Antibiotic Prophylaxis in Dentistry

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Abstract

Antibiotic prophylaxis for the prevention of infective endocarditis related to dental therapy is a widespread therapeutic intervention. Recently, updated and revised guidelines on this treatment modality have been set forth in the form of consensus statements. It is evident that the risk of spontaneous bacteremia is much greater in a diseased oral cavity than it is in a healthy oral cavity. Perhaps most important in the prevention of infective endocarditis is early identification of at-risk patients and prompt referral to oral health specialists for comprehensive evaluation and treatment. The judicious use of antibiotic prophylaxis for prevention of infective endocarditis, in conjunction with optimal oral health care, should serve to minimize the adverse effects of antibiotic therapy and at the same time reduce the significant morbidity and mortality associated with these infections.

K**ey Words:** Antibiotic prophylaxis, infective endocarditis, prosthesis, dentistry.

One of the most common indications for the use of antibiotic prophylaxis in dentistry has been for the prevention of infective endocarditis and infections resulting from implanted prosthetic devices or materials. The topic of antibiotic prophylaxis in dentistry has been the subject of considerable controversy and debate. Numerous studies on the use and misuse of antibiotic prophylaxis have been performed (1–5). Cost-benefit analysis is likely to become the main determinant of its continued use. For this reason, the rationale, as well as the appropriate indications, for its use must be determined. Recently, two major conjoint panels have convened to apprise the health care community on these very issues (6, 7).

The cost-benefit ratio of any therapy, including all potential adverse effects, must be determined. Studies of this nature with respect to the treatment of infective endocarditis have already been conducted (8–15). The injudicious use of antibiotic therapy has proven to be expensive as well as directly responsible for development of resistant microorganisms.

The most common adverse effects of antibiotic therapy are listed in Table 1. Certainly, many

TABLE 1

Complications of Antibiotic Therapy

Direct Toxicity
Gastrointestinal
(e.g,. nausea, vomiting, diarrhea, abdominal pain)
Hematologic
(e.g., neutropenia, thrombocytopenia, hemolysis)
Alteration in normal flora
(e.g., pseudomembranous colitis, candidiasis)
Nephrotoxicity
(e.g., renal function test, abnormalities, proteinuria, renal failure)
Neuropathy
(e.g., VIIIth nerve dysfunction, peripheral neuropathy)
Drug interactions
(e.g., clarithromycin-terfenadine, altered clearance)
Hepatobiliary
(e.g., jaundice, liver function test, abnormalities, hepatitis)
Hypersensitivity Reactions
Cutaneous eruptions
(e.g., rash, urticaria, exfoliative dermatitis)
Serum sickness (e.g., immune complex reactions)
Immediate hypersensitivity
(e.g., penicillin anaphylaxis, bronchospasm, laryngeal edema)

of the adverse effects are of minimal clinical significance and have little impact. On an acute basis, anaphylaxis is the most feared of the possible consequences, and the risk of this potentially fatal complication has been studied (16–18). Of greater concern over the long term is the progressive development of drug-resistant organisms (19, 20). This is a potentially catastrophic problem which is difficult to assess. In addition, the financial implications of developing new drug therapies and treating patients with multi-drug-resistant infections are certain to be enormous. Therefore, it is incumbent upon the health care community to determine which patients would benefit most clearly from prophylactic antibiotic therapy and those who would not. The adverse outcomes associated with use of antibiotic therapy must be assessed in comparison to the costs and morbidity related to treating infective endocarditis or infected prosthetic materials. If the risk-benefit and cost-benefit ratios are critically examined, it becomes clear that if there are specific therapeutic indications based on sound physiologic, anatomic and scientific evidence, then antibiotic prophylactic therapy may be justified.

The risk of complications with therapy (Table 1) must be assessed, stratified and compared with complications when antibiotic therapy is withheld. When these risks have been elucidated, appropriate recommendations can then be made. The stratification of risks must be based on the likelihood of developing the disease and the probable outcome should the patient develop disease (1, 21–23). These factors could be classified as risk categories based upon the morbidity and mortality associated with the outcome. The American Dental Association (ADA) in conjunction with the American Heart Association (AHA) convened a panel to provide updated information on the following: risk stratification and classification based upon a review of the current literature; pharmacology; pharmacokinetics; and microbiology associated with the oral cavity. The risk stratification scheme, as developed by the panel of experts, is seen in Table 2.

TABLE 2
Risk Stratification for Infective Endocarditis

High Risk Category
Prosthetic cardiac valves, including bioprosthetic and homograft valves
Previous bacterial endocarditis
Complex cyanotic congenital heart disease (e.g., single ventricle states, transposition of the great arteries, tetralogy of Fallot)
Surgically constructed systemic pulmonary shunts or conduits
Moderate Risk Category
Most other congenital cardiac malformations (other than above or below)

Acquired valvar dysfunction
(e.g., rheumatic heart disease)
Hypertrophic cardiomyopathy
Mitral valve prolapse with valvar regurgitation
and/or thickened leaflets

Endocarditis Prophylaxis Not Recommended

Negligible-risk category
(no greater risk than the general population)
Isolated secundum atrial septal defect
Surgical repair of the atrial septal defect, ventricular
septal defect, or patent ductus arteriosus
(without residua beyond 6 months)
Previous coronary artery bypass graft surgery
Mitral valve prolapse without valvular regurgitation
Physiologic, functional, or innocent heart murmurs
Previous Kawasaki disease without valvular dysfunction
Previous rheumatic fever without valvular dysfunction
Cardiac pacemakers (intravascular and epicardial)
and implanted defibrillators

From Dajani AS, Taubert KA, Wilson W, et al. Prevention of bacterial endocarditis. Recommendations by the American Heart Association. JAMA 1997; 277:1794-1801 (6).

TABLE 3
Microbiology of Endocarditis

Streptococci	50.3%
Staphylococci	24.9%
Enterococci	6.1%
Gram-negative	5.7%
Fungi	1.0%
Other	2.7%
Culture negative	9.3%

Adapted from Tunkel AR, Mandell GL. Infecting microorganisms. In: Kaye D. editor. Infective endocarditis. 2nd ed. New York: Raven Press; 1992. p. 86 (24).

The most common microbial flora of the oral cavity, as well as the most common oral flora implicated in infective endocarditis, have been identified (Table 3) (24, 25). With the aid of the recently convened panel, updated information has been provided on those procedures most likely to

result in transient bacteremias which may seed anatomic irregularities and prosthetic materials. In addition, the most effective therapies for these organisms have also been clearly defined (Table 4) (26). In brief, the use of antibiotic therapy must aim to cover the normal flora of the oral cavity, namely streptococcal species. Further, an appropriate antibiotic must be administered in therapeutic doses prior to those procedures that are likely to result in bacteremia (Table 5).

TABLE 4
Pharmacotherapy for Prevention

Situation	Agent	Regimen†
Standard general prophylaxis	Amoxicillin	Adults– 2.0 g; children– 50 mg/kg orally 1 h before procedure.
Unable to take oral medication	Ampicillin	Adults–2.0 g IM or IV; children–50 mg/kg IM or IV within 30 min before procedure.
Allergic to penicillin	Clindamycin or	Adults–600 mg; children– 20 mg/kg orally 1 h before procedure.
	Cephalexin+ or cefadroxil+	Adults–2.0 g; children– 50 mg/kg orally 1 h before procedure.
	Azithromycin or clarithromycin	Adults–500 mg; children– 15mg/kg orally 1 h before procedure.
Allergic to penicillin and unable to take medications	Clindamycin or	Adults–600 mg; children– 20 mg/kg IV within 30 min before procedure.
	Cefazolin+	Adults–1.0 g; children– 25mg/kg IM or IV within 30 min before procedure.
High-risk patients	Ampicillin plus gentamicin	Adults–ampicillin 2.0 g IM or IV (not to exceed 2.0 g) plus gentamicin 1.5 mg/kg (not to exceed 120 mg) within 30 min before procedure; 6 h later, ampicillin 1 g IM/IV or amoxicillin 1 g orally.

		Children–ampicillin 50 mg/kg IM or IV (not to exceed 2.0 g) plus gentamicin 1.5 mg/kg within 30 min before procedure; 6 h later, ampicillin, 25 mg/kg IM/IV or amoxicillin 25 mg/kg orally .
High-risk patients allergic to ampicillin/amoxicillin	Vancomycin plus gentamicin	Adults–vancomycin 1.0 g IV over 1–2 h plus gentamicin 1.5 mg/kg IV/IM (not to exceed 120 mg); complete injection/infusion within 30 min before procedure. Children–vancomycin 20 mg /kg IV over 1–2 h plus gentamicin 1.5 mg/kg IV/IM; complete injection/infusion within 30 min before procedure.
Moderate-risk patients	Amoxicillin or ampicillin	Adults–amoxicillin 2.0 g orally 1 h before procedure, or ampicillin 2.0 g IV/IM within 30 min before procedure. Children–amoxicillin 50 mg/kg orally 1 h before procedure or ampicillin 50 mg/kg IM/IV within 30 min before procedure.
Moderate-risk patients allergic to ampicillin/amoxicillin	Vancomycin	Adults–vancomycin 1.0 g IV over 1–2h;complete infusion within 30 min before procedure. Children–vancomycin 20 mg/kg IV over 1–2 h; complete infusion within 30 min before procedure.

IM= intramuscular; IV= intravenous.
*Total children's dose should not exceed adult dose.
+Cephalosporins should not be used in individuals with immediate-type hypersensitivity reaction (urticaria, angioedema, or anaphylaxis) to penicillin.
†No second dose of vancomycin or gentamicin is recommended

From Dajani AS, Taubert KA, Wilson W, et al. Prevention of bacterial endocarditis. Recommendations by the American Heart Association. JAMA 1997; 277:1794-1801 (6).

TABLE 5

Dental Procedure and Endocarditis Prophylaxis

Endocarditis Prophylaxis Recommended*
Dental extractions
Periodontal procedure including surgery, scaling and root planing, probing, and recall maintenance
Dental implant placement
Endodontic (root canal) instrumentation or surgery only beyond the apex
Subgingival placement of antibiotic fibers or strips
Initial placement of orthodontic bands but not brackets
Intraligamentary local anesthetic injections
Prophylactic cleaning of teeth or implants where bleeding is anticipated
Endocarditis Prophylaxis Not Recommended
Restorative dentistry + (operative and prosthodontic) with or without retraction cord ++
Local anesthetic injections (non-intraligamentary)
Intracanal endodontic treatment; post placement and buildup placement of rubber dams
Postoperative suture removal
Placement of removable prosthodontic or orthodontic appliances
Taking of oral impressions
Fluoride treatments
Taking of oral radiographs
Orthodontic appliance adjustment
Shedding of primary teeth

*Prophylaxis is recommended for patients with high- and moderate-risk cardiac conditions

+ This includes restoration of decayed teeth (filling cavities) and replacement of missing teeth.

++ Clinical judgement may indicate antibiotic use in selected circumstances that may create significant bleeding

From Dajani AS, Taubert KA, Wilson W, et al. Prevention of bacterial endocarditis. Recommendations by the American Heart Association. JAMA 1997; 277:1794-1801 (6).

The use of antibiotic therapy as prophylaxis for patients with prosthetic implants has been questioned. The joint panel representing the American Academy of Orthopedic Surgeons and the ADA has defined the appropriate therapeutic indications for prophylaxis in patients with prosthetic implants; it is summarized in Table 6. The most significant factor

TABLE 6

Patients at Potential Increased Risk of Hematogenous Total Joint Infection

Immunocompromised/Immunosuppressed Patients
Inflammatory arthropathies: rheumatoid arthritis, systemic lupus erythematosus
Disease-, drug- or radiation-induced immunosuppression

Other Patients

Insulin-dependent (Type 1) diabetes
First 2 years following joint replacement
Previous prosthetic joint infections
Hemophilia

Advisory Statement. Antibiotic prophylaxis for dental patients with total joint replacements. American Dental Association; American Academy of Orthopaedic Surgeons. J Am Dent Assoc 1997; 128:1004-1008 (7).

appears to be the use of prosthetic materials and the time frame in which they have been placed. Studies have shown that the incidence of infection decreases over time and that, after a critical interval, the use of antibiotic prophylaxis can no longer be substantiated based on the currently available information (27). However, mitigating factors such as immunocompetence of the patient, when the implant was placed, and the type of implant placed still may justify their use but clearly not on a routine basis.

Special situations may arise which do not fit neatly into the currently recommended guidelines, and in these cases clinical judgment must be used in formulating the therapeutic plan. There may be certain factors in any particular case that may justify the use of prophylactic antibiotic therapy. These guidelines clearly denote that they are not intended to substitute for proper clinical judgment. However, any decision made must be based on the most current and accurate information available, as well as a thorough understanding of the pathophysiology, attendant risks of treatment and non-treatment, and the microbiology and pharmacology associated with the condition.

Finally, it is prudent to note that the likelihood of developing bacteremia and its related adverse outcomes is related to the health of the oral cavity (28–30). Patients who are likely to be at risk for infective endocarditis or who may require prosthetic grafts should always undergo dental evaluation. Appropriate preventive medicine and dentistry can greatly benefit those patients at risk. Referral to the dental specialist for comprehensive evaluation and treatment is indicated, because carious teeth and periodontal disease are contributory factors in bacteremic episodes (1). Proper oral health can minimize bad outcomes by eliminating sources of infection (31, 32). Until prior dental referral is included in the pre-operative evaluation, it is likely that significant numbers of patients will require antibiotic prophylaxis for urgent or emergent procedures. When patients undergo comprehensive evaluation, a formal treatment plan may be established. In this way, multiple procedures may be performed at the same visit, thereby reducing the number of appointments and the number of times that the patient will need prophylaxis. This would decrease costs, reduce adverse drug effects and lessen both the short- and long-term emergence of drug-resistant bacteria (33–35).

Summary

It has become apparent that a person with a diseased oral cavity is at high risk for developing spontaneous bacteremia after dental intervention. Because spontaneous bacteremia cannot be prevented, it behooves the health care team to mandate dental evaluation and treatment for their patients who are at risk for complications related to bacteremia. Even in the well-cared-for mouth,

the need for urgent care will arise; but the likelihood of this can be minimized with proper evaluation and care. The judicious use of antibiotic prophylaxis for prevention of infective endocarditis in conjunction with optimal oral health care should serve to minimize the adverse effects of antibiotic therapy and at the same time reduce the significant morbidity and mortality associated with these infections.

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