Asian Journal of Orthopaedic Research

Volume 8, Issue 4, Page 26-32, 2022; Article no.AJORR.96701

The Prevalence of Postoperative Wound Infection in Orthopedic Surgery at Bangabandhu Sheikh Mujib Medical College (BSMMC), Faridpur, Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/96701

Original Research Article

Received: 10/11/2022
Accepted: 29/12/2022
Published: 30/12/2022

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ABSTRACT

Background: Surgical site infections (SSI) in orthopaedic surgery are reported to have a prevalence ranging from 1 to 22%. These infections significantly impact various aspects of patient care, including increasing the cost of treatment, prolonging the use and abuse of antibiotics, and raising the levels of morbidity and rehabilitation required.

Aim of the Study: The objective of this study is threefold; firstly, to delineate the occurrence of SSI after elective orthopedic surgeries; secondly, to outline the epidemiological attributes of SSIs, including the timeline of SSI onset and the bacterial agents responsible; and lastly, to determine the autonomous risk factors that correlate with SSI.

Methods: This prospective study was conducted in the Department of Orthopedics, Bangabandhu Sheikh Mujib Medical College (BSMMC), Faridpur, Bangladesh, from June 2021 to July 2022.

Results: A total of 100 patients participated in the study, and 6 out of 80 cases were diagnosed with an infection at the operative site on postoperative day 5. The overall incidence of infection in this study was 7.50%. The gram-positive and gram-negative bacteria isolated from the surgical site infection were E. Coli and Staphylococcus aureus, respectively. E. Coli was found in 3 cases (42.9%), while Staphylococcus aureus was found in 4 cases (57.1%). Furthermore, we discovered a significant negative correlation between the time of antibiotic administration and pre-operative stay.

Conclusion: Moreover, numerous surgical procedures do not follow standard protocols, and various perioperative situations require modifications to established preventive measures. In our recent study on antibiotic prophylaxis, we found that prophylactic antibiotic treatments should be provided for a diverse range of surgical operations. It was observed that the types of harmful microorganisms and the degree of antibiotic resistance significantly varied among hospitals.

Keywords: Surgical site infection; orthopaedic surgery; risk factors.

1. INTRODUCTION

“Surgical site infections (SSIs) are a rare but severe complication following elective orthopaedic surgeries, such as total joint arthroplasty and orthopaedic spine surgeries. These infections can lead to poor outcomes and increased healthcare costs” [1,2]. In Bangladesh, with the rise of orthopaedic surgeons and aggressive marketing by manufacturing companies for high-technology orthopaedics, there has been an increase in such surgeries being performed. However, no data is available on the incidence of infections following these surgeries. Since the operating environments in different hospitals can vary, a wide variation in infection rates can be expected. However, most orthopaedic centres report an incidence of less than 2% [3,4]. “Older patients, who often have comorbid conditions, are more vulnerable to the adverse effects of postoperative SSIs. Mc. Garry et al. reported that SSI in elderly patients had been associated with a greater than fivefold mortality rate and twofold prolonged duration of hospitalization compared to younger patients” [2]. “Several measures have been implemented to reduce the incidence of SSIs, such as antibiotic prophylaxis, surgical site preparation, laminar airflow in the operating room, and preoperative screening for Staphylococcus aureus carriers” [5]. However, many studies on SSI following orthopaedic surgeries were single institution-based and included only a fraction of potential risk factors. To more accurately identify independent risk factors for SSIs, studies with a relatively large sample size of patients, including a wide variety of risk factors, and controlling for multiple risk factors within individuals should be conducted. This study aimed to describe the prevalence of SSI following elective orthopaedic surgeries, the epidemiological characteristics of SSIs, including the timing of SSI development and causative bacteria, and to identify the independent risk factors associated with SSI.

2. METHODOLOGY AND MATERIALS

A prospective study was conducted at the Department of Orthopedics, Bangabandhu Sheikh Mujib Medical College (BSMMC), Faridpur, Bangladesh, between June 2021 and July 2022. The study involved enrolling and analyzing 80 patients. The study's primary objective was to evaluate the impact of preoperative and postoperative systemic antibiotics on the incidence of postoperative wound infections. Additionally, the study aimed to assess the role of sterile measures, such as scrub suits, masks, sterile gloves, gowns, drapes, and operating room environments, in reducing surgical site infection. Finally, the efficacy of surgical asepsis, including surgeons' hand scrub and antibiotics before surgery, was also evaluated.

Inclusion criteria:

- Patients above the age of 18 years.
- Patients who underwent elective orthopaedic surgery.

Exclusion criteria:

- Immune deficiency.
- Patients on long-term corticosteroids.
- Patients undergoing immunosuppressive therapy.
- Patients with open fractures require external fixation devices in the operating room.

We adhered to standard aseptic protocols, which involved using sterilized equipment, gowns, drapes, and gloves that had been autoclaved. Before the surgery, a regular scrub was performed for 5 minutes. Throughout the operation, we followed surgical principles to minimize tissue manipulation and ensure proper hemostasis. Additionally, the incision site was treated with a combination of spirit and 5% povidone-iodine. When necessary, drains were used, and the incision was closed using sutures or staples that had been treated with betadine or Neosporin ointment before being covered with an adhesive bandage. Ceftriaxone injections were administered continuously throughout the postoperative phase, and patients were monitored until discharge. We examined the wound for signs of infection on the third, eighth, and twelfth postoperative days. If a patient met any criteria for wound infection, we sent a wound specimen to the clinical microbiology laboratory for routine culture operation. To present our data, we used suitable tables and graphs and clearly described each one. We used the statistical package for social science (SPSS) program on Windows to perform all statistical analyses. Continuous parameters were expressed as mean±SD, and categorical parameters were expressed as frequency and percentage. We used the student's t-test to compare continuous parameters and the Chi-Square test to compare categorical parameters. A value of $P<0.05$ and a 95.0% confidence interval were considered statistically significant.

3. RESULTS

The study was conducted with 80 patients, among whom 6 cases (7.50%) had an infection at the operative site on postoperative day 5. The highest incidence of postoperative infection was observed among the 41-60 age group, with 4 cases (14.3%) out of 28 cases. One case in the age group of 21-40 years and 2 cases in the age group of >60 years were also found. The mean age of patients with absent and present surgical site infections (SSIs) was 38.45±12.21 and 52.00±14.32, respectively, with an average mean age of 39.45±12.32 for both groups. There was no significant difference in age between the two groups (p-value=0.245). Females had a higher incidence of SSIs (15.2%, 5 cases) compared to males (3.0%, 2 cases), with a chi-square value of 5.0273 and a p-value of 0.024(S) between the two groups. The pre-operative stay in the SSIs absent group was 4.22±0.84 days, while it was 1.45±0.45 days in the SSIs present group, which was statistically significant (p<=0.04). The SSIs present group had a more extended hospital stay than the absent group, with mean and SD values of 17.45±3.44 and 8.75±2.33 days, respectively, which were statistically significant (p-value=0.01). A significant negative correlation was found between the time of antibiotic administration and pre-operative stay (r-value=-.397**, p-value=0.005). In contrast, a significant positive correlation was found between the time of antibiotic administration and postoperative stay (r-value=.821**, p-value=0.005). Gram-positive and gram-negative bacteria were isolated from the surgical site infection findings, with 3 cases (42.9%) having E. Coli and 4 cases (57.1%) having Staphylococcus aureus, which was identified by the KIRBY-BAUER Disc Diffusion Method following the Clinical Laboratory Standards Institute (CLSI) guidelines.

Table 1. Distribution of surgical site infection among the study population (N=80)

Surgical site infection	Frequency	Percentage
Present	6	7.50
Absent	74	92.50
Total	80	100.00

Table 2. Age distribution of the study population (N=80)

Age group	SSIs Absent (n=74)		SSIs Present (n=06)		P-value
	N	%	No	%	
18-20	25	33.78	2	33.33	0.245
21-40	24	32.43	2	33.33	
41-60	4	14.3	1	16.67	
>60	6	8.11	1	16.67	
Total	74	100.00	6	100.00	
Mean±SD	38.45±12.21		52.00±14.32		

Table 3. Sex distribution of the study population (N=80)

Sex	SSIs Absent (n=74)		SSIs Present (n=06)		P-value
	N	%	N	%	
Male	52	70.27	2	3.0	0.024
Female	22	29.73	4	15.2	
Total	74	100	7	100	

Table 4. Incidence about the hospital stay

Variables	Mean±SD	Mean±SD	P Value
Pre-operative Stay	4.22±0.84	1.45±0.45	0.04
Post-operative stay	8.75±2.33	17.45±3.44	0.01

Table 5. Correlation between the time of antibiotic administration and Pre-Operative stay

Correlation	Pre-operative stay	Antibiotic administration	P-Value
Pearson Correlation	1	-.397**	<0.0001
No cases	80	100	

Table 6. Correlation between the time of antibiotic administration and Post-Operative stay

Correlation	Pre-operative stay	Antibiotic administration	P-Value
Pearson Correlation	1	.821**	<0.0001
No cases	80	100	

Table 7. Organism Isolated

Organism Isolated	Frequency	Percentage
Staphylococcus aureus	3	42.9
E. Coli	4	57.1
Total	7	100.00

Table 8. Sensitivity pattern of gram-positive bacteria

Antimicrobial agents	*Staphylococcus aureus* (n=3)		
	Sensitive	Intermediate	Resistant
Gentamycin (GEN)	4	0	0
Nitrofurantoin (NIT)	2	2	0
Ciprofloxacin (CIP)	0	0	4
Teicoplanin (TEI)	0	4	0
Cefoxitin (CX)	0	2	2
Tetracyclin(TE)	2	4	0
Vancomycin (VA)	4	2	0
Piperacillin	6	0	0
Tazobactam	6	0	0

Table 9. Sensitivity pattern of gram-negative bacteria

Antimicrobial agents	*Escherichia coli* (n=2)		
	Sensitive	Intermediate	Resistant
Gentamycin (GEN)	1	2	0
Nitrofurantoin (NIT)	1	2	0
Ciprofloxacin (CIP)	2	0	0
Amoxy+Clavulanic (AMX)	0	0	3
Imipenem (IPM)	3	0	0
Amikacin (AK)	1	2	0
Co-Trimoxazole (COT)	2	0	1
Ceftazidime (CAZ)	0	0	3
Cefepime	2	0	1
Piperacillin	3	0	0
Tazobactam	3	0	0

4. DISCUSSION

The current study reports that surgical site infections (SSIs) occur at a rate of 6.0%. The study identified several independent risk factors associated with SSIs, including the presence of more people in the operating room, and contaminated or dirty wounds. Among the different age groups, the highest number of cases of postoperative infections were reported in the 41-60-year-old group, with 4 (14.3%) out of 28 cases. The mean age of the SSIs absence group was 38.45±12.21, while the mean age of the present group was 52.00±14.32, with a p-value of 0.245, indicating no significant difference in age between the groups. Regarding gender, the incidence of SSIs was disproportionately high in females 15.2% (5 cases)], while males accounted for 3.0% (2 cases). The chi-square value between the groups was 5.0273, and the p-value was 0.024, indicating a significant association between gender and SSIs. The incidence rate of SSIs in this study was higher than that of orthopedic patients in wealthy countries but also higher than that of some emerging countries. The CDC classified 50% of cases as Class-II (Clean and Contaminated), while 25% were classified as Class-I and Class-III [6]. Our study found that dirty, unclean, and trauma-related wounds may have contributed to SSIs. On the other hand, increased SSI rates in clean wounds can be attributed to a lack of financial resources, antiquated equipment, inadequate operating room ventilation, and infection control measures. Although several studies revealed no link between the National Nosocomial Infections Surveillance (NNIS) index and SSIs, our investigation found a strong link between the NNIS score and SSIs [7]. "Regarding hospital stays, the average pre-operative stay in the SSIs absent group was 4.22±0.84 days, while in the SSIs present group, it was 1.45±0.45 days, which was statistically significant (p=0.04). The SSIs present group spent a long time in the hospital than the absent group. The mean and SD values of hospital stay in both groups were 17.45±3.44 and 8.75±2.33, respectively, with a p-value of 0.01. The bulk of SSIs is caused by the growing trend of short-stay hospitalization" [8]. Compared to the group lacking SSIs, the current group had the longest operation time, 147.50 minutes for the current set of SSIs. The absence of SSIs was 72.45 minutes. Our analysis revealed significant differences among the subjects with a p-value of 0.004. Previous research has identified Staphylococcus aureus and gram-negative bacteria as the most prevalent causal agents [6]. "Although mupirocin successfully reduced Staphylococcus aureus nasal carriage, it did not decrease surgical site infections" [9]. "Gram-positive and gram-negative bacteria were retrieved from surgical sites in three (42.9%) cases. Staphylococcus aureus was identified in 4 (57.1%) of the cases. An increased population in the operating room can increase surgical site infection rates by 1.5 to 3.8 times" [10]. Our operating rooms are old and poorly ventilated. Ultra-clean air systems and exhaust-ventilated clothes are recommended for joint prosthesis surgeries because air is a primary source of infection transmission. Reducing the number of people in the operating room may have a similar effect. The standard wound categorization, as demonstrated in our study, is an essential predictor of surgical site infection. The ASA score is a well-established predictor of surgical site infection, and our findings are consistent with previous research [11]. A recent study confirmed that "shaving could increase the risk of infection, and the CDC recommends against shaving before or shortly before surgery, preferably with electric clippers" [12]. Our findings support previous research indicating that infection following surgery prolongs inpatient stays [13]. Some aspects of the study could be improved. Because of its short duration, it may not account for seasonal variations. The demographics of the hospital population, such as age, may shift during the winter months. More than one phone call within 30 days of the procedure may be necessary to monitor surgical site infections. We infer that the number of postoperative surgical site infections was low because the median total hospital stay was 28 days, as postoperative infections typically emerge within four weeks of surgery. Because of the limited patient group, the study needed more power to determine the impact of less common characteristics, so a larger patient population would be preferable. Might all influence the decision and duration of perioperative prophylaxis? There are no studies that can help in these circumstances. Surgical wound care and antimicrobial prophylaxis necessitate ongoing monitoring of prophylaxis failures and perioperative data changes.

5. LIMITATIONS OF THE STUDY

Limitations are inevitable in hospital-based studies, including the current research endeavour. The study's specific guidelines were duly noted and adhered to. However, caution must be exercised when generalizing the results obtained from this study to the entire nation or even the global population. Another shortcoming of this study was the relatively smaller sample size compared to other studies conducted in this field. Additionally, the brevity of the trial period made it difficult to conclude complications and mortality.

6. CONCLUSION AND RECOMMENDATIONS

In surgical procedures and postoperative situations, there are specific scenarios where standard preventive regimens may not be applicable. These include preoperative infections in non-wound areas, allergy to penicillin or cephalosporin, trauma, emergency surgeries, and preoperative infections in non-wound sites. In such cases, decision-making regarding perioperative prophylaxis can be challenging, as there are no specific guidelines to follow. To address this issue, healthcare providers must exercise caution and careful judgment when deciding on perioperative prophylaxis in the scenarios above. Additionally, ongoing monitoring of prophylaxis failures and perioperative data changes is crucial in ensuring successful surgical wound care and antimicrobial prophylaxis. Further research is needed to guide the optimal prophylactic measures in non-standard situations, and guidelines should be developed to assist healthcare providers in making informed decisions in these circumstances.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/96701