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ORIGINAL ARTICLE

Role of Topical Vancomycin Paste in Reduction of Sternal Wound Infections in Cardiac Surgery; A Comparative Study at a Tertiary Care Hospital; Hayatabad Medical Complex, Peshawar

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ABSTRACT

Background: Cardiac surgery procedures are labeled as clean procedures, but still these procedures carry a high risk for postoperative infectious complications. For the majority of cardiac procedures median sternotomy is the standard surgical approach, which carries the risk of sternal wound infections (SWI).
Objective: To determine whether applying topical vancomycin paste to the sternal edges following open heart surgery will reduce the rate of sternal wound infections (SWI) or not.
Methods: This quasi experimental study was conducted at the Department of Cardiac Surgery, Hayatabad Medical Complex, Peshawar, from May to October 2025, and included 60 patients planned for open heart surgery. Two equal groups of 30 patients were made. The patients (n=30) in group A received topical vancomycin paste applied to the sternal wound, while patients in group B (n=30) underwent standard sternal wound closure without any topical antimicrobial agents. Postoperatively patients were followed for a period of one month for sternal wound infection . Also the data about major risk factors such as diabetes mellitus (DM), smoking, prolonged cardiopulmonary bypass time (CPB time) and cross clamp time were collected.
Results: Baseline characteristics were comparable between groups. Superficial sternal wound infection was observed in 0% (0/30) of the patients receiving vancomycin paste, whereas 10% patients (3/30) in the routine closure group (p = 0.237) were affected. The risk difference for superficial sternal wound infection was -10% (95% CI: -20.7% to 0.7%). No deep infections occurred in either cohort. All other postoperative outcomes were similar between groups.
Conclusion: Topical vancomycin paste demonstrated a clinically favorable trend with zero superficial sternal wound infections in the treatment group versus 10% in the control group, although this difference did not reach statistical significance (p=0.237) due to the small sample size. The intervention was safe. These findings support the need for adequately powered, multi-center randomized trials to determine definitive efficacy.
Keywords: Cardiac surgery, Vancomycin paste, Sternal wound infection

INTRODUCTION: Cardiac surgery procedures are labeled as clean procedures, but still these procedures carry a substantial risk for postoperative infectious complications. The median sternotomy is the standard surgical approach for the majority of cardiac procedures, which carries the risk of sternal wound infections (SWI). Sternal Wound Infection occurs in up to 8% of cases [1], with superficial sternal wound infections (SSWI) 0.5% to 8% being more common than deep sternal wound infections (DSWI) 0.5% to 5.6%[2,3,4,5]. Superficial sternal wound infections (SSWI) involve the skin, subcutaneous tissue, and chest muscle fascia, whereas deep sternal wound infections (DSWI) extend to the sternum, mediastinal tissues, or both. In large European and US cardiac centers, annually reported rate of deep sternal wound infection ranges from 1% to 2%[4,5]. Morbidity

and mortality are greatly effected by deep sternal wound infections (DSWI) following open heart surgery[1].Thus results in increase hospitalization duration and treatment costs. Administering antibiotics prophylactically, maintaining tight glycemic control with intravenous insulin infusions, and avoiding bone wax, reduces the sternal wound infections effectively [6,7]. Even with these preventive protocols, the incidence rate of DSWI ranges from 0.5% to 6.8% and remains a major concern for cardiac surgeons [7]. Multiple factors related to patients such as advanced age, female sex, obesity, diabetes mellitus, and perioperative hyperglycemia increases the risk of DSWI[8]. The clinical presentation of superficial or deep sternal wound infections is different from each other. SSWI mostly involves localized signs such as redness, discharge, subcutaneous fluid accumulation, and wound dehiscence, while DSWI is characterized by fever, chest pain, sternal instability, and purulent mediastinal discharge[9,10,11]. Vancomycin, a glycopeptide antibiotic has shown good results in reducing SWI when applied topically and is highly effective against methicillin-resistant Staphylococcus aureus (MRSA) and coagulase-negative Staphylococci [12]. Literature shows that when vancomycin applied topically it achieves greater local wound concentrations as compared to systemic administration, with prolonged therapeutic levels lasting for several hours post-application[13]. The role of topical vancomycin in sternal wound infection (SWI) prophylaxis is assessed in a meta-analysis (n = 20 039) by Kowalewski et al. [14]. A significant 76% decrease in overall SWI risk [RR 0.24; 95% confidence interval (CI): 0.06–0.91; P = 0.04; I^2= 70%] and an equivalent 76% risk reduction in deep sternal wound infection (DSWI) (RR: 0.24; 95% CI: 0.06–0.99; P= 0.05; I^2= 58%) were reported in the analysis. Regardless of these important findings, the authors observed marked heterogeneity among the four included studies, with differences in vancomycin doses ranging from 250 mg to 10 g, follow-up durations from 1 to 12 months, and definitions of the primary outcome. The Lazar group at Harvard[2,15,16] also retrospectively analyzed 1075 patients who underwent open heart surgery via median sternotomy approach, and not even a single case of DSWI has been reported. In their regimen, they used a combination of topical and intravenous vancomycin, as well as strict glycemic control. However, differences in application protocols and outcome definitions across the literature underscore the need for further work on this topic. Although the positive outcomes observed in the meta-analysis performed by Kowalewski et al. and the Harvard team are encouraging, heterogeneity still exists in vancomycin dosing, delivery techniques, and outcomes among various studies. In addition, there is little evidence available concerning the use of topical vancomycin paste on sternal edges for preventing SSIs among patients of South Asian origin who underwent heart surgery. Hence, the present study was conceived to evaluate the hypothesis that intraoperative administration of vancomycin paste on sternal edges is significantly more effective than conventional closure in decreasing SSI among patients undergoing CABG.

Methods: This quasi-experimental study was conducted at the Department of Cardiac Surgery, Hayatabad Medical Complex, Peshawar, from 1st May 2025 to 31st October 2025. Ethical Approval (HMC-QAD-F-00, Approval number 1956, dated 9-08-2024) was obtained from Hayatabad Medical Complex, Peshawar. The study cohort consisted of 60 patients who underwent conventional on-pump CABG. The participants' ages ranged from 42 to 80 years. The sample size was calculated using WHO sample size software for hypothesis testing of two proportions. Based on an anticipated 76% reduction in the primary outcome (sternal wound infection rate) with 5% significance level and 80% power, a total sample size of 60 participants (30 per group) were determined to be adequate for this study. Total required sample: 60 (30 intervention/30 control).

Eligibility criteria: Inclusion criteria were adult patients (≥18 years) undergoing elective, isolated, primary on-pump coronary artery bypass grafting (CABG) via median sternotomy. Exclusion criteria were emergency or salvage surgery, redo-sternotomy, concomitant valve or aortic procedures, known allergy to vancomycin, active systemic infection at the time of surgery, or anticipated inability to complete the 30-day follow-up.

All participants provided written informed consent before enrollment. Preoperative patient preparation included shaving the trunk, groin, and limbs, followed by a shower using chlorhexidine gluconate. Standard perioperative antibiotic prophylaxis for all patients comprised intravenous ceftriaxone (1 g) and vancomycin (1 g), both administered every 12 hours starting at anesthesia induction. This regimen was continued for 72 hours postoperatively.

In our patients' blood glucose levels were maintained with a sliding scale. Patients who were known diabetics were given their own anti-diabetic medications, plus a sliding scale was used. However, the majority of patients exhibited serum glucose levels above 180 mg/dL during this time.

At the operating table, the scrub nurse prepared the vancomycin paste immediately before closure. This involved mixing 2g of vancomycin hydrochloride powder with 2-3 ml of normal saline to form a clay-like mass, which was then firmly pressed into the cancellous bone.

This prospective, non-randomized, comparative cohort study employed a natural-experiment framework based on surgeon-specific closure protocols. A total of 60 consecutive patients undergoing elective CABG were allocated to one of two cohorts determined by the operating surgeon's established practice. **Group A (Topical Vancomycin group; n=30)** consisted of all patients operated on by Surgeon A, whose standard practice includes applying a topical vancomycin solution (2 g in 2–3 mL of normal saline) directly to the sternal edges prior to closure. While patients in **Group B (Routine Closure group; n=30)** were operated by Surgeon B, who does not use any topical antimicrobials, solutions, or sprays. Both surgeons had comparable experience in cardiac surgery (>10 years of independent practice and >500 median sternotomies each), and all other perioperative, anesthetic, and postoperative protocols were identical between the two groups. The application of topical vancomycin paste was the only difference in their treatment. We asked patients to come for follow-up and examined them for sternal wound infection (SWI) over a period of one month. Even though the allocation was based on surgeon's choice (which is subject to bias), it was considered in the design of the experiment, and we did not statistically control for the surgeon effect since we believed that the similarity of baseline and procedural factors would compensate for any bias.

Sternal wound infection was diagnosed clinically based on the presence of purulent drainage, wound dehiscence with surrounding erythema or induration, or positive wound culture. Infections were classified as superficial if limited to skin/subcutaneous tissue without sternal instability or mediastinal involvement, and deep if involving sternal bone, mediastinum, or associated with sternal instability or fever [adapted from CDC surgical site infection criteria].

A standardized surgical protocol was adapted for all patients, consisted of a median sternotomy approach, harvest of the left internal thoracic artery as a pedicle graft and cardiopulmonary bypass with a membrane oxygenator. All the vessel with significant coronary lesion and diameter more than 1.5mm were bypassed. Grafting strategy was decided by operating surgeon. 4 figure-of eight sternal wires were used in sternal closure, while fascial and subcutaneous layers were closed with running absorbable sutures (Vicryl). Bone wax was not used for sternal hemostasis in any patient, as it has been associated with increased infection risk [7]. The skin was closed with a 2-0 absorbable Vicryl Rapide suture.The first outcome measure was the incidence of superficial and deep sternal wound infection in the 30 days following surgery. Secondary outcomes were the time to extubation, intensive care unit stay and overall hospital stay.

SPSS software (version-20) was used for statistical analysis. Continuous data are expressed as mean ± standard deviation, while categorical variables are summarized as frequencies and percentages. The normality of continuous variables was assessed using the Shapiro-Wilk test prior to applying independent t-tests. All continuous data met the assumption of normal distribution. Group differences in the incidence of sternal wound infection were assessed using Fisher's exact test due to low expected cell counts (including zero events in the vancomycin group). Continuous variables were compared using independent t-tests. A p-value <0.05 was considered statistically significant. A p-value of <0.05 was considered statistically significant.

RESULTS: Baseline demographic and clinical characteristics, including age, sex, diabetes, smoking, hypertension, and operative variables (cardiopulmonary bypass and cross-clamp times), were comparable between the two groups, with all p-values exceeding 0.05 (Tables 1 and 2).

Table 1. Patients characteristics of both groups N=60

Characteristic	Vancomycin Group (n = 30)	Routine closure Group (n = 30)	p-value
Demographic Factors			
Age (years), Mean ± SD	57.53 ± 6.94	59.90 ± 7.39	0.202
Male Gender, n (%)	18 (60.0%)	22 (73.3%)	0.273

Characteristic	Vancomycin Group (n = 30)	Routine closure Group (n = 30)	p-value
Clinical Comorbidities			
Diabetes Mellitus, n (%)	11 (36.7%)	7 (23.3%)	0.260
Smoker, n (%)	1 (3.3%)	4 (13.3%)	0.353
Hypertension, n (%)	11 (36.7%)	8 (26.7%)	0.405

Abbreviations: SD, standard deviation; ICU, intensive care unit; HbA1c, glycated hemoglobin.

Pre-operative metabolic parameters, including HbA1c (7.19 ± 2.79 vs. 6.72 ± 2.44; $p = 0.493$), body mass index (23.40 ± 3.21 vs. 23.70 ± 2.41; $p = 0.682$), and hemoglobin (13.52 ± 1.40 vs. 13.84 ± 1.43; $p = 0.374$), were similar between the groups. Operative variables such as cardiopulmonary bypass time (104.93 ± 18.23 vs. 106.07 ± 20.53 minutes; $p = 0.816$) and aortic cross-clamp time (77.70 ± 15.32 vs. 78.80 ± 16.89 minutes; $p = 0.792$) also showed no significant difference, suggesting procedural consistency.

Table 2. Preoperative and operative characteristics of both groups N=60

Characteristic	Vancomycin Group (n = 30)	Routine closure Group (n = 30)	p-value
Pre-operative Metrics			
HbA1c (%), Mean ± SD	7.19 ± 2.79	6.72 ± 2.44	0.493
Body Mass Index (kg/m²), Mean ± SD	23.40 ± 3.21	23.70 ± 2.41	0.682
Hemoglobin (g/dL), Mean ± SD	13.52 ± 1.40	13.84 ± 1.43	0.374
Operative Details			
Cardiopulmonary Bypass Time (min), Mean ± SD	104.93 ± 18.23	106.07 ± 20.53	0.816
Cross-clamp Time (min), Mean ± SD	77.70 ± 15.32	78.80 ± 16.89	0.792

Abbreviations: BMI, body mass index; CPB, cardiopulmonary bypass.

Post-operative Outcomes:

Postoperative recovery parameters, including ventilation duration, ICU stay, and total hospital stay, were similar between groups (all $p > 0.05$; Table 3).

Primary Outcome – Sternal Wound Infection:

Three (10.0%, 3/30) cases of superficial sternal wound infection were recorded in the routine closure group, while the group treated with topical vancomycin had none (0/30) ($p = 0.237$, Fisher's exact test). The absolute risk difference was -10% (95% CI: -20.7% to 0.7%), and the relative risk was not estimable due to zero events in the vancomycin arm. All 60 patients completed the 30-day follow-up, with no losses to follow-up. Although this difference did not reach statistical significance, the absence of infections in the vancomycin group suggests a clinically meaningful trend toward reduced infection risk with topical vancomycin application. No deep sternal wound infections were observed in the study.

Table 3. Postoperative characteristics of both groups N=60

Characteristic	Vancomycin Group (n = 30)	Routine closure Group (n = 30)	p-value
Postoperative Outcomes			
Ventilation Duration (hours), Mean ± SD	7.17 ± 3.24	7.73 ± 4.96	0.603
ICU Stay (hours), Mean ± SD	44.27 ± 7.24	43.40 ± 3.76	0.551
Hospital Stay (days), Mean ± SD	5.73 ± 0.45	5.53 ± 0.51	0.104
Postoperative Wound Infections			
Superficial Sternal Wound Infection, n (%)	0 (0.0%)	3 (10.0%)	0.237
Deep Sternal Wound Infection, n (%)	0 (0.0%)	0 (0.0%)	N/A

DISCUSSION: This prospective non-randomized comparative cohort study conducted at Hayatabad Medical Complex, Peshawar, investigated the efficacy of topical vancomycin paste in decreasing sternal wound infections (SWI) following open heart surgery. The main finding was a lower observed incidence of superficial SWI in the vancomycin group (0% vs. 10% in the control group), although this difference was not statistically significant (p=0.237).The well-balanced baseline and operative characteristics between groups strengthen the internal validity of this comparison by reducing measured confounding; however, due to the non-randomized design, residual confounding from unmeasured factors cannot be entirely excluded. No deep sternal wound infections were observed in both groups. Among the three superficial sternal wound infections two were managed conservatively with intravenous antibiotics and one required closure with a prolene vertical mattress suture.

Our findings align with the existing literature supporting topical vancomycin for SWI prophylaxis. The observed 10% absolute difference in superficial SWI (0% vs. 10%) in our study is aligned with the effect sizes reported in the literature. For example, a randomized trial of 416 patients conducted by Vander Salm and colleagues[17] reported a significant decrease in SWI from 3.6% to 0.45%.

Similarly, Fowler et al.[16] and others[2,18]have demonstrated same benefits. Arruda et al.[19] reported significant low infection rate of 0.49% in a large cohort of 1,020 patients further stating the importance of this intervention. Our data also shows similar protective trend in our patient population.

However, it is also necessary to recognize the existence of some research works reporting no significant effect of the treatment on the disease under investigation. Lander et al. [18] report the results of a retrospective study involving more than 5,000 patients, according to which the application of vancomycin paste does not significantly decrease the incidence rate of deep sternal wound infections. The inconsistency in the data might be explained by differences in patient risk profile, vancomycin dose used (1g or 2g), and the definition of infection itself.

The lack of statistical power in primary outcome of our study is a critical point of interpretation, explained by our small sample size. To get a statistically significant difference for a less occurring event like SWI our study was underpowered with 30 patients per group. Although not statistically significant, the observed difference may be clinically relevant. Because from a patient perspective, avoiding SWI is very important, as these infections results in significant morbidity and mortality. In the treatment group, complete absence of infection represents a very important clinical signal that needs attention.

Several limitations of our study must be noted. First, the small sample size (N=60) is the main limitation, resulting in inadequate statistical power to detect a significant difference for a relatively uncommon event like sternal wound infection. Second, the quasi-experimental design with allocation by surgeon introduces potential selection bias, as unmeasured differences in surgical technique or perioperative care (desour documented comparable experience) could have influenced outcomes. Third, this was a single-center study, which may limit generalizability to other patient populations and healthcare settings. Fourth, the absence of blinding in outcome

assessment is a potential source of detection bias. Despite these limitations, the complete absence of infections in the vancomycin group represents a clinically meaningful signal that warrants further investigation. However, despite such limitations, the noted progression to no infections in the treatment group, combined with the fact that this finding is consistent with many other studies conducted before, makes a case for further research. Nevertheless, since there was no statistically significant outcome found, we avoid making any conclusive statements about its efficacy.

CONCLUSION: In cardiac surgery patients, the application of topical vancomycin paste was associated with a favorable clinical trend toward fewer sternal wound infections, though this did not reach statistical significance in this underpowered study. Although this study was underpowered and the finding was not statistically significant, the complete absence of infections in the vancomycin group combined with its low cost, favorable safety profile, and consistency with prior meta-analyses, suggests potential clinical utility. Larger, multi-center randomized trials are warranted to confirm efficacy. The potential role of topical vancomycin in surgical practice warrants confirmation through adequately powered, multi-center randomized controlled trials before it can be universally recommended.

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