

# Prevention of Infective Endocarditis: Revised Guidelines from the American Heart Association and the Implications for Dentists

David K. Lam, DDS; Ahmed Jan, DDS;  
George K.B. Sándor, MD, DDS, PhD, FRCD(C), FRCSC, FACS;  
Cameron M.L. Clokie, DDS, PhD, FRCD(C)

## Auteur-ressource

Dr Sándor  
Courriel : [george.sandor@utoronto.ca](mailto:george.sandor@utoronto.ca)



## SOMMAIRE

L'endocardite infectieuse est une infection microbienne rare, mais délétère, des valvules cardiaques ou endocarde, le plus souvent liée à des défauts cardiaques congénitaux ou acquis. L'American Heart Association (AHA) a récemment mis à jour ses recommandations pour la prophylaxie pendant les procédures dentaires. Les révisions auront une incidence profonde à la fois sur le patient et sur le dentiste. Le but du présent article est d'examiner la pathogenèse et le tableau clinique de l'endocardite infectieuse et de discuter des lignes directrices de 2007 de l'AHA et de leurs implications pour les dentistes.

Pour les citations, la version définitive de cet article est la version électronique : [www.cda-adc.ca/jcda/vol-74/issue-5/449.html](http://www.cda-adc.ca/jcda/vol-74/issue-5/449.html)

Infective endocarditis is an uncommon but potentially life-threatening microbial infection of the heart valves or endocardium, most often related to congenital or acquired cardiac defects. High morbidity and mortality rates remain associated with the infection despite advances in diagnosis, antimicrobial therapy, surgical techniques and management of associated complications. Since the American Heart Association (AHA) produced guidelines on the prevention of infective endocarditis in 1997,<sup>1</sup> many groups have questioned the efficacy of antimicrobial prophylaxis in patients who undergo dental procedures and have suggested that this recommendation be revised.<sup>2-6</sup>

The AHA appointed a writing group, including experts in the prevention and treatment of infective endocarditis from the American Dental Association, the Infectious Diseases Society of America and the American Academy

of Pediatrics, to review input from national and international experts on the disease. The recommendations of this group culminated in the 2007 AHA guidelines on prophylaxis for infective endocarditis, which will have a profound impact on both patients and dental practitioners.

The purpose of this paper is to review the pathogenesis and clinical presentation of infective endocarditis and discuss the new guidelines on prophylaxis and their implications for dentists.

## Pathogenesis of Infective Endocarditis

Turbulent blood flow produced by certain types of congenital or acquired heart disease may traumatize the endothelium and result in the deposition of platelets and fibrin on the damaged endocardium or endothelial surface. This may result in the formation of sterile vegetations, a condition known as nonbacterial thrombotic endocarditis.<sup>6,7</sup> Invasion of the bloodstream by

**Table 1** Diagnosis of infective endocarditis<sup>7</sup>

Major criteria
Positive blood culture
Echocardiogram evidence of endocardial involvement
New valvular regurgitation
Minor criteria
Predisposing heart condition
Intravenous drug use
Fever
Vascular phenomena (emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial hemorrhage, Janeway lesions)
Immunologic phenomena (glomerulonephritis, Osler's nodes, Roth's spots, rheumatoid factor)
Isolated blood culture or serologic evidence of active infection
Echocardiogram findings consistent with endocarditis but not diagnostic of the disease

microbes that can colonize this damaged site may result in infective endocarditis.

### Odontogenic Sources of Transient Bacteremia

In 1909, Horder discovered an association between dental health and infective endocarditis, when he noted that "infection is grafted upon a previously sclerosed endocardium... the source of the infecting agent, in most of the cases, is the mouth."<sup>8</sup> Oral mucosal surfaces are populated by a dense endogenous microflora. Trauma to these surfaces, particularly the gingival crevice around teeth, releases these microbial species transiently into the bloodstream.

Transient bacteremia caused by the viridans group of streptococci and other oral microflora commonly occurs during dental extractions, other procedures and even during routine daily activities.<sup>6,7</sup> The frequency and intensity of the resulting bacteremias is related to the nature and magnitude of the tissue trauma, the density of microbial flora and the degree of inflammation or infection at the trauma site. The species entering the bloodstream depends on the endogenous microflora that colonize the traumatized site.

### Microbial Adherence

The focus of infection is determined by the ability of various microbial species to adhere to specific anatomic sites.<sup>6</sup> Mediators of bacterial adherence serve as virulence factors in the pathogenesis of infective endocarditis. Some streptococci in the viridans group contain a lipoprotein receptor antigen I (LraI) that acts as a major adhesin to the fibrin platelet matrix of nonbacterial thrombotic endocarditis.<sup>6,9</sup>

### Microbial Proliferation within a Vegetation

Once attached to an anatomic focus, these microorganisms stimulate further deposition of fibrin and platelets on their surface. Thus buried, the microorganisms can multiply rapidly, apparently uninhibited by host defenses.<sup>6</sup> More than 90% of the microorganisms in mature valvular vegetations are unresponsive to antibiotics as they are metabolically inactive.<sup>6,10</sup>

Thus, infective endocarditis arises from complex interactions between the bloodstream microbial pathogen and the matrix molecules and platelets at sites of endocardial cell damage.

### Clinical Presentation of Infective Endocarditis

#### Signs and Symptoms

The classic symptoms of infective endocarditis include fever, anemia, positive blood cultures and heart murmur.<sup>7</sup> However, diagnosis must always involve a high level of clinical suspicion, as these classic findings may not always be present (**Table 1**). Other symptoms may include fatigue, weight loss, night sweats, anorexia and arthralgia. Emboli may result in chest pain, abdominal pain, blindness, paralysis and hematuria. Petechiae may occur on skin or mucosal tissues and linear hemorrhages may be visible under the nails. Osler's (subcutaneous) nodes, Janeway lesions (flat, nontender, red spots on palms and soles that blanch on pressure) and retinal hemorrhages may also be noted.

#### Laboratory Findings

- Leukocytosis with neutrophilia
- Increased erythrocyte sedimentation rate
- Positive C-reactive protein
- Increased levels of serum immunoglobulins
- Blood cultures positive for pathogen
- Positive rheumatoid factor

#### Electrocardiogram Findings

- Prolonged PR interval (caused by abscess)
- Silent myocardial infarction (caused by emboli in coronary artery)

#### Echocardiography

- Vegetations
- Valvular perforations
- Other abnormalities (e.g., abscesses, pericarditis)

### Prophylaxis for Infective Endocarditis during Dental Procedures

#### Rationale for Prophylaxis

The 1997 AHA guidelines<sup>1</sup> recommended antimicrobial prophylaxis to prevent infective endocarditis among patients with underlying cardiac conditions who must undergo bacteremia-producing procedures. The recommendation was based on the following factors: infective endocarditis is an uncommon but life-threatening disease and prevention is

**Box 1** Cardiac conditions with the highest risk of adverse outcome from infective endocarditis and for which prophylactic dental procedures are recommended<sup>6</sup>

- Prosthetic cardiac valve
- Previous infective endocarditis
- Congenital heart disease<sup>a</sup>
  - Unrepaired cyanotic congenital heart disease, including palliative shunts and conduits
  - Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure<sup>b</sup>
  - Repaired congenital heart disease with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization)
- Cardiac transplantation with subsequent cardiac valvulopathy

<sup>a</sup>Except for the conditions listed here, antibiotic prophylaxis is no longer recommended for any other form of congenital heart disease.

<sup>b</sup>Prophylaxis is recommended because endothelialization of prosthetic material occurs within 6 months after the procedure.

preferable to treatment of established infection; certain underlying cardiac conditions predispose patients to infective endocarditis; bacteremia with organisms known to cause infective endocarditis is common during invasive dental procedures; antimicrobial prophylaxis is effective in preventing infective endocarditis in animals; and antimicrobial prophylaxis was thought to be effective in preventing infective endocarditis associated with dental procedures in humans.

#### **Primary Reasons for Revision of the Guidelines**

Although the rationale for prophylaxis of infective endocarditis remains valid, it does not compensate for the lack of data demonstrating a benefit. Moreover, antibiotic prophylaxis is not risk free. Penicillins cause allergic reactions among 1%–10% of patients. The risk of death from anaphylactic reaction is 5 times greater than that from treating infective endocarditis.<sup>11</sup> Maintenance of optimal oral health and hygiene may reduce the incidence of bacteremia from daily activities and is more important than prophylactic antibiotics for a dental procedure in reducing the risk of infective endocarditis.

#### **Revised AHA Guidelines on Prophylaxis for Infective Endocarditis**

In its 2007 guidelines,<sup>6</sup> the AHA concluded that bacteremia resulting from daily activities is much more likely to cause infective endocarditis than bacteremia associated with a dental procedure. Moreover, they concluded that only an extremely small number of cases of infective endocarditis might be prevented by antibiotic prophylaxis even if prophylaxis is 100% effective. Thus, antibiotic prophylaxis is not

recommended based solely on an increased lifetime risk of acquisition of infective endocarditis.

As a result, the revised guidelines were greatly simplified. The major changes include the following: infective endocarditis prophylaxis for dental procedures is recommended only for patients with underlying cardiac conditions associated with the highest risk of adverse outcome from infective endocarditis (**Box 1**). Antibiotic prophylaxis is no longer recommended for those with any other form of congenital heart disease.

Prophylaxis is recommended for all dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa *only* for patients at highest risk of adverse outcome from infective endocarditis (**Box 1**). Prophylaxis is no longer needed for routine anesthetic injections through noninfected tissue, dental radiographs, placement of removable prosthodontic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, shedding of deciduous teeth or bleeding from trauma to the lips or oral mucosa.

The recommended antibacterial regimens for dental procedures remain unchanged (**Table 2**).

#### **Discussion**

The vast majority of cases of infective endocarditis caused by oral microflora likely result from random bacteremias caused by routine daily activities, such as chewing food, brushing teeth, flossing, use of water irrigation devices and other activities.<sup>6,7</sup> These transient bacteremias usually clear within 10 minutes.<sup>7</sup> For example, tooth brushing was found to introduce bacteria into the bloodstream in about 40% of people tested<sup>7</sup>; similarly, chewing paraffin or oral irrigation produced transient bacteremias in 50% of people.<sup>7</sup> Guntheroth<sup>12</sup> estimated that with normal physiologic use of the oral cavity, about 5,376 minutes of transient bacteremias occur each month in the average person. Thus based on the high frequency of physiologic bacteremias and the low incidence of dental procedures preceding the onset of infective endocarditis, the odds of a case of infective endocarditis occurring from physiologic “seeding” of oral bacteria is 1,000 times greater than after a dental procedure.<sup>12</sup> However, the presence of dental disease may increase the risk of bacteremia associated with these routine activities.

As health care providers, dentists must consider the benefits of infective endocarditis prevention along with the risks of administering antibiotics: adverse drug events, the financial cost of antibiotics, the development of bacterial drug resistance and medicolegal concerns. But no matter how we weigh the risks and benefits of prophylaxis for infective endocarditis, until prospective clinical trials are conducted, its true efficacy will remain unclear.

Based on the revised 2007 AHA guidelines,<sup>6</sup> substantially fewer patients will meet the criteria for infective endocarditis prophylaxis before dental procedures. The new

**Table 2** Prophylactic antibiotic regimens before a dental procedure<sup>6</sup>

Patient group	Antibiotic	Dose (single, 30–60 min before procedure)	
		Adults	Children
Able to take oral medication	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin	2 g IM or IV	50 mg/kg IM or IV
	OR Cefazolin or ceftriaxone	1 g IM or IV	50 mg/kg IM or IV
Allergic to penicillins or ampicillin and able to take oral medication	Cephalexin <sup>a,b</sup>	2 g	50 mg/kg
	OR Clindamycin	600 mg	20 mg/kg
	OR Azithromycin or clarithromycin	500 mg	15 mg/kg
Allergic to penicillins or ampicillin and unable to take oral medication	Cefazolin or ceftriaxone <sup>b</sup>	1 g IM or IV	50 mg/kg IM or IV
	OR Clindamycin	600 mg IM or IV	20 mg/kg IM or IV

Note: IM = intramuscular, IV = intravenous.

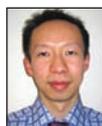
<sup>a</sup>Or other first- or second-generation oral cephalosporin at equivalent adult or pediatric dose.

<sup>b</sup>Cephalosporins should not be given to a patient who has a history of anaphylaxis, angioedema or urticaria with penicillins or ampicillin.

recommendations may understandably cause concern at multiple levels. There will be concern among patients who have previously received antibiotic prophylaxis to prevent infective endocarditis before dental procedures and are now advised that such prophylaxis is unnecessary. Moreover, there may be concerns amongst physicians, who in the past have supported antibiotic prophylaxis and may not be aware of the recent changes to the guidelines. There may be concern on the part of regulators who now must decide whether to modify their practice guidelines to mirror those of the current AHA recommendations. Similarly there may be initial resistance within certain hospitals to follow the new recommendations.

It is thus important for dentists to be familiar with both the AHA guidelines and the rationale behind them. This will allow them to alleviate their own concerns, re-educate their patients about the changes and communicate effectively with their medical colleagues to optimize the continued safe delivery of patient care. ♦

## THE AUTHORS



**Dr. Lam** is the chief resident in the division of oral and maxillofacial surgery and anesthesia, Mount Sinai Hospital; Ph.D. Harron Scholar, Collaborative Program in Neuroscience; and clinician-scientist fellow at the University of Toronto Centre for the Study of Pain, Toronto, Ontario.



**Dr. Jan** is a senior resident in the division of oral and maxillofacial surgery and anesthesia, Mount Sinai Hospital, University of Toronto, Toronto, Ontario.



**Dr. Sándor** is clinical director of the graduate program in oral and maxillofacial surgery and anesthesia, Mount Sinai Hospital; coordinator of pediatric oral and maxillofacial surgery, The Hospital for Sick Children and Bloorview Kids Rehab; professor of oral and maxillofacial surgery, University of Toronto, Toronto, Ontario; professor at the Rega Institute for Regenerative Medicine, University of Tampere, Tampere, Finland; and docent in oral and maxillofacial surgery, University of Oulu, Oulu, Finland.



**Dr. Clokie** is a professor and head of oral and maxillofacial surgery and anesthesia, University of Toronto, Toronto, Ontario.

**Correspondence to:** Professor George K.B. Sándor, The Hospital for Sick Children, S-525, 555 University Avenue, Toronto, ON M5G 1X8.

The authors have no declared financial interests.

This article has been peer reviewed.

## References

- Dajani AS, Taubert KA, Wilson W, Bolger AF, Bayer A, Ferrieri P, and others. Prevention of bacterial endocarditis: recommendations by the American Heart Association. *JAMA* 1997; 277(22):1794–801.
- Strom BL, Abrutyn E, Berlin JA, Kinman JL, Feldman RS, Stolley PD, and others. Dental and cardiac risk factors for infective endocarditis: a population-based, case-control study. *Ann Intern Med* 1998; 129(10):761–9.
- Durack DT. Antibiotics for prevention of endocarditis during dentistry: time to scale back? *Ann Intern Med* 1998; 129(10):829–31.
- Durack DT. The incidence of infective endocarditis following surgical repair of a major congenital defect varied by type of heart defect. *Evid Based Cardiovasc Med* 1998; 2(3):74.
- Lockhart PB, Brennan MT, Fox PC, Norton HJ, Jernigan DB, Strausbaugh LJ. Decision-making on the use of antimicrobial prophylaxis for dental procedures: a survey of infectious disease consultants and review. *Clin Infect Dis* 2002; 34(12):1621–6. Epub 2002 May 23.
- Wilson W, Taubert KA, Gewitz M, Lockhart PB, Baddour LM, Levison M, and others. Prevention of infective endocarditis: guidelines from the Amer-

ican Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. *Circulation* 2007; 116(15):1736–54. Epub 2007 Apr 19.

7. Little JW, Falace DA, Miller CS, Rhodus NL. Infective endocarditis. In: Dental management of the medically compromised patient. 6th edition. Toronto: Mosby, Inc.; 2002. p. 21–51.

8. Durack DT. Prevention of infective endocarditis. *N Engl J Med* 1995; 332(1):38–44.

9. Burnette-Curley D, Wells V, Viscount H, Munro CL, Fenno JC, Fives-Taylor P, and other. FimA, a major virulence factor associated with *Streptococcus parasanguis* endocarditis. *Infect Immun* 1995; 63(12):4669–74.

10. Durack DT, Beeson PB. Experimental bacterial endocarditis. II. Survival of a bacteria in endocardial vegetations. *Br J Exp Pathol* 1972; 53(1):50–3.

11. Gould FK, Elliott TS, Foweraker J, Fulford M, Perry JD, Roberts GJ, and others. Guidelines for the prevention of endocarditis: report of the Working Party of the British Society for Antimicrobial Chemotherapy. *J Antimicrob Chemother* 2006; 57(6):1035–42. Epub 2006 Apr 19.

12. Guntheroth WG. How important are dental procedures as a cause of infective endocarditis? *Am J Cardiol* 1984; 54(7):797–801.