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## 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 i.e 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.

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

## 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

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  $\pm$  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  $59.1 \pm 8.3$  years whereas mean age of patients in normal saline group was  $62.3 \pm 7.9$  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

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

Variable	Vancomycin (N=138)	Normal Saline (N=138)	p-value
Age (Mean $\pm$ SD)	59.1 $\pm$ 8.3	62.3 $\pm$ 7.9	0.03
BMI (Mean $\pm$ SD)	24.8 $\pm$ 4.8	25.1 $\pm$ 4.2	0.70
Gender			
Male	102 (74%)	107(77.5%)	0.57
Female	36(26.0%)	31(22.5%)	
Hypertension	46 (33.3%)	51 (37.0%)	0.11
Diabetes	18(13.0%)	31(22.5%)	0.05
Smokers	20 (36.3%)	14 (25.4%)	0.30

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

Variable name	Vancomycin (n=138)	Normal saline (n=138)	P Value
Blood transfusion	33(23.9%)	23(16.7%)	0.06
Wound infection			
• Chest	4 (2.9%)	6 (4.3%)	0.07
Type of wound			
• Skin	2 (1.4%)	4(2.9%)	0.15
• Soft	2(1.4%)	2(1.4%)	
• Mediastinitis	0	0	
SSI at 2 weeks	2(1.4%)	4(2.9%)	1.0
SSI at 4 weeks	2(1.4%)	2(1.4%)	0.83
Bypass time ( in min) (mean+SD)	111.3 $\pm$ 43.4	120.4 $\pm$ 37.0	0.15
Cross clamp time( in min) (mean+SD)	66.2 $\pm$ 33.7	72.7 $\pm$ 29.1	0.19

index (BMI) and co-morbidities like hypertension and smoking. The normal saline group had more diabetic patients 31(22.5%) than the vancomycin group 18(13.0%) as shown in table 1.

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.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 neither benefit nor harm in reducing SSI when compared to no or saline solution irrigation [12].

The findings of our RCT were further supported by Lander et al [13]. The main finding of their study reported that vancomycin paste did not reduce the incidence of deep sternal wound infection after cardiac surgery.

Lazar et al 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].

Cost effectiveness of the two topical agents was determined by a study that also helped us to evaluate the economic rationale for judicious topical use of vancomycin in our every-day clinical practice. In this study, cost effectiveness analysis showed that the local administration of the vancomycin injection was not cost saving. These findings are in line with our study results as the budget of using vancomycin injection was higher in group I as compared to group II (normal saline) with  $p < 0.001$  [15].

Our study also has limitations that may significantly influence its findings. We performed a single center study and had limited data on details about administration of

systemic perioperative antibiotics. The incidence of surgical site infection dropped over the study period probably due to implementation of updated STS antibiotic prophylaxis guidelines for cardiac surgery [16] and quality improvement initiatives for appropriate and timely administration of perioperative antibiotics, implementation of perioperative glucose management protocols [17], patient-specific sternal closure techniques including double wires and sternal bands [18] and surgical site infection registry for SSI surveillance [19].

In summary, our study findings conclude the application of vancomycin solution in the sternal wound does not reduce the frequency of SWI. It is possible that vancomycin locally in high concentrations as a biologically degradable substrate may provide benefit for prevention of SWI by allowing more effective delivery of vancomycin in the wound. More prospective, randomized and blinded trials are necessary in high-risk populations, in obese patients, diabetics, and patients with renal insufficiency or advanced heart failure prior to changing our practices in cardiac surgery patients.

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## References

- Schimmer C, Özkur M, Sinha B, Hain J, Gorski A, et al. (2012) Gentamicin-collagen sponge reduces sternal wound complications after heart surgery: a controlled, prospectively randomized, double-blind study. *J Thorac Cardiovasc Surg* 143: 194-200. [Link: https://goo.gl/jkfYX6](https://goo.gl/jkfYX6)
- Singh K, Anderson E, Harper JG (2011) Overview and Management of Sternal Wound Infection. *Semin Plast Surg* 25: 25-33. [Link: https://goo.gl/Q1MLHf](https://goo.gl/Q1MLHf)
- Gelijns AC, Moskowitz AJ, Acker MA (2014) Management practices and major infections after cardiac surgery. *J Am Coll Cardiol* 64: 372-381. [Link: https://goo.gl/Y7PuMB](https://goo.gl/Y7PuMB)
- Meszaros K, Fuehrer U, Grogg S (2016) Risk factors for sternal wound infection after open heart operations vary according to type of operation. *Ann Thorac Surg* 101: 1418-1425. [Link: https://goo.gl/9GTCmC](https://goo.gl/9GTCmC)
- Stulberg JJ, Delaney CP, Neuhauser DV, Aron DC, Fu P, et al. (2010) Adherence to surgical care improvement project measures and the association with postoperative infections. *JAMA* 303: 2479-2485. [Link: https://goo.gl/m73Zbw](https://goo.gl/m73Zbw)
- Edmiston CE, Spencer M, Lewis BD (2011) Reducing the risk of surgical site infections: did we really think SCIP was going to lead us to the promised land? *Surg Infect Larchmt* 12: 169-177. [Link: https://goo.gl/jvXTvs](https://goo.gl/jvXTvs)
- Kowalewski M, Pawliszak W, Zaborowska K, Navarese E, Szwed KA, et al. (2015) Gentamicin-collagen sponge reduces the risk of sternal wound infections after heart surgery: meta-analysis. *J Thorac Cardiovasc Surg* 149: 1631-1640. [Link: https://goo.gl/B4SL6E](https://goo.gl/B4SL6E)
- Lazar HL, Barlam T, Cabral H (2011) The effect of topical vancomycin applied to sternotomy incisions on postoperative serum vancomycin levels. *J Card Surg* 26: 461-465. [Link: https://goo.gl/9h1x2t](https://goo.gl/9h1x2t)

9. Lazar HL, Ketchedian A, Haime M, Karlson K, Cabral H (2014) Topical vancomycin in combination with perioperative antibiotics and tight glycemic control helps to eliminate sternal wound infections. *J Thorac Cardiovasc Surg* 148: 1035-1040. [Link: https://goo.gl/n7fLhR](https://goo.gl/n7fLhR)
10. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG (1992) CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections *Infect Control Hosp Epidemiol.* 13: 606-608. [Link: https://goo.gl/cZcnYF](https://goo.gl/cZcnYF)
11. Vander Salm TJ, Okike ON, Pasque MK, Pezzella AT, Lew R, et al. (1989) Reduction of sternal infection by application of topical vancomycin. *J Thorac Cardiovasc Surg* 98: 618-622. [Link: https://goo.gl/32zivv](https://goo.gl/32zivv)
12. Arora A, Bharadwaj P, Chaturvedi H, Chowbey P, Gupta S, et al. (2017) Deliberation from Ethicon Panelists for Drafting Clinical Practice Guidelines for Surgical Site Infections (SSIs) Prevention in line with Global Guidelines. World Health Organization, Delhi.
13. Lander HL, Ejiogor JI, McGurk S, Tsuyoshi K, Shekar P, et al. (2016) Vancomycin Paste Does Not Reduce the Incidence of Deep Sternal Wound Infection After Cardiac Operations. *Ann Thorac Surg* 103: 497-503. [Link: https://goo.gl/zoieSa](https://goo.gl/zoieSa)
14. Lazar HL, Barlam T, Cabral H (2011) The effect of topical vancomycin applied to sternotomy incisions on postoperative serum vancomycin levels. *J Card Surg* 26: 461-465. [Link: https://goo.gl/PKGPNw](https://goo.gl/PKGPNw)
15. Takeuchi M, Wakao N, Kamiya M, Hirasawa A, Murotani K, et al. (2018) A double-blind randomized controlled trial of the local application of vancomycin versus ampicillin powder into the operative field for thoracic and/or lumbar fusions. *J Neurosurg Spine* 29: 553-559. [Link: https://goo.gl/NDAifm](https://goo.gl/NDAifm)
16. Engelman R, Shahian D, Shemin R, Guy TS, Bratzler D, et al. (2007) The Society of Thoracic Surgeons Practice Guideline Series: Antibiotic Prophylaxis in Cardiac Surgery, Part II: Antibiotic Choice. *Ann Thorac Surg* 83: 1569-1576. [Link: https://goo.gl/VXx7df](https://goo.gl/VXx7df)
17. Furnary AP, Cheek DB, Holmes SC, Howell WL, Kelly SP (2006) Achieving Tight Glycemic Control in the Operating Room: Lessons Learned from 12 Years in the Trenches of a Paradigm Shift in Anesthetic Care. *Semin Thorac Cardiovasc Surg* 18: 339-345. [Link: https://goo.gl/8hRLFV](https://goo.gl/8hRLFV)
18. Shaikhezai K, Robertson FL, Anderson SE, Slight RD, Brackenbury ET (2012) Does the Number of Wires Used to Close a Sternotomy Have an Impact on Deep Sternal Wound Infection? *Interact Cardiovasc Thorac Surg* 15: 219-222. [Link: https://goo.gl/2cdnpd](https://goo.gl/2cdnpd)
19. Pervaiz F, Abbas S, Chaudhry IA, Iqbal A, Javaid R, et al. (2018) Reducing surgical site infections through quality improvement initiative: A tertiary cardiac care facility experience in a developing country. *J Surg Surgical Res* 4: 010-014. [Link: https://goo.gl/GXkh8o](https://goo.gl/GXkh8o)