

UPDATE ON INFECTIONS IN ARTICULAR PROSTHESIS

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ABSTRACT

The implantation of joint prostheses, especially for the hip and knee, is becoming increasingly common. This provides a significant reduction in discomfort and an immeasurable improvement in patient mobility. Reviews of the worldwide literature indicate that 1 to 5% of these prostheses become infected, although it is important to remember that as the number of operations performed to implant these prostheses increases, so will the number of cases of this type of infection. Gram-positive bacteria predominate in contaminations of joint prostheses, in particular *Staphylococcus aureus* and *Staphylococcus epidermidis*. Infections caused by gram-negative bacilli and fungi such as *Candida* sp have been reported with increased frequency throughout the world. Infections of joint prostheses present characteristic signs

that can be divided into acute manifestations (severe pain, high fever, toxemia, heat, redness and wound secretions) and chronic manifestations (progressive pain, cutaneous fistula formation and pus drainage, without fever). The definitive diagnosis of the infection should be made through cultures to isolate the microorganism, using material collected from joint fluid puncture, surgical wound secretions, and surgical debridement. It is essential to cover for methicillin-resistant *Staphylococcus aureus*, given the epidemiological importance of this agent in these infections. The total duration of antibiotic therapy ranges from six weeks to six months, and this treatment should be adjusted as needed, based on the results from culturing.

Keywords – Joint Prosthesis; Infection/diagnosis; Infection/therapy

INTRODUCTION

The implantation of joint prostheses, especially for the hip and knee, is becoming increasingly common. This provides a significant reduction in discomfort and an immeasurable improvement in patient mobility^(1,2). It has been estimated that, including both primary and revision surgery, around 800,000 operations to implant hip and knee prostheses are performed every year, in the USA alone⁽³⁾ (Figure 1). Furthermore, although in

small numbers, implantations of joint prostheses for the shoulder, elbow, wrist and temporomandibular joint are also becoming more common⁽²⁾. Reviews of the worldwide literature indicate that 1 to 5% of these prostheses become infected, although it is important to remember that as the number of operations performed to implant these prostheses increases, so will the number of cases of this type of infection⁽⁴⁾ (Figure 2). Even though infection occurs less frequently than mechanical loss of the prosthesis, it is considered to be the most devastating of

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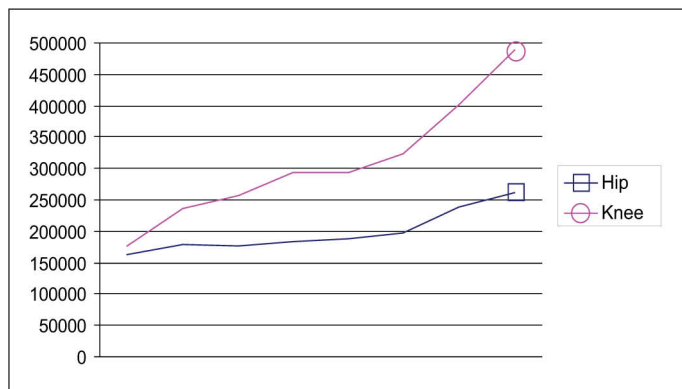
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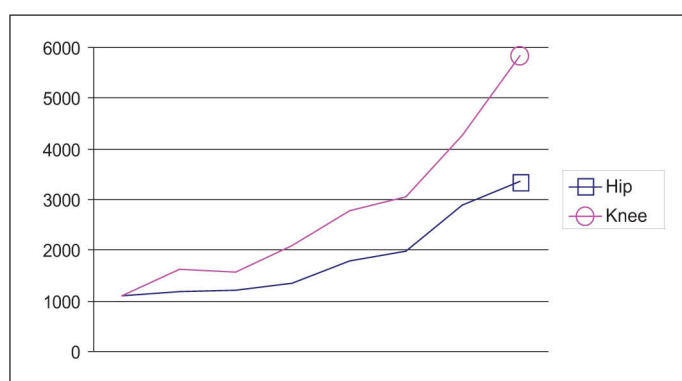
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Adapted from: Kurtz *et al*⁽³⁾.

Figure 1 – Evolution of the number of knee and hip prostheses implanted in the USA between 1990 and 2004.



Adapted from: Kurtz *et al*⁽³⁾.

Figure 2 – Evolution of the number of infections in prostheses diagnosed in the USA between 1990 and 2004.

the complications, leading to prolonged hospitalization, repeated surgical interventions and even definitive loss of the implant, with shortening of the affected limb and significant permanent deformities^(1,2).

Risk factors and physiopathogenesis

The main risk factors predisposing towards infections in joint prostheses that are cited in the literature are: advanced age, malnutrition, obesity, diabetes mellitus, HIV infection at an advanced stage, presence of a distant focus of infection and a history of arthroscopy or infection in a previous arthroplasty. Patients with rheumatoid or psoriatic arthritis are also at greater risk of postoperative infection, which has been estimated to be three to eight times greater than for other patients. Prolonged duration of surgery (more than 150 minutes), blood transfusion and carrying out bilateral arthroplasty in a single operation are other factors relating to greater occurrence of infection. Any factor that delays the healing of the surgical wound, such as ischemic necrosis, hematoma, cellulitis and/or wound abscess, increases the

risk of infection, since the deep tissues contiguous with the prosthesis do not have any local defense barriers^(1,2,4). It is important to emphasize that the presence of the joint prosthesis leads to impairment of the function of the local granulocytes that accumulate around the implant: these become partially degranulated, with diminution of the production of dismutase superoxide and damage to the defense capacity against bacteria, particularly against *Staphylococcus aureus*. Thus, the presence of the implant diminishes the size of the bacterial inoculum needed for infection to take place, by more than 100,000-fold⁽⁵⁾.

Joint prostheses can become infected through three different routes: direct implantation, hematogenesis and reactivation of latent infection⁽²⁾.

Penetration of microorganisms into the wound during surgery can occur through either endogenous or exogenous sources. Examples of such sources include the patient's skin microbiota, the surgical team's limbs, the environment or even contaminated implants.

Bacteremia from distant foci may cause contamination of the prosthesis through a hematogenic route. The primary foci most frequently reported in the worldwide literature are the respiratory tract, skin, urinary tract, dentition and gastrointestinal tract^(2,5).

Gram-positive bacteria predominate in contaminations of joint prostheses, especially *Staphylococcus aureus* and *Staphylococcus epidermidis*. However, infections caused by Gram-negative bacilli and fungi such as *Candida sp* are being reported with greater frequency all around the world⁽⁵⁾.

Clinical presentations and diagnosis

Infections of joint prostheses present characteristic signs that can be divided into acute manifestations such as intense pain, high fever, toxemia, heat, redness and operative wound secretions, and chronic manifestations, namely progressive pain and formation of skin fistulas with drainage of purulent secretions, which in most cases are without fever. The clinical presentation depends on the virulence of the etiological agent involved, the nature of the infected tissue and the infection acquisition route. Several classifications have been put forward to define the moment at which the contamination occurred and, through this, to establish the likely etiological agent involved and the best therapeutic strategy^(1,2,5).

Nonspecific laboratory tests such as leukogram, erythrocyte sedimentation rate, alpha-1-acid glycoprotein and

C-reactive protein may help in the diagnosis⁽²⁾.

The radiographic abnormalities may be similar to those found in case of mechanical losses, and thus do not contribute towards diagnosing the infection. Ultrasound may be useful for locating deeper accumulations and for guiding diagnostic puncture. Scintigraphic methods are considered to be more specific for the differential diagnosis, especially when techniques involving leukocytes or immunoglobulin labeled with radioisotopes are used⁽²⁾.

The definitive diagnosis for the infection is achieved through isolating the microorganism in cultures made from joint fluids obtained via puncture, secretions from the surgical wound and materials collected during surgical debridement^(1,2).

Preventive measures

Preoperative assessments on patients who are candidates for primary arthroplasty are of fundamental importance for preventing postoperative infections, with the aims of identifying and treating quiescent foci of infection, stabilizing comorbidities and, when possible, reducing the use of immunosuppressant drugs. In addition to this care, the following are recommended⁽⁶⁾:

- Hospitalization close to the time of the operation;
- Rigorously controlled cleaning, sterilization and handling of all surgical materials that are to be used;
- Maintenance of adequate cleanliness and climate control conditions in the operating theater;
- Limited shaving, also performed close to the time of the operation, using depilatory creams and not cutting devices;
- Mechanical cleaning of the surgical site using antiseptic solutions such as chlorhexidine;
- Creation of special surgical environment with differentiated gowning and, optionally, use of laminar flow;
- Adequate antibiotic prophylaxis, starting during the one-hour period preceding induction of anesthesia, and maintained for 24 hours;
- Control over body temperature and blood glucose levels throughout the operative period;
- Shortest duration of operation possible with the appropriate technique;
- Dressings carefully applied using an aseptic technique;
- Early mobilization of the patient during the postoperative period.

Treatment

Success in treating joint prosthesis infections depends on extensive surgical debridement and adequate and effective antibiotic therapy^(2,4). Infectious conditions that develop during the first year after the operation are considered to be hospital infections and, until receiving the results from cultures that were obtained in the surgical center, should be treated with antibiotics that act on the hospital microbiota of the hospital service where the surgery was performed. It is recommendable to start empirical antibiotic therapy at the time of inducing anesthesia, which avoids the risks to patients resulting from surgical manipulation of the focus of infection without adequate coverage but does not interfere with any positive results from cultures on material collected during the operation. It is fundamentally important to have coverage for methicillin-resistant *S. aureus*, given the epidemiological importance of this agent in these infections⁽⁵⁾. The total duration of antibiotic therapy ranges from six weeks to six months, and the treatment should be adjusted when necessary, based on the results from the cultures on the material that was collected^(1,2,4,8).

Joint prosthesis infections that are manifested during the first two to three weeks after the operation to implant the prosthesis can be treated initially with extensive surgical cleaning combined with antibiotic therapy over a six-week period^(8,9). Infections that are manifested after this period, caused by the formation of a biofilm and adherence of bacteria to the implanted material, should be treated with extensive surgical cleaning together with removal of the joint prosthesis, which can be replaced in either a single or a two-stage procedure. In such cases, the total duration of antibiotic administration is six months^(7,10). The flow diagrams below summarize the current recommendations for managing these infections (Figures 3 and 4).

The highest therapeutic success rates, which can reach 93%, relate to removal of the infected prosthesis combined with prolonged antibiotic therapy, which should be chosen based on the etiological agent that was isolated during the removal surgery, followed by implantation of a new prosthesis in a second surgical procedure, generally performed six to eight weeks later^(7,10). Polymethyl methacrylate cement impregnated with gentamicin or tobramycin can be used for the re-implantation of prostheses after infections. In cases of methicillin-resistant *S. aureus*, the cement can be impregnated with vancomycin.

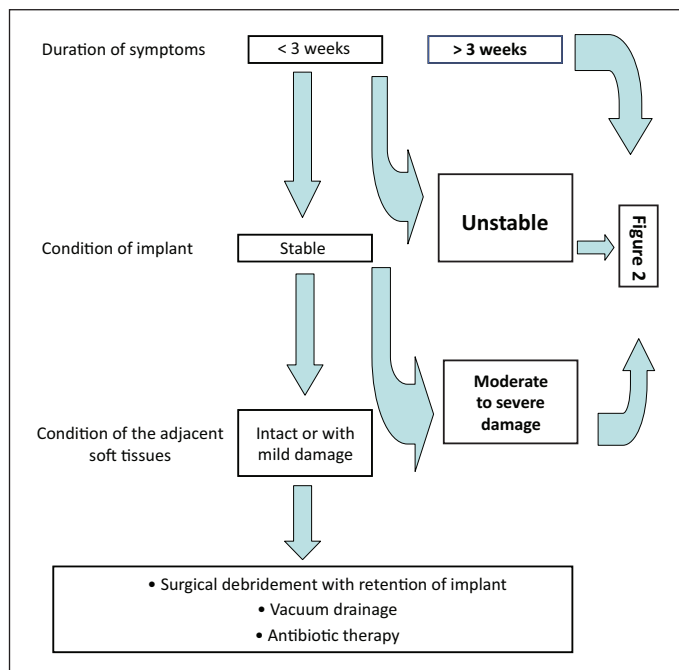


Figure 3 – Management for acute postoperative infections in arthroplasty cases.

FINAL REMARKS

Joint prosthesis infections have been increasing worldwide in parallel with the growth in the numbers of procedures carried out. These are worrying events in any of their presentation, not only because of the potential seriousness but also because of the high cost

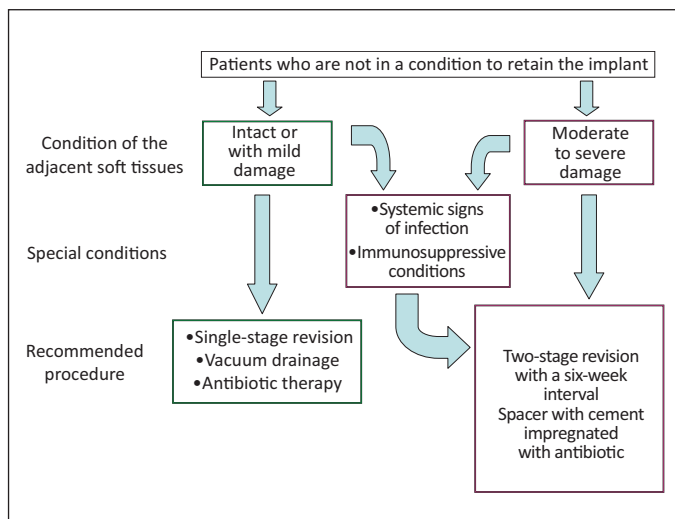


Figure 4 – Management for postoperative infections in arthroplasty cases with an indication for removal of the implant.

to patients and to the entire healthcare system. In indicating joint prosthesis implantation surgery, it is fundamentally important to always implement actions to prevent such infections, with careful observation of all of the factors that might contribute towards increasing the risk of this complication. Once the infection has become established, rapid clinical and laboratory diagnosis, associated with adequate management, will especially contribute towards increasing the possibility of definitive resolution of the process.

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