TABLE 93-8 ECHOCARDIOGRAPHIC INDICATIONS FOR SURGICAL INTERVENTION IN INFECTIVE ENDOCARDITIS

VEGETATION
Persistent vegetation after systemic embolization
Anterior mitral valve leaflet vegetation (particularly if ≥1 embolic events occur during the first 2 wk of antimicrobial therapy)*
Increase in vegetation size despite appropriate antimicrobial therapy*†
VALVULAR DYSFUNCTION
Acute aortic or mitral insufficiency with signs of ventricular failure†
Heart failure unresponsive to medical therapy†
Valve perforation or rupture†
Large abscess or extension of abscess despite appropriate antimicrobial therapy†
PARAVALVULAR EXTENSION
Valvular dehiscence, rupture, or fistula†
New heart block†
Large abscess or extension of abscess despite appropriate antimicrobial therapy†

Modified from Baddour LM, Wilson WR, Bayer AS, et al: Infective Endocarditis: diagnosis, antimicrobial therapy, and management of complications: a statement for healthcare professionals from the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease, Council on Cardiovascular Disease in the Young, and the Councils on Clinical Cardiology, Stroke, and Cardiovascular Surgery and Anesthesia, American Heart Association; endorsed by the Infectious Diseases Society of America, Circulation 111:e394–e433, 2005.

*Surgery may be required because of risk of embolization.

†Surgery may be required because of failure of medical therapy or heart failure.

valve shunts, or a patent ductus arteriosus, analogous to IE at other sites. As with IE, continuous or high-grade bacteremia in the absence of an intracardiac vegetation should suggest the diagnosis. Imaging studies (e.g., PET scans) delineate the extent of arterial involvement. Treatment is the same as for IE.

The term *suppurative thrombophlebitis* refers to an intravenous infection that is characterized by an intravenular abscess; it is a complication of the use of central venous catheters. Patients have phlebitis with high fevers (>102° F, compared with <102° F in uncomplicated phlebitis with fevers) and bacteremia due to a skin organism (e.g., *S. aureus*). Treatment consists of a combination of antibiotic therapy and resection of the involved venous segment.

CENTRAL VENOUS CATHETER–RELATED BLOODSTREAM INFECTIONS

Central venous catheter–related bloodstream infections are relatively common, with an annual incidence of approximately 200,000 in the United States. Central venous catheter infection should be suspected if the patient develops fevers, chills, or hypotension without another obvious source of infection. The likelihood of infection increases with the length of time the catheter is in place. In addition to the clinical signs, blood cultures, drawn from the periphery as well as the line, should demonstrate growth of the causative organism. If the culture drawn from the catheter shows growth of bacteria at least 2 hours earlier than the peripheral blood cultures do, infection associated with the central line, rather than bacteremia in the setting of a catheter, should be strongly suspected.

Treatment of catheter-related infections varies depending on what action will be taken with the catheter (i.e., removal, exchange, or salvage). In any case, empirical antibiotic therapy should be initiated against the most likely pathogens. Empirical therapy should cover *S. aureus* and nosocomial gram-negative bacilli. Therapy may then be modified based on the results of blood cultures or catheter tip culture. If a catheter-related bloodstream infection is suspected, immediate removal of the catheter should occur if the infection has led to septic shock or IE. The line also should be removed if blood cultures remain positive for the causative organism for 72 hours longer, or if evidence of septic thrombophlebitis develops.

Salvage therapy may be considered in hemodynamically stable patients except when the infection is caused by *S. aureus, P. aeruginosa*, *Bacillus* spp, *Micrococcus* spp, *Propionibacterium acnes* or other propionibacteria, fungi, or mycobacteria. Salvage therapy relies on concurrent use of systemic antimicrobial agents and antibiotic or ethanol locks.

Guidewire exchange should be reserved for cases in which there is a high risk for complications if the original catheter were to be removed. Guidewire exchange has a lower chance of eliminating the infection than does removal of the catheter.

For a deeper discussion of these topics, please see Chapter 76, "Infective Endocarditis," in Goldman-Cecil Medicine, *25th Edition.*

SUGGESTED READINGS

Baddour LM, Cha YM, Wilson WR: Clinical practice: infections of cardiovascular implantable electronic devices, N Engl J Med 367:842–849, 2012.

Bor DH, Woolhandler S, Nardin R, et al: Infective endocarditis in the U.S., 1998–2009: a nationwide study, PLoS ONE 8(e60033):2013.

Brouqt P, Raoult D: Endocarditis due to rare and fastidious bacteria, Clin Microbiol Rev 14:177–207, 2001.

Fournier PE, Thuny F, Richet H, et al: Comprehensive diagnostic strategy for blood culture-negative endocarditis: a prospective study of 819 new cases, Clin Infect Dis 51:131–140, 2010.

Fernández-Hidalgo N, Almirante B, Gavaldà J, et al: Ampicillin plus ceftriaxone is as effective as ampicillin plus gentamicin for treating *Enterococcus faecalis* infective endocarditis, Clin Infect Dis 56:1261–1268, 2013.

Garcia-Cabera E, Fernandez-Hidalgo N, Almirante B, et al: Neurological complications of infective endocarditis: risk factors, outcome, and impact of cardiac surgery: a multicenter observational study, Circulation 127:2272–2284, 2013.

Kang DH, Kim YJ, Kim SH, et al: Early surgery versus conventional treatment for infective endocarditis, N Engl J Med 366:2466–2473, 2012.

Kiefer T, Park L, Tribouilloy C, et al: Association between valvular surgery and mortality among patients with infective endocarditis complicated by heart failure, JAMA 306:2239–2247, 2011.

Li JS, Sexton DJ, Mick N, et al: Proposed modifications to the Duke criteria for the diagnosis of infective endocarditis, Clin Infect Dis 30:633–638, 2000.

Mermel LA, Allon M, Bouza E, et al: Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 Update by the Infectious Disease Society of America, Clin Infect Dis 49:1–45, 2009.

Mylonakis E, Calderwood SB: Infective endocarditis in adults, N Engl J Med 345:1318–1330, 2001.

Wilson W, Taubert KA, Gewitz M, et al: Prevention of infective endocarditis: guidelines from the American 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 116:1736–1754, 2007.