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## Evaluation of risk factors of late Periprosthetic joint infection: A retrospective study

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### Abstract

**Background:** Prosthetic Joint Infection that develops at a variable length of time after an index joint replacement procedure is known as Late Prosthetic Joint Infection. There must be an asymptomatic period clinical and/or radiographic signs, after an initially successful index procedure. The current study aims to retrospectively identify the risk factors for late PJI following primary total joint arthroplasty and classify those significant risk factors as either non-modifiable or potentially modifiable for intervention prior to surgery. Till date not many studies has been done in Indian subcontinent, which prompted us for the study.

**Material and Methods:** We report our experience in 33 cases of Late PJI and its causative factors including microorganisms and its subsequent management, of deep infection following over 5000 primary joint replacements carried out over 6 years (2013 may to 2019 September) at IMS & SUM Hospital, Bhubaneswar. All patients were followed up for delayed PJI for a minimum period of one year postoperatively involving review of all readmissions, returns to the operating room, positive cultures, morbid obesity, UTI, dental procedures, UGI endoscopy, skin diseases etc.

**Results:** Significant risk factors for late PJI after primary TJA included active tobacco use, diabetes and related comorbidities, *S. aureus* colonization, UTI, morbid obesity, skin diseases, UGI endoscopy, male gender, age  $\geq 55$  yrs. These risk factors can be broadly divided into modifiable and non-modifiable risk factors. Modifiable risk factors like such active tobacco use and *S. aureus* colonization can be eliminated to reduce the incidence of late PJI.

**Conclusion:** The current study aims to identify the risk factors of late PJI after primary arthroplasty, thus patients can be counselled properly prior to undergoing TJA, which should help them make treatment decisions regarding these procedures. Apart from this the modifiable risk factors can be addressed prior to surgery, thus the overall incidence of late PJI can be reduced.

**Keywords:** Delayed, peri prosthetic joint infection, primary arthroplasty, risk factors, modifiable, non-modifiable

### Introduction

Late Periprosthetic joint infections (PJI) following a primary total joint arthroplasty (TJA) are rare complications but can lead to inferior outcomes. The incidence of late PJI following Total Knee Arthroplasty ranges from 0.5% to 1.8% [1, 3] and the incidence can be even higher in high-risk groups [4]. Late PJI develops at a variable length of time after the primary arthroplasty procedure. There is an asymptomatic period clinical and/or radiographic signs, after an initially successful index procedure. Late PJI is distinct from infections occurring due to intraoperative contamination. As regards definition of late PJI, most of the literature have suggested that any infection occurring after one year of primary Arthroplasty should be considered as late. Coventry defined 3 stages of PJI. Stage I is an acute infection that occurred within 3 months of the index procedure. Stage II is a delayed infection that occurred between 3 months and 2 years after the index procedure where there was no pain-free interval. Stage III is a hematogenous infection where there is a pain-free stage [5]. Garvin and Hanssen defined a late PJI as one that occurred 4 weeks after the index procedure with an insidious clinical onset [6]. McPherson *et al.* defined a chronic infection as one that had symptoms for 4 weeks or longer [7]. Fares Haddad *et al.* classified late PJI as late hematogenous PJI, where there was an asymptomatic period followed by clinical and/or radiographical signs of infection.

The workgroup feels that late PJI arises as a result of bacteraemia at a later stage [8] and should be differentiated from infections occurring due to intraoperative contamination. A number of policies have been adopted perioperatively to minimize the incidence of infection including antibiotic prophylaxis, surgical site preparation, contained surgeon exhaust suits, laminar airflow, and bacterial decolonization of *Staphylococcus aureus* [9, 10]. Elimination of modifiable risk factors prior to surgery can reduce the risk of infection following total joint arthroplasty. The aim of the current study is to, retrospectively identify the risk factors for late PJI following primary total joint arthroplasty and to classify them as non-modifiable or modifiable for intervention prior to surgery. Some of the patient-related factors like diabetes, obesity, *S. aureus* colonization, and tobacco use have been associated with increased risk of late PJI following total joint arthroplasty [1, 9, 11, 12, 13].

**Material and Methods:** We analyzed data from 33 primary arthroplasty procedures performed at IMS&SUM Hospital, Bhubaneswar which ended up in delayed PJI. All patients were monitored for delayed PJI for a minimum period of one year postoperatively through an aggressive hospital surveillance program involving review by our infection control department of all readmissions, returns to the operating room, and positive cultures. Prior to surgery, only 16 patients were screened for nasal colonization of *S. aureus*, prescribed a 5-day course of mupirocin ointment for nasal decolonization, and provided chlorhexidine wipes for application to the skin the evening before and morning of surgery. Among the rest 17 patients who were not screened for nasal colonization of *S. aureus*, 2 showed growth of *S. aureus* from wound. Infection prophylaxis during the study timeframe involved administration of intravenous antibiotics within 1 hour prior to incision and continued 24 hours postoperatively. For patients who screened positive for methicillin resistant *S. aureus* (MRSA), vancomycin was administered as prophylaxis while a second-generation cephalosporin was administered for patients with a negative screen for MRSA. Surgical approach, anaesthesia type, and implant type varied based on patient characteristics and surgeon preference. Postoperative wound management involved sterile dressing for a period of 1–3 days postoperatively with serial dressing changes as needed until the wound was dry. Deep vein thromboembolism (DVT) prophylaxis involved various regimens each of which adhered to the recommendations of the American College of Chest Physicians (ACCP) and the American Academy of Orthopaedic Surgeons (AAOS). Patient demographic and comorbidity data abstracted through the medical chart review are listed in Table 1-7. Diabetes status that involved a positive history of diabetes mellitus and any related organ damage such as retinopathy, neuropathy and nephropathy, was noted. Tobacco use was defined as use within one month prior to surgery. Modifiable risk factors were defined as those factors that could potentially be treated or optimized prior to elective surgery. Questionnaire to study the risk factors subdivided into 3 groups-Hospital related factors, Perioperative factors, Patient related factors.

## Analysis

**Table 1:** (Total entries)

Total entries	Unilateral	Bilateral
TKR	21	3
THR	5	1
TSR	3	0

**Table 2:** (Sex Distribution)

Sex	u/l TKR	b/l TKR	u/l THR	b/l THR	u/l TSR	b/l TSR
Male	15	2	3	1	2	0
Female	6	1	2	0	1	0

**Table 3:** (Hospital Related Risk Factors)

Hospital Related Risk Factors	No. of cases attributed
Screening for MRSA by nasal & perineal swab	3 (9.09%)
Catheter associated UTI	9(27.27%)
Central line associated	0

**Table 4:** (Peri-operative Risk Factors)

Peri-operative Risk Factors	No. of cases attributed
Optimisation of surgical environment	0
Prophylactic Antibiotic Administration preparation of surgical site	0
Contained exhaust suit for surgeon	0
Laminar airflow OT	0
Bacterial Decolonization of <i>Staph. aureus</i>	0

## Patient Related Factors

**Table 5:** (Non-modifiable Factors)

Non-modifiable Risk Factors	No. of cases attributed
Sex (Male gender)	23(69.69%)
Age(>=55yrs)	24(72.72%)

**Table 5:** (Disease Related Risk Factors)

Disease Related Risk Factors	No. of cases attributed
Diabetes & related Comorbidities	12(36.36%)
Cardiac comorbidities	3(9.09%)
GI comorbidities	3(9.09%)
Pulmonary Comorbidities	1(3.03%)
Skin diseases	6(18.18%)
Renal comorbidities	3(9.09%)
Immunocompromised.	2(6.06%)

**Table 6:** (Life style Related Risk Factor)

Life style Related Risk Factor	No. of cases attributed
Tobacco use 1month prior to surgery	3(9.09%)
Morbid obesity	9(27.27%)

**Table 7:** (Medical Procedure Related Risk Factors)

Factors	No. of cases attributed
Dental Procedures	2(6.06%)
UGI endoscopy	4(12.12%)
Colonoscopy	3(9.09%)

**Table 8:** (Organisms Isolated)

Organisms Isolated	No. of cases
Klebsiella	5(15.15%)
Enterococci	3(9.09%)
Acinetobacter	5(15.15%)
Enterobacter cloacae	3(9.09%)
<i>Staph. aureus</i>	3(9.09%)
<i>E. coli</i>	12(36.36%)
<i>Pseudomonas</i>	2(6.06%)

**Table 9:** (Management options)

Management options	No. of cases
Debridement only	3(9.09%)
Debridement with insert exchange	10(30.30%)
2 stage revision	18(54.54%)
Arthrodesis	2(6.06%)

### Discussion

Late PJI following primary arthroplasty can lead to inferior outcomes and increased costs. The current study aims to identify risk factors of late PJI following primary arthroplasty and to classify them as non-modifiable or modifiable by intervention prior to surgery. Significant risk factors for infection after primary TKA included active tobacco use, DM and *S. aureus* colonization. Some of these risk factors such as tobacco use and *S. aureus* colonization are potentially modifiable, and efforts to minimize or eliminate these modifiable risk factors may help to improve late PJI rates following primary TJA. Several studies have suggested association between *S. aureus* nasal colonization and development of PJI [12, 14, 15]. 18–24% of the general population I have been shown to be colonized with *S. aureus* [16, 17]. Surgical site infection (SSI) involving *S. aureus* is associated with preoperative nasal colonization [18]. In our study *S. aureus* colonization is a significant and independent risk factor for late PJI following primary arthroplast, with a total of 3 cases (9.09%) out of 33 cases. Tobacco use among our patients within one month prior to surgery was an independent and significant predictor of risk for infection following primary arthroplasty, with a total of-cases. Singh *et al.* suggested that active tobacco use had a significantly increased risk compared to those with no prior tobacco use [19]. In our study we found that active tobacco use had additive effects with other risk factors. Uncontrolled diabetes is usually associated with increased risk of infection and poor wound healing [9]. Marchant *et al.* found uncontrolled diabetes can increase infection rates by two-fold [20]. In the our study population, a diagnosis of diabetes with related complications were found to be a significant and independent risk factor for late PJI, with a total of 12cases (36.36%). 9cases had morbid obesity (27.27%). Medical procedures like, dental procedures, GI endoscopy prior to primary arthroplasty can cause bacteraemia and has been attributed as potential risk factor for PJI. In our study population, 4 patients (12.12%) had undergone upper GI endoscopy, 2 cases (6.06%) dental procedures and 3(9.09%) cases had undergone colonoscopy. In our study *E. coli* was the most common organism isolated, with 12cases (36.36%) showing growth of the organism, followed by *Klebsiella* and *Acinetobacter* 5cases each (15.15%). 18cases (54.54%) were managed by two stage revision surgery, where stage-I involved, removal of implants, thorough debridement, antibiotic spacer placement and administration of IV antibiotics as per the culture and sensitivity reports. Stage-II involved removal of spacer and application of revision implants, once parameters like ESR, CRP became normal following application of antibiotic spacer and IV antibiotic administration. 10 cases (30.30%) were managed with thorough debridement, insert exchange and administration of IV antibiotics. 3 cases (9.09%) with superficial infections were managed with thorough debridement and antibiotics. 2 cases (6.06%) with failed revision surgeries due to recurrent infections, were managed by arthrodesis of the joint involved along with IV antibiotics.

### Conclusion

The current study aimed to identify the risk factors of late PJI after primary arthroplasty, thus patients can be counselled

properly prior to undergoing total Joint arthroplasty, which should help them make treatment decisions regarding these procedures. Apart from this the modifiable risk factors can be addressed prior to surgery, thus the overall incidence of late PJI can be reduced.

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