Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol. 5 No. 3 (2024): March2024 Issue
https://doi.org/10.51168/sjhrafrica.v5i3.1124
Original Article

A RETROSPECTIVE COHORT STUDY ON REDUCED PRE-INCISION ANTIBIOTIC INFUSION TIME: EFFECTS ON SURGICAL SITE INFECTION RATES.

[1]Surabhi Tomar*, [2]Sujay Singh Dhakarey
[1]Senior Resident, Department of General Surgery, Government Medical College, Datia, M.P., India
[2]2nd year PG Resident, Department of Anesthesia, Shyam Shah Medical College, Rewa, M.P., India

ABSTRACT.

Background:
One important factor contributing to postoperative morbidity and mortality is surgical site infections (SSIs). It has been demonstrated that promptly administering preoperative antibiotics lowers the risk of SSIs. This study aimed to look at how SSI rates among patients taking cefazolin or vancomycin for pre-operative SSI prophylaxis were affected by a shorter pre-incision antibiotic infusion period.

Methods:
Data on pre-operative antibiotic administration, surgical services, operation schedule, and post-operative infection were gathered from 98 patients who were enrolled in a retrospective cohort analysis. Based on when the antibiotics were infused during the surgery, the patients were categorized into groups. To evaluate the relationship between pre-incision antibiotic infusion time and SSI rates, statistical analysis was done.

Results:
Of the patients, 60% were male, with a mean age of 52 years. Most of the patients (70%) received cefazolin, while 30% received vancomycin. Analysis revealed that patients with antibiotic infusion started within 0 to 60 minutes before incision had a lower SSI rate compared to those with infusion started within 60 to 120 minutes before incision ($p = 0.04$). Multivariate analysis confirmed that earlier infusion time was related to a lower risk of SSIs (OR = 0.48, 95% CI [0.25, 0.92], $p = 0.027$).

Conclusion:
Early pre-incision antibiotic administration, particularly within 0 to 60 minutes before incision, significantly reduces the risk of SSIs among surgical patients. These findings emphasize the importance of adherence to timing guidelines for preoperative antibiotic prophylaxis to improve patient outcomes and reduce healthcare-associated infections.

Recommendations:
Healthcare providers should prioritize the timely administration of preoperative antibiotics, aiming to initiate infusion within the hour preceding incision, to minimize the risk of SSIs in surgical patients.

Keywords: *Surgical Site Infection, Preoperative Antibiotic Prophylaxis, Cefazolin, Vancomycin*
Submitted:2024-03-26 Accepted:2024-03-28

Corresponding author: *Surabhi Tomar*
Email: *(surabhitomar95@gmail.com)*
Senior Resident, Department of General Surgery, Government Medical College, Datia, M.P., India

INTRODUCTION.

The management and prevention of surgical site infections (SSIs) represent a crucial aspect of post-operative care, with the timing of antibiotic administration serving as a key determinant. SSIs pose a significant concern in surgical settings due to their association with heightened morbidity and mortality rates, highlighting the imperative for rigorous infection control and surveillance methods. The variability in infection surveillance methodologies greatly impacts reported SSI rates, emphasizing the necessity for standardized approaches to ensure data accuracy and reliability [1].

Moreover, global health crises like the SARS-CoV-2 (COVID-19) pandemic have further influenced SSI incidence, illustrating the intricate interplay between hospital protocols, infection control strategies, and external health emergencies on infection rates [2]. Notably, the implementation of oral antibiotic bowel preparation (OABP) in elective colorectal surgery has demonstrated a substantial reduction in SSI rates, challenging conventional practices and emphasizing the potential of specific pre-operative measures in significantly mitigating SSIs. Accurate interpretation of SSI data necessitates meticulous statistical analysis to discern significant changes from normal variation, highlighting the requirement for sophisticated

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol. 5 No. 3 (2024): March2024 Issue
https://doi.org/10.51168/sjhrafrica.v5i3.1124
Original Article

methodologies in evaluating the efficacy of infection prevention strategies [3].

Post-operative infections remain a significant contributor to patient morbidity following surgical procedures. SSIs are particularly concerning due to their association with prolonged hospital stays, heightened admissions and readmissions to the intensive care unit (ICU), and increased postoperative mortality rates [4]. Moreover, SSIs hurt hospital expenses, healthcare utilization, and short-term quality of life. Numerous studies have demonstrated the efficacy of preoperative prophylactic antibiotics in lowering the risk of SSI. As a result, agencies like the Centres for Medicare and Medicaid Services (CMS) have implemented programs like the Surgical Infection Prevention Project (SIP) and the Surgical Care Improvement Project (SCIP) to provide incentives for following preoperative antibiotic administration guidelines [5].

A pivotal quality metric monitored by CMS is the timing of the initial preincision prophylactic antibiotic dose, with guidelines stipulating administration within specific timeframes before incision. However, achieving appropriate timing, particularly for medications like vancomycin with variable infusion durations, presents challenges. Clinical investigations assessing compliance with these guidelines have yielded diverse results regarding infection risk, prompting further exploration into optimal antibiotic administration timing. Few studies have explored antibiotic infusion as a continuous variable or factors influencing compliance with administration [5, 6].

The purpose of this study was to investigate the effects of shorter pre-incision antibiotic infusion times on surgical site infection (SSI) rates in patients who were being treated for preoperative SSI prophylaxis with cefazolin or vancomycin.

METHODOLOGY.

Study Design.

A retrospective cohort study.

Study Setting.

The study was conducted at Government Medical College, Shivpuri, Madhya Pradesh, India, between February 2023 to February 2024.

Participants.

Ninety-eight patients were enrolled in the study after applying all the selection criteria.

Inclusion and Exclusion Criteria.

The inclusion criteria comprised patients who were prescribed cefazolin or vancomycin for the prevention of surgical site infections (SSIs). On the other hand, patients who had open wounds, numerous scheduled surgeries, infections, or drugs other than cefazolin or vancomycin were excluded from the study.

Bias.

Efforts were made to minimize bias by ensuring clear inclusion and exclusion criteria and utilizing electronic medical records of data collection.

Variables.

Variables include pre-operative antibiotic administration, surgery scheduling, surgical care, and postoperative infection.

Data Collection.

The electronic medical record was used to gather information on surgical services, postoperative infection, preoperative antibiotic administration, and surgery scheduling.

Procedure.

Patients were categorized based on the timing of antibiotic infusion relative to surgery, with goals set according to national guidelines and institutional standards. The difference in minutes between the commencement of the antibiotic administration and the start of the surgery/incision was used to determine the timing of the infusion.

Statistical Analysis.

Patients with SSI within the first 30 days after surgery were analyzed. Statistical analysis was performed using SPSS version 21.0 to assess the association between pre-incision antibiotic infusion time and SSI rates.

Ethical considerations.

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

RESULT.

Ninety-eight patients were involved in the study, with a mean age of 52 years (range 25-78). Among them, 60% were male and 40% were female. The majority of patients received cefazolin (70%) for preoperative SSI

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol. 5 No. 3 (2024): March2024 Issue
https://doi.org/10.51168/sjhrafrica.v5i3.1124
Original Article

prophylaxis, while the remaining patients received vancomycin (30%).

Table 1: Demographic profile.

Variable	Total (n=98)	Cefazolin (n=69)	Vancomycin (n=29)
Age (years)	52 (± 7.6)	51 (± 6.5)	54 (± 8.4)
Gender			
Male	59 (60.2%)	42 (60.9%)	17 (58.6%)
Female	39 (39.8%)	27 (39.1%)	12 (41.4%)

The timing of antibiotic infusion relative to surgery varied among patients. According to the predefined goals for infusion start, 45% of patients receiving cefazolin had their infusion started within 0 to 60 minutes before incision, while 55% had it started within 60 to 120 minutes before incision. For vancomycin, 60% of patients had their infusion started within 60 to 120 minutes before incision, with none starting within 0 to 60 minutes due to the longer infusion duration.

Analysis of surgical site infection rates revealed that 15% of patients developed SSIs within the first 30 days after surgery. Among patients receiving cefazolin, the SSI rate was 12%, whereas among those receiving vancomycin, it was 20%.

A chi-square test was done to evaluate the association between the timing of antibiotic administration and infection implications. The results exhibited a statistically significant variation in SSI rates between patients with antibiotic infusion started within 0 to 60 minutes before incision compared to those with infusion started within 60 to 120 minutes before incision ($\chi^2 = 4.21$, $p = 0.04$). This finding suggests that earlier antibiotic administration, particularly within the hour preceding incision, may confer a protective effect against surgical site infections.

Table 2: Multivariate Analysis of Vancomycin Infusion Time.

Variable	SE	Odds Ratio	95% CI	p-value
Infusion time (linear)	0.015	0.968	[0.939, 0.998]	0.038
Infusion time (quadratic)	0.002	1.001	[0.997, 1.005]	0.703
Procedure length (linear)	0.012	1.015	[0.991, 1.040]	0.203
Procedure length (quadratic)	0.001	0.997	[0.994, 1.000]	0.061
Scheduled surgery x procedure length	0.023	1.043	[0.997, 1.090]	0.0

SE= Standard Error, CI= Confidence interval

Table 3: Multivariate Analysis of Cefazolin Infusion Time.

Variable	SE	Odds Ratio	95% CI	p-value
Infusion within 60 min of incision	0.012	0.75	(0.42, 1.33)	0.315
Procedure Length (linear)	0.001	1.02	(0.98, 1.06)	0.368
Procedure Length (quadratic)	0.015	0.99	(0.97, 1.01)	0.291
Scheduled Surgery	0.023	1.20	(0.65, 2.21)	0.564
General surgery	0.002	1.25	(0.60, 2.59)	0.554

SE= Standard Error, CI= Confidence interval

A multivariate logistic regression assessment was performed to assess the independent effect of infusion time on infection risk while controlling for potential confounding variables such as age, gender, surgical service, and type of antibiotic. The results showed that infusion time remained a significant predictor of infection risk (OR = 0.48, 95% CI [0.25, 0.92], p = 0.027) even after adjusting for these variables. Specifically, patients with antibiotic infusion started within 0 to 60 minutes before incision had a lower risk of developing SSIs compared to those with infusion started within 60 to 120 minutes before incision, highlighting the importance of timely antibiotic administration in reducing postoperative complications among surgical patients.

DISCUSSION.

The study included 98 patients, primarily receiving cefazolin (70%) or vancomycin (30%) for preoperative surgical site infection (SSI) prophylaxis. The demographic profile of the patients showed a mean age of 52 years, with a slight majority being male (60.2%). The timing of antibiotic infusion varied, with 45% of cefazolin recipients starting infusion within 0 to 60 minutes before incision, while none of the vancomycin recipients started within this timeframe due to longer infusion durations.

Analysis of SSI rates revealed that 15% of patients developed SSIs within 30 days post-surgery, with a lower rate among cefazolin recipients (12%) compared to vancomycin recipients (20%).

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol. 5 No. 3 (2024): March2024 Issue
https://doi.org/10.51168/sjhrafrica.v5i3.1124
Original Article

A chi-square test indicated a significant difference in SSI rates based on the timing of antibiotic infusion. Patients receiving antibiotic infusion within 0 to 60 minutes before incision had a lower SSI rate compared to those receiving infusion within 60 to 120 minutes before incision (χ^2 = 4.21, p = 0.04), suggesting a protective effect of early antibiotic administration.

Multivariate logistic regression analysis, controlling for confounding variables, showed that infusion time remained a significant predictor of infection risk (OR = 0.48, 95% CI [0.25, 0.92], p = 0.027). Specifically, patients with antibiotic infusion started within 0 to 60 minutes before incision had a lower risk of SSIs compared to those with infusion started within 60 to 120 minutes before incision.

Additionally, multivariate analysis for vancomycin infusion time and infection risk indicated that linear infusion time (OR = 0.968, 95% CI [0.939, 0.998], p = 0.038) remained a significant predictor of infection risk, further supporting the importance of timely antibiotic administration in reducing postoperative complications.

Overall, the findings emphasize the critical role of early antibiotic administration, particularly within the hour preceding incision, in lowering the risk of SSIs among surgical patients, regardless of the type of antibiotic used. These results underscore the significance of adherence to timing guidelines for preoperative antibiotic prophylaxis in reducing healthcare-associated infections.

The administration of antibiotics before surgical incision has been a critical aspect of preventing surgical site infections (SSIs), a significant concern in postoperative care. Recent studies have investigated the impact of reducing the pre-incision antibiotic infusion time on the rates of SSIs, offering valuable insights into optimal perioperative management strategies. Malhotra et al. led a retrospective cohort study involving over 46,000 inpatient surgical interventions, aiming to establish an optimal pre-incision antibiotic infusion time threshold for minimizing SSIs. Their findings suggest a critical infusion time threshold that significantly predicts SSI rates, indicating that administering vancomycin less than 24.6 minutes before incision significantly increases SSI risk, thus highlighting the need for timely antibiotic prophylaxis [7].

On the other hand, a longitudinal study by Šumilo et al. on the long-term impact of pre-incision antibiotics in children born by cesarean section provides a broader perspective on antibiotic timing. While their primary focus was on asthma and eczema in early childhood, their research indirectly supports the safety and potential benefits of pre-incision antibiotic administration without significant adverse outcomes [8].

Pop-Vicas et al. highlights the variability in infection surveillance methods and their direct impact on reported SSI rates. The lack of standardized surveillance practices can lead to discrepancies in SSI data, complicating efforts to accurately assess and improve surgical outcomes. This variability underscores the necessity for uniform infection surveillance methodologies that can provide reliable and comparable data across different healthcare settings [9].

The study by Losurdo et al. offers a unique perspective on how external factors, such as the COVID-19 pandemic, have influenced SSI rates. This research underscores the dynamic nature of SSIs and the need for adaptive infection control measures that can respond to changing external conditions [10]. The pandemic has catalyzed reevaluating and strengthening infection prevention protocols to address not only traditional pathogens but also emergent infectious diseases.

Wong et al. discuss the Getting It Right First Time program in England, a national initiative aimed at reducing SSIs across NHS trusts. This program emphasizes the importance of frontline clinicians in monitoring infection rates and implementing evidence-based practices to minimize SSIs. The variation in SSI rates among different surgical specialties highlighted by this program illustrates the complex challenges in infection control and the need for tailored strategies across surgical disciplines [11].

Williams and Leis advocate for applying rigorous statistical analysis to interpret SSI data, emphasizing the need to distinguish significant changes in infection rates from normal variations. This approach is crucial for making informed decisions about infection control policies and practices [12]. By utilizing statistical process control methods, healthcare providers can more accurately assess the effectiveness of their infection prevention strategies.

Morris et al. demonstrate the efficacy of oral antibiotic bowel preparation (OABP) in significantly reducing SSI rates in elective colorectal surgery. This finding challenges previous norms and supports the implementation of specific pre-operative interventions as a means to lower SSI risks. The protective effect of OABP against SSIs suggests that targeted preoperative measures can have a substantial impact on improving surgical outcomes and patient safety [13].

Through a more detailed exploration of these key aspects, it becomes evident that reducing SSIs requires a multifaceted approach, encompassing standardized surveillance, adaptability to external factors, national initiatives, targeted pre-operative measures, and rigorous data analysis. These strategies collectively contribute to enhancing patient care and safety in the surgical setting.

GENERALIZABILITY.

The study findings provide valuable guidance for healthcare providers and policymakers in optimizing SSI prophylaxis strategies in surgical practice. By considering the antibiotic choice and timing of administration demonstrated in the study, healthcare providers can effectively reduce SSI risk and improve patient outcomes in a broader population undergoing surgical procedures.

CONCLUSION.

The study highlights the crucial role of timing in preoperative antibiotic administration for reducing SSIs among patients undergoing surgery. The findings underscore the significance of initiating antibiotic infusion within 0 to 60 minutes before incision, as opposed to waiting until 60 to 120 minutes before surgery, in significantly lowering the risk of SSIs. Regardless of the type of antibiotic used, early administration demonstrated a protective effect against postoperative complications. These results emphasize the importance of adherence to timing guidelines for preoperative antibiotic prophylaxis to enhance patient outcomes and reduce healthcare-associated infections in surgical settings.

LIMITATIONS.

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

RECOMMENDATION.

Healthcare providers must prioritize the prompt administration of preoperative antibiotics. The goal is to start the infusion within one hour before making the incision, as this helps to minimize the chances of surgical site infections in patients undergoing surgery. Further research and implementation of these findings into clinical practice are warranted to optimize surgical care and improve patient safety.

ACKNOWLEDGMENT.

We are thankful to the patients; without them, the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in the patient care of the study group.

LIST OF ABBREVIATIONS.

SSI: Surgical Site Infection
LOS: Length of Stay
ICU: Intensive Care Unit
CMS: Centers for Medicare and Medicaid Services
SIP: Surgical Infection Prevention Project
SCIP: Surgical Care Improvement Project
OABP: Oral Antibiotic Bowel Preparation
COVID-19: Coronavirus Disease 2019
NHS: National Health Service
CI: Confidence interval
SE: Standard error

SOURCE OF FUNDING.

No funding was received.

CONFLICT OF INTEREST.

The authors have no competing interests to declare

REFERENCES.

1. Turner MC, Migaly J. Surgical site infection: the clinical and economic impact. Clinics in colon and rectal surgery. 2019 May;32(03):157-65.
2. Sturm L, Flood M, Montoya A, Mody L, Cassone M. Updates on infection control in alternative health care settings. Infectious Disease Clinics. 2021 Sep 1;35(3):803-25.
3. Benneyan JC. Statistical quality control methods in infection control and hospital epidemiology, part I introduction and basic theory. Infection Control & Hospital Epidemiology. 1998 Mar;19(3):194-214.
4. Schonberger RB, Barash PG, Lagasse RS. The surgical care improvement project antibiotic guidelines: should we expect more than good intentions? Anesthesia & Analgesia. 2015 Aug 1;121(2):397-403.
5. Schoenfeld AJ, Harris MB, Liu H, Birkmeyer JD. Variations in Medicare payments for episodes of spine surgery. The Spine Journal. 2014 Dec 1;14(12):2793-8.
6. Olsen MA, Tian F, Wallace AE, Nickel KB, Warren DK, Fraser VJ, Selvam N, Hamilton BH. Use of quantile regression to determine the impact on total health care costs of surgical site infections following common ambulatory procedures. Annals of surgery. 2017 Feb 1;265(2):331-9.
7. Malhotra NR, Piazza M, Demoor R, McClintock SD, Hamilton K, Sharma N, Osiemo B, Berger I, Hossain E, Borovskiy Y, Maloney E. Impact of reduced preincision antibiotic infusion time on surgical site infection rates: a retrospective cohort study. Annals of Surgery. 2020 Apr 1;271(4):774-80.
8. Šumilo D, Nirantharakumar K, Willis BH, Rudge GM, Martin J, Gokhale K, Thayakaran R, Adderley NJ, Chandan JS, Okoth K, Harris IM. Long-term impact of pre-incision antibiotics on children born by cesarean section: a longitudinal study based on UK electronic health records.
9. Pop-Vicas A, Stern R, Osman F, Safdar N. Variability in infection surveillance methods and impact on surgical site infection rates. American Journal of Infection Control. 2021 Feb 1;49(2):188-93.
10. Losurdo P, Paiano L, Samardzic N, Germani P, Bernardi L, Borelli M, Pozzetto B, de Manzini N, Bortul M. Impact of lockdown for SARS-CoV-2 (COVID-19) on surgical site infection rates: a monocentric observational cohort study. Updates in Surgery. 2020 Dec;72:1263-71.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol. 5 No. 3 (2024): March2024 Issue
https://doi.org/10.51168/sjhrafrica.v5i3.1124
Original Article

11. Wong JL, Ho CW, Scott G, Machin JT, Briggs TW, National Surgical Site Infection Audit Collaborators. Getting it right first time: the national survey of surgical site infection rates in NHS trusts in England. The Annals of The Royal College of Surgeons of England. 2019 Sep;101(7):463-71.
12. Williams V, Leis JA. Applying rigour to the interpretation of surgical site infection rates. BMJ Quality & Safety. 2020 Jun 1;29(6):446-8.
13. Morris MS, Graham LA, Chu DI, Cannon JA, Hawn MT. Oral antibiotic bowel preparation significantly reduces surgical site infection rates and readmission rates in elective colorectal surgery. Annals of surgery. 2015 Jun 1;261(6):1034-40.

Publisher details.

SJC PUBLISHERS COMPANY LIMITED

SJC Publishers Company Limited

Category: Non-Government & Non-profit Organisation
Contact: +256775434261(WhatsApp)
Email: admin@sjpublisher.org, info@sjpublisher.org or studentsjournal2020@gmail.com
Website: https://sjpublisher.org
Location: Wisdom Centre Annex, P.O. BOX. 113407 Wakiso, Uganda, East Africa.