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Prevalence of surgical site infections and antibiotic resistance pattern in a Tertiary care Orthopaedic unit

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Abstract

Introduction: Surgical site infections (SSIs) in orthopaedic surgeries pose a significant risk to outcomes. These infections ranging from superficial to periprosthetic joint complications result from various factors including patient-related conditions and environmental factors. *Staphylococcus aureus*, with increasing antibiotic resistance, is a predominant cause. Perioperative antibiotic prophylaxis recommended by the WHO is crucial. Establishing national surveillance considering local antibiotic resistance and continuous auditing are essential for formulating effective guidelines to prevent and manage SSIs.

Methods: This is a retrospective study conducted at a tertiary care hospital from December 2022 to November 2023 at the orthopaedic unit. The study population was all the patients who had surgical site infections following clean orthopaedic surgeries during the study period. An institutional-level ethical clearance was obtained.

Results: This retrospective study conducted at a tertiary orthopaedic unit in Jaffna, Sri Lanka, aimed to investigate surgical site infections (SSI) following clean orthopaedic surgeries. Analyzing data from 1676 surgeries over one year, the study identified 83 culture-proven SSIs, yielding an annual incidence of 4.95%. The majority of SSIs occurred in males (62.7%) and were associated predominantly with lower limb surgeries (83.1%). Contrary to global trends, *Pseudomonas* emerged as the most common causative organism (31.3%).

Discussion: Notably, the study revealed significant variations in antibiotic sensitivity patterns among isolated organisms. While *Pseudomonas* exhibited sensitivity to a wide range of antibiotics, *coliforms* displayed resistance to several agents. This emphasizes regional and institutional differences in antibiotic resistance patterns.

Conclusion: Continuous large-scale institutional audits are crucial for shaping effective antibiotic policies. The study underscores the dynamic nature of SSI aetiology, emphasizing the need for tailored preventive measures based on regional data.

Keywords: Surgical site infections; Antibiotic resistance pattern; *Staphylococcus aureus*; Antibiotic sensitivity

1. Introduction

Surgical site infection (SSI) is a common postoperative complication that occurs in the site of incision, deep surgical organ or space [1]. SSI has a great impact on the outcome of orthopaedic surgeries. Orthopaedic SSI can be classified into superficial, deep, and periprosthetic joint infections or complications following joint surgery [2]. Contaminated instruments or environmental conditions of the healthcare facility and multiple patient factors such as previous SSI,

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obesity, diabetes, elderly patients, alcoholism, hypoalbuminemia, smoking, history of malignancy, long-term steroid usage, rheumatoid arthritis, and hypothyroidism contribute to the development of SSIs [3,4].

The most common cause of SSIs in recent years is due to *Staphylococcus aureus* [4]. Also, *Staphylococcus aureus* is the most common causative organism for orthopaedic implant-associated infections, which is very difficult to treat due to high levels of antibiotic resistance and limited treatment options [5,6].

One of the WHO-recommended measures for the prevention of SSIs is perioperative antibiotic prophylaxis [7]. The presence of a national surveillance system and guidelines on antibiotic use for infections based on the local antibiotic-resistant pattern and the common causative organisms is essential in preventing SSIs. Continuous auditing of the causative organisms and the resistance pattern will help in formulating local as well as national guidelines to prevent and treat SSIs [6].

2. Methodology

This is a retrospective descriptive institutional-based study done on prospectively maintained data. The study was carried out at the orthopaedic unit in a teaching hospital located in the northern corner of Sri Lanka in the city of Jaffna. This is the only tertiary care centre in the northern province. The unit has two wards (male and female), with a bed strength of 40 each performing approximately 220 clean surgeries per month.

Data was collected from December 2022 to November 2023 by the orthopaedic surgical trainees of the unit. Trainees accompanied the orthopaedic consultants who clinically identified the SSIs.

Pus/swab samples of the identified SSI patients were sent for antibiotic susceptibility testing. The study population was all the patients who had surgical site infections following clean orthopaedic surgeries during the study period. An institutional-level ethical clearance was obtained. Data was collected from the microbiology reports and clinic records of the patient using a data extraction sheet. Details such as age, ward they were admitted before and after surgery, type and site of surgery, organism isolated in culture and the antibiotic sensitivity of those organisms were analysed using charts, graphs and percentages. All the patients received a prophylactic antibiotic of a single dose of intravenous amoxicillin clavulanate before the surgery. All patients who had culture-proven SSIs following clean orthopaedic surgeries were only included in the study. SSIs following contaminated surgeries were excluded.

The researchers entered the data in Excel and analysed using percentages, charts and graphs.

3. Results

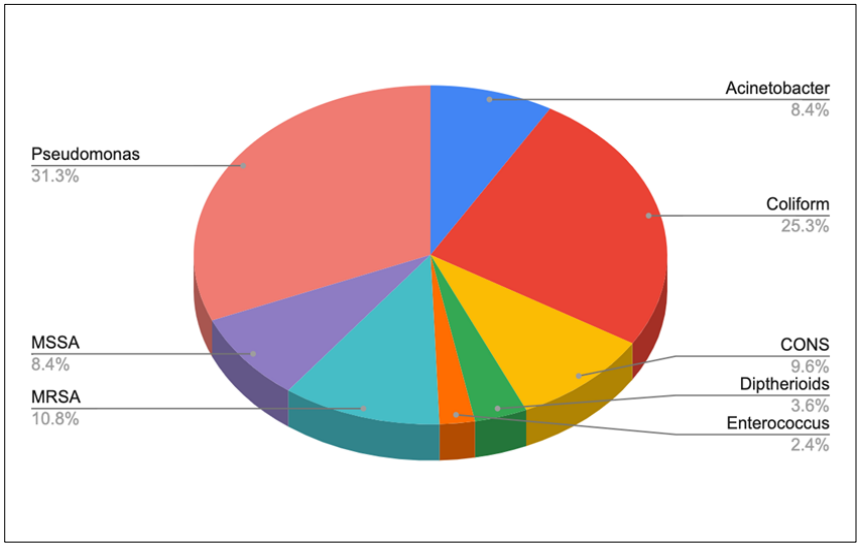

Figure 1 Pie chart showing the percentages of organisms isolated in the surgical site infections

A total of 83 culture-proven SSIs were identified out of 1676 clean orthopaedic surgeries during the study period. The incidence of SSI was 4.95% per year. The mean age of the population was 54.43. Fifty-two (62.7%) from male and 31 (37.3%) from female wards respectively. Out of those, 69 (83.1%) of the SSIs were in the lower limb surgeries and the rest were in the upper limb.

Pseudomonas was isolated in 31.3% (n=26) of the SSIs, *Coliform* in 25.3% (21), and Methicillin-resistant *Staphylococcus aureus* (MRSA) in 10.8% (n=9) (figure 1). Most of the SSIs, 16.7%(n=14) were encountered in Tibial open reduction and internal fixation (ORIF) followed by Austin moor hemiarthroplasty (AMH) at 10.7% (n=9) (table 1).

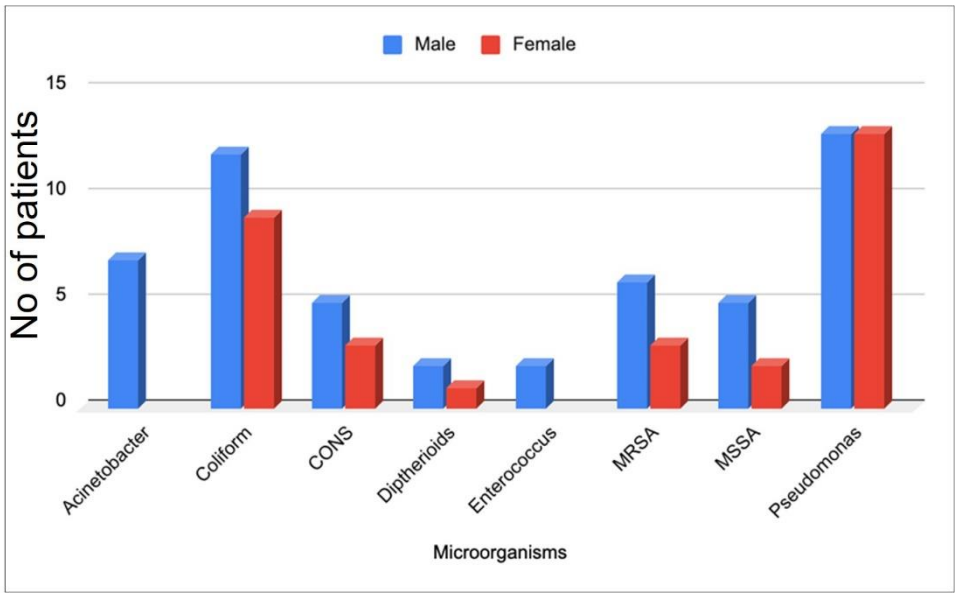

Figure 2 Distribution of isolated organisms in surgical site infection among males and females

The common organisms in both male and female wards are *pseudomonas*, 25% and 41.9% each followed by *coliforms*,23.10% and 29% each (figure 2). The common organism in both lower limb and upper limb surgeries is *pseudomonas*, 30.4% and 35.7% each, followed by *coliforms* 27.5% in lower limbs and CONS (21.4%) in upper limbs (figure 3).

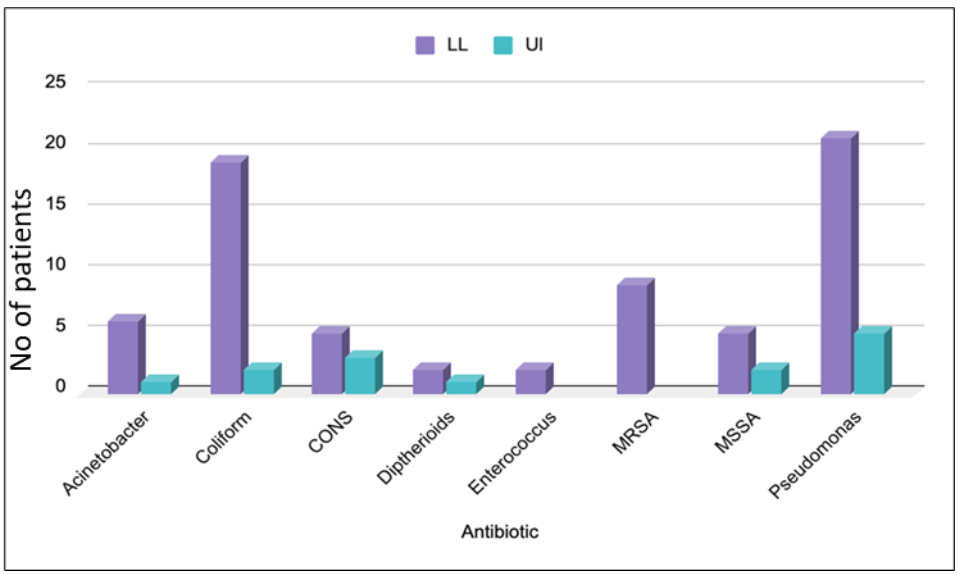

Figure 3 Distribution of organisms in surgical site infection in upper limb and lower limb

Out of the isolated *Pseudomonas*, 84.6%(n=22) were sensitive to Amikacin, 80.7%(n=21) were sensitive to Netilmicin, 38.46%(n=10) were sensitive to Gentamycin,30.7% (n=8) to ciprofloxacin, 30.7% (n=8) to piperacillin, 26.9%(n=7) to

Norfloxacin and 23%(n=6) to Norfloxacin. Only 3.8% of isolated *Pseudomonas* were resistant to cefuroxime, cefotaxime, cotrimoxazole and Amikacin each.

Out of the isolated *coliforms*, 52.3% (n=11) were sensitive to Amikacin and Netilmicin. 38%(n=8) sensitive to cotrimoxazole, 28.5% (n=6) to Tazobactam and Cefotaxime each, 23.8%(n=5) to ciprofloxacin, and 15.38%(n=4) to Gentamycin, Cefuroxime, Aztreonam and Norfloxacin each,14.28% (n=3) to Imipenem and 4.76% (n=1) to ampicillin, meropenem and flucloxacillin each.71.4%(n=15) of the isolated coliforms were resistant to cefuroxime, 47.6%(n=10) to cefotaxime, 42.8%(n=9) to amikacin and ampicillin each, 38% (n=8) to cotrimoxazole, 19% (n=4) Tazobactam, 14.28% (n=3) to Clindamycin, ciprofloxacin and Aztreonam each, 9.5% (n=2) to meropenem,4.76% to norfloxacin and Netilmicin each.71.42% (n=5) of the isolated *Acinetobacter* were resistant to Amikacin.

Table 1 Type of surgery

	Frequency	**Percent**
Ankle joint arthrodesis	1	1.2
AMH	9	10.7
Bimalleolar ORIF	4	4.8
BKA	2	2.4
DHS	2	2.4
Distal femur ORIF	2	2.4
EJ K WIRE	1	1.2
Elbow ORIF	1	1.2
Femoral ORIF	5	6
Fibula ORIF	2	2.4
Humerus IM nail	1	1.2
Humerus ORIF	4	4.8
Laminectomy	1	1.2
Lateral malleolar ORIF	2	2.4
MC ORIF	1	1.2
Osteotomy correction	1	1.2
Patella TBW	2	2.4
Patellar TBW	3	3.6
PFNA	5	6
Radius + Ulna ORIF	2	2.4
Talus ORIF	1	1.2
THR	3	3.6
Tibial IM nail	7	8.3
Tibial ORIF	14	16.7
TKR	3	3.6
Ulna ORIF	3	3.6
Total	83	100

4. Discussion

Surgical site infection (SSI) is defined as microbial contamination of the surgical wound within 30 days of a surgical procedure or within 1 year after surgery if an implant is placed in the procedure [8]. The incidence of SSI in our study was 4.95% which is comparable to the worldwide literature. It is stated that the estimated incidence in the US is 1.07% [9]. In a study conducted in an orthopaedic centre in the United States, the incidence was 2.55% [10]. Another Indian study among 1205 orthopaedic patients showed an incidence of 7.6% [6].

The majority of the patients affected by SSIs were males (62.7%). This has also been seen in the literature. It shows that male sex is a significant risk factor for SSIs [6,11]. Most of the SSIs are related to lower limb surgeries which can also be observed in other studies [10].

The commonest organism in our study is *pseudomonas* followed by *coliforms* which differs from other published literature. A very recent Indian study among orthopaedic patients revealed that *Staphylococcus aureus* was the most common pathogen causing SSIs (33%) [6]. Another US study also reveals that the most common infective organism was *Staphylococcus* species including MRSA, followed by *Acinetobacter* and *pseudomonas* species [10]. In a Chinese study, CONS(coagulase negative *staphylococcus aureus*) was the predominant SSI causative pathogen in orthopaedic surgery.

Although *Pseudomonas* is the most common organism isolated in our study, they are sensitive to a wide range of antibiotics. However, coliforms show resistance to a wide spectrum of antibiotics. This shows that SSIs and the antibiotic-resistant pattern have regional as well as institutional variations. This emphasises the need for institutional-based large-scale audits and implementation of institutional as well as national-wide antibiotic policies.

5. Conclusion

SSIs have a great impact on the outcome of orthopaedic surgeries. The incidence of SSI in our unit is 4.95%. Most SSIs occur in male patients. The common organism in our study population is Pseudomonas whereas *Staphylococcus aureus* is in other published literature. The organism and antibiotic resistance patterns have regional variations. The antibiotic policies should be based on local data and local guidelines which have to be updated with continuous auditing of data.

Limitation

A long study period with a large sample size has to be considered to make amendments to the local antibiotic policy. The risk factors and the outcome of the SSIs were not considered in this study.

Recommendation

The authors recommend a large-scale study to analyse the local antibiotic sensitivity pattern and the authorities to implement local antibiotic policies to treat and prevent SSIs.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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