respectively. Recrudescent endocarditis on a new implanted prosthetic valve follows surgery for active NVE and PVE in 2% and 6–15% of patients, respectively. These frequencies do not justify the risk of an adverse outcome due to a delay in surgery, particularly in patients with severe heart failure, valve dysfunction, and uncontrolled staphylococcal infections. Delay is justified when infection is controlled and CHF is resolved with medical therapy.

Neurologic complications of endocarditis may be exacerbated as a consequence of cardiac surgery. The risk of neurologic deterioration is related to the type of neurologic complication and the interval between the complication and surgery. Whenever feasible, cardiac surgery should be delayed for 2–3 weeks after a nonhemorrhagic embolic infarction and for 4 weeks after a cerebral hemorrhage. A ruptured mycotic aneurysm should be treated before cardiac surgery.

Antibiotic Therapy after Cardiac Surgery Organisms have been detected on Gram's stain—or their DNA has been detected by polymerase chain reaction—in excised valves from 45% of patients who have successfully completed the recommended therapy for endocarditis. In only 7% of these patients are the organisms, most of which are unusual and antibiotic resistant, cultured from the valve. Detection of organisms or their DNA does not necessarily indicate antibiotic failure; in fact, relapse of endocarditis after surgery is uncommon. Thus, when valve cultures are negative in uncomplicated NVE caused by susceptible organisms, the duration of preoperative plus postoperative treatment should equal the total duration of recommended therapy, with ~2 weeks of treatment administered after surgery. For endocarditis complicated by paravalvular abscess, partially treated PVE, or cases with culture-positive valves, a full course of therapy should be given postoperatively.

Extracardiac Complications Splenic abscess develops in 3–5% of patients with endocarditis. Effective therapy requires either image-guided percutaneous drainage or splenectomy. Mycotic aneurysms occur in 2–15% of endocarditis patients; one-half of these cases involve the cerebral arteries and present as headaches, focal neurologic symptoms, or hemorrhage. Cerebral aneurysms should be monitored by angiography. Some will resolve with effective antimicrobial therapy, but those that persist, enlarge, or leak should be treated surgically if possible. Extracerebral aneurysms present as local pain, a mass, local ischemia, or bleeding; these aneurysms are treated surgically.

OUTCOME

Factors that can adversely affect outcome include older age, severe comorbid conditions and diabetes, delayed diagnosis, involvement of prosthetic valves or the aortic valve, an invasive (*S. aureus*) or antibiotic-resistant (*P. aeruginosa*, yeast) pathogen, intracardiac and major neurologic complications, and an association with health care. Death and poor outcome often are related not to failure of antibiotic therapy but rather to the interactions of comorbidities and endocarditis-related end-organ complications. In developed countries, overall survival rates are 80–85%; however, rates vary considerably among subpopulations of endocarditis patients. Survival rates for patients with NVE caused by viridans streptococci, HACEK organisms, or enterococci (susceptible to synergistic therapy) are 85–90%. For *S. aureus* NVE in patients who do not inject drugs, survival rates are 55–70%, whereas 85–90% of injection drug users survive this infection. PVE beginning within 2 months of valve replacement results in mortality rates of 40–50%, whereas rates are only 10–20% in later-onset cases.

PREVENTION

To prevent endocarditis (long a goal in clinical practice), past expert committees have supported systemic antibiotic administration prior to many bacteremia-inducing procedures. A reappraisal of the evidence for antibiotic prophylaxis for endocarditis by the American Heart Association and the European Society of Cardiology culminated in guidelines advising its more restrictive use. At best, the benefit of antibiotic prophylaxis is minimal. Most endocarditis cases do not follow a procedure. Although dental treatments have been widely considered to predispose to endocarditis, such infection occurs no more frequently in patients who are undergoing dental treatment than in matched controls who are not. Furthermore, the frequency and magnitude of bacteremia associated with dental procedures and a routine day's activities (e.g., tooth brushing and flossing) are similar; because dental procedures are infrequent events, exposure of cardiac structures to bacteremic oral-cavity organisms is notably greater from routine daily activities than from dental care. The relation of gastrointestinal and genitourinary procedures to subsequent endocarditis is even more tenuous than that of dental procedures. In addition, cost-effectiveness and cost-benefit estimates suggest that antibiotic prophylaxis represents a poor use of resources.

Nevertheless, studies in animal models suggest that antibiotic prophylaxis may be effective. Thus it is possible that rare cases of endocarditis are prevented. Weighing the potential benefits, potential adverse events, and costs associated with antibiotic prophylaxis, the American Heart Association and the European Society of Cardiology now recommend prophylactic antibiotics (Table 155-7) only for those patients at highest risk for severe morbidity or death from endocarditis (Table 155-8). Maintaining good dental hygiene is essential. Prophylaxis is recommended only when there is manipulation of gingival tissue or the periapical region of the teeth or perforation of the oral mucosa (including surgery on the respiratory tract). Prophylaxis is not advised for patients undergoing gastrointestinal or genitourinary tract procedures. High-risk patients should be treated before or

TABLE 155-7 ANTIBIOTIC REGIMENS FOR PROPHYLAXIS OF ENDOCARDITIS IN ADULTS WITH HIGH-RISK CARDIAC LESIONS[a,b]

A. Standard oral regimen
Amoxicillin: 2 g PO 1 h before procedure
B. Inability to take oral medication
Ampicillin: 2 g IV or IM within 1 h before procedure
C. Penicillin allergy
1. Clarithromycin or azithromycin: 500 mg PO 1 h before procedure
2. Cephalexin[c]: 2 g PO 1 h before procedure
3. Clindamycin: 600 mg PO 1 h before procedure
D. Penicillin allergy, inability to take oral medication
1. Cefazolin[c] or ceftriaxone[c]: 1 g IV or IM 30 min before procedure
2. Clindamycin: 600 mg IV or IM 1 h before procedure

[a]Dosing for children: for amoxicillin, ampicillin, cephalexin, or cefadroxil, use 50 mg/kg PO; cefazolin, 25 mg/kg IV; clindamycin, 20 mg/kg PO or 25 mg/kg IV; clarithromycin, 15 mg/kg PO; and vancomycin, 20 mg/kg IV. [b]For high-risk lesions, see Table 155-8. Prophylaxis is not advised for other lesions. [c]Do not use cephalosporins in patients with immediate hypersensitivity (urticaria, angioedema, anaphylaxis) to penicillin.

Source: Table created using the guidelines published by the American Heart Association and the European Society of Cardiology (W Wilson et al: Circulation 116:1736, 2007; and G Habib et al: Eur Heart J 30:2369, 2009).

TABLE 155-8 HIGH-RISK CARDIAC LESIONS FOR WHICH ENDOCARDITIS PROPHYLAXIS IS ADVISED BEFORE DENTAL PROCEDURES

Prosthetic heart valves
Prior endocarditis
Unrepaired cyanotic congenital heart disease, including palliative shunts or conduits
Completely repaired congenital heart defects during the 6 months after repair
Incompletely repaired congenital heart disease with residual defects adjacent to prosthetic material
Valvulopathy developing after cardiac transplantation[a]

[a]Not a target population for prophylaxis according to recommendations of the European Society for Cardiology.

Source: Table created using the guidelines published by the American Heart Association and the European Society of Cardiology (W Wilson et al: Circulation 116:1736, 2007; and G Habib et al: Eur Heart J 30:2369, 2009).