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Introduction

Although cardiac surgery procedures drop into the class of so-called “clean procedures”, but they remain loaded with the risk of infectious complications. Most cardiac surgery procedures are conducted using the median sternotomy. The frequency of sternal wound infection (SWI) ranges from 0.5% to 8.0% and is linked with significant morbidity, mortality, and treatment cost. Surgical access site can never be fully prevented by peri-operative antibiotic prophylaxis after cardiac surgery [1,2]. Numerous predictive factors for surgical site infections in cardiac surgery have been recognized, including insulin dependent diabetes mellitus, obesity, and prolonged and emergency/urgent surgery [4,5]. With an overall rise in prevalence of these comorbidities, it is anticipated that the number of patients at high risk for the development of this potentially devastating problem will increase. Despite various population based studies, sternal wound infections after sternotomy procedures have not significantly improved [6,7]. With strengthened scrutiny for infection-related complications after cardiac surgery, the development of added preventative treatment strategies has become a high priority.

A subject of growing interest has been the use of topical antibiotics used at the time of surgery. These regimens, utilizing various agents such as topical vancomycin and cefazolin as well as gentamycin collagen implants, have been applied directly along the sternal edges [8]. The trial use of these antimicrobial agents in a localized, nonsystemic method has been positive and shown to offer protection against the incidence of sternal wound infections [9].

Vancomycin is often administered intravenously for situations in which elevated blood levels are required. This can be beneficial for patients who require postoperative antibiotic prophylaxis, such as those undergoing cardiac surgery, where the risk of endocarditis is high. However, the use of intravenous vancomycin carries a risk of nephrotoxicity, especially in patients with pre-existing kidney disease. This risk can be reduced by using a topical vancomycin solution, which is applied directly to the surgical site and does not require systemic administration. This can be particularly advantageous for patients who may be at risk for nephrotoxicity or who require a less invasive treatment option.

Research Article

Topical Vancomycin in Cardiac surgery to reduce Sternal wound Infections: A Randomized Controlled trial at a Tertiary Cardiac Care facility

Abstract

Objective: To determine the effectiveness of topical vancomycin in reducing the incidence of sternal wound infections (SWI) in patients undergoing coronary artery bypass graft (CABG) surgery.

Study design: Randomized Controlled Trial (RCT).

Material and methods: This double blinded randomized clinical trial was carried out on 276 patients scheduled for elective CABG surgery. Patients were divided into two equal groups. In patients of group A (n=138) topical vancomycin solution was used in the sternal wound, and patients in group B (n=138) topical normal saline before sternal wound closure in coronary artery bypass graft surgery. The incidence of sternal wound infection was followed over an 18 months period. Major risk factors like diabetes mellitus (DM), smoking, and prolonged operation time (ie cardiopulmonary bypass time (CPB time) and cross clamp time were also evaluated.

Results: There was no significant difference between the two groups in demographics (age, gender, body mass index (BMI) and co-morbidities like hypertension and smoking. Vancomycin group had more diabetic patients than the normal saline group. The cost effectiveness of the two topical agents was also compared (p<0.001).

Conclusion: Topical vancomycin and normal saline had no significant influence on the incidence of SWI rate in 276 consecutive cardiac surgery patients.
antibiotic prophylaxis in cardiac surgery. Many cardiac surgeons also apply vancomycin paste topically to the sternal edges. There have been a limited number of studies to date that investigate the topical application of vancomycin in the sternal wound to reduce the incidence of sternal wound infection.

We hypothesized that topical vancomycin is associated with a reduced frequency of sternal wound infection. To prove this hypothesis, we carried out this randomized controlled trial at our institution to evaluate the evidence based effectiveness of local administration of vancomycin in the sternal wounds to reduce the occurrence of sternal wound infections after coronary artery bypass graft surgery (CABG).

**Patients and Methods**

A total of 276 consecutive patients undergoing conventional on pump CABG surgery from Jan 2015 to Dec 2017 were included in the study. After the Institutional Review Board approval, an informed and written consent was obtained from all the participants.

**Study groups**

All patients received perioperative antibiotics, comprising of cefazolin (2 g intravenously [IV] every 8 hours) and vancomycin (1 g IV every 12 hours) on induction of anesthesia. The IV antibiotics were continued for 48 hours after surgery. Intravenous insulin infusions were used in diabetic patients starting at the time of induction of anesthetic and continuing for 24 hours to maintain serum glucose values between 120 and 180 mg/dL. Consecutive 276 patients scheduled for elective CABG, were randomly allocated in two groups A and B using computer generated random number tables. Patients in group A (n=138) received topical vancomycin solution (2gms in 50 ml of normal saline), and patients in group B (n=138) received a spray of normal saline (50 ml on Normal saline) in the sternal wound before sternal closure. The incidence of deep sternal wound infection was evaluated over an 18 month duration. Major risk factors like diabetes mellitus (DM), smoking, and prolonged operation time, cardiopulmonary bypass time and cross clamp time were also taken in to consideration for their implications on the outcome with the use of topical antimicrobial.

**Surgical technique**

Surgical techniques was standard for both groups. The access was through a median sternotomy. All procedures were performed on cardiopulmonary bypass using heparin–bonded cardiopulmonary bypass circuits with a membrane oxygenator. The left internal thoracic artery (ITA) was harvested as a pedicle graft in all patients. All coronary lesions with a stenosis greater than 50% with a vessel diameter >1.5 mm were grafted. Bilateral ITAs were used at the discretion of the individual surgeon. The sternum was routinely closed with 4, figure–of–eight sternal wires. The fascia, subcutaneous layer were closed with running, absorbable sutures (Vicryl). Skin closure was done with absorbable 3–0 suture (Vicryl Rapide).

**Definition of surgical site infections**

The criteria used for the definition and classification of sternal wound infections were according to the Centers for Disease Control and Prevention [10]. Depths 1 and 2 were defined as a superficial infectious process limited to the subcuticular and subcutaneous layers with no involvement of the sternal bone. Depths 3 and 4, which involved the sternal bone or wires and collections beneath the sternum, were considered deep infections. A wound was considered infected only if a positive culture for an organism was obtained. Reported infections included all infections that developed within 1 year of surgery.

**Statistical analysis**

The data collected were analyzed using SPSS software (version–23). Continuous variables are described as mean ± standard deviation whereas qualitative variables were analyzed by frequencies and percentages. The Fisher exact test and chi square test were used to test statistical significance for the incidence of sternal wound infections between the groups.

**Results**

The results are summarized in tables 1,2. The mean age of patients in vancomycin group was 59.1 ± 8.3 years whereas mean age of patients in normal saline group was 62.3 ± 7.9 years. There were 102 (74%) males and 36(26.0%) females in vancomycin group. The distribution of males and females in normal saline group was 107(77.5%) vs 31(22.5%). There was no statistically significant difference between the groups regarding demographics including age, gender, body mass index, smoking, hypertension, diabetes mellitus.

**Table 1: Patient’s characteristics of both groups N=276.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Vancomycin (N=138)</th>
<th>Normal Saline (N=138)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Mean ± SD)</td>
<td>59.1 ± 8.3</td>
<td>62 ± 7.9</td>
<td>0.03</td>
</tr>
<tr>
<td>BMI (Mean ± SD)</td>
<td>24.8 ± 4.8</td>
<td>25.1 ± 4.2</td>
<td>0.70</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>102 (74%)</td>
<td>107 (77.5%)</td>
<td>0.57</td>
</tr>
<tr>
<td>Female</td>
<td>36 (26.0%)</td>
<td>31 (22.5%)</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>46 (33.3%)</td>
<td>51 (37.0%)</td>
<td>0.11</td>
</tr>
<tr>
<td>Diabetes</td>
<td>18 (13.0%)</td>
<td>31 (22.5%)</td>
<td>0.05</td>
</tr>
<tr>
<td>Smokers</td>
<td>20 (36.3%)</td>
<td>14 (25.4%)</td>
<td>0.30</td>
</tr>
</tbody>
</table>

**Table 2: Post operative Patient’s characteristics of both groups N=276.**

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Vancomycin (n=138)</th>
<th>Normal saline (n=138)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood transfusion</td>
<td>33(23.9%)</td>
<td>23(16.7%)</td>
<td>0.06</td>
</tr>
<tr>
<td>Wound infection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest</td>
<td>4 (2.9%)</td>
<td>6 (4.3%)</td>
<td>0.07</td>
</tr>
<tr>
<td>Type of wound</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td>2 (1.4%)</td>
<td>2(1.4%)</td>
<td>0.15</td>
</tr>
<tr>
<td>Soft</td>
<td>2(1.4%)</td>
<td>4(2.9%)</td>
<td></td>
</tr>
<tr>
<td>Mediastinitis</td>
<td>2(1.4%)</td>
<td>2(1.4%)</td>
<td></td>
</tr>
<tr>
<td>SSI at 2 weeks</td>
<td>2(1.4%)</td>
<td>4(2.9%)</td>
<td>1.0</td>
</tr>
<tr>
<td>SSI at 4 weeks</td>
<td>2(1.4%)</td>
<td>2(1.4%)</td>
<td>0.83</td>
</tr>
<tr>
<td>Bypass time (in min) (mean±SD)</td>
<td>111.3±43.4</td>
<td>120.4±37.0</td>
<td>0.15</td>
</tr>
<tr>
<td>Cross clamp time (in min) (mean±SD)</td>
<td>66.2±33.7</td>
<td>72.7±29.1</td>
<td>0.19</td>
</tr>
</tbody>
</table>

The incidence of deep sternal wound infection in the vancomycin group versus normal saline group was found to be 4(2.9%) vs 6(4.3%) however this was not statistically significant (p value 0.07). There is no statistically significant difference between the groups regarding cross clamp time, cardiopulmonary bypass time and in duration of observation of SSI. However, there was a significant difference in the cost effect of both the groups vancomycin and normal saline (p <0.001) table 2.

Discussion

In this prospective double blinded randomized controlled trial of 276 patients, we wanted to assess our institutional-specific practice of vancomycin application before sternal closure in CABG surgery. Our experience showed that the use of this topical antibiotic was not a useful adjunct for the prevention of sternal wound infections. The overall SSI rate of the sternal wound infection was 3.6 % (2.9 % in the vancomycin-group, 4.3 % in the normal saline-group). Our findings are contradictory with other studies that have revealed that topical vancomycin reduces sternal wound infections. Vander Salm and colleagues [11], found that the use of topical vancomycin prepared as slurry, in conjunction with perioperative systemic antibiotics, reduced the incidence of sternal wound infections from 3.6% to 0.45% (p value 0.02) in a blinded, prospective, randomized trial involving 416 patients. 

Our study results are in line with Arora et al who deliberated that the antibiotic irrigation of the incisional wound has the potential to prevent sternal wound infection after cardiac surgery.

Our study also documented the use of topical vancomycin applied to the sternotomy incision does not result in persistently elevated levels of serum vancomycin following cardiac surgical procedures. Furthermore, topical vancomycin does not potentiate the emergence of drug-resistant infections [14].

Acknowledgement

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References


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