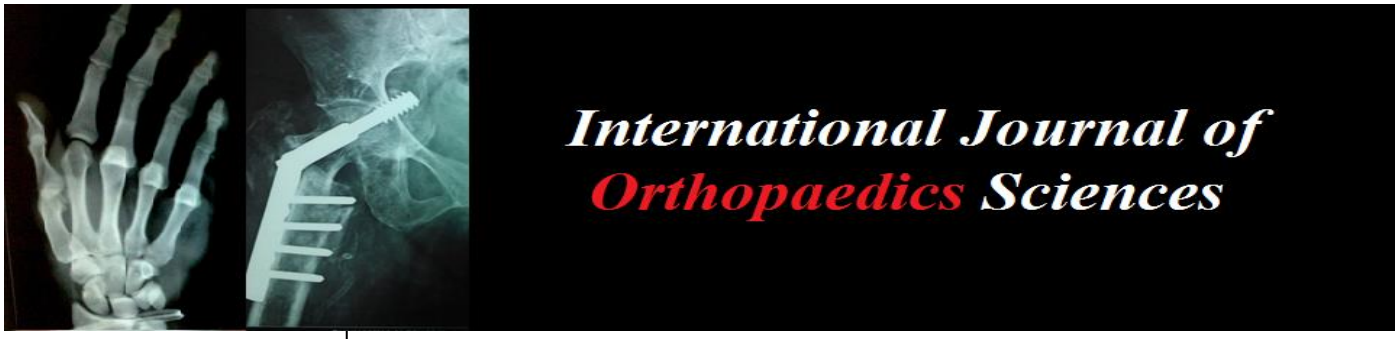

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Microbiology of total knee arthroplasty

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Abstract
Objective: The aim of the study identify the common organism causing Prosthetic Joint Infection (PJI) and the drug resistance spectrum of the most common organisms causing PJI, to help in choosing appropriate antibiotics.
Methods: The study was a retrospective study of the patients who received revision and re-revision of total knee arthroplasty for different reasons in our institution from August 2016 to August 2019. The isolated bacteria strains and drug-resistance rates for each pathogen for different antibiotics were presented.
Results: There were 36 cases in the infectious group and 29 cases in the non-infectious group (PJI was diagnosed according to the diagnosing criteria from the Workgroup of the Musculoskeletal Infection Society). Of the 36 strains isolated, Gram-positive bacteria were the most common pathogenic organisms. *Staphylococcus aureus* (11, 39.28%) was the most common pathogen followed by *Staphylococcus epidermidis* (7, 25.00%) and *Corynebacterium* (5, 17.86%). Penicillin (86.11%), erythromycin (50.00%) and clindamycin (53.37%) showed high antibiotic resistance rate. In addition, the second-generation cephalosporins, usually as the prophylactic antibiotic, resistance rate was high (20%).
Conclusion: This study provides some information on the most common organisms at our institution and the selection of antibiotics in the peri-operative period. Cefuroxime and clindamycin might not be appropriate for use as prophylactic antibiotics in revision total knee or hip arthroplasty. Vancomycin is ideal for empiric antibiotic use in suspected PJI cases because of the low drug-resistance rate.

Keywords: Total knee arthroplasty, PJI, vancomycin

Introduction
Total knee arthroplasty has been considered in recent times as a successful and cost-effective method of alleviating knee pain in patients with osteoarthritis of knee [1]. The total numbers of arthroplasties have been increasing steadily, as a result of which the number of revision arthroplasties are also on the increase.
Although, the 10 year survivals of the arthroplasties are close to 94%, aseptic loosening and prosthetic joint infection are still major reasons for revision surgery [2, 3]. Prosthetic joint infections are a severe and cumbersome complication to both surgeon and the patient following total knee arthroplasty, and account for 22% of all the revision arthroplasties performed [1, 3, 4].
The prevalence of PJI in patients undergoing TKA's is about 1% and with such high number of patients undergoing the revision surgeries, it is important for the surgeon to understand the reasons for PJI following TKA [3, 5, 6]. The treatment of PJI is quite different from patient without PJI for revision arthroplasty. Although there are biomarkers such as interleukin-6 (IL-6) have improved the specificity, diagnosis of PJI remains difficult for orthopaedic surgeons [7, 8]. In addition sometimes low grade infections may be underdiagnosed as some cases are recognised as aseptic loosening.
Although there are methods such as use of prophylactic antibiotics to lower the incidence of PJI, joint infection is still the most dreadful reason for failure of TKA. It is often associated with substantial morbidity and significant health care expenditure [8, 9, 10].
The epidemiology of PJI associated microbiological and related drug resistance conditions vary among various countries. *Staphylococcus aureus* and *Staphylococcus epidermidis* are most common pathogens identified [3, 4, 10].

For patients with PJI's extended use of antibiotics is necessary and drug resistance should not be over looked. Accurate microbiological diagnosis of PJI is essential for success of the whole treatment and could permit the use of effective antibiotic.

The present study examined the common microorganisms and drug related resistance of bacterial strains, to provide additional data on PJI in India and to help surgeons choose appropriate antibiotics.

Materials and Methods

Patients

This was a retrospective descriptive study of the patients who received revision and re-revision of total knee arthroplasty for different reasons in our institution from August 2016 to August 2019. PJI is diagnosed according to the diagnosing criteria from the Workgroup of the Musculoskeletal Infection Society [11]: (i) there is a sinus tract communicating with the prosthesis; or (ii) a pathogen is isolated by culture from at least two separate tissue or fluid samples obtained from the affected prosthetic joint; or (iii) four of the following six criteria exist: (a) elevated serum erythrocyte sedimentation rate (ESR) and serum C-reactive protein (CRP) concentration, (b) elevated synovial leukocyte count, (c) elevated synovial neutrophil percentage (PMN%), (d) presence of purulence in the affected joint, (e) isolation of a microorganism in one culture of periprosthetic tissue or fluid, or (f) greater than five neutrophils per high-power field in five high-power fields observed from histological analysis of periprosthetic tissue at ×400 magnification.

The exclusion criteria included: (i) patients who lacked any of the essential examinations for the diagnosis of PJI; (ii) revision total knee arthroplasty for periprosthetic fracture; and (iii) patients who received revision total knee arthroplasty for metal allergy.

Data Collection

This was a retrospective study of all the patients who underwent revision total knee arthroplasty at BIRRD (T) Hospital during the period of August 2016 to August 2019. All the demographic data, laboratory data and data regarding the primary and secondary surgery were collected.

Statistical Methods

Patients were divided into two groups according to the diagnosis criteria. Patients who met the criteria for PJI were identified as the infectious group; the others were identified as the non-infectious group. Continuous variables are reported as the mean and the standard deviation (SD), and categorical variables are reported as proportions. Differences between groups at the baseline were assessed using the two-sided *t*-test and the χ^2-test for continuous and categorical variables, respectively. Statistical significance was set as $P < 0.05$. All statistical analyses were performed using IBM SPSS software for Windows version 20.0 (SPSS, Chicago, IL, USA).

Results

The demographic characteristics of 65 patients who underwent revision total knee arthroplasty for various reasons are presented in Table 1. No significant differences were found in sex and age between the two groups. The median survival duration of prosthesis in the infection group was 3.0 years and 6.5 years in non-infectious group, there was statistical difference between the groups (X^2 =118.22, P<0.001)

Table 1: Baseline characteristics

Groups	N	Gender (male/female)	Age (years, mean)
Infectious group	36	23/13	65.1
Non-infectious group	29	17/12	64.4
P-value		0.209	0.778

Pathogens

In total, 30/36 patient's microbiological culture in the infectious group and 4/29 patient's microbiological culture in the non-infectious group showed positive results and 36 strains of pathogens were isolated of which 28 (77.77%) were gram positive and 8 (22.22%) were gram negative.

Among gram positive pathogens, *Staphylococcus aureus* (11, 39.28%) was the most common pathogen followed by *Staphylococcus epidermidis* (7, 25.00%) and *Corynebacterium* (5, 17.86%). Three cases of mixed pathogen infection were observed, of which 2 pathogens were isolated in 2 cases (*Staphylococcus epidermidis* and *Micromonas luteus*) and 1 case of *Staphylococcus hemolticus.* Among gram negative organisms, *Enterococcus faecium* (4, 50%) was the most common followed by a case of each *Propinobacterium acnes, Pseudomonas aeruginosa, Serratia marcescens* and *Enterococcus fecalis.* (Figure 1).

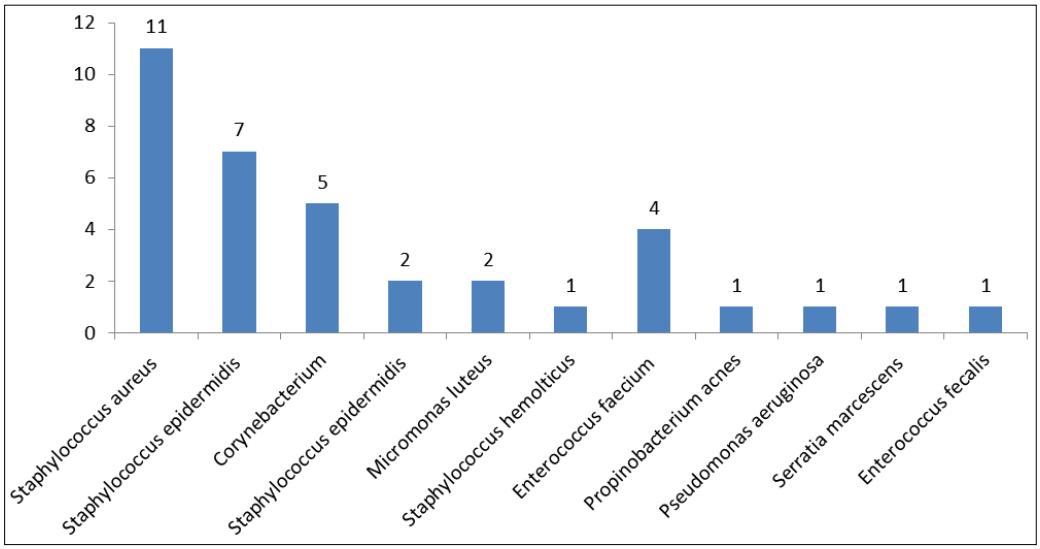

Fig 1: Strains of bacteria isolated

Penicillin, cephalosporin, macrolides, antitubercular drugs showed high resistance (Table 2). Of the 11 strains of *Staphylococcus aureus* observed almost all of them are penicillin resistant and erythromycin resistant and meanwhile, approximately half of them were clindamycin and cotrimoxazole resistant. Two strains of *Enterococcus faecium* and 1 strain of *Enterococcus fecalis* were found and were resistant to aminoglycosides. No Vancomycin resistant bacterium found.

Table 2.

Drug	Total number	Drug resistant strain	Percentage
Penicillins			
Oxacillin	36	20	55.56
Penicillin	36	31	86.11
Ampicillin	36	20	55.56
Piperacillin	36	11	30.56
Cephalosporins			
Ceftriaxone	36	13	36.11
Cefotaxime	34	7	20.59
Cefazolin	36	3	8.33
Cefepime	34	4	11.76
Cefuroxime	23	2	8.70
Cefotetan	23	3	13.04
Carbapenems			
Imepenem	36	2	5.56
Meropenem	36	3	8.33
Beta-lactams			
Piperacillin/Tazobactum	36	1	2.78
Cefoperazone/Sulbactum	36	2	5.56
Aminoglycosides			
Gentamycin	36	4	11.11
Amikacin	36	7	19.44
Tetracyclins			
Tetracyclin	36	2	5.56
Tigecyclin	36	1	2.78
Chloramphenicols			
Chloramphenicol	36	5	13.89
Macrolides			
Erythromycin	36	18	50.00
Flouroquinolones			
Levofloxacin	34	11	32.35
Lincosamides			
Clindamycin	15	8	53.37
Polypeptides			
Vancomycin	36	1	2.78
Teicoplanin	36	1	2.78
Polymyxin B	36	4	11.11
Others			
Rifampicin	33	3	9.09
Nitrofurantoin	34	6	17.65
Cotrimoxazole	15	7	46.67
Linezolid	36	2	5.56

Discussion

Although the use of prophylactic antibiotics has decreased the rate of revision TKA, aseptic loosening and infection are still two key reasons. In some studies, PJI has been cited as the most common reason for revision arthroplasty, but diagnosing PJI is most times difficult [12, 13]. Synovial fluid culture is important and necessary when the patient's CRP and ESR are elevated [12, 14, 15]. In addition, the drug-resistance test can provide useful information regarding the choice of antibiotics in peri-operative care of the patient with PJI [15].

This is a descriptive study investigating common pathogens in PJI and drug-resistance rates for different commonly-used antibiotics. We also included patients with aseptic loosening because some patients might have low-grade infections in this group. Gram-positive bacterium is still the most common pathogenic bacteria in PJI, accounting for over 50% of cases, and in our study the proportion of isolated G+ bacteria was 26 (76.47%); *Staphylococcus aureus* was the largest in number.

Revision surgeries are treatment of choice for PJI. In the preoperative and postoperative period, longer antibiotic use is crucial relative to primary TKA; therefore, microbiological culture and drug sensitive tests are important [15, 16]. Cefuroxime is the most commonly used prophylactic antibiotic for elective orthopedic surgery [17]. Clindamycin is prescribed instead if the patient has a history of being allergic to cephalosporins; however, we found that both second generation cefuroxime and clindamycin exhibited high resistance rates in this group of patients [18, 19].

Negative microbiological cultures makes the diagnosis of PJI even more difficult, and culture-negative PJI accounted for 23% of all cases [20]. One possibility is that the sampling method of samples was not appropriate; for example, using the electrocautery to resect the tissues could sterilize the bacteria and affect the culture rate [15, 20, 21].

Our study limitation has few limitations. First, the study was a retrospective study where data was collected from the patient's case files; therefore, some cases of low grade infection might have been missed. Second, the sample size of the study is small compared to larger studies available from other countries. Further study should focus on finding common bacterium in patients undertaking elective orthopaedic surgery in India, and further tests on the appropriateness of using cefuroxime and clindamycin in prophylaxis in primary TKA.

Conclusion

The current study provides some information on the most common pathogens in revision TKA at our institution. Use of cefuroxime and clindamycin in revision TKA patients should proceed with caution, because of the high drug-resistance rate.

References

1. Maloney WJ. National joint replacement registries: has the time come?. J Bone Joint Surg Am. 2001; 83:1582-1585
2. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revisionhip and knee arthroplasty in the United States from 2005 to 2030. J Bone JointSurg Am. 2007; 89:780-785.
3. Bozic KJ, Kurtz SM, Lau E, Ong K, Vail TP, Berry DJ. The epidemiology ofrevision total hip arthroplasty in the United States. J Bone Joint Surg Am. 2009; 91:128-133.
4. Pulido L, Ghanem E, Joshi A, Purtill JJ, Parvizi J. Periprosthetic joint infection: the incidence, timing, and predisposing factors. Clin Orthop Relat Res. 2008; 466:1710-1715.
5. Di Cesare PE, Chang E, Preston CF, Liu CJ. Serum interleukin-6 as a marker ofperiprosthetic infection following total hip and knee arthroplasty. J Bone JointSurg Am. 2005; 87:1921-1927.
6. Grau L, Gunder MA, Schneiderbauer M. Difficult-to-detect low-grade infectionsresponsible for poor outcomes in Total knee arthroplasty. Am J Orthop (BelleMead NJ). 2017; 46:E148-E153.
7. Claassen L, Ettinger S, Pastor MF, Budde S, Windhagen H, Floerkemeier T. The value of arthroscopic neosynovium biopsies to diagnose periprosthetic kneejoint low-grade infection. Arch Orthop Trauma Surg. 2016; 136:1753-1759.
8. Vasso M, Schiavone Panni A. Low-grade periprosthetic knee infection: diagnosis and management. J Orthop Traumatol. 2015; 16:1-7.
9. Kurtz SM, Lau E, Watson H, Schmier JK, Parvizi J. Economic burden ofperiprosthetic joint infection in the United States. J Arthroplasty. 2012; 27(8):61-65.e1.
10. Kapadia BH, Berg RA, Daley JA, Fritz J, Bhave A, Mont MA. Periprostheticjoint infection. Lancet. 2016; 387:386-394
11. Parvizi J, Zmistowski B, Berbari EF *et al*. New definition for periprostheticjoint infection: from the Workgroup of the Musculoskeletal Infection Society. ClinOrthop Relat Res. 2011; 469:2992-2994.
12. Parvizi J, Della Valle CJ. AAOS clinical practice guideline: diagnosis andtreatment of periprosthetic joint infections of the hip and knee. J Am Acad OrthopSurg. 2010; 18:771-772.
13. Zhai Z, Li H, Qin A *et al*. Meta-analysis of sonicationfluid samples fromprosthetic components for diagnosis of infection after total joint arthroplasty. J Clin Microbiol. 2014; 52:1730-173.
14. Miyamae Y, Inaba Y, Kobayashi N *et al*. Different diagnostic properties of C-reactive protein, real-time PCR, and histopathology of frozen and permanent sections in diagnosis of periprosthetic joint infection. Acta Orthop. 2013; 84:524-529.
15. Esposito S, Leone S, Bassetti M *et al*. Italian guidelines for the diagnosisand infectious disease management of osteomyelitis and prosthetic joint infections in adults. Infection. 2009; 37:478-496.
16. Barrett L, Atkins B. The clinical presentation of prosthetic joint infection. J Antimicrob Chemother. 2014; 69(1):25-27.
17. Esposito S, Leone S. Prosthetic joint infections: microbiology, diagnosis, management and prevention. Int J Antimicrob Agents. 2008; 32:287-293.
18. Boot W, Moojen DJ, Visser E *et al*. Missed low-grade infection in suspectedaseptic loosening has no consequences for the survival of total hip arthroplasty. Acta Orthop. 2015; 86:678-683.
19. Baratz MD, Hallmark R, Odum SM, Springer BD. Twenty percent of patientsmay remain colonized with methicillin-resistant staphylococcus aureus despite adecolonization protocol in patients undergoing elective total joint arthroplasty. Clin Orthop Relat Res. 2015; 473:2283-2290.
20. Hedke J, Skripitz R, Ellenrieder M *et al*. Low-grade infection after a total kneearthroplasty caused by *Actinomyces naeslundii*. J Med Microbiol. 2012; 61(8):1162-1164.
21. Patel A, Pavlou G, Mujica-Mota RE, Toms AD. The epidemiology of revisiontotal knee and hip arthroplasty in England and Wales: a comparative analysis with projections for the United States. A study using the National Joint Registry dataset. Bone Joint J. 2015; 97:1076-1081.