TABLE 155-1 ORGANISMS CAUSING MAJOR CLINICAL FORMS OF ENDOCARDITIS

Organism	Percentage of Cases							
	Native Valve Endocarditis		Prosthetic Valve Endocarditis at Indicated Time of Onset (Months) after Valve Surgery			Endocarditis in Injection Drug Users		
	Community-Acquired (n = 1718)	Health Care–Associated (n = 1110)	<2 (n = 144)	2–12 (n = 31)	>12 (n = 194)	Right-Sided (n = 346)	Left-Sided (n = 204)	Total (n = 675)[a]
Streptococci[b]	40	13	1	9	31	5	15	12
Pneumococci	2	—	—	—	—	—	—	—
Enterococci[c]	9	16	8	12	11	2	24	9
Staphylococcus aureus	28	52[d]	22	12	18	77	23	57
Coagulase-negative staphylococci	5	11	33	32	11	—	—	—
Fastidious gram-negative coccobacilli (HACEK group)[e]	3	—	—	—	6	—	—	—
Gram-negative bacilli	1	1	13	3	6	5	13	7
Candida spp.	<1	1	8	12	1	—	12	4
Polymicrobial/miscellaneous	3	3	3	6	5	8	10	7
Diphtheroids	—	<1	6	—	3	—	—	0.1
Culture-negative	9	3	5	6	8	3	3	3

[a]The total number of cases is larger than the sum of right- and left-sided cases because the location of infection was not specified in some cases. [b]Includes viridans streptococci; *Streptococcus gallolyticus*; other non–group A, groupable streptococci; and *Abiotrophia* and *Granulicatella* spp. (nutritionally variant, pyridoxal-requiring streptococci). [c]Primarily *E. faecalis* or nonspeciated isolates; occasionally *E. faecium* or other, less likely species. [d]Methicillin resistance is common among these *S. aureus* strains. [e]Includes *Haemophilus* spp., *Aggregatibacter aphrophilus*, *Aggregatibacter actinomycetemcomitans*, *Cardiobacterium hominis*, *Eikenella* spp., and *Kingella* spp.

Note: Data are compiled from multiple studies.

complicating systemic lupus erythematosus and the antiphospholipid antibody syndrome.

Organisms that cause endocarditis enter the bloodstream from mucosal surfaces, the skin, or sites of focal infection. Except for more virulent bacteria (e.g., *S. aureus*) that can adhere directly to intact endothelium or exposed subendothelial tissue, microorganisms in the blood adhere at sites of NBTE. The organisms that commonly cause endocarditis have surface adhesin molecules, collectively called microbial surface components recognizing adhesin matrix molecules (MSCRAMMs), that mediate adherence to NBTE sites or injured endothelium. Adherence is facilitated by fibronectin-binding proteins present on many gram-positive bacteria; by clumping factor (a fibrinogen- and fibrin-binding surface protein) on *S. aureus*; by fibrinogen-binding surface proteins (Fss2), collagen-binding surface protein (Ace), and Ebp pili (the latter mediating platelet adherence) in *Enterococcus faecalis*; and by glucans or FimA (a member of the family of oral mucosal adhesins) on streptococci. Fibronectin-binding proteins are required for *S. aureus* invasion of intact endothelium; thus these surface proteins may facilitate infection of previously normal valves. If resistant to the bactericidal activity of serum and the microbicidal peptides released locally by platelets, adherent organisms proliferate to form dense microcolonies. Microorganisms also induce platelet deposition and a localized procoagulant state by eliciting tissue factor from the endothelium or, in the case of *S. aureus,* from monocytes as well. Fibrin deposition combines with platelet aggregation and microorganism proliferation to generate an infected vegetation. Organisms deep in vegetations are metabolically inactive (nongrowing) and relatively resistant to killing by antimicrobial agents. Proliferating surface organisms are shed into the bloodstream continuously.

The clinical manifestations of endocarditis—other than constitutional symptoms, which probably result from cytokine production—arise from damage to intracardiac structures; embolization of vegetation fragments, leading to infection or infarction of remote tissues; hematogenous infection of sites during bacteremia; and tissue injury due to the deposition of circulating immune complexes or immune responses to deposited bacterial antigens.

CLINICAL MANIFESTATIONS

The clinical endocarditis syndrome is highly variable and spans a continuum between acute and subacute presentations. NVE, PVE, and endocarditis due to injection drug use share clinical and laboratory manifestations (Table 155-2). The causative microorganism is primarily responsible for the temporal course of endocarditis. β-Hemolytic streptococci, *S. aureus*, and pneumococci typically result in an acute course, although *S. aureus* occasionally causes subacute disease. Endocarditis caused by *Staphylococcus lugdunensis* (a coagulase-negative species) or by enterococci may present acutely. Subacute endocarditis is typically caused by viridans streptococci, enterococci, CoNS, and the HACEK group. Endocarditis caused by *Bartonella* species, *T. whipplei*, or *C. burnetii* is exceptionally indolent.

TABLE 155-2 CLINICAL AND LABORATORY FEATURES OF INFECTIVE ENDOCARDITIS

Feature	Frequency, %
Fever	80–90
Chills and sweats	40–75
Anorexia, weight loss, malaise	25–50
Myalgias, arthralgias	15–30
Back pain	7–15
Heart murmur	80–85
New/worsened regurgitant murmur	20–50
Arterial emboli	20–50
Splenomegaly	15–50
Clubbing	10–20
Neurologic manifestations	20–40
Peripheral manifestations (Osler's nodes, subungual hemorrhages, Janeway lesions, Roth's spots)	2–15
Petechiae	10–40
Laboratory manifestations	
Anemia	70–90
Leukocytosis	20–30
Microscopic hematuria	30–50
Elevated erythrocyte sedimentation rate	60–90
Elevated C-reactive protein level	>90
Rheumatoid factor	50
Circulating immune complexes	65–100
Decreased serum complement	5–40