INTRODUCTION

Antimicrobial prophylaxis for bacterial endocarditis in select patients has become the standard of medical care in the United States. This practice exists despite the fact that there are no randomized controlled human studies in patients with underlying structural heart disease that definitely establish that antibiotic prophylaxis provides protection against endocarditis during procedures that induce bacteremia. This chapter is based on the recommendations formulated and published by the American Heart Association (AHA) in 1997 (1). When the AHA published the recommendations, it was expressly stated that the document was meant as a guideline and is “not intended as the standard of care or as a substitute for clinical judgment.” The 1997 guidelines represent an update from recommendations published by the AHA in 1990.

The updated version reflected the following changes:

1. It emphasized that most cases of endocarditis are not attributable to an invasive procedure.
2. If endocarditis does develop, cardiac conditions were stratified into high, moderate, and negligible risk categories based on the potential outcome.
There is clearer specification of procedures that may cause bacteremia and for which prophylaxis is recommended.

The algorithm of mitral valve prolapse (MVP) is recommended for the prophylaxis.

The initial amoxicillin dose for oral and dental procedures is reduced to 2 g, and a follow-up dose was no longer recommended.

For penicillin-allergic patients, clindamycin and other alternatives replaced erythromycin as the drug of choice.

Prophylactic regimens for gastrointestinal (GI) and genitourinary (GU) procedures were simplified.

**WHICH CARDIAC CONDITIONS SHOULD BE PROPHYLAXED?**

The AHA recommends prophylaxis for those patients with a higher risk of developing endocarditis than the general population and for those patients at risk of high morbidity or mortality if endocarditis occurs. This includes patients with conditions classified as high or moderate risk (see Table 1).
In the 1997 guidelines, MVP was recognized to represent a spectrum of valvular changes and clinical conditions. When normal valves prolapse with one or more systolic clicks but no murmurs and no Doppler-demonstrated mitral regurgitation, the risk of endocarditis is not increased over the normal population. Antibiotic prophylaxis is not recommended in this scenario. Antibiotic prophylaxis is recommended in MVP associated with audible clicks and murmurs of mitral regurgitation or by Doppler-demonstrated mitral insufficiency. Likewise, myxomatous mitral valve degeneration with regurgitation is an indication for antibiotic prophylaxis.

WHICH PROCEDURES ARE BACTEREMIA-PRODUCING PROCEDURES?

The AHA recommendations define significant bacteremias as those caused by organisms commonly associated with endocarditis and attributable to identifiable procedures. These significant bacteremias result from the following:

**Dental and Oral Procedures**

The degree of oral inflammation and infection directly influences the magnitude and incidence of bacteremias resulting from dental and oral procedures. The greater the degree of inflammation, the more likely it will result in bacteremia. Optimal oral health through regular professional care and the use of appropriate dental products such as toothbrushes and floss is advised especially for individuals who are at risk of developing bacterial endocarditis.

Endocarditis prophylaxis is recommended for the following procedures in patients with high- and moderate-risk cardiac conditions:

1. Dental extractions.
2. Periodontal procedures including surgery, scaling, and root planing, probing and recall maintenance.
3. Dental implant placement and reimplantation of avulsed teeth.
4. Endodontic (root canal) instrumentation or surgery only beyond the apex.
5. Subgingival placement of antibiotic fibers or strips.
6. Initial placement of orthodontic bands but not brackets.
7. Intraligamentary local anesthetic injections.
8. Prophylactic cleaning of teeth or implants where bleeding is anticipated.

Endocarditis prophylaxis is not recommended in these procedures:

1. Restorative dentistry.
2. Local anesthetic injections.
3. Intracanal endodontic treatment; postplacement and buildup.
4. Placement of rubber dams.
5. Postoperative suture removal.
6. Placement of removable prosthodontic or orthodontic appliances.
7. Taking of oral impressions.
8. Fluoride treatments.
10. Orthodontic appliance adjustment.
11. Shedding of primary teeth.

**Respiratory, Gastrointestinal, and Genitourinary Tract Procedures**

The guidelines recommend endocarditis prophylaxis for the following procedures:

*Respiratory tract:*
- Prophylaxis recommended for high- and moderate-risk patients.
- Tonsillectomy and/or adenoidectomy.
- Surgical operations that involve respiratory mucosa.
- Bronchoscopy with a rigid bronchoscope.

*GI Tract:*
- Prophylaxis recommended for high-risk patients; optional for moderate-risk patients.
- Sclerotherapy for esophageal varices.
- Esophageal stricture dilation.
- Endoscopic retrograde cholangiography with biliary obstruction.
- Biliary tract surgery.
- Surgical operations that involve intestinal mucosa.

*GU Tract:*
- Prophylaxis recommended for high- and moderate-risk patients.
- Prostatic surgery.
- Cystoscopy.
- Urethral dilation.

Endocarditis prophylaxis is not recommended for these procedures:

*Respiratory tract:*
- Endotracheal intubation.
- Bronchoscopy with a flexible bronchoscope, with or without biopsy.*
- Tympanostomy tube insertion.

*GI tract:*
- Transesophageal echocardiography (TEE).*
- Endoscopy with or without GI biopsy.*

*GU tract:*
- Vaginal hysterectomy.*
- Vaginal delivery.*
- Cesarean section.*

*Prophylaxis is optional for high-risk patients.*
In uninfected tissue:

- Urethral catheterization.
- Uterine dilation and curettage.
- Therapeutic abortion.
- Sterilization procedures.
- Insertion or removal of intrauterine devices.

Other procedures in which prophylaxis is not recommended include the following:

- Cardiac catheterization including balloon angioplasty.
- Implanted cardiac pacemakers.
- Implanted defibrillators and coronary stents.
- Incision biopsy of surgically scrubbed skin.
- Circumcision.

**WHAT PROPHYLACTIC REGIMENS SHOULD BE USED?**

Prophylaxis should be given perioperatively in doses that are high enough to ensure an adequate concentration in the bloodstream during and after the procedure. To avoid antimicrobial resistance, the antibiotics should be initiated shortly before the procedure and not continued for more than 6–8 h after. The guidelines suggest practitioners use their own judgment when determining the choice of antibiotics and the number of doses to be administered in individual cases or in special circumstances. Because endocarditis may occur despite appropriate antibiotic prophylaxis, health care providers should maintain a high index of suspicion for endocarditis when evaluating unexpected clinical signs or symptoms. These might include unexplained fever, night chills, weakness, or arthralgias.

**Regimens for Dental, Oral, Respiratory Tract, or Esophageal Procedures**

*Streptococcus viridans* is the most common cause of endocarditis following these procedures (see Table 2).

**Regimens for GU and Nonesophageal GI Procedures**

*Enterococcus faecalis* is the most common cause of bacterial endocarditis that occurs following GU and GI tract surgery or instrumentation. The guidelines recommend parenteral antibiotics in high-risk patients. In moderate-risk patients, a parenteral or oral regimen is provided. For procedures in which prophylaxis is not routinely recommended, physicians may choose to give antibiotics to high-risk patients (see Table 3).

**Special Situations**

**Patients Already on Antibiotics**

If the patient is taking an antibiotic normally used for endocarditis prophylaxis, the suggestion is to select a drug from a different class rather than increasing the
dose of the current antibiotic. For example, if a patient is taking oral penicillin for the secondary prevention of rheumatic fever, he or she may have relatively resistant *viridans streptococci* in his or her oral cavities. In this situation, the patient should be placed on clindamycin, azithromycin, or clarithromycin.

**PROCEDURES INVOLVING INFECTED TISSUES**

Incision and drainage or other procedures involving infected tissues may result in bacteremia with the same organism causing the infection. Prophylaxis for endocarditis should be given to individuals at high or moderate risk of endocarditis using a therapy directed at the most likely pathogen causing the primary infection.

**PATIENTS WHO RECEIVE ANTICOAGULANTS**

Patients on anticoagulants should be prophylaxed with intravenous or oral regimens rather than intramuscular injections.

**PATIENTS WHO UNDERGO CARDIAC SURGERY**

The guidelines recommend careful preoperative dental evaluation so that dental treatment can be completed before cardiac surgery whenever possible. *Staphylococcus aureus*, coagulase-negative staphylococci, or diptheroids most often causes endocarditis associated with open-heart surgery. Streptococci, Gram-negative bacteria, and fungi are cited as being less common. No single antibiotic

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<thead>
<tr>
<th>Situation</th>
<th>Agent</th>
<th>Regimen</th>
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<tbody>
<tr>
<td>Standard general prophylaxis</td>
<td>Amoxicillin</td>
<td>Adults: 2 g; children: 50 mg/kg orally 1 h before procedure</td>
</tr>
<tr>
<td>Unable to take oral medications</td>
<td>Ampicillin</td>
<td>Adults: 2 g i.m. or i.v.; children: 50 mg/kg i.m. or i.v. within 30 min before procedure</td>
</tr>
<tr>
<td>Allergic to penicillin</td>
<td>Clindamycin or Cephalexin or cefadroxil or Azithromycin or clarithromycin</td>
<td>Adults: 600 mg; children: 20 mg/kg orally 1 h before procedure</td>
</tr>
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i.m., intramuscularly; i.v., intravenously.
regimen is effective against all these organisms. Prophylaxis should therefore be
aimed primarily against staphylococci. First generation cephalosporins are most
often used. Perioperative prophylactic antibiotics are recommended for patients
with cardiac conditions that predispose them to endocarditis and for patients
having surgery for placement of prosthetic heart valves or prosthetic intravas-
cular or intracardiac materials.

SOURCES