

LITERATURE REVIEW

ANTIBIOTIC PROPHYLAXIS FOR DENTAL PATIENTS AT RISK OF INFECTIVE ENDOCARDITIS - AN UPDATE

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ينصح باستعمال المضادات الحيوية كإجراء وقائي في المرضى المعرضين لخطر تطور حدوث التهاب شغاف القلب الإنتاني ، وذلك عند تطبيق الإجراءات السننية التي يمكن أن تؤدي إلى نزيف من اللثة أو الأغشية المخاطية .
 ثم وضع أنظمة وجرعات متعددة من مجموعات مختلفة كالمجمعية الأمريكية لأمراض القلب والمجمعية البريطانية للمعالجات الكيميائية والجراثومية ومنظمات أخرى .
 تهدف هذه المقالة إلى مناقشة مختلف المواصفات مع التأكيد على الإستطباب المناسب لكل منها ، كما تهدف إلى التأكيد على دور طبيب الأسنان على التقييم الصحيح للإجراءات التي قد تؤدي إلى تجرثم الدم وتحديد المضاد الحيوي الملائم لذلك .

Antibiotic prophylaxis is recommended for patients who are at risk of developing infective endocarditis when undergoing dental procedures likely to induce gingival or mucosal bleeding. Several detailed regimens have been put forward by different groups, such as the American Heart Association, the British Society of Antimicrobial Chemotherapy and others. Recommendations for prescription are discussed in detail with emphasis on their proper indications. The dentist's role in correctly evaluating the procedure which could induce bacteremia as well as the appropriate antibiotic prophylaxis in these instances are highlighted.

Introduction

Infective endocarditis (IE) is a relatively uncommon disease, its precise incidence being unknown. Patients with certain cardiac

abnormalities are thought to be at risk of IE whenever they undergo dental procedures likely to cause a transient bacteremia. IE remains one of the major medical conditions of concern to the dental profession because of its mortality and morbidity, and in view of the fact that its incidence is not decreasing.^{1,2} It is a rare, serious and sometimes fatal disease that occurs when bacteria enters the blood stream and infect the lining of the heart.

Streptococcus viridans^ a bacterial species

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commonly found in the mouth, has been isolated in 75% of IE cases.³ Although many species of bacteria and fungi, both intraoral and extra-oral, can cause IE, *S. viridans* IE has traditionally been blamed on dental procedures. The American Heart Association (AHA) therefore advises dentists to put their patients with known cardiac anomalies on a specific antibiotic regimen directed against *S. viridans* before commencing dental procedures likely to cause bacteremia.⁴

As people retain their teeth longer, they may be more likely to undergo transient bacteremias every time they chew or brush their teeth.¹ However, in a study of 1322 patients with IE, Guntheroth found that only 3.6% had had an extraction within the 2-month period prior to the onset of illness.⁵ Guntheroth then reviewed studies on bacteremia and found that bacteremia had been reported in 40% of patients after dental extractions, 38% after chewing and 25% after tooth brushing.⁵ In view of such relatively high occurrence of bacteremia following routine functional activities, it is in fact necessary to emphasize those dental procedures which constitute a threat to patients at risk.

Dental procedures which may precipitate infective endocarditis

Table 1 lists invasive procedures as well as non-invasive dental procedures and oral activities which may place a patient at risk of IE.⁶ Poor oral hygiene, periodontal infection and periapical infection may also produce a bacteremia in the absence of dental procedures.⁴

There is controversy about the types of dental procedure which should be covered by a prophylactic antibiotic. While it is generally agreed that conventional injection of local anesthetic solutions does not require antibiotic cover, the British Society of Anti-Microbial Chemotherapy (BSAC) has warned against the use of intra-

ligamentary anesthesia in patients at risk of IE, as it can cause severe bacteremia.⁷ Obtaining alginate impression may cause bleeding, but not bacteremia.⁸ The necessity for systemic chemoprophylaxis prior to root canal treatment is controversial.⁹ Some believe that antibiotic prophylaxis is required for extirpation of a pulp, whether it is vital or non-vital. At the same visit, diagnostic radiograph for determination of working length should be taken to ensure that, at further appointments, extra-canal instrumentation would be unlikely. Antibiotic cover would not be required at further visits for preparation and obturation if the dentist is sure that neither instrument nor debris would be pushed beyond the apical foramen.

The dentist is often concerned about treatment that may occasionally give rise to bacteremia, for example, when preparing teeth for supragingival restorations. It is unrealistic and undesirable to give systemic prophylaxis for the majority of such procedures and a pre-operative mouth rinse and gingival irrigation with 0.2% chlorhexidine should suffice.³⁴

Table 1. Occurrence of bacteremia associated with various dental procedures and oral activities.

Procedure	Bacteremia (% of cases)
Extractions	
Single	51
Multiple	68-100
Subgingival scaling	51-83
Gingivectomy	83
RCT	
Intra canal instrumentation	0
Extra canal instrumentation	31
Flossing	20-58
Chewing	17-50
Tooth brushing	7-50

Guidelines for antibiotic prophylaxis

1. The BSAC¹⁰ recommends a prophylactic antibiotic for:

- Extractions
- Periodontal surgery
- Scaling

2. The AHA⁴ⁿ recommends prophylaxis for at risk patients before dental procedures which are likely to induce gingival or mucosal bleeding such as:

- Dental extractions
- Periodontal procedures including surgery, scaling, root planning and probing
- Root canal instrumentation beyond the apex
- Reimplantation of avulsed teeth
- Dental implant placement
- Subgingival placement of antibiotic fibers and strips
- Initial placement of orthodontic bands but not brackets intraligamentary local anesthetic injections
- Prophylactic cleaning of implants and teeth where bleeding is anticipated

AHA⁴ guidelines do not recommend an antibiotic before:

- Dental procedures not likely to induce significant gingival or mucosal bleeding
- Injection of local intra-oral anesthetic (except intra-ligamentary injection)
- Shedding of primary teeth
- Insertion of new dentures
- Intracanal endodontic treatment; post-placement and buildup
- Placement of rubber dams
- Postoperative suture removal

- Fluoride treatment
- Taking of oral radiographs
- Orthodontic appliance placement and adjustment

3. Various authors have made further recommendations:

- 1) The risk of IE in susceptible patients can be reduced by:
 - Maintenance of good oral hygiene
 - Prevention of oral diseases
 - Educating patients in the prevention of dental and periodontal diseases
 - Recall 6-monthly⁵
- 2) The magnitude and frequency of spontaneous bacteremia may be reduced with the following measures, which are far more important than antibiotic prophylaxis in reducing the incidence of bacteremia,⁵:
 - De-germing the oral cavity with 0.2% chlorhexidine mouthwash before dental procedures^{3,4,1011}
 - Spacing dental appointments (for patients requiring prophylaxis) at least 1-2 weeks apart.^{3,4,n}
 - Patients already taking a penicillin should be given an alternative antibiotic before dental procedures.^{4 n}

Medical conditions requiring antibiotic prophylaxis

The following are cardiac conditions which require antibiotic prophylaxis^{4,10}:

- Prosthetic heart valve
- Previous bacterial endocarditis, even in the absence of heart disease
- Congenital cardiac malformations (cyanotic)
 - Patent ductus arteriosus
 - Coarctation of the aorta
 - Tetralogy of Fallot

Aortic stenosis

Pulmonary stenosis

- Acquired/rheumatic valvular dysfunctions even after surgery
- Aortic and mitral valve regurgitation
- Mitral valve prolapse with mitral regurgitation

Special risk conditions

Patients with the following medical conditions require the use of stringent prophylactic regimens^{4,10}.

- Prosthetic heart valve
- Previous history of endocarditis
- Patient with surgically reconstructed systemic pulmonary shunt or conduits

Medical conditions NOT requiring antibiotic prophylaxis⁴:

- Isolated atrial septal defect (ASD)
- Successful surgical repair beyond 6-months of ASD, ventricular septal defect (VSD) and patent ductus arteriosus (PDA)
- Previous coronary bypass graft surgery (CABG)
- Mitral valve prolapse without valvular regurgitation
- Previous rheumatic fever without valvular dysfunction
- Physiologic, functional or innocent heart murmurs
- Heart transplantation beyond 6-months
- Cardiac pacemakers and implanted defibrillators
- Kawasaki disease with valvular dysfunction

Specific recommendations for chemoprophylaxis of IE

The standard oral doses for antibiotic prophylaxis in vulnerable cardiac patients before

dental procedures, as recommended by the BSAC¹⁰ and AHA⁴ are given in Table 2. The regimen of Amoxicillin 3 g given 1 hour before the procedure, furthermore, applies in most countries while a second or several additional doses of Amoxicillin is/are recommended in some countries, especially for high-risk patients¹³ (Table 3).

The foregoing recommendations notwithstanding, the basis for chemo-prophylaxis of IE is far from clear,^{9,14} and will be discussed later. Previously, AHA recommended 3g of Amoxicillin an hour before a procedure and then 1.5g 6 hours after the initial dose. Recently, however, they have recommended a reduced dose of 2g an hour before a procedure with no second dose.⁴

The following are the regimens for specific situations as recommended by the Endocarditis Working Party of the BSAC.⁷ These are summarized for adults in Table 4 and doses for children of various antimicrobials are given in Table 5.

A. Under local or no anesthesia

For patients not allergic to penicillin and not given penicillin more than once in the previous month:

Amoxicillin

Adults: 3g single oral dose one hour before dental procedure

Table 2. BSAC AND AHA regimens for oral chemoprophylaxis for IE.

	Not allergic to penicillin	Allergic to penicillin
BSAC	Amoxicillin 3g 1 h before procedure	Clindamycin 600 mg 1 h before procedure
AHA	Amoxicillin 2g 1 h before procedure	Clindamycin 600 mg 1h before procedure or Cephalexin 2g 1 h before procedure

Table 3. Comparison of national recommendations for oral chemoprophylaxis for IE.^{13,4}

	Not allergic to penicillin	Allergic to penicillin
All countries	Amoxicillin 3 g 1 hour before	Clindamycin 1 hour before
<i>Specific additional recommendations by country</i>		
France	No second dose	600 mg
Germany	Penicillin 2 million units ¹	600 mg
Netherlands	No second dose	Erythromycin 1g + 500 mg x 3 ¹
Scandinavia	No second dose	300-600 mg
Switzerland	+750 mg x 7 (if high risk)	600mg+300mg x 7 (if high risk)
U.K.	No second dose	600 mg
U.S.A.	No second dose	600 mg

¹Instead of amoxicillin
instead of clindamycin

Children: 5-10 years: half adult dose;
under 5 years: quarter adult dose

For patients allergic to penicillin:

Clindamycin

Adults: 600mg single oral dose one hour before dental procedure

Children: 5-10 years: half adult dose; under 5 years: quarter adult dose

B. Under general anaesthesia

For patients not allergic to penicillin and not given penicillin more than once in the previous month.

Amoxicillin (intravenous or intramuscular)

Adults: 1g IV or 1g in 2.5ml 1% lignocain hydrochloride IM at the time of induction followed by 500 mg orally six hours later

Amoxicillin (oral)

Adults: 3g oral dose four hours before GA, followed by another 3g orally after operation

Amoxicillin & Probenecid orally

Adults: Amoxicillin 3g together with

probenecid 1g four hours before operation

C. Special Risk Patients

For patients not allergic to penicillin and who have not had penicillin more than once in the previous month:

Adults: 1g Amoxicillin IV + 120mg gentamycin IV/IM pre-op or at the time of induction: followed by 500mg amoxicillin orally six hours later

Children: Amoxicillin 50mg/kg body weight and gentamycin 2mg/kg by foregoing administration routes

For patients allergic to penicillin or who have had penicillin more than once in the previous month:

Vancomycin and gentamycin

Adults: Vancomycin 1g by slow IV infusion over at least 100 min, followed by gentamycin 120mg IV at the time of induction or fifteen minutes before surgical procedure

Children: Vancomycin 20mg/kg by IV infusion followed by gentamycin 2mg/kg IV

Table 4. Recommended adult antibiotic regimens for the prophylaxis of dentally-induced IE.⁷

Not allergic to penicillin	Allergic to penicillin*
Local or no anaesthetic Amoxicillin 3g orally 1h pre-op	Clindamycin 600mg orally 1 h pre-op
General anaesthetic Amoxicillin 1g IM or IV at induction and 500mg orally 6h later or Amoxicillin 3g orally 4h pre-op and amoxicillin 3g orally post-op or Amoxicillin 3g and probenecid 1g orally 4 h pre-op	These patients are classified as special risk
Special risk patients Amoxicillin 1g IM/IV and gentamycin 120mg IM pre-op or at induction and amoxicillin 500mg orally 6h later	Teicoplanin 400mg IV and gentamycin 120mg IV pre-op or at induction or Clindamycin 300mg IV given over 10 min in 50ml of diluent pre-op or at induction and 150mg (oral or IV) later or Vancomycin 1g slow IV infusion (over not less than 100 min) followed by gentamycin 120mg IV pre-op or at induction

*Also patients who have been prescribed penicillin more than once in the previous month.

Table 5. Children's doses for recommended antibiotics.

Antibiotic	Dosage
Amoxicillin or clindamycin	under 10 years: half adult dose under 5 years: quarter adult dose
Vancomycin	under 10years: 20mg/kg
Gentamycin	under 14 years: 6mg/kg (or 2mg/kg if with Teicoplanin) under 10 years: 2mg/kg
Teicoplanin	under 14 years: 6mg/kg

Teicoplanin and gentamycin

Adults: Teicoplanin 400mg IV + gentamycin 120mg IV at time of induction or fifteen minutes before the surgical procedure

Children: Teicoplanin 6mg/kg + gentamycin 2mg/kg IV

Clindamycin

Adults: Clindamycin 300mg by IV infusion over at least 10 min at the time of induction or 15 min before the surgical procedure, followed by 150mg orally or 150mg IV infusion over at least 10 min 6 hours later

Children: 5-10 years: half adult dose; under 5 years: quarter adult dose

Paediatric doses of amoxicillin (by weight):

< 15kg	=	750mg
15 -30kg	=	1500mg
> 30 kg	=	3000mg

Controversies

Several studies have stated that the incidence of IE has remained the same over the last 50 years despite the use of antibiotic prophylaxis,¹² thus challenging its efficacy and questioning its impact on the prevention of IE in high risk patients. Durack¹⁵ has documented the apparent failure of antibiotic prophylaxis in patients harboring

both drug sensitive and drug resistant microorganisms. There is no single drug or combination of agents which are effective against all bacteria, especially as they continue to evolve and develop resistance. For example, during the 1940s and early 1950s most staphylococcal infections were susceptible to the penicillins but by the 1980s almost all strains were resistant to this drug.¹⁵

Similarly, Fleming and colleagues¹⁶ have demonstrated a significant rise in penicillin-resistant oral streptococci after repeated doses of the same drug. Therefore, the AHA has recommended a minimum of one week between procedural sessions and the use of different antibiotics.⁴ Although the first choice for IE prophylaxis remains penicillin and its derivatives, they are not without undesirable side effects. For example, the incidence of severe anaphylaxis causing death with parenteral penicillin is estimated to be similar to, if not slightly higher than, that of IE in the general population (around 0.05%), questioning the rationale behind its use particularly in low risk patients.¹⁷

In view of these considerations and the as yet unsubstantiated connection between IE and dental procedures, the efficacy of antibiotic prophylaxis in general is somewhat questionable. For this reason it can be viewed as a "percentage game" and perhaps even a somewhat arbitrary strategy.

Conclusion

Whether dental or other medical procedures are truly direct inducers of IE remains to be proven, as it is only a cause-effect relationship in animal models which has led to the current human protocols. It follows that the recommendation of IE prophylaxis may be more predicated upon ethical and legal rather than scientific considerations.

Some dental practitioners feel that prescription of a prophylactic antibiotic is the cardiologist's responsibility, whereas in fact it is the dentist who best understands the magnitude of bacteremic risk for the procedure in question. Thus, dental practitioners should be well aware of these risks and the recommended regimens for antibiotic prophylaxis, so as to avoid their indiscriminate use.

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