Risk Factors for Sternal Wound Infections
after Open-Heart Surgery at Peninsula Regional Medical Center

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Objectives
• 1. Identify the common risk factors for sternal wound infections after open heart surgeries
• 2. Identify the EBP driven interventions to reduce the sternal wound infections
• Update current practice protocol

Research Problem
• Sternal wound infection (SWI) rates increased above the CDC Benchmark in the first quarter of 2012 and second quarter of 2013
  o First quarter 2012 rate was 4.39%
  o Second quarter of 2013 was 3.28%
• CDC Benchmark for open heart surgical wound infection rate is 2.55% (CDC, 2012)
Purpose
• To identify the common risk factors among patients with SWI after open-heart surgery
• To identify recommendations for practice changes

Research Question
• What were the common risk factors directly related to the SWI rates in open heart patients at Peninsula Regional Medical Center (PRMC) from 2011 to 2015?

Review of Literature
Background

- Coronary Artery Bypass Graft (CABG) most common open-heart surgery (OHS) in the United States
  - > 500,000 open-heart surgeries performed each year (University of Michigan, 2012)
- There are about 400 open-heart surgeries performed at PRMC annually (PRMC OHS annual report, 2015)

Background (cont.)

- SWIs are one of the most devastating complications of open-heart surgery
  - Multiple operative and non-operative procedures
  - Impacts activities of daily living
  - Increased hospital costs [Al-Zaru, et al., 2010]

Incidence of Sternal Wound Infection

- The incidence of superficial SWI after open-heart surgery between 0.5 to 8% (Singh, et al, 2011)
- The incidence of deep SWI after open-heart surgery between 0.8% and 5.0% (Kubota, et al, 2013)
Post-Operative Mortality Rates of SWI

- The associated mortality rate of superficial SWI in the literature ranges from 0.5 to 9%.
- The associated mortality rate of deep SWI ranges from 10 to 47% (Singh, et al, 2011).

Selected SWI Risk Factors

<table>
<thead>
<tr>
<th>Preoperative</th>
<th>Age, gender, tobacco use, BMI &gt;30, Methicillin-resistant staphylococcus aureus (MRSA) + Hypertension, diabetes, Heart failure (HF), Past Myocardial Infarction (MI), ejection fraction &lt; 30%</th>
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<tr>
<td>Intraoperative</td>
<td>Cardiopulmonary Bypass-time &gt;150 min, Urgent/Emergency surgery, Type of surgery (CABG, CABG + valve, valve replacement or repair, Aortic surgery), Closure device Bilateral internal mammary artery used</td>
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<tr>
<td>Postoperative</td>
<td>Blood transfusion, inotropes &gt;24 hours, Mechanical ventilation &gt; 24 hours, Re-exploration for bleeding</td>
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(Al-Zaur et al., 2010; Filsoufi, 2009; Shaikhrezai et al., 2012; Bryan et al., 2013; Eriksson et al., 2011)

Consequences of SWI

- Long term antibiotic therapy
- Implications for activities of daily living
  - 37% problems carrying a grocery bag
  - 67% problems putting on a coat 6 years after open heart surgery

(Eriksson et al., 2011)
Implication of SWI on Cost

• Cost of open-heart surgery (OHS) without complications range from $90,000 to over $150,000 (Blue Cross, 2015)
• Cost significantly increases with SWI to estimated 2.8 times higher (Singh et al., 2011)
• Medicare does not reimburse hospitals for care related to SWI (Greco et al., 2015)

2012 EBP Changes Due to Increased Infections

1. Reinforced hand hygiene
2. Chest hair clipping instead of shaving in males
3. More thorough operating room cleaning
4. Prophylactic use of Vancomycin paste
5. Opsite Post-Op Visible® dressing
6. Chloraprep for post-op wound care
7. Wound Vac for SWI

Research Methods
Approval & Access

- Approval
  - PRMC Cardiothoracic Surgical Group
  - Salisbury University Committee on Human Research
  - PRMC IRB

- Access
  - Infection control database
  - Electronic medical records review through CV surgical database

Design: Sampling and Method

- Descriptive, retrospective design
- Medical record review
- All OHS patients with sternal wound infections 2011-2015
  - Total infections = 28 cases
  - Final sample size = 21 cases

Exclusion Criteria

- The infection not in sternal incision
- In total, 7 records were excluded
  - Graft donor sites: leg, thigh or groin incision
  - Empyema
    - 2011: 2 groin infections
    - 2012: 1 leg
    - 2013: 1 thigh
    - 2014: 1 empyema and 1 leg
    - 2015: 1 leg
Variables of Interest

- Demographic variables
- Comorbidities
- Type of surgery
- Pre-operative, intra-operative, and post-operative risk factors

Data Collection and Analysis

- Collected and organized with paper data collection tool
- Data coded and entered into IBM SPSS Statistics Version 22
  - Descriptive statistics
  - Correlations
- Patient information kept confidential

Results
Results - Demographics

- Age ranged from 38 to 81 years, \(M = 58.5, \pm 11.0\)
- CPB time ranged from 24 to 142 minutes, \(M = 78.5, \pm 33.13\)
- BMI ranged from 21.8 to 50.7 kg/m\(^2\), \(M = 34.7, \pm 7.9\)
- Pre-operative ejection fraction 25 to 73%, \(M = 50.5, \pm 13.5\)

Figure 1: Annual Sternal Wound Infection Rate by Year and Quarter (2011-2015) Compared to CDC Benchmark SWI Infection Rate

Infection rate by year and quarters (Year: total # infections/total # surgeries in each year)

Results – SWI Risk Factors

- 90.5\% of patients \(n=19\) history of hypertension
- 88.0\% \(n=18\) history of DM
- 81\% \(n=17\) history of smoking
- 66.7\% \(n=14\) blood transfusion
- 66.7\% \(n=14\) male gender
- 66.7\% \(n=14\) BMI >30
- 57.1\% \(n=12\) history of heart failure
Results (cont.)

- 47.6% (n=10) on inotrope(s) > 24 hours
- 38.1% (n=8) on ventilator > 24 hours
- 33.3% (n=7) had bilateral internal mammary artery used
- 9.50% (n=2) used IABP

Common Characteristics of Patients with SWI

- Older age
- Male gender
- History of Hypertension
- History of Diabetes
- Smoking
- BMI>30

Correlations Between Risk Factors and SWI

- No significant correlations were found between risk factors and SWI
  - No significant correlation between type of infection and type of closure device used (p > .05)
  - No significant correlations between SWI and pre-operative history of renal failure, IABP use, post-operative CVA or sepsis (p > .05)
Limitations

- Non-experimental, descriptive design
- Small non-random sample
- No control group for comparison
- Data collected from one institution

Conclusions

Common risk factors among patients at PRMC with SWIs:
- Older age, male gender, higher BMI, smoking
- History of: hypertension, diabetes, heart failure
- Longer CPB time, bilateral internal mammary artery
- Post-op blood transfusion, ventilator > 24 hours, and inotropes > 24 hours.

Recommendations for future research

- Further research with larger sample with compression group
- Encourage standardization of medical records
- Emphasize inpatient education
- Encourage medical professionals to use EBP
Literature Review: EBP Recommendations

- Routine antimicrobial prophylaxis
- Chlorhexidine gluconate nasal ointment
- Minimally invasive procedures
- Thermoregulation
- Laminar airflow (Operating room)
- Supplemental oxygen
- Local (surgical site) antibiotic delivery
- Glucose control

(Up to Date, 2015)

EBP Recommendations for PRMC

- Review and revise the dressing protocol, last revision 2010
  - Practice changes need to be added to the policy; this was just updated in 2016.
- Use Chloraprep instead Duraprep for reopen at bedside and also post-op dressing changes
  - Chloraprep (2% chlorhexidine gluconate and 70% isopropyl alcohol)
  - Duraprep (0.7% iodine and 74% isopropyl alcohol) (Tsai & Caterson, 2014)
- Nurses continue to follow EBP
  - Education committee to periodically review literature for EBP changes and updates

Why Change Wound Care?

- Several studies have shown Chloraprep was twice as effective as Duraprep in terms of eradicating bacteria from the skin, with decreased rates of positive cultures of 30% vs. 65% (Tsai & Caterson, 2014)
Dissemination

- The completed research findings have been presented to the cardiothoracic surgical group and CTICU staff at PRMC on March 26th, 2015
- EBP conference 2016

Thank you!

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Family and Friends

Any Questions?
References

• PRHC Open heart surgery annual SWI rate report. (2014).