Open Chest Duration Following Congenital Cardiac Surgery Increases Risk for Surgical Site Infection

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Background:

- Surgical site infections (SSI) following congenital heart surgery remain a significant source of morbidity and mortality with an estimated incidence as high as 11% [1]
- Delayed sternal closure (DSC) is often necessitated particularly in neonates to limit the deleterious effects of sternal closure on post-operative hemodynamics.
- While open chest resuscitation is an established risk factor for post-operative infection, the effect of open chest duration on infection remains less well-defined.

Purpose:

- Evaluate incidence of SSI in a single institution patient cohort with delayed versus primary chest closure.
- Determine the effect of open chest duration on the incidence of surgical site infection.

Methods:

- Retrospective review of institutional Society of Thoracic Surgeons dataset, 2015 to 2020.
- Patients with SSI were identified within a prospectively collected institutional dataset and matched accordingly.
  - Definition of infection was standardized prospectively among a multi-disciplinary team reviewing all potential SSI.
    - Initiation of antibiotics for presumptive clinically-diagnosed infection
    - Positive wound culture obtained by standardized technique
    - Requirement for incisional re-opening/debridement as judged by surgeon
  - Audits for all DSC patients were performed by retrospective chart review to confirm both SSI diagnosis and open chest duration.

Results:

- 2582 operations were performed in 2492 patients:
  - 195 DSC cases/177 patients
  - 2387 primary chest closure (PCC) cases
- 177 patients with DSC were evaluated to determine the association of open chest duration on the incidence of SSI.

DSC Patient Characteristics:

Table 1. Patient characteristics for 177 delayed sternal closure (DSC) patients with SSI vs non-SSI

Patient characteristics	SSI (n=17)#	Non-SSI (n=160)#	P value†
Age	0.15±0.21	0.71±2.7	0.386
Female Gender	10 (58.5%)	69 (43.1%)	0.216
Weight (kg)	3.6±1.7	5.3±8.6	0.426
Race/Ethnicity	N (%)	N (%)	
Caucasian	2 (11.8)	72 (45)	**0.017**
Black	1 (5.9)	6 (3.8)	0.668
Hispanic	9 (52.9)	47 (29.4)	0.087
Other	5 (29.4)	35 (21.9)	0.480

Categorical variables are expressed as N (%). Continuous variables are expressed as mean with standard deviation.
† P values less than 0.05 are bolded.
Abbreviations: kg, kilograms.

DSC Patient Operative Details:

Table 2. Operative details for 177 delayed sternal closure (DSC) patients with SSI vs non-SSI

Operative characteristics	SSI (n=17)#	Non-SSI (n=160)#	P value†
Norwood procedure	4 (23.5)	45 (28.1)	0.687
TAPVC	3 (17.6)	12 (7.50)	0.153
Aortic arch repair	2 (11.8)	2 (1.25)	**0.005**

Categorical variables are expressed as N (%). Continuous variables are expressed as mean with standard deviation.
† P values less than 0.05 are bolded.
Abbreviations: TAPVC, total anomalous pulmonary venous connection.

DSC Patient Outcomes:

Table 3. Outcomes for 177 delayed sternal closure (DSC) patients with SSI vs non-SSI

Outcomes	SSI (n=17)#	Non-SSI (n=160)#	P value†
Open chest duration	14.2±16.2	4.31±4.86	**0.024**
Postoperative mortality	2 (11.8)	26 (16.3)	0.630

Categorical variables are expressed as N (%). Continuous variables are expressed as mean with standard deviation.
† P values less than 0.05 are bolded.

DSC PATIENTS HAD A HIGHER INCIDENCE OF POST-OPERATIVE SSI COMPARED TO PCC PATIENTS

Summary:

- The incidence of SSI within the cohort was 1.8% (n=47)
- DSC patients had significantly higher incidences of SSI (8.7%) than PCC patients (1.3%, p=0.041, OR:6.7)
- Within the DSC cohort, patients that went on to develop SSI had a longer open chest duration (mean=14.2 days) when compared to non-SSI DSC patients (mean=4.31 days)

Limitations:

- All ages and operations were included.
- Antibiotic utilization was not audited.
- Continuous gram-positive coverage during open chest period is standardized at our institution.
- Day of SSI onset is subjective with limited standardization.

Conclusion:

- Incidence of SSI is higher in patients undergoing delayed sternal closure compared to patients with primary chest closure.
- Duration of post-operative open chest resuscitation is associated with an increased risk of post-operative SSI.
- Prolonged open chest duration represents a potentially modifiable risk factor for SSI predisposition.
- Daily post-operative assessment of candidacy for chest closure is supported to minimize the risk of SSI.

Reference:

[1] Harder EE, Gaies MG, Yu S, et al. Risk factors for surgical site infection in pediatric cardiac surgery patients undergoing delayed sternal closure. J Thorac Cardiovasc Surg 2013;146:326-33.