Recent Trends in Management of Infected Total Hip Replacement

Essay

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بسم الله الرحمن الرحيم

قَالُوا سبحانك لاَ علم لَنا إلاّ ما

علّمتنا إنك أنت الْعليم الْحكيم

صدق الله العظيم

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Mohamed Emar Mohamed Nasef

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List of Abbreviations

ABC : Antibiotic bone compound
AGS : Antigranulocyte scintigraphy
BMI : Body mass index
BS : Bone scintigraphy
CNS : Coagulase-negative staphylococci
CRP : C-reactive protein
ESR : Erythrocyte sedimentation rate
FDA : Food and Drug Administration
FDG : F-fluoro-2-deoxyglucose
GS : Ga^{67}-citrate scintigraphy
HMPAO : Hexamethyl propyleneamine oxime
LS : Labeled leucocyte scintigraphy
MRSA : Methicillin-resistant *S. aureus*
MS : Marrow scintigraphy
PCR : Polymerase chain reaction
PET : Position emission tomography
PJI : Periprosthetic joint infection (PJI)
S. aureus *: Staphyloccus aureus*
SPECT : Single photon emission computed tomography
THR : Total hip replacement
TJA : Total joint arthroplasty
TNF-α : Tumor necrosis factor alpha
VRE : Vancomycin-resistant enterococci
WBC : White blood- cell count

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Introduction

Total joint arthroplasty is a safe and effective procedure improving the quality of life and restoring function to patients with arthritis of the hip. Although its general success is beyond dispute, postoperative complications such as periprosthetic joint infection (PJI) still occur. Currently, PJI is an important mechanism of implant failure and need for revision arthroplasty [1].

PJI is the most serious complication, occurring in 0.3 to 1.7% of hip arthroplasties. The frequency of infection is increasing as the number of primary arthroplasties increases. [1]

Patient-related risk factors for infection include previous revision arthroplasty or previous infection associated with a prosthetic joint at the same site, tobacco abuse, obesity, rheumatoid arthritis, a neoplasm, immunosuppression, and diabetes mellitus. [2]

Surgical risk factors include simultaneous bilateral arthroplasty, a long operative time (>2.5 hours), and allogeneic blood transfusion. [2]

Postoperative risk factors include wound-healing complications (e.g., superficial infection, hematoma, delayed healing, wound necrosis, and dehiscence), atrial fibrillation, myocardial infarction, urinary tract infection, prolonged hospital stay, and *Staphyloccus Aureus* (*S.Aureus*) bacteremia. [2]

PJIs are typically classified based on timing of occurrence of infection. According to a standard clinical classification scheme, early-onset infection occurs within 3 months of total joint arthroplasty (TJA), delayed onset infection occurs within 3-24 months, and late-onset infection occurs after 24 months. [3]

The most prosthetic joint infections are caused by Staphylococci (*S. aureus*) and coagulase-negative staphylococcus species) that account for more than half of cases of prosthetic-hip. *S.aureus* infection is particularly common in patients with rheumatoid arthritis. Other bacteria and fungi cause the remainder of cases. Up to 20% of cases are polymicrobial, most commonly involving methicillin-resistant *S. aureus* (MRSA) or anaerobes. Approximately 7 % of cases are culture-negative, often in the context of previous antimicrobial therapy. [4]

The pathogenesis of infection associated with a prosthetic joint involves interactions among the implant, the host's immune system, and the involved microorganism or microorganisms. Only a small number of microorganisms is needed to seed the implant; such organisms adhere to the implant and form a biofilm in which they are protected from conventional antimicrobial agents and the host immune system. Associated microorganisms are often skin bacteria that are inoculated at joint implantation. In some cases, organisms seed the implant hematogenously or through compromised local tissues. [5]

Infection with virulent organisms (e.g., *S. aureus* and gram-negative bacilli) inoculated at implantation is typically manifested as acute infection in the first 3 months (or, with hematogenous seeding of the implant, at any time) after surgery, whereas infection with less virulent organisms [e.g., coagulase-negative staphylococci (CNS) and *P. acnes*] is more often manifested as chronic infection several months (or years) postoperatively. [6]

The most common symptom of infection associated with a prosthetic joint is pain. In acute infection, local signs and symptoms (e.g., severe pain, swelling, erythema, and warmth at the infected joint) and fever are common. Chronic infection generally has a more subtle presentation, with pain alone, and it is often accompanied by loosening of the prosthesis at the bone–cement interface and sometimes by sinus tract formation with discharge. [6]

The tentative diagnosis of an infection is made by means of history (delayed wound healing, postoperative superficial infection, persisting wound drainage, and/or pain), C-reactive protein (CRP) (greater than 10 mg/L), erythrocyte sedimentation rate (greater than 30 mm/hour), radiographs (periostitis, osteopenia, endosteal reaction, and/or rapid progressive loosening or osteolysis), and/or bone scan. When at least two of these parameters are observed, a joint aspiration and biopsy are performed. All antibiotic therapy should stopped 4 weeks before aspiration and biopsy to minimize the risk of false-negative results. [7]

A definitive diagnosis of infection can be made from the evaluation of intraoperative specimens obtained from both the acetabular and femoral sides. These tissue samples are evaluated by histopathological examination, microbiological culture, and real-time polymerase chain reaction (PCR) for the detection of bacterial DNA. [8]

Radionuclide imaging is not affected by metallic hardware and is the current imaging modality of choice for evaluation of suspected joint replacement infection. The primary role of nuclear medicine in the evaluation of a painful joint replacement is to differentiate aseptic loosening from infection. Combined leukocyte-marrow scintigraphy is currently regarded as the imaging modality of choice for diagnosing prosthetic joint infections. [18] F-fluoro-2-deoxyglucose (FDG)-position emission tomography (PET) enables visualization of hyperglycolytic inflammatory cells (i.e., leukocytes, macrophages and other immunologically active cells). Antigranulocyte scintigraphy with monoclonal antibodies or antibody fragments may be another attractive approach to detect. [9]

Optimal treatment of prosthetic joint infections involves the eradication of infection while maintaining function of the joint and patient quality of life. The successful treatment of prosthetic joints is contingent on the elimination of the biofilm-dwelling micro-organism. The two mainstay methods of achieving this are either through surgical removal of the prosthesis or through use of biofilm-active antibiotics in conjunction with surgical debridement and retention of the prosthesis. [10]

Administration of antibiotic therapy without surgical management is not routinely recommended, as it is rarely associated with successful cure. Antibiotic suppression alone is generally reserved for patients with significant co-morbidities in whom surgery is contraindicated. [3]

The surgical strategies used to treat arthroplasty infections include: resection arthroplasty, one-stage or two-stage exchange procedures, amputation, and debridement and retention. Resection arthroplasty entails the removal of all foreign material including cement and resection of devitalized tissue and bone, and may or may not involve arthrodesis. Exchange procedures involve resection arthroplasty with re-implantation of a new joint prosthesis performed at the time of removal of the infected prosthesis (one-stage exchange) or delayed by a variable period of time while antibiotic therapy is administered (two-stage exchange). Debridement and retention of the prosthesis usually involves open arthrotomy, removal of all infected and necrotic bone, and exchange of liners and lavage of the joint. [11]

A two-stage protocol for Prosthetic joint infections treatment had the lowest risk for both prosthetic joint infection recurrence and need for additional surgery in comparison with all other strategies developed for prosthetic joint infection therapy. Therefore, it should be accepted as the method of choice. One-stage hip re-implantation is a less reliable approach in which it is inevitable to strictly respect the indication criteria.

Other methods are either less reliable or associated with a high risk of repeat surgeries, or provide functionally unacceptable outcomes. [12]

Resection arthroplasty and amputation are generally reserved for patients with refractory infections particularly where there is severe loss of bone stock or in patients where functional improvement following revision is unlikely. [11]

Aim of the Study

To illustrate the recent trends in diagnosis and treatment of infected total hip replacement and how this affect the patient's activity and life quality, bringing back a useful member to the community and offering him a healthy comfortable life.