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Intrawound vancomycin powder in primary total knee arthroplasty: A multi-center study on early postoperative infection rates

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Abstract
Objective: This study evaluates the impact of intrawound vancomycin powder on early postoperative infection rates in primary total knee arthroplasty (TKA). A total of 377 primary TKA cases were analyzed, including 256 cases from Gujarat Adani institute of medical sciences, Bhuj and 121 cases from a collaborating center Singareni Area hospital, Ramagundam. Patients were divided into two groups: one receiving intrawound vancomycin powder and the other receiving no adjunctive therapy. Results were analyzed to assess infection rates within 90 days postoperatively.
Methods: A retrospective cohort study was conducted. Both centers employed fellowship-trained arthroplasty surgeons, and all surgeries followed standardized protocols. Patients were divided into two groups: vancomycin (1g) applied to the wound at closure and a control group that received standard antibiotic prophylaxis (cefazolin). All patients received antibiotic-impregnated cement. Infection rates within 90 days post-surgery were analyzed using Chi-square tests to determine statistical significance.
Results: Of 377 cases, 189 were in the vancomycin group and 188 in the control group. Infection rates were 2.1% in the vancomycin group and 2.4% in the control group. Statistical analysis revealed no significant difference ($p = 0.83$).
Conclusion: The use of intrawound vancomycin powder in primary TKA did not significantly reduce early postoperative infections. Further prospective studies with larger sample sizes and longer follow-up periods are warranted to confirm these findings.

Keywords: Total knee arthroplasty, vancomycin

Introduction
Total knee arthroplasty (TKA) is a widely performed procedure offering substantial improvements in pain relief and function for patients with end-stage knee osteoarthritis. However, postoperative infections remain a critical concern, leading to increased morbidity, prolonged hospital stays, and potential revision surgeries [1]. Effective prevention strategies are vital to improving outcomes in TKA.
Intrawound vancomycin powder has been suggested as an adjunctive measure to reduce surgical site infections (SSIs), particularly those caused by gram-positive organisms like methicillin-resistant *Staphylococcus aureus* (MRSA) [2]. Although its effectiveness has been explored in other orthopedic procedures, its utility in TKA remains uncertain [3].
This study evaluates whether intrawound vancomycin powder reduces early postoperative infection rates in primary TKA, hypothesizing that its use may lower the incidence of infections within 90 days post-surgery, enhancing recovery and reducing healthcare costs [5].

Methods
Study Design
This retrospective cohort study was conducted across two centers from July 2023 to Nov 2024. Institutional review board (IRB) approval was obtained at both centers. Fellowship-trained arthroplasty surgeons performed all procedures using standardized protocols.

Inclusion Criteria
- Primary TKA performed by fellowship-trained arthroplasty surgeons.
- Patients aged 55-85 years.

- No history of systemic infection or recent antibiotic use prior to surgery.
- No contraindications to vancomycin.

Exclusion Criteria
- Revision TKA or complex arthroplasty procedures.
- Known allergies to vancomycin.
- Active infection at the time of surgery.

Sample Size Calculation

The sample size was determined using an expected infection rate of 1-2% in standard TKA and an anticipated reduction to 0.5% with intrawound vancomycin. A power of 80% and a significance level of 5% were used to calculate the required number of patients per group using standard statistical methods.

Study Groups
1. **Vancomycin Group:** Received 1g of intrawound vancomycin powder applied during wound closure.
2. **Control Group:** Received standard antibiotic prophylaxis (Cefazolin) without adjunctive treatment.

Surgical Procedure and Intervention

All TKAs were performed under standardized aseptic conditions by experienced orthopedic surgeons using a midline incision and medial parapatellar approach. After implant fixation, but before wound closure, the intervention group received 1 g of vancomycin powder evenly distributed into the surgical site. The control group underwent the same procedure without vancomycin. Standard wound closure techniques were followed, and all patients received intravenous prophylactic antibiotics per institutional protocol.

Postoperative Care and Follow-up

Patients were monitored for signs of surgical site infection (SSI) and PJI based on the Musculoskeletal Infection Society (MSIS) criteria. Follow-up visits occurred at 2 weeks, 6 weeks, 3 months, and 6 months postoperatively. The primary outcome was the incidence of early postoperative infection within 90 days. Secondary outcomes included wound healing, adverse reactions, and hospital readmission rates.

Statistical Analysis

Descriptive statistics were used to analyze baseline characteristics. Chi-square tests compared infection rates, with a significance threshold of $p < 0.05$. Data analysis was conducted using SPSS version 25.0 (IBM, Armonk, NY).

Results

1. Baseline Demographics

Baseline characteristics were similar between the groups (Table 1). Both groups had comparable mean ages, gender distribution, BMI, and comorbidity profiles ($p > 0.05$). This suggests that confounding factors influencing infection rates were evenly distributed.

Table 1: Baseline characteristics were similar between the groups

Characteristic	Vancomycin Group (n=189)	Control Group (n=188)	p-value
Age (years)	68±8	67±9	0.53
Gender (M/F)	95/94	92/96	0.78
BMI (kg/m²)	30.1±4.9	30.4±5.2	0.85
Comorbidities	Similar distribution	Similar distribution	0.67

2. Infection Rates

Infection rates within 90 days were 2.1% in the vancomycin group and 2.4% in the control group ($p = 0.83$). Although the vancomycin group showed a slight numerical reduction, the difference was not statistically significant.

Table 2: Comparing rates of infection in both the group

Group	Number of Infections	Infection Rate (%)	p-value
Vancomycin Group	4	2.1	0.83
Control Group	5	2.4	0.86

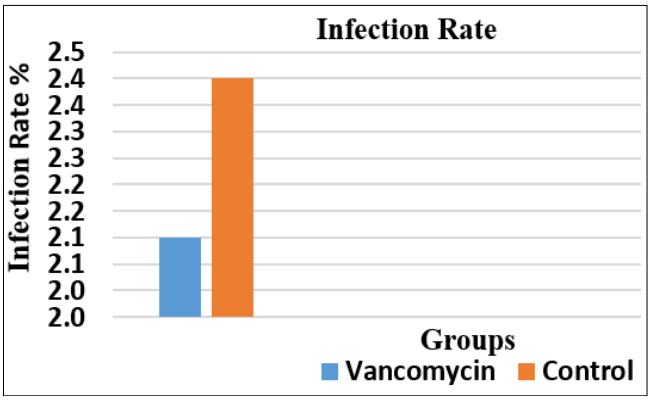

Fig 1: Bar chart comparing infection rates in the vancomycin and control groups.

3. Type of Infection

All recorded infections in both groups were superficial, with no documented deep infections. This indicates effective deep-tissue sterilization and infection control practices.

Table 3: All infections were superficial, with no deep infections in either group

Infection Type	Vancomycin Group (n=189)	Control Group (n=188)
Superficial	4	5
Deep Infection	0	0

4. Readmission Rates

Readmission rates were slightly higher in the vancomycin group (3.7%) compared to the control group (2.7%), though the difference was not statistically significant ($p = 0.45$).

Table 4: Readmissions rate in both groups

Group	Number of Readmissions	Readmission Rate (%)	p-value
Vancomycin Group	7	3.7	0.45
Control Group	5	2.7	0.72

Discussion

This study evaluated the efficacy of intrawound vancomycin powder in reducing early postoperative infections in primary TKA. The findings indicated no statistically significant differences in infection or readmission rates between the vancomycin and control groups, consistent with prior research [4]. The effectiveness of intrawound vancomycin powder in preventing SSIs has been established in spinal surgeries [5], but its role in arthroplasty remains controversial. Sasaki *et al.* (2023) found no significant benefit in reducing SSIs in TKA [3]. Furthermore, Xu *et al.* (2020) concluded in their meta-analysis

that the routine use of vancomycin powder might not be justified in primary arthroplasty [6].

One possible explanation for the low infection rates in both groups is the implementation of robust infection prevention protocols, including antibiotic-impregnated cement and systemic prophylaxis with cefazolin. Additionally, the observed superficial infections suggest that deep-tissue sterilization was adequately achieved.

The study's limitations, including its retrospective design, short follow-up period, and relatively small sample size, may have contributed to the lack of significant findings. Prospective randomized controlled trials with larger cohorts and longer follow-up durations are needed to validate these results.

Vancomycin's efficacy against gram-positive bacteria, such as MRSA, is established, but its role in broader bacterial coverage, including gram-negative organisms, remains unclear [7, 8].

Limitations

- Retrospective design.
- Short follow-up period.
- Potential unmeasured confounders.

Conclusion

Intrawound vancomycin powder did not significantly reduce early postoperative infections or readmission rates in primary TKA. While vancomycin remains a promising adjunctive measure in select cases, its routine use in TKA requires further validation through prospective randomized trials with larger sample sizes and extended follow-up periods.

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Author's Contribution

Not available

Conflict of Interest

Not available

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