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Prosthetic Joint Infections: A Warning about the Emerging Risk of Multidrug-Resistant Bacteria in Morocco

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Abstract

Introduction: Prosthetic joint infection (PJI) is a serious complication of arthroplasty, associated with significant morbidity and therapeutic challenges, particularly due to biofilm formation and the emergence of multidrug-resistant (MDR) bacteria. In Morocco, where osteoarticular trauma and resistant nosocomial pathogens are frequent, a local assessment of PJIs is warranted. The objectives of our study are to determine the frequency of infections in prostheses, specify the epidemiology and resistance profile of isolated strains to antibiotics. ***Methods:*** This is a retrospective study conducted in the bacteriology laboratory of the Mohammed V Military Teaching Hospital in Rabat over a 4-year period (2015–2018), involving 572 arthroplasties. Samples were processed using standard microbiological techniques, and antimicrobial susceptibility testing was performed by the disk diffusion method and interpreted according to CA-SFM/EUCAST guidelines. ***Results:*** Out of 53 samples received, 37 (69.8%) were culture-positive. Twenty-four cases of PJIs were confirmed, representing an infection rate of 4.19%, predominantly affecting hip prostheses (3.49%). Delayed infections (3–24 months post-surgery) were the most frequent (87.5%). Gram-positive cocci accounted for 59.5% of isolates, followed by Enterobacterales at 31.7%. *Staphylococcus aureus* was 100% methicillin-susceptible, while 26% of coagulase-negative staphylococci were methicillin-resistant. Resistance rates among Enterobacterales were 32% for cefotaxime and 4% for imipenem. ***Conclusion:*** PJIs represent a major issue in our setting, with a predominance of staphylococci and an alarming emergence of multidrug-resistant Gram-negative bacilli. These findings highlight the need for rigorous diagnostic protocols, strengthened preventive measures, and antibiotic policies tailored to the local microbiological ecology.

Keywords: Prosthetic joint, infection, antibiotics, MDR, SARM.

INTRODUCTION

Arthroplasty has become a common surgical procedure aimed at restoring joint function and improving the quality of life in patients suffering from degenerative or post-traumatic musculoskeletal diseases. It is estimated that approximately 285,000 arthroplasties are performed annually in the United States and 220,000 in France, with these numbers steadily increasing due to population aging and expanded surgical indications [1,2].

Despite advances in orthopedic surgery, anesthesia, and infection control, prosthetic joint infection (PJI) remains one of the most feared complications. It occurs in 0.5 to 2% of primary procedures and up to 5% in revision surgeries [3,4]. These infections are notoriously difficult to eradicate due to the formation of bacterial biofilms on the prosthetic surfaces, which shield bacteria from antibiotics and immune responses [5,6].

In Morocco, the high incidence of road traffic accidents—resulting in around 3,500 deaths and more than 10,000 serious injuries annually [7] has contributed to a growing number of major orthopedic surgeries, and indirectly, to an increased risk of PJIs.

The aim of this study was to determine the frequency of prosthetic joint infections in our institution,

characterize the bacterial epidemiology, and describe the antimicrobial susceptibility profiles of the isolated strains.

METHODS

This retrospective study was conducted in the bacteriology laboratory of the Mohammed V Military Teaching Hospital (HMIMV) in Rabat, covering the period from 2015 to 2018. It included all patients from whom samples were collected due to suspected prosthetic joint infection, among a total of 572 arthroplasties performed during the study period. Epidemiological data were extracted from the laboratory information system.

Samples were handled under strict aseptic conditions using a Class II laminar flow hood. Bacteriological diagnosis included multiple steps: direct microscopic examination after Gram staining to detect neutrophils and bacteria, followed by inoculation onto several culture media, including blood agar, chocolate agar, blood agar supplemented with nalidixic acid and colistin (ANC), Schaedler agar, and brain–heart infusion broth for enrichment.

Incubation was carried out under conditions specific to each medium: aerobic atmosphere at 37°C for 24 hours to 7 days for blood and chocolate agar, and anaerobic atmosphere at 37°C for 7 days to one month for ANC and Schaedler media.

Solid samples (tissue fragments or prosthetic material) were ground and subjected to sonication to disrupt bacterial biofilms and release microorganisms before inoculation. Liquid samples (superficial or deep pus) were directly inoculated.

Pathogen identification was based on morphological, cultural, and biochemical characteristics, using appropriate API identification kits (API 20E, API Staph, API Strep). Antimicrobial susceptibility testing was performed using the agar diffusion method in accordance with the guidelines of the Antibiogram Committee of the French Society of Microbiology (CA-SFM) and EUCAST standards [5,10,14].

RESULTS

During the study period (2015–2018), a total of 572 arthroplasties were performed, including 258 total hip replacements (THRs), 311 total knee replacements (TKRs), and 3 shoulder prostheses. A total of 53 microbiological samples were collected in the context of suspected prosthetic joint infection. Among these, 37 samples (69.8%) yielded positive cultures, while 16 samples (30.2%) were sterile. In our series, 24 cases of prosthetic joint infection were confirmed, corresponding to an overall infection rate of 4.19%. This rate was higher for THRs (3.49%) compared to TKRs (0.69%). No infections were reported in shoulder prostheses. The distribution of infections according to the postoperative interval revealed a predominance of delayed infections (between 3 and 24 months), accounting for 87.5% of cases (see Table 1).

Table 1: Distribution of infections according to postoperative onset interval

Onset interval	Number of cases	Percentage (%)
Early infection (< 3 months)	2	8.3%
Delayed infection (3–24 months)	21	87.5%
Late infection (> 2 years)	1	4.2%
Total	**24**	**100%**

Among the 37 culture-positive samples, the most frequently identified were deep pus (40.5%) and tissue fragments (16.2%). Pathogens were also isolated from prosthetic material and blood cultures in a significant number of cases (see Table 2).

Table 2: Distribution of positive samples by type (n = 37)

Type of sample	Number of cases	Percentage (%)
Deep pus	15	40.5%
Tissue fragment	6	16.2%
Blood culture	6	16.2%
Prosthetic material	5	13.5%
Superficial pus	4	10.8%
Bone tissue	1	2.8%

In total, 41 bacterial strains were isolated from the 37 positive samples. Gram-positive cocci were the most frequently isolated microorganisms (59.5%), predominantly coagulase-negative staphylococci (CNS), followed by *Staphylococcus aureus*. Enterobacterales accounted for approximately 31.6% of isolates, with a predominance of *Klebsiella pneumoniae* and *Enterobacter cloacae*. Non-fermenting Gram-negative bacilli (mainly *Pseudomonas aeruginosa* and *Acinetobacter baumannii*) were identified in 9.8% of cases. In addition, two streptococcal strains and one micrococcus were also isolated (see table 3).

Table 3: Distribution of isolated germs (n = 41)

Isolated bacteria	Number of strains	Percentage (%)
Coagulase-negative staphylococci	15	36,6 %
Staphylococcus aureus	9	22,0 %
Enterobacteria	13	31,6%
Non-fermenting Gram-negative bacilli	4	9,8 %
Streptococci	2	4,9 %
Micrococci	1	2,4 %

Antibiotic susceptibility testing revealed that *Staphylococcus aureus* isolates were 100% resistant to penicillin G, but remained susceptible to all other tested antibiotics. No methicillin-resistant *Staphylococcus aureus* (MRSA) was detected. Coagulase-negative staphylococci showed 100% resistance to penicillin G, 26% resistance to cefoxitin (indicating methicillin resistance), 13% to rifampicin, 20% to fosfomycin, 33% to fusidic acid, and 45% to ciprofloxacin.

Enterobacterales exhibited high resistance rates: 72% of isolates were resistant to amoxicillin, 56% to amoxicillin-clavulanic acid, 32% to cefotaxime, and 56% to ciprofloxacin. Resistance to imipenem was observed in 4% of isolates, while 32% were resistant to gentamicin and 23% to amikacin. An extended-spectrum beta-lactamase (ESBL) phenotype was detected in 26% of Enterobacterales strains.

Among non-fermenting Gram-negative bacilli, *Pseudomonas aeruginosa* showed resistance to ceftazidime in 12% of cases and to imipenem in 22%. In contrast, all isolates of *Acinetobacter baumannii* were resistant to both ceftazidime and imipenem (100%).

DISCUSSION

The observed infection rate (4.19%) is consistent with rates reported in surgical revisions, but slightly higher than those reported in primary arthroplasties [3,4,8]. This difference may reflect the complexity of the cases treated in our tertiary hospital and the high prevalence of local risk factors. The predominance of delayed infections (87.5%), occurring between 3 and 24 months, is consistent with the literature, which describes subacute or chronic PJIs as often caused by low-virulence bacteria that are difficult to diagnose early [6,9]. Coagulase-negative staphylococci (CNS), which predominate in our series (36.6%), are typical agents of this type of infection. Their ability to form biofilms explains their persistence on implants [5,10]. Staphylococcus aureus (22%) is also a major pathogen associated with acute forms of PJIs. Universal resistance to penicillin G in our series is expected [11], but the absence of methicillin-resistant strains (MRSA) is notable, although subject to regional variations. Enterobacteria (31.6%), particularly Klebsiella pneumoniae and Enterobacter cloacae, were more common than in Western series (5–15%) [12], highlighting the uniqueness of our hospital ecology. The high rate of ESBL (26%) is a warning sign in terms of treatment choices [13].

Non-fermenting bacilli (9.8%), particularly Pseudomonas aeruginosa and Acinetobacter baumannii, are associated with worrying multi-resistance. All strains of A. baumannii were resistant to carbapenems, suggesting the presence of carbapenemases [14,15].

The resistance of CNS to cefoxitin (26%) reflects the frequency of methicillin-resistant strains [11,16]. Multi-resistance to ciprofloxacin (45%) complicates empirical antibiotic regimens.

Deep samples (pus, fragments, material) were the most contributory. The use of sonication to release bacteria from biofilms, combined with prolonged cultures, improved diagnostic yield, in line with recent recommendations [17,18].

CONCLUSION

PJIs represent a serious complication of arthroplasty, with significant morbidity. Our study highlights a significant frequency (4.19%) in a Moroccan context marked by a high prevalence of multidrug-resistant bacteria. CNS predominate, but ESBL-producing Enterobacteriaceae and multidrug-resistant non-fermenting bacilli represent a growing challenge. These results underscore the need for rigorous microbiological diagnosis, optimized prevention, and a therapeutic strategy guided by local bacterial ecology.

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