

ORIGINAL RESEARCH

MRSA in orthopaedic implants with emphasis on associated risk factors

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ABSTRACT

Post-operative wound infection rate in implants and prosthesis is reported to be between two and thirteen percent. This makes it not only a problem to the surgeon but to all who have a stake in the care of Orthopaedic and trauma patients. The microbiology of post-operative wound infection in implants has changed very little over time except for the emergence of resistant organisms. Approval was obtained from the institutional ethical committee before the commencement of the study. Informed consent was obtained from the study population. All patients satisfying the inclusion criteria were documented. Patients were interviewed by structured questionnaire. In this study, the rate of proportion of risk factors was smoking 53 (68.83%) followed by alcoholism 43 (55.84%), open fracture 14 (18.18%), UTI 13 (16.88%), DM 8 (10.38%), anemia 6 (7.79%), malnutrition 5 (6.49%) HTN 4 (5.19%), and old age 2 (2.59%). Cefoxitin and Oxacillin disc sensitivity done on Muller-Hinton agar revealed that 14 (46.87%) were Methicillin resistant *Staphylococcus aureus* and 18 (56.25%) were Methicillin sensitive *Staphylococcus aureus*.

Keywords: Methicillin - Resistant *Staphylococcus Aureus*, Orthopaedic Implant Infections, Muller-Hinton Agar

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Introduction

Methicillin resistant *Staphylococcus aureus* (MRSA) strains emerged soon after the introduction of Methicillin into clinical practice. In addition to being a nosocomial pathogen, MRSA has become a community pathogen. Methicillin resistant (MR) *Staphylococci* are common and challenging pathogens associated with prosthetic joint infection (PJI).¹

Post-operative wound infection rate in implants and prosthesis is reported to be between two and thirteen percent. This makes it not only a problem to the surgeon but to all who have a stake in the care of Orthopaedic and trauma patients. The microbiology of post-operative wound infection in implants has changed very little over time except for the emergence of resistant organisms. Coagulase-positive and coagulase-negative *Staphylococci* account for 45 to 55% of these infections, regardless of the type of implant. The main organism associated with the SSI of Orthopaedic implant surgeries is *Staphylococcus aureus* (50%) followed by *E.coli* and *Proteus* (33.3%) and *Klebsiella* (16.6%). Methicillin - resistant *Staphylococcus aureus* (MRSA) strains were first

identified in 1961, immediately after the introduction of Methicillin in clinical settings. The Methicillin resistance in *Staphylococci* is due to acquisition of the *mecA* gene, which encodes the low-affinity Penicillin binding protein 2a. The presence of the *mecA* gene in *S.aureus* defines Methicillin resistance, while the absence of the gene indicates Methicillin susceptibility.²

Post-surgery Methicillin resistant *Staphylococcus aureus* (MRSA) infection can lead to considerable morbidity and mortality in Orthopaedic patients. Surgical site infections with *Staphylococcus aureus* in Orthopaedic patients are difficult to treat. Infection due to Methicillin-resistant *Staphylococci* showed a worse outcome. This resistance to treatment is primarily due to the development of a bacterial biofilm on the implant material. *Staphylococci* cycling to foreign bodies by specialised adhesins and form a biofilm which provides a niche hiding them from antibiotic access. Thus, infections of prosthetic devices cannot be controlled by antimicrobial therapy; therefore, they inevitably require surgical removal. Donlan *et al* recently defined the bacterial biofilm as a

sessile microbial community characterized by cells that attach to a substratum or to each other, are embedded in a matrix of extracellular polymeric substances that they have produced, and exhibit an altered phenotype with respect to growth rate and gene expression.^{3,4}

A combination of laboratory, histopathology, microbiology and imaging studies is required for diagnosis of prosthetic joint infection. Treatment often requires removal of the infected prosthesis and prolonged intravenous antimicrobial therapy.

Prevention of prosthetic joint infection includes augmentation of the host response, optimizing the wound environment, and reduction of bacterial deposition into the wound in preoperative, intraoperative, and postoperative periods.⁵

Currently the treatment options for MRSA infections are limited to very few and expensive drugs like Vancomycin and Teicoplanin. Vancomycin has emerged as a drug of choice in treating patients with Methicillin-resistant Staphylococci. However, resistance to Vancomycin has been reported against slime-producing Staphylococci.

A low incidence of the infection may depend upon the design of the operating theatre, meticulous surgical technique and rigid aseptic discipline.⁶

Methodology

Approval was obtained from the institutional ethical committee before the commencement of the study. Informed consent was obtained from the study population. All patients satisfying the inclusion criteria

were documented. Patients were interviewed by structured questionnaire.

Study population

Patients admitted with orthopaedic implant infection in orthopaedic post operative and septic ward.

Case definition

Diagnosis of orthopaedic implant infection is based on clinical data (pain, swelling and warmth of the joint, discharge and fever), together with one or more of the parameters mentioned below: elevated ESR, elevated C-reactive protein and leukocytosis over 12,000 or WBC less than 4000 cells.

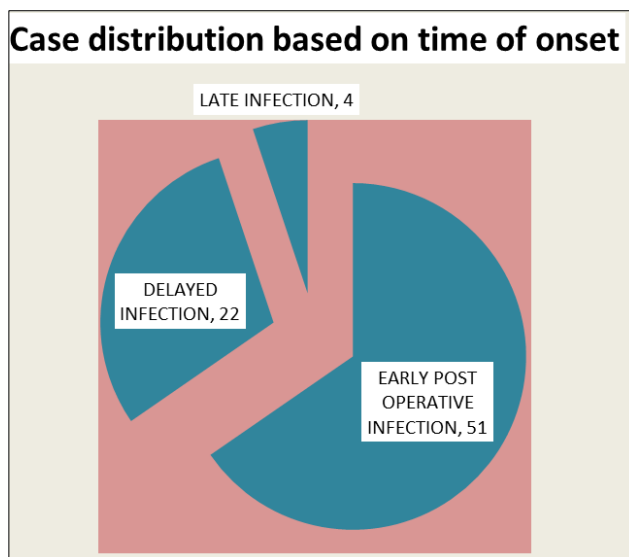
Inclusion criteria: Patients with infected Orthopaedic implants in Post-Operative and septic Orthopaedic wards.

Exclusion criteria: Isolation of polymicrobial flora.

Data collection

Data collection included name, age, address, date of admission, diagnosis at admission, physical examination finding. Date of surgery, duration of hospital stay, nutritional status, underlying illness (diabetes mellitus, uremia, chronic arthritis and concurrent urinary tract infection), type of implant, duration of procedures, smoking and alcoholism were also recorded.

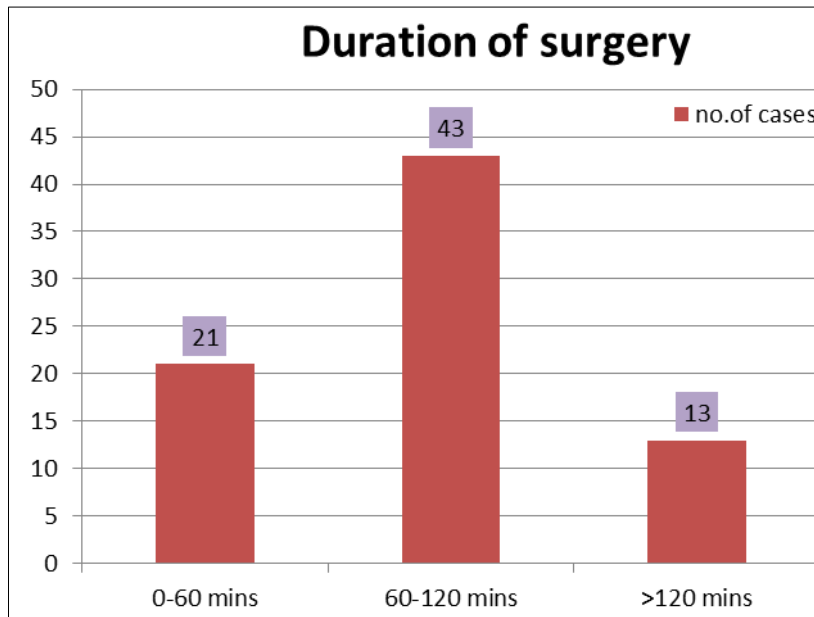
Results



Graph 1: Case distribution of Orthopaedic implant infections based on time of onset

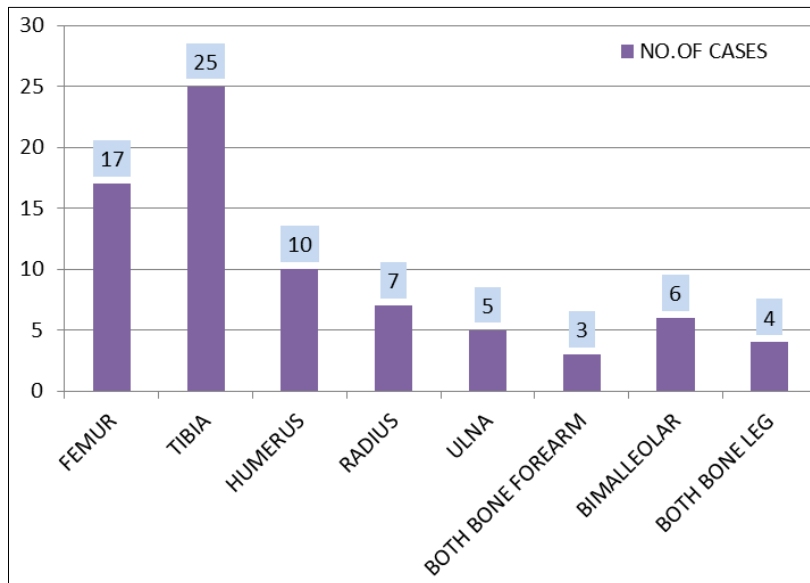
In our study, it showed that majority of cases, 66.23% were in early post-operative period, followed by

delayed infections 28.57% and 5.19% in late infections.



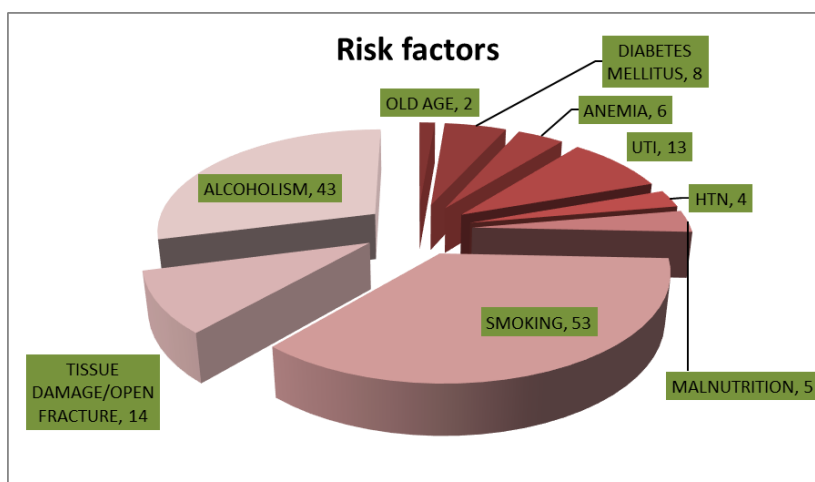
Graph 2: Infected cases based on duration of surgery

In this study, the duration of surgery > 120 mins comprised of only 13 (16.88%) cases. Only 21 (27.27%) cases had surgery within 0-60 mins and majority of surgeries between 60-120 mins were 43 (55.84%).



Graph 3: Case distribution of Orthopaedic implant infections based on site affected

In this study, tibia was the most common bone infected by femur 17 (22.07%), and humerus 10 (12.98%). 25 (32.46%) followed



Graph 4: Correlation between risk factors and Orthopaedic implant infection

In this study, the rate of proportion of risk factors was (16.88%), DM 8(10.38%), anemia 6(7.79%), smoking 53 (68.83%) followed by alcoholism 43 (55.84%), open fracture 14(18.18%), UTI 13 (2.59%), malnutrition 5 (6.49%) HTN 4 (5.19%), and old age 2 (2.59%).

Table 1: Distribution of *Staphylococcus aureus* based on Methicillin sensitivity

Methicillin sensitivity	Number	Percentage
MRSA	14	46.87%
MSSA	18	56.25%

Cefoxitin and Oxacillin disc sensitivity done on Muller-Hinton agar revealed that 14 (46.87%) were Methicillin resistant *Staphylococcus aureus* and 18 (56.25%) were Methicillin sensitive *Staphylococcus aureus*.

Discussion

In our study, 66.23% of infected cases were in early post-operative period, 28.57% in delayed and 5.19% in late infection. Roopashree *et al*⁷ found 54.34% of infected cases were in early post operative period, 26.08% in delayed and 19.56% in late infection in her study and Khosarvi A.D *et al*⁸ found 72.9% were in early postoperative period, 22.6% with delayed and 4.5% with late infections.

In our study, the duration of surgery > 120 mins comprised of only 13 (16.88%) cases. Only 21 (27.27%) cases had surgery within 60 mins and majority of surgeries, 43(55.84%) were between 60-120 mins. In a study done by Muhammad Shoaib Khan⁹,

prolonged surgery time was responsible for infections. Surgery length is directly connected with SSI events. Surgery length of more than 120 minutes is a risk factor for infection. Longer surgery length means increased tissue exposure time and team fatigue, enhancing technical errors and decreasing the organism’s systemic defenses.

In our study, it has been noted that infected implants were more common in surgeries done in tibia and femur, where tibia (32.46%) > femur (22.07%).

Infection has been noted in less numbers in other areas (humerus, radius, ulna, etc), in contrast to other studies by Roopashree *et al*⁷ where femur 34.74% was found to be infected more than tibia 28.26% and Anisha *et al*¹⁰ found femur 26% to be more affected than tibia 16%. The inherently low bloodflow to the cortical bone which is compromised to a greater extent by the surgical techniques required for device implantation. The reaming of the bone results in death of the tissue in the immediate area and further decreases the blood supply and an increased presence of a dead bony tissue.

In our study, the rate of proportion of risk factors was highest with smoking 53 (68.83%) followed by alcoholism 43 (55.84%), open fracture 14 (18.18%), UTI 13 (16.88%), DM 8(10.38%), anemia 6 (7.79%), malnutrition 5 (6.49%), HTN 4 (5.19%), and old age 2 (2.59%). Noted risk factors in Khosarvi AD⁸ were smoking 33.3%, diabetes 20.6% and drug addiction 1.8%. According to Marjoet *et al*¹¹ and Muhammad Shoaib Khan⁹, the duration of surgery is identified as the most important risk factor.¹²

Conclusion

MRSA was detected in 46.87% of isolates from infected cases. Hence, the choice of empiric antibiotics should be based both on local pathogen prevalence and antimicrobial susceptibility and on the identification of patients with selected clinical parameters at high risk of developing infections caused by resistant organism. In future, a more comprehensive

study with a long follow up period is needed to develop a good treatment protocol for Orthopaedic implant infections and also to create a good protocol for prevention of Orthopaedic implant infections.

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