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Research Article

Role of Topical Vancomycin in Preventing Sternal Wound Infection Following Coronary Artery Bypass Grafting

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Abstract

Background: Sternal wound infection (SWI) remains a serious postoperative complication following coronary artery bypass grafting (CABG), contributing to increased morbidity, prolonged hospitalization and healthcare costs. The use of topical vancomycin powder has emerged as a potential strategy to reduce surgical site infections in cardiac surgery. This study aimed to evaluate the effectiveness of topical vancomycin in preventing SWI among Bangladeshi patients undergoing isolated CABG. *Methods:* This prospective comparative study was conducted at the Department of Cardiac Surgery, United Hospital Limited, Dhaka, Bangladesh, from January 2025 to June 2025. A total of 400 patients undergoing isolated CABG were enrolled and divided into two equal groups: the control group (n = 200) received standard antibiotic prophylaxis, while the other group received vancomycin group (n = 200). Postoperative outcomes, including incidence and microbiology of SWI, ICU stay, hospital stay and 30-day morbidity and mortality, were analyzed. *Results:* The overall incidence of SWI was significantly lower in the vancomycin group (3.0%) compared to the control group (9.0%, p = 0.01). Staphylococcus aureus (both methicillin-sensitive and MRSA) was the predominant pathogen. The vancomycin group showed significantly shorter ICU (3.2 ±1.6 vs. 3.8 ±2.1 days, p = 0.01) and hospital stays (9.8 ±4.3 vs. 12.4 ±6.5 days, p < 0.001), with lower morbidity rates. *Conclusion:* Topical vancomycin application effectively reduces the incidence of sternal wound infection and shortens postoperative recovery time without increasing adverse outcomes among Bangladeshi CABG patients.

Keywords

Coronary Artery Bypass Grafting, Sternal Wound Infection, Topical Vancomycin, Postoperative Outcomes

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1. Introduction

Coronary artery bypass grafting (CABG) is one of the most commonly performed cardiac surgical procedures worldwide and remains the gold standard for the treatment of advanced coronary artery disease [1]. Despite significant advancements in surgical techniques, anesthesia and perioperative care, postoperative infections—particularly sternal wound infections (SWI)—continue to be among the most serious complications associated with CABG [2]. The reported incidence of SWI varies between 0.5% and 8%, depending on patient comorbidities, surgical practices and institutional infection control protocols. Although relatively uncommon, these infections are associated with increased morbidity, prolonged hospital stay, higher healthcare costs and in severe cases, mediastinitis and mortality [3].

The pathogenesis of SWI is multifactorial, involving patient-related risk factors such as diabetes mellitus, obesity, smoking and chronic obstructive pulmonary disease, as well as procedure-related factors including prolonged operative time, use of bilateral internal mammary arteries and postoperative wound management [4]. The most frequently isolated pathogens are Staphylococcus aureus and coagulase-negative staphylococci, including methicillin-resistant strains (MRSA) [5]. Given the increasing prevalence of antibiotic-resistant organisms, strategies to prevent surgical site infections have become a crucial aspect of cardiac surgical care.

Topical application of vancomycin powder to the surgical wound has emerged as a simple, safe and cost-effective method to reduce postoperative infections, especially in high-risk surgeries such as spine and cardiac procedures [6]. The local use of vancomycin achieves high tissue concentrations directly at the site of potential contamination while maintaining low systemic levels, thereby minimizing the risk of systemic toxicity [7]. Several international studies have demonstrated the efficacy of topical vancomycin in reducing the rate of deep sternal wound infections following cardiac surgery [8]. However, evidence from developing countries, particularly in South Asian settings such as Bangladesh, remains limited and institutional infection control practices vary widely [9].

In Bangladesh, the burden of postoperative wound infections remains a challenge due to high patient load, variable sterilization standards and limited infection control resources [10]. Therefore, the introduction of an affordable, locally applicable intervention such as topical vancomycin could have significant clinical and economic benefits if proven effective [11].

The objective of this study was to evaluate the effectiveness of topical vancomycin powder in reducing the incidence of sternal wound infection following coronary artery bypass grafting and to compare postoperative outcomes between patients receiving topical vancomycin and those receiving standard prophylaxis alone.

2. Methodology & Materials

This prospective comparative study was conducted in the Department of Cardiac Surgery, United Hospital Limited, Dhaka, Bangladesh, over a six-month period from January 2025 to June 2025. A total of 400 patients who underwent isolated coronary artery bypass grafting (CABG) were included in the study. The patients were divided into two equal groups: 200 in the control group who received standard surgical prophylaxis and 200 in the vancomycin group who, in addition to standard prophylaxis, received topical vancomycin powder applied to the sternal wound before closure.

All adult patients (aged ≥18 years) undergoing primary elective isolated CABG with median sternotomy were included. Patients with prior cardiac surgery, emergency CABG, concomitant valve or aortic procedures, known allergy to vancomycin, pre-existing wound infection, renal failure, or immunocompromised conditions were excluded from the study.

Standard perioperative antibiotic prophylaxis was given to all patients according to institutional protocol. In the vancomycin group, 1 gram of sterile vancomycin powder were applied topically over the sternal edges and mediastinal tissue after sternal wire closure. All surgeries were performed by experienced cardiac surgeons under similar operative and aseptic conditions. Postoperative care, wound management and follow-up were standardized for both groups.

The primary outcome was the incidence of sternal wound infection (SWI) within 30 days postoperatively, classified as superficial or deep according to the Centers for Disease Control and Prevention (CDC) criteria. Secondary outcomes included microbiological profile of infected wounds, length of intensive care unit (ICU) stay, hospital stay, readmission rate and 30-day mortality. Data were collected prospectively using a structured checklist and verified from hospital records.

Statistical analysis was performed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD) and compared between groups using the independent sample t-test. Categorical variables were presented as frequencies and percentages and compared using the Chi-square test or Fisher's exact test where appropriate. A p-value < 0.05 was considered statistically significant.

3. Results

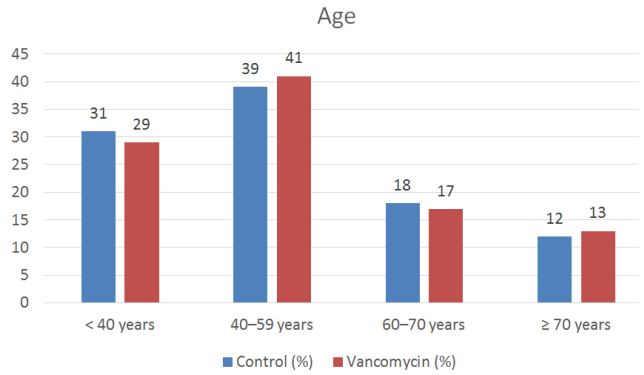

Figure 1. *Distribution of Patients by Age Group (n = 400).*

Independent sample t-test was used to compare mean age between the two groups.

Figure 1 shows the distribution of patients by age group shows that most participants were between 40–70 years, comprising 57% in the control group and 58% in the vancomycin group. Younger patients (<40 years) represented 31% and 29%, while those aged ≥70 years accounted for 12% and 13% in the respective groups. The mean ages were similar (62.1 ± 8.5 vs. 61.4 ± 8.2 years; p = 0.28).

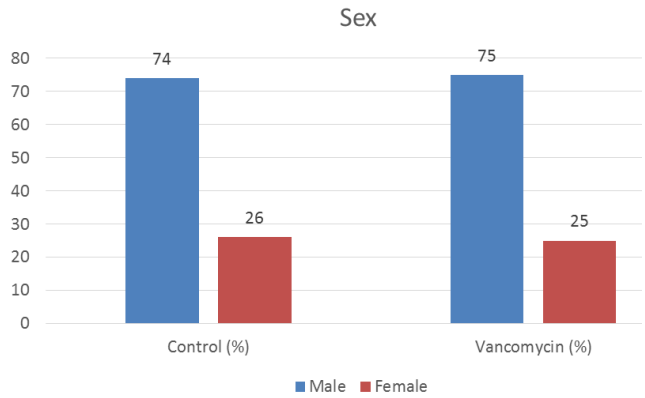

Figure 2. *Distribution of Patients by Gender (n = 400).*

Chi-square test was applied to compare gender distribution between the two groups.

Bar chart showing male predominance in both groups, with 74% males in the control group and 75% in the vancomycin group. The gender distribution was comparable between groups with no statistically significant difference (p = 0.78).

Table 1. *Clinical characteristics (n = 400).*

Variable	Control (n = 200)	Vancomycin (n = 200)	p-value
BMI, kg/m ²(mean ± SD)	26.8 ± 3.5	26.6 ± 3.4	0.45
Diabetes mellitus — n (%)	90 (45.0)	82 (41.0)	0.38
Hypertension — n (%)	124 (62.0)	118 (59.0)	0.55
Current smoker — n (%)	60 (30.0)	58 (29.0)	0.78
COPD — n (%)	18 (9.0)	16 (8.0)	0.69
EuroSCORE II (mean ± SD)	2.8 ± 1.2	2.7 ± 1.1	0.9

Data are presented as mean ± SD or n (%). Continuous variables were compared using the independent t-test and categorical variables were compared using the chi-square test.

Table 1 summarizes the clinical characteristics of the study population (n = 400). The mean BMI was similar between the control (26.8 ± 3.5 kg/m ²) and vancomycin groups (26.6 ± 3.4 kg/m ²). Diabetes mellitus was present in 45% of control patients and 41% of the vancomycin group, while hypertension affected 62% and 59%, respectively. The prevalence of current smokers was 30% in the control group versus 29% in the vancomycin group. Overall, no significant differences were observed between groups, indicating comparable baseline characteristics.

Table 2. *Operative and intraoperative variables.*

Variable	Control (n = 200)	Vancomycin (n = 200)	p-value
Number of grafts (mean ± SD)	3.1 ± 0.8	3.0 ± 0.7	0.12

Variable	Control (n = 200)	Vancomycin (n = 200)	p-value
Use of internal mammary artery — n (%)	180 (90.0)	185 (92.5)	0.3
Cardiopulmonary bypass time, min (mean ± SD)	78 ± 22	76 ± 20	0.18
Re-exploration for bleeding — n (%)	11 (5.5)	7 (3.5)	0.32
Prolonged ventilation >24 h — n (%)	10 (5.0)	7 (4.0)	0.62

Data are expressed as mean ± SD or n (%). Continuous variables were compared using the independent t-test and categorical variables were compared using the chi-square or Fisher's exact test as appropriate.

Table 2 summarizes the operative characteristics of patients undergoing coronary artery bypass grafting (CABG) in both the control and vancomycin groups. The mean number of grafts performed was comparable between the two groups (3.1 ± 0.8 vs. 3.0 ± 0.7; p = 0.12). The use of the internal mammary artery was high and similar in both groups (90.0% vs. 92.5%; p = 0.30). The mean cardiopulmonary bypass time was also comparable (78 ± 22 min vs. 76 ± 20 min; p = 0.18). Re-exploration for bleeding occurred in 5.5% of control patients and 3.5% of vancomycin patients (p = 0.32), while prolonged ventilation (>24 hours) was required in 5.0% and 4.0%, respectively (p = 0.62).

Table 3. *Incidence and classification of sternal wound infection (SWI)*

Outcome	Control (n = 200)	Vancomycin (n = 200)	p-value
Any SWI — n (%)	18 (9.0)	6 (3.0)	0.01
Superficial SWI — n (%)	12 (6.0)	2 (1.0)	0.04
Deep SWI — n (%)	5 (2.5)	2 (1.0)	0.22
Mediastinitis	1 (0.5)	0 (0.0)	0.31
Time to diagnosis, days (median, IQR)	12 (8–18)	11 (7–15)	0.45

Data are presented as n (%) or median (interquartile range, IQR). Categorical variables were compared using the chi-square and continuous variables were compared using the Mann–Whitney U test. Statistical significance was set at $p < 0.05$.

Table 3 compares the incidence and severity of sternal wound infections (SWI) between patients receiving standard prophylaxis (control) and those receiving vancomycin. The overall incidence of SWI was significantly lower in the vancomycin group compared to the control group (3.0% vs. 9.0%; p = 0.01). Although both superficial and deep SWI were less frequent in the vancomycin group, the reduction in superficial SWI was statistically significant (p = 0.04), while the difference in deep SWI was not (p = 0.22). Mediastinitis was rare, observed only in one patient (0.5%) in the control group (p = 0.31). The median time to diagnosis was similar between groups (12 vs. 11 days; p = 0.45), indicating no significant delay or difference in onset.

Table 4. *Microbiological pattern of sternal wound infections (all positive cultures, N = 24).*

Organism	Overall (n = 24)	Control (n = 18)	Vancomycin (n = 6)
Staphylococcus aureus (methicillin-sensitive)	8	6	2
MRSA	4	3	1
Coagulase-negative staphylococci	3	2	1
Pseudomonas aeruginosa	3	2	1
Klebsiella pneumoniae	2	2	0

Organism	Overall (n = 24)	Control (n = 18)	Vancomycin (n = 6)
Polymicrobial	2	2	0
No growth	2	1	1

Data are presented as n (%) and represent all positive wound cultures. Percentages are calculated relative to the total number of SWI cases (N = 24).

Table 4 presents the distribution of bacterial isolates identified from culture-positive sternal wound infections among the study patients. The most frequently isolated organism was methicillin-sensitive Staphylococcus aureus (MSSA), found in 8 cases (6 in the control group and 2 in the vancomycin group). Methicillin-resistant Staphylococcus aureus (MRSA) accounted for 4 cases (3 control, 1 vancomycin), while coagulase-negative staphylococci and Pseudomonas aeruginosa were each isolated in 3 cases. Klebsiella pneumoniae and polymicrobial infections were detected in 2 cases each, predominantly in the control group. Two cultures showed no growth, one in each group. Overall, Gram-positive cocci were the predominant pathogens in both groups.

Table 5. *Postoperative outcomes and complications.*

Outcome	Control (n = 200)	Vancomycin (n = 200)	p-value
ICU stay, days (mean ± SD)	3.8 ± 2.1	3.2 ± 1.6	0.01
Hospital stay, days (mean ± SD)	12.4 ± 6.5	9.8 ± 4.3	<0.001
30-day readmission — n (%)	8 (4.0)	4 (2.0)	0.25
30-day mortality — n (%)	2 (1.0)	1 (0.5)	0.56
Acute renal dysfunction — n (%)	9 (4.5)	12 (6.0)	0.49

Data are expressed as mean ± SD or n (%). Continuous variables were compared using the independent t-test and categorical variables were compared using the chi-square or Fisher's exact test. Statistical significance was defined as $p < 0.05$.

Table 5 summarizes postoperative outcomes and complications among patients undergoing coronary artery bypass grafting (CABG) with or without topical vancomycin application. The vancomycin group demonstrated significantly shorter ICU stays (3.2 ± 1.6 vs. 3.8 ± 2.1 days; $p = 0.01$) and reduced total hospital stay (9.8 ± 4.3 vs. 12.4 ± 6.5 days; $p < 0.001$), indicating faster recovery. Although 30-day readmission and mortality rates were lower in the vancomycin group, these differences were not statistically significant ($p = 0.25$ and $p = 0.56$, respectively). The incidence of acute renal dysfunction was comparable between groups ($p = 0.49$).

4. Discussion

Sternal wound infection (SWI) remains a significant postoperative complication after coronary artery bypass grafting (CABG), contributing to increased morbidity, prolonged hospital stay and higher healthcare costs. In this study involving 400 Bangladeshi patients, we observed that topical application of vancomycin significantly reduced the incidence of SWI from 9.0% in the control group to 3.0% in the vancomycin group ($p = 0.01$). This finding aligns closely with multiple international and regional studies supporting the efficacy of topical vancomycin in preventing sternal wound infections following cardiac surgery.

Lazar et al., first demonstrated that topical vancomycin applied to the sternal edges achieved effective local antibiotic concentrations without elevating systemic serum levels, ensuring safety against nephrotoxicity [12]. Similarly, Arruda et al. and Shah and Jadhav reported a marked decline in mediastinitis and superficial infections when vancomycin paste was used on the sternal bone before closure. The incidence of SWI was significantly lower in the vancomycin group than in controls (3.0% vs. 9.0%; $p = 0.01$). Superficial and deep infections were less frequent in the vancomycin group, ($p = 0.04$ and $p = 0.22$). Mediastinitis occurred in one control patient only ($p = 0.31$), supporting these findings [13, 14].

The protective effect of topical vancomycin is particularly relevant in low- and middle-income countries like Bangladesh, where the burden of surgical site infections remains higher due to variable infection control practices and high prevalence of Staphylococcus aureus and MRSA. Microbiological analysis in our series revealed S. aureus (methicillin-sensitive and

MRSA) as the leading pathogen, consistent with previous findings by Khan and Jalal-ud-Din and Nine et al., who highlighted S. aureus as the predominant organism in Bangladeshi cardiac units [15, 16]. This supports the rationale for using vancomycin, which provides potent local coverage against Gram-positive organisms.

Our results also corroborate the meta-analysis by Zhang et al., who analyzed 14 studies and confirmed a significant reduction in both superficial and deep sternal infections with topical vancomycin without an increase in adverse outcomes [17]. Likewise, Kowalewski et al., reviewed data from over 40,000 cardiac surgery patients and found topical vancomycin reduced SWI risk by nearly 50%, emphasizing its role as an effective prophylactic adjunct [18]. In a similar systematic review, Kowalewski et al., confirmed that regional antibiotic delivery methods such as vancomycin powder or paste were safe and beneficial across diverse surgical settings [19].

The shorter ICU (3.2 ±1.6 vs. 3.8 ±2.1 days, $p = 0.01$) and hospital stay (9.8 ±4.3 vs. 12.4 ±6.5 days, $p < 0.001$) in our vancomycin group are clinically relevant, reflecting reduced postoperative complications and improved recovery. Comparable observations were reported by Donovan et al. and Jadhao et al., who demonstrated that topical vancomycin not only reduced infection rates but also shortened hospital stays and readmissions [20, 21]. The 30-day readmission rates were lower in the vancomycin group, consistent with these findings.

Interestingly, other local antibiotic agents such as rifamycin and bacitracin have also been explored for SWI prevention. Aygun et al. and De Santo et al., reported that topical rifamycin reduced wound complications among high-risk and diabetic patients [22, 23]. Chan et al., also demonstrated benefit with topical bacitracin, but vancomycin remains the most studied and effective agent against Gram-positive organisms responsible for most mediastinal infections [24].

The incidence of acute renal dysfunction was comparable between groups ($p = 0.49$) and mortality rates were lower with vancomycin use ($p = 0.56$), confirming its safety profile as also emphasized by Lazar et al. and Zhang et al., [12, 17]. These findings are particularly important in our clinical setting, where systemic antibiotic overuse and renal impairment are major concerns.

5. Limitations of the Study

This study had several limitations. It was conducted at a single center with a relatively short follow-up period, which may limit the generalizability of the findings to all Bangladeshi cardiac surgery populations. Additionally, factors such as intraoperative sterility variations, antibiotic prophylaxis adherence and nutritional status were not fully controlled, which could have influenced infection rates. A larger multicenter study with longer follow-up would provide more comprehensive evidence regarding the effectiveness of topical vancomycin in preventing sternal wound infections.

6. Conclusion

In conclusion, topical vancomycin application significantly reduced both superficial and deep sternal wound infections, shortened ICU and hospital stays and showed no adverse systemic effects among Bangladeshi CABG patients. Overall, the present study supports the growing body of evidence favoring topical vancomycin as an effective, low-cost and locally applicable strategy for reducing sternal wound infections in CABG patients. Considering the higher baseline infection rates and microbial resistance patterns in Bangladesh, incorporating topical vancomycin into standard sternal closure protocols could substantially reduce postoperative complications and healthcare burden.

Abbreviations

CABG	Coronary Artery Bypass Grafting
SWI	Sternal Wound Infection
ICU	Intensive Care Unit
MRSA	Methicillin-Resistant Staphylococcus aureus

Author Contributions

Tania Nusrat Shanta: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

Mirza Mohammad Nazmus Saquib: Conceptualization, Investigation, Resources, Software

Syed Golam Azam: Funding acquisition, Visualization

Md. Arif Ullah Bhuiyan: Resources, Validation, Visualization

Arif Ahmed Mohiuddin: Funding acquisition, Project administration, Resources, Validation

Md. Shadequl Islam: Methodology, Project administration, Supervision, Validation

Chowdhury Mohammad Mosabber Rahman: Methodology, Project administration, Validation, Visualization

Musarat Jahan: Resources, Validation, Writing – review & editing

Nazneen Nawal: Resources, Supervision, Validation

Conflicts of Interest

The authors declare no conflicts of interest.

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