



## Editorial

# Total hip arthroplasty periprosthetic infection management, the dilemma remains

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Periprosthetic joint infection (PJI) after total hip arthroplasty (THA) possesses a burden on the patient, the surgeon, and the health-care system.<sup>[1]</sup> Besides having an economic burden, it carries a negative psychological impact on the patient and the surgeon.<sup>[2]</sup> Proper management of PJI requires integration of three major stages, first: Preventing PJI before it even starts; second: Accurate diagnosis once PJI is suspected; and third: Radical treatment if PJI is confirmed. However, rapid advancement and lack of definitive guidelines make the PJI management research arena full of controversies and updates.

## PREVENTION

### Patient related

It starts by defining the patient at great risk of developing post-operative PJI, such as patients with high body mass index, diabetes, and malnutrition.<sup>[2]</sup> More recently, Vitamin D deficiency had been identified as a modifiable risk factor for PJI development.<sup>[3]</sup> Patient optimization before surgery is a crucial step in prevention.

### Surgery related

Operative room environment, debate still exists regarding the role of airflow (laminar airflow vs. conventional ventilation systems) inside the operative theater and its relation to surgical site infection (SSI),<sup>[4]</sup> the type of surgeon wear either a conventional standard surgical gown or the modern space suits with a helmet ventilation system, had been discussed as a contributing risk for development of SSI and deep PJI.<sup>[5]</sup> Role of antibiotics, for the administration of prophylaxis antibiotics preoperatively, what is the appropriate agent, route of administration, and the number of doses, had been an area of debate; however, strong agreement on a single dose 1<sup>st</sup> or 2<sup>nd</sup> generation cephalosporin 30–60 min before incision, which should be adjusted according to patient weight, with vancomycin reserved for patients with a known penicillin allergy or colonization with MRSA.<sup>[5]</sup> The use of cement loaded with antibiotics was an area of discussion as well; some studies showed a mild protective effect against PJI if a single antibiotic-loaded cement was used,<sup>[6]</sup> others showed non-inferiority of plain cement use,<sup>[7]</sup> and further studies suggested that dual antibiotic-

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loaded cement is better.<sup>[8]</sup> Intraoperative measurements, lavage solutions used during and by the end of the procedure, an irrigation solution of normal saline mixed with vancomycin and polymyxin showed its efficacy in preventing PJI in a study including about 2000 patients,<sup>[9]</sup> on the other hand, the use of povidone-iodine lavage showed conflicting evidence for its efficacy against PJI.<sup>[10]</sup> Another new player detected in the game of PJI prevention was the bearing surfaces, as shown in some studies that patients who had ceramic on ceramic bearings showed a lower incidence of PJI. Furthermore, the introduction of Vitamin E blended polyethylene acetabular liners showed improved resistance to infection.<sup>[11]</sup>

## DIAGNOSIS

Reaching a solid diagnosis of PJI is challenging and sometimes cannot be reached until after revision surgery; there is no single perfect test for diagnosing PJI, with most of the available tests cannot consistently exclude infection.<sup>[1]</sup> A new “traffic light” approach for defining the possibility of PJI in arthroplasty patients was introduced based on clinical, laboratory, and imaging studies; they divided this approach into three zones where a patient in the green zone is unlikely to be infected, patients in the amber zone are likely to be infected, and patient in the red zone is infected.<sup>[1]</sup> On the other side, the minor diagnostic criteria suggested by the most recent International Consensus Meeting (ICM) for PJI in 2018 were tested for its validity in a study including 345 cases; it showed excellent sensitivity and specificity of 0.96 and 0.84, respectively.<sup>[12]</sup> Apart from the most commonly used serum and synovial biomarkers, mainly serum erythrocyte sedimentation rate, C-reactive protein (CRP), and synovial white blood cells count.<sup>[13]</sup> Recently, various markers were introduced for evaluating and diagnosing PJI; of the recent serum markers is D-dimer, which showed sensitivity up to 96%. However, it showed low specificity and accuracy reaching 32% and 61%, respectively.<sup>[13]</sup> Further, new synovial biomarkers were introduced, such as synovial leukocyte esterase, synovial CRP, synovial alpha-defensin, and synovial C-reactive.<sup>[14]</sup> Of the previously mentioned new markers, D-dimer, leukocyte esterase, and alpha-defensin are included in the ICM minor criteria for diagnosing PJI.<sup>[12,14]</sup>

## TREATMENT

After establishing a solid diagnosis of PJI and deciding on revision surgery, the debate starts again regarding the best surgical approach: Debridement and acute implant retention (DAIR), single-stage revision, or two-stage revision.<sup>[15]</sup> Each approach has its pros and cons and specific criteria at which it could be applied. Another crucial advancement in the treatment plan is introducing new implant coatings (which have prevention and curative roles); local hydrogel coatings showed their efficacy in preventing infection when used

with cementless implants to manage patients diagnosed with chronic PJI with no effect on the implant osteointegration properties.<sup>[16]</sup> Povidone-iodine was used as a coating for hip implants, which resulted in no infection when implanted in revision cases for PJI.<sup>[17]</sup> Furthermore, silver nanoparticles were used as coatings, which showed promising results regarding reducing the post-operative incidence of PJI.<sup>[18]</sup> However, the efficacy and widespread use of these coatings still to be proved.

## WHAT IS THE POSSIBLE FUTURE ADVANCEMENT?

1. New diagnostic tools, such as molecular diagnostic techniques, DNA-based molecular diagnostics, and next-generation sequencing (such as Illumina sequencing),<sup>[19]</sup> while new synovial biomarkers such as D-lactate showed promising diagnostic abilities.<sup>[20]</sup>
2. The use of machine learning and artificial intelligence technologies to reach diagnosis<sup>[21]</sup> and predict which patient will fail a particular surgical procedure such as DAIR.<sup>[22]</sup>
3. The use of newly developed antibiotics and anticancer drugs showed its efficacy against various microbial species.
4. New management lines as the enzymatic, ultrasound, bacteriophage, and photodynamic therapies have shown promising results.
5. Trials on vaccination against certain bacterial species had been tried.
6. Trials on immune therapy as an alternative to antibiotics showed positive results in animal trials.

PJI after THA is a devastating complication with a harmful impact on the patient, surgeon, and the health-care system. Development and innovation in different stages of management are constantly evolving. Therefore, the need for establishing a specialized Musculoskeletal Infection Society in our area is mandatory to help detect the size of such problem in our countries and help develop new guidelines accustomed to our patients.

## AUTHORS' CONTRIBUTIONS

OAF carried out the conception, AAK carried out the literature search and drafted the manuscript. OAF did the critical revision. Both authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

## ETHICAL APPROVAL

The authors confirm that this editorial had been prepared in accordance with COPE roles and regulations. Given the nature of the editorial, the IRB review was not required.

### Declaration of patient consent

Patient consent was not required as there are no patients in this editorial.

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### Conflict of interest

There is no conflict of interest.

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