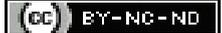


Prevalence of Methicillin Resistant *Staphylococcus aureus* Colonisation in Patients undergoing Total Joint Arthroplasty: A Retrospective Observational Study

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ABSTRACT

Introduction: Methicillin Resistant *Staphylococcus aureus* (MRSA) presents a significant, yet preventable, complication in Total Joint Arthroplasties (TJAs). Surgical Site Infections (SSIs) of prosthetic joints resulting from MRSA lead to substantial patient morbidity, mortality, and impose a significant burden on healthcare budgets. One method to mitigate these risks is to screen for MRSA colonisation prior to elective surgeries. The prevalence of MRSA colonisation in nasal mucosa ranges from 0.18-7.2% in different patient populations, with a nosocomial prevalence of 1.7%.

Aim: To determine the prevalence of MRSA colonisation in all patients undergoing elective TJA, including Total Hip Replacement (THR) or Total Knee Replacement (TKR).

Materials and Methods: A retrospective observational study was conducted on a total of 407 patients scheduled for elective TJAs. Data from 407 patients who underwent elective TJA between January 2020 and December 2022 (a period of three years) were selected for the study. Data compilation and analysis of the study subjects were performed retrospectively until March 2023 at the Sanjay Gandhi Institute of Trauma and Orthopaedics, a tertiary care Orthopaedic centre in Bengaluru,

Karnataka, India. The study subjects were screened for MRSA colonisation through nasal swab culture and sensitivity. Patients with positive MRSA culture results were treated with decolonisation therapy, which involved the local application of 2% mupirocin and chlorhexidine body wash for five days. Descriptive data analytics were employed in the study, and tables were generated using Microsoft Word 2010 and Microsoft Excel 2010 (Microsoft Corp, Redmond, WA, USA).

Results: The prevalence rates of MRSA nasal colonisation were n1=8 (8.42%), n2=2 (2%), and n3=16 (7.55%) for the years 2020 (n1), 2021 (n2), and 2022 (n3), respectively, at the centre. The period prevalence rate of MRSA colonisation in the nasal mucosa over three years was N=26 (6.4%).

Conclusion: The present study revealed a high period prevalence of MRSA colonisation (6.4%) in patients undergoing TJAs. Therefore, all elective TJAs should undergo MRSA screening and decolonisation using 2% intranasal mupirocin and daily chlorhexidine body wash for five days as a successful treatment modality for all patients with MRSA-positive nasal colonisation. This approach helps prevent postoperative SSIs caused by MRSA.

Keywords: Arthroplasty, Chlorhexidine bodywash, Surgical site infections

INTRODUCTION

The most common organism causing joint infections is *Staphylococcus aureus*, and its colonisation in the anterior nares is 25 to 30% in the general population. Therefore, carriers of *S. aureus* are at an increased risk of developing SSI postoperatively [1]. Postoperative infections are reported to be ten times greater in *S. aureus* carriers than in non carriers in developed countries, although recorded data is lacking for the developing world [2]. The two primary subtypes of *S. aureus* are Methicillin-Sensitive *S. aureus* (MSSA) and the more virulent MRSA. The risk of infection in MRSA-colonised patients is greater than in patients who are not colonised with MRSA [3].

MRSA is a major adverse but preventable postoperative wound infection in TJAs. SSIs of the prosthetic joints due to MRSA lead to considerable patient morbidity, mortality, and contribute to a large burden on the healthcare budget [4]. As it is a preventable condition, the present study was conducted to screen for MRSA colonisation prior to elective surgeries and to calculate the prevalence of MRSA in patients undergoing elective TJAs. Since data on the prevalence of MRSA nasal colonisation in the centre is lacking, the study was conducted. MRSA is the most common cause of skin, soft-tissue, and procedure-related infections [5]. Annually, the prevalence and burden of MRSA are more than 50% of all invasive infections in the United States and around 30-40% in India, with anterior nares being one of the reservoirs for MRSA carriage [6,7]. The average

prevalence of MRSA colonisation in north India was 26.14-43% in different patient populations [8]. Colonisation of nasal mucosa by MRSA, its identification, and prevention through a standard treatment protocol are considered modifiable risk factors [9].

Several studies have shown the prevalence of *S. aureus* in patients undergoing TJA in developed countries, but in developing countries, there is limited epidemiological data [10,11]. The aim of the present study was to determine the prevalence of MRSA colonisation in a population undergoing elective TJAs, and the objective was to reduce the risk of SSIs due to MRSA. Based on the prevalence of MRSA colonisation, this study enables us to evaluate and manage MRSA-colonised patients who undergo elective TJAs. All patients positive for MRSA colonisation were treated with 2% intranasal mupirocin and daily chlorhexidine body wash for five days as a successful prophylactic measure.

MATERIALS AND METHODS

A retrospective observational study was conducted on a total of 407 patients. Data from 407 patients who underwent elective TJAs from January 2020 to December 2022 (for a period of three years) were selected for the study. The data compilation and analysis of the study subjects were completed until March 2023 at Sanjay Gandhi Institute of Trauma and Orthopaedics, a tertiary care Orthopaedic centre in Bengaluru, Karnataka, India, retrospectively.

Inclusion criteria: All elective cases with an age greater than 18 years, planned for TJA (either knee or hip replacement), in our hospital from January 2020 to December 2022 were included in the study.

Exclusion criteria: All emergency surgeries, prior SSIs, pathological fractures, intra-articular steroid injections in the last two months, patients aged less than 18 years, and patients who required revision Total Hip Arthroplasty (THA) or Total Knee Replacement (TKR) were excluded from the study.

The prevalence of a disease is the probability of having the disease (MRSA) at a specific point or period in time for a defined population. A mathematical formula was used to calculate the sample size required for a prevalence study. The prevalence rate was calculated using the following formula:

(New and pre-existing cases of the disease during the same period/ Population size during the same period)×100 [12].

The period prevalence was calculated using the formula: [12]

Period prevalence rate (%)=(Total number of all infected cases for a period/ Total population for the same period)×100.

Period prevalence rate of MRSA colonisation (%)=(Total number of all TJAs tested positive for MRSA for a given period/Total number of all TJAs screened for MRSA for the same period)×100

All study subjects (407) were screened for MRSA colonisation through nasal swab culture and sensitivity. This was a time-bound study; hence, only the records available during the study duration were considered. Patients with positive MRSA culture results (26) were treated with decolonisation therapy, which involved local application of 2% mupirocin and chlorhexidine body wash for five days. Routine medical clearance was obtained from each patient. After obtaining consent from all eligible patients, demographic data of age, gender, and co-morbid conditions such as diabetes mellitus and hypertension were collected. Patients undergoing elective TJA were screened for MRSA through nasal swab culture and sensitivity test at the centre. Nasal swabs were collected and plated on Blood agar media. After 18-24 hours of incubation, colonies resembling *Staphylococcus aureus* (i.e., β-haemolytic colonies) were picked and identified through smear and biochemical tests. Sensitivity testing for cefoxitin (Methicillin) was performed using the standard Kirby Bauer disc diffusion method [6,13], and results were reported within 48 hours of sample collection as either MRSA positive or negative. The 26 patients who tested positive for MRSA were treated with nasal application of 2% mupirocin ointment and chlorhexidine body wash twice daily for five consecutive days [2]. After five days of treatment, a repeat nasal swab for MRSA culture and sensitivity was performed. After decolonisation, all 26 patients who initially tested positive for MRSA became negative after one course of treatment. Only patients with negative MRSA screening culture underwent TJA at the centre. Once the results were negative, patients proceeded with TJA. The surgeon followed the standard clinical practice of preoperative scrubbing, painting with povidone iodine solution, draping, and the use of a prophylactic antimicrobial regimen.

The antibiotic used was injectable ceftriaxone 1 g intravenously, administered one hour prior to surgery, and a second dose at the end of surgery for a total of two doses.

STATISTICAL ANALYSIS

Descriptive data analytics were conducted in the present study. Results for continuous measurements are presented as mean±SD, while results for categorical measurements are presented as counts (%). The statistical software used for data analysis was Statistical Analysis System (SAS) version 9.2 for Windows, developed by SAS Institute Inc., Cary, NC, USA, and the Statistical Package for Social Sciences (SPSS Complex Samples) Version 21.0 for Windows, developed by SPSS, Inc., Chicago, IL, USA. Microsoft Word 2010

and Microsoft Excel 2010, developed by Microsoft Corp, Redmond, WA, USA, were used to generate tables.

RESULTS

In the present study, a total of 407 patients underwent TJAs during the three-year study period from January 2020 to December 2022. They were screened for MRSA prior to TJAs (TKR and THR).

A total of 95,100 and 212 patients underwent TJA in the years 2020, 2021, and 2022, respectively. The data of all the patients is shown in [Table/Fig-1].

	Year 2020	Year 2021	Year 2022	Total
THR	50 (20.66%)	52 (21.49%)	140 (57.85%)	242 (59.46%)
TKR	45 (27.27%)	48 (29.09%)	72 (43.64%)	165 (40.54%)
Total	95	100	212	407

[Table/Fig-1]: Total number of THR and TKR patients screened for MRSA. THR: Total hip replacement; TKR: Total knee replacement

The study patient's age and gender variables are as mentioned in [Table/Fig-2,3], respectively. The majority of the patients who underwent TJAs were in the age group of 41-60 years, among whom females were predominant.

Age (years)	2020 (n=95)	2021 (n=100)	2022 (n=212)
<40	0	2 (2%)	12 (5.66%)
41-60	51 (53.68%)	69 (69%)	165 (77.83%)
>60	44 (46.32%)	29 (29%)	35 (16.51%)
Mean age	60.00±8.85	59.62±14.12	56.91±6.91

[Table/Fig-2]: Age variable in all TJAs screened for MRSA.

Gender	2020 (year) (n=95)	2021 (n=100)	2022 (n=212)
Female	82 (86.32%)	86 (86%)	140 (66.04%)
Male	13 (13.68%)	14 (14%)	72 (33.96%)

[Table/Fig-3]: Gender variable in all TJAs screened for MRSA.

Among the 407 subjects screened for MRSA, a total of 76 patients had diabetes mellitus, and 89 had hypertension as co-morbid illnesses, which were treated and well controlled prior to surgery [Table/Fig-4].

Co-morbidities	2020 (n=95)	2021 (n=100)	2022 (n=212)	Total (n=407)
DM	24 (25.26%)	18 (18%)	34 (16.03%)	76 (18.67%)
HTN	19 (20%)	12 (12%)	58 (27.35%)	89 (21.86%)

[Table/Fig-4]: Co-morbid illness in TJAs screened for MRSA. DM: Diabetes mellitus; HTN: Hypertension

In the present study, the prevalence rates of MRSA nasal colonisation were 8.42%, 2%, and 7.55% for the years 2020, 2021, and 2022, respectively. The dip in the prevalence rate in 2021 to 2% was due to the COVID-19 pandemic. Surgeries were deferred during 2021 as per government restrictions for elective surgeries. The period prevalence of MRSA colonisation in nasal mucosa for a period of three years was 6.3%. All 26 MRSA-positive patients underwent decolonisation with 2% intranasal mupirocin and chlorhexidine bodywash for a period of five days (see [Table/Fig-5]). After completing the treatment, those 26 patients were rescreened for MRSA colonisation, and all had negative MRSA culture results (100% decolonisation achieved).

Year	MRSA positive	Total population undergoing TJA	Prevalence
2020	8	95	8.42% (n1)
2021	2	100	2% (n2)
2022	16	212	7.55% (n3)
Total for 3 years	26	407	6.4% (N)

[Table/Fig-5]: Prevalence rate of MRSA colonisation in the three year study period.

TJA was performed after ensuring negative reports on repeat culture of nasal swabs for MRSA.

DISCUSSION

As patients colonised with *S. aureus* have a nine- to ten-fold increased risk of developing SSIs [1,2], and MRSA colonisation confers an additional four-fold increased risk of infective complications compared to MSSA colonisation [2], this study was conducted to assess MRSA colonisation and its prevalence in all patients admitted for elective TJAs in this study. The risk factors associated with *S. aureus* colonisation are poorly defined. Common risk factors include gender, age, recent hospitalisation, ethnicity, genetic predisposition, diabetes mellitus, Human Immunodeficiency Virus (HIV), haemodialysis, other concurrent skin infections, and misuse of antibiotic treatment [14,15].

The approach to MRSA screening differs among institutions. It is influenced by the institution's SSI rates in TJAs due to MRSA, patient subpopulations seen, and treatment provided accordingly [16]. Hence, the present study aimed to determine the prevalence of MRSA colonisation in a subset of the population undergoing TJAs admitted to the centre. These patients are subjected to "screen and treat protocol" (i.e., screening all TJAs for MRSA colonisation prior to surgery and treatment of MRSA positive patients with 2% intranasal mupirocin and daily chlorhexidine body wash for five days and to ensure decolonisation of MRSA).

The present study had a prevalence rate of 6.4% for MRSA nasal colonisation among 407 patients undergoing elective TJAs, compared to other studies as shown in [Table/Fig-6] [17-19]. The higher prevalence rate of 6.4% for MRSA colonisation in the present study could be attributed to the higher incidence and prevalence of MRSA colonisation on the skin and mucosa in the local community.

Authors	Country	Study population	Prevalence
Present study	India	407	6.4%
Hadi H et al., [17]	Iran	226	1.8%
Tsang STJ et al., [18]	UK	273	2.3%
Baratz MD et al., [19]	USA	3434	5%

[Table/Fig-6]: Comparison of prevalence rate of MRSA nasal colonisation with other studies in cases undergoing elective TJAs [17-19].

A larger study in the general population needs to be conducted to determine the actual prevalence in the local community. A total of 100% decolonisation was achieved in all 26 MRSA-positive patients by treating them with 2% intranasal mupirocin and chlorhexidine bodywash for a period of five days before undergoing TJA. However, similar studies conducted by Pietrzak JRT et al., and Moroski NM et al., showed MRSA decolonisation rates of 98% and 92%, respectively [2,20]. Jeans E et al., demonstrated that MSSA decolonisation was more effective than MRSA decolonisation using nasal mupirocin application and chlorhexidine bodywash for five days [21].

Therefore, the use of intranasal mupirocin and chlorhexidine bodywash has shown promising results. Among the two most common treatment protocols, namely the "Screen and Treat" protocol [22,23] and the policy of universal decolonisation [16], the present study supports the efficacy of screening and subsequently treating patients colonised with MRSA. Studies conducted by Åkesson P et al., Sousa RJ et al., Schweizer ML et al., Kohler P et al., and Sai N et al., have also suggested the screen and treat protocol for MRSA colonisation prior to TJAs to prevent SSIs, which aligns with the findings of the present study [16,24-27].

Limitation(s)

The present study was conducted at a single centre, and the prevalence rate was influenced by the Coronavirus Disease-2019 (COVID-19) pandemic, which resulted in the deferral of elective surgeries.

CONCLUSION(S)

The periodic prevalence rates of MRSA colonisation in patients undergoing elective TJAs at the centre were 8.42%, 2%, and 7.55% in the years 2020, 2021, and 2022, respectively. The dip in the period prevalence rate in 2020 was due to the COVID-19 pandemic, as all elective surgeries were deferred during this period at the centre. The overall periodic prevalence rate of MRSA nasal colonisation in all elective cases undergoing TJAs during the three-year study period was found to be 6.4%. There was a high prevalence of MRSA colonisation in patients undergoing TJAs at the centre. Therefore, it is advisable to perform routine MRSA screening on all elective cases undergoing TJAs to reduce the risk of postoperative MRSA septic sequelae. The present study recommends MRSA screening and decolonisation with intranasal 2% mupirocin and Chlorhexidine bodywash daily for five days as a successful treatment modality for nasal MRSA-positive patients.

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