessment of knowledge and practice on wound care including sternal wounds in the nursing staff (before/after introduction of proposed guidelines and sternal wound care pathways)

Name of the responder:

Please select the most suitable option. Please select the option by ticking it.

Q1 Are you aware about classification of sternal wound infections?

A Yes

B No

C Any comments:

Responders n-15	Correct response %	Incorrect response %
Pre test	08 (53%)	07 (47%)
Post test	14 (93%)	01(7%)

Q2 Are you aware about any sternal wound care management protocols or pathways in children?

A Yes

B No

C Any comments:

Responders n-15	Correct response %	Incorrect response %
Pre test	07 (47%)	08 (53%)
Post test	15 (100%)	00

Q3 As per international guidelines, the non-infected wound bed assessment includes.

A Depth, size, tissue type, etiology and tissue perfusion

B Depth, tissue perfusion, surrounding skin condition and odor

C New breakdown, Exudate, Redness, Depth, Smell

Responders n-15	Correct response %	Incorrect response %
Pre test	03 (20%)	12 (80%)
Post test	15 (100%)	00

Q4 Deep wound infection has following local wound findings (diagnostic criteria)-

A Swelling, temperature raise, exposed bones, new breakdown, redness, smell

B Perfusion defect, biofilm, reduced local temperature

C Not sure

Responders n-15	Correct response%	Incorrect response %
Pre test	08 (53%)	07 (47%)
Post test	15 (100%)	00

Q.5. Are you aware about significance of local temperature in the wound infection?

A It is a predictor of deep infection

B. It is not significant

C Don't know

Responders n-15	Correct response%	Incorrect response %
Pre test	07 (47%)	08 (53%)
Post test	15 (100%)	00

Q6 Slimy Glue like substance on wound base called Biofilm is made up of.

A Epithelial layer

B Polymicrobial community

C Granulation tissue

D Fibrous tissue

Responders n-15	Correct response%	Incorrect response %
Pre test	04 (27%)	11 (73%)
Post test	15 (100%)	00

Q7 Black, soft and wet or hard and dry necrotic tissue due to inadequate blood supply is in a wound is called.

A Slough

B Eschar

C Granulation

D Biofilm

E Not sure

Responders n-15	Correct response%	Incorrect response %
Pre test	07 (47%)	08 (53%)
Post test	15 (100%)	00

Q8 Wound or surrounding infection can be measured by infrared thermometer?

A Yes

B No

C Not sure

Responders n-15	Correct response%	Incorrect response %
Pre test	10 (67%)	05 (33%)
Post test	15 (100%)	00

Q9 Which of the following mechanism of action relates to VAC dressing/therapy?

A Promoting edema

B Inhibiting granulation tissue formation and perfusion

C Wound space expansion

D Decreasing exudate and infectious material

Responders n-15	Correct response%	Incorrect response %
Pre test	08 (53%)	07 (47%)
Post test	15 (100%)	00

Q10 Which dressing has best likelihood of reducing related pain during VAC sponge removal?

A Gauze

B Foam

C Bio-Done

D Intervening non-adherent

Responders n-15	Correct response%	Incorrect response %
Pre test	04 (27%)	11 (73%)
Post test	15 (100%)	00

Q11 Which of the following is important consideration for early implementation of VAC dressing in sternal wounds?

A Continuous sternal movement due to respiration

B Wet wound

C Deep wound

D All of above

Responders n-15	Correct response%	Incorrect response %
Pre test	11 (73%)	04 (27%)
Post test	15 (100%)	00

Q12 When the patient experiences the greatest pain during wound care?

A Autolytic debridement

B Dressing removal

C Saline cleansing

D All of above

Responders n-15	Correct response%	Incorrect response %
Pre test	07 (47%)	08 (53%)
Post test	15 (100%)	00

Q13 Comorbidities and nutrition have impact on the sternal wound healings?

A Yes

B No

C Not sure

Responders n-15	Correct response%	Incorrect response %
Pre test	11 (73%)	04 (27%)
Post test	15 (100%)	00

Q14 Factors associated with impaired healing in pediatric cardiac surgery patients are:

A Tissue perfusion

B Complexity of surgery

C Hypothermia

D All of above

Responders n-15	Correct response%	Incorrect response %
Pre test	08 (53%)	07 (47%)
Post test	15 (100%)	00

Q15 Have you seen/aware about use of any method or device for local wound temperature measurements?

A Yes

B No

C If yes, please explain briefly:

Responders n-15	Correct response% (seen/aware)	Incorrect response % (not seen)
Pre test	07 (47%)	08 (53%)
Post test	15 (100%)	00