Antibiotic Prophylaxis and Dental Treatment in Patients with Hip and Knee Arthroplasty

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Total hip and knee arthroplasty surgery has been found to significantly improve health-related quality of life.1 Over one million total hip and knee arthroplasties are estimated to be performed in the United States annually, with this number projected to increase to 4 million by the year 2030.2,3 In Canada, approximately 92,000 hip and knee replacements were performed in the fiscal year 2009-2010.4 (Figs. 1a,b) Although the overall outcome of joint arthroplasty is excellent, late prosthetic infection is a rare but devastating complication that causes significant morbidity and mortality.5 The financial cost of managing a septic prosthetic joint is estimated to be 3-4 times the cost of a primary total joint arthroplasty.6 Therefore, strategies to prevent prosthetic joint infection remain a priority. (Fig. 2)

The role of antibiotic prophylaxis to decrease perioperative infection in total joint arthroplasty surgery has been well established.7 However, the role of antibiotic prophylaxis in patients with a joint replacement prior to invasive dental treatment is less clear and has been the subject of intense debate in the literature for decades.8,9 Further fuelling the controversy is the current lack of consensus among the respective professional societies of the American Dental Association (ADA) and the American Academy of Orthopaedic Surgeons (AAOS). This brief article will serve to highlight several of the controversial issues related to the prophylactic use of antibiotics for dental procedures in patients with hip and knee replacements.

History of Advisory Statements

In 1990, a collaborative workshop with a group of orthopaedic surgeons and dentists resulted in an editorial

article stating that there was limited evidence to support the prophylactic use of antibiotics before dental procedures. Nevertheless, penicillin V was recommended for use in prosthetic joint patients despite the acknowledged lack of evidence.10,11 The first advisory statement issued from the ADA/AAOS was in 1997,12 which was then slightly modified in 2003.13 (Table 1) They stated that antibiotic prophylaxis was not mandatory for routine dental procedures in most patients with joint arthroplasties, but should be considered in those with an increased risk. Patient factors and type of dental procedure dictated levels of risk. Patients at greater risk were defined as having a joint replacement within the past two years; previous sepsis of a joint arthroplasty, inflammatory arthropathies, type-1 diabetes, hemophilia, immunosuppression, and past or present malignancy. High risk dental procedures included extractions, periodontal procedures, implant placement, root canal, placement of orthodontic bands, specialized local anesthetic injections, and procedures where bleeding was anticipated (Table 2).

In 2009, without collaborative involvement of any non-orthopaedic specialties (and revised in June 2010), the AAOS released an information statement.14 It differed from the 2003 consensus statement by recommending antibiotic prophylaxis for all patients who have a total joint replacement before any invasive procedure that may produce bacteremia, regardless of the length of time after the joint replacement surgery (Table 1). The AAOS justifies this recommendation by acknowledging the "potential adverse outcomes and cost of treating an infected joint replacement." However no quality evidence was included to support this position. Perhaps emotion and potential medical-legal ramifications that are ever present in the United States influenced these authors. It is important to note however, that despite many subsequent articles referring to this statement as a guideline, it is in fact not a guideline and never claims to be one. Rather it states that it "was developed as an educational tool based on the opinion of the authors. Readers are encouraged to consider the information presented and reach their own conclusions."14 While this topic has garnered more interest recently, no clear guidelines or consensus currently exist, which creates a difficult dilemma for surgeons and dentists alike.

Rationale for antibiotic prophylaxis

Before the use of antibiotics can be recommended routinely before dental treatment, the following questions need to be investigated. 1) Can bacteria enter the bloodstream from dental procedures? 2) Can orthopaedic implants become infected from hematogenous oral sources? 3) Can antibiotic treatment prevent bacteremia and in turn, reduce orthopaedic prosthetic infection rates? 4) Lastly, what are the risks of treatment? Each one of these issues will thus be addressed.

Bacteremia

There is extensive evidence to support that bacteremia occurs as a result of dental treatment.15,16,17 Some of the highest levels have been demonstrated during extraction of erupted, periodontally involved teeth. After tooth extraction, the majority of positive blood cultures are identified within minutes and most episodes last less than 20 minutes.16,17 There is a wide spectrum of bacteria cultured, including both aerobic and anaerobic organisms. The most common types are streptococci, mostly of the viridans group, and actinomyces respectively.15,17

Interestingly, transient bacteremia of oral organisms may occur spontaneously without any dental treatment. Daily chewing, teeth clenching and tooth brushing has been demonstrated to produce bacteremia, particularly in individuals with periodontal disease.16,18 The cumulative exposure to transient bacteremia through these daily activities is several times higher than the single exposure that a patient is subjected to during dental procedures.19 It is impractical however to recommend prophylaxis for routine daily activities.

Dental Procedures and Joint Prosthetic Infection

Post-operative prosthetic joint infections (PJI) are uncommon and occur at a rate of 1-2%.20 Late prosthetic infection (> 3 months from surgery) has been postulated to occur as a result of hematogenous spread of bacteria from a distant site.21 Various sites have been implicated including skin, genitourinary tract, gastrointestinal tract, soft tissues and the mouth.22 However, the evidence linking late infection of a prosthetic joint to dental procedures is weak at best.

An early prospective study in 1984 by Ainscow and Denham followed 1000 patients with 1112 joint arthroplasties over 6 years. Of these, 224 patients had received invasive dental treatment and not all of them received prophylactic antibiotics. No late PJI were observed in this subgroup.23 A retrospective review by Waldman et al24 analyzed 3490 patients with total knee arthroplasties. Late infections were seen in 62 (1.8%), of which only seven (0.2%) were possibly related to dental work. Six out of the seven patients did not receive any antibiotic prophylaxis. Furthermore, Laporte et al25 retrospectively reviewed 2973 patients with total hip arthroplasty. Late infections were seen in 52 (1.7%), but they were of the opinion that only three (0.1%) were associated with dental procedures. None of the three patients received prophylaxis. Both of these retrospective studies implicated dental procedures based on temporal association with infection which is indeed compelling but not definitive proof.

To our knowledge, there is only one prospective case-control study investigating whether dental procedures are risk factors for prosthetic hip and knee infection. Berberi et al26 assessed 339 patients with PJI and 339 patients with prosthetic joints that did not become infected. They reported that neither low-risk or high-risk dental procedures were associated with an increased risk of prosthetic infection.

In addition to dental treatment there is also the matter of untreated periodontal disease. Ching et al27 reported four late PJIs with Streptococcus viridans in patients with poor oral health who had not had any dental procedures. This study implicates an oral origin for infection rather than formal dental manipulation, which perhaps emphasizes the need for good oral hygiene prior to and after arthroplasty surgery.

Careful review of the literature reveals that no article has proven the association of dental procedures and PJI definitively. Most studies fail to collect simultaneous cultures from the mouth, blood and joint and have not used advanced techniques to confirm genetically identical bacterial species from the mouth and joint. Therefore, reports suggestive of oral manipulation as an origin of prosthetic infection are largely based on anecdote.

Antibiotic Prophylaxis

Several studies have investigated the efficacy of antibiotics to prevent bacteremia during dental procedures. Coulter et al28 reported a reduction in the incidence of bacteremia following tooth extraction in children from 63% to 35% after the use of antibiotics. Similar observations were reported by Lockhart et al29 who noted a significant decrease in the incidence of bacteremia from 89% in a placebo group to 33% in the group given amoxicillin following invasive dental care. Furthermore, Brennan et al30 in a placebo-controlled trial, demonstrated that amoxicillin reduced the incidence of bacteremia from 20% in the placebo group to 6% in those patients given amoxicillin. While these studies demonstrated a reduction in bacteremia, they also showed that prophylactic antibiotics do not fully eliminate it.

The efficacy of antibiotic prophylaxis prior to dental treatment in preventing PJI has not been evaluated in a randomized controlled study. Furthermore, there is no evidence supporting or refuting the use of the recommended regimen for prophylaxis i.e. amoxicillin or clindamycin. In the case-control study by Berberi et al26 prophylactic use of antibiotics before dental procedures was not associated with a lower risk of PJI. In

addition, a study reviewing late PJI found that some patients who had an invasive dental procedure had received the appropriate prophylactic antibiotics.31 This suggests that full protection from infection is not guaranteed even if prophylactic antibiotics are administered.

Risks/Costs of Antibiotic Prophylaxis

If prophylactic antibiotics are to be used the benefits have to outweigh the potential risks. The morbidity and cost of managing a PJI is significant, however antibiotics have their own potential burden. Anaphylaxis, although rare, can be life threatening. There are also the associated risks of increased bacterial resistance to the commonly prescribed antibiotics and the development of gastrointestinal infections e.g. Clostridium difficile, which can inflict a significant toll on the patient. From a financial perspective, it has been estimated that it may be cheaper to provide no prophylaxis and treat the joint infections than providing antibiotic prophylaxis for all.32 Concerns about these risks may outweigh any hypothetical benefit related to the prophylactic prevention of PJI.

Conclusion

The practice of administering prophylactic antibiotics prior to dental treatment for patients with total joint arthroplasty remains a contentious issue. The supportive evidence for such an indication appears equivocal at best. No randomized controlled trial has been performed, and therefore we cannot conclusively endorse or refute the use of antibiotic prophylaxis. The overall low incidence of late prosthetic joint infections along with an even lower rate from possible dental procedures suggests a large patient recruitment would be required to obtain any meaningful data. Of further concern, frequent daily activities such as tooth brushing, particularly in the presence of poor dentition, collectively produce bacteremia in greater magnitude than dental office procedures. Therefore, orthopaedic surgeons and dentists should put greater emphasis on promoting good oral hygiene and eliminating periodontal disease in this group of patients, both before and after prosthetic joint surgery.

This debate ultimately needs to be resolved with evidence-based guidelines issued from a collaborative effort of the respective professional societies. In the meantime, as stated in the AAOS information statement, "Practitioners must exercise their own clinical judgement in determining whether or not antibiotic prophylaxis is appropriate."14 May we also suggest that lines of communication remain open between dentists and surgeons in order to facilitate the optimization of dental fitness in these patients. **OH**

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Oral Health welcomes this original article.

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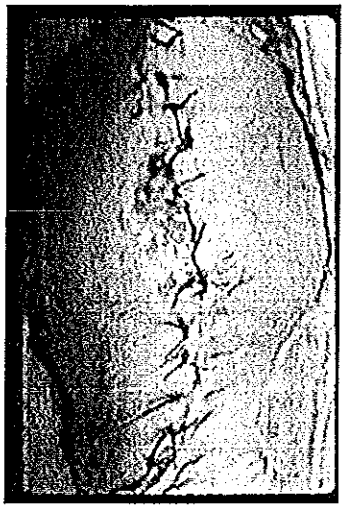

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