

Infective endocarditis: An atlas of disease progression for describing, staging, coding, and understanding the pathology

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 Supplemental material is available online.

The clinical picture of infectious endocarditis (IE)—its microorganisms, diagnostic criteria (Duke and modified Duke criteria),^{1,2} involved valve, native versus prosthetic valve, and complications—has been well described. Less well described is the pathologic stage. Although recognized as prognostically important, the pathologic description has often been limited to the presence or absence of vegetations and peri- and paravalvular abscess.³⁻⁵ From our large experience^{6,7} and long-standing interest, we have developed a deep understanding of the pathologic features of IE. Thus, we wished to share this knowledge and try to systematize and standardize the description and staging of IE. Therefore, we have described our understanding of the pathophysiology and pathologic features of IE, translated this into an instrument for recording and coding, and illustrated the main pathologic concepts in an atlas.

DOCUMENTATION

The basis of the present review was the observations and photographic documentation of IE pathologic features in the operating room. Photographs were selected strategically according to the concept illustrated and at different phases of the operation to illustrate essential points. Relevant frames from echocardiographic examinations have been added. Because obtaining good images of aortic valve pathologic features is easier than obtaining good images

of mitral valve pathologic features, photographs of aortic valve IE dominate in the atlas. This also reflects the prevalence of the disease and the diversity of the aortic pathology. Only a limited selection of illustrations has been provided in print. The material available online is more comprehensive and includes portions of echocardiographic videos; it is essential for a better understanding of this paper.

PATHOPHYSIOLOGY

The key to understanding IE is appreciating the pathologic progression.⁸⁻¹⁰ Circulating organisms, bacteria or other— injected, absorbed from the mouth or gastrointestinal tract, or entering the circulation from an infection focus—adhere to damaged areas of the endocardium (valves, ventricular septal defect), endothelium (patent ductus), or foreign material in the bloodstream (prosthetic heart valves, pacemaker leads).

Such damaged areas often have depositions of platelets, fibrin, or clots (sometimes termed “nonbacterial endocarditis”),⁸ facilitating adherence, protection, and growth of the organisms. The organisms multiply and develop colonies, attracting fibrin deposits and cells to form vegetations. Vegetations are the main source of embolization. The risk of embolism is related to the vegetation location, size, and mobility¹¹; however, embolic material can also originate from other sources, such as abscess cavities. Aortic valve vegetations can flip back and forth and cause secondary lesions on the anterior mitral valve leaflet (common) or aortic wall (uncommon), termed “kissing lesions.” The organisms produce and release enzymes that disintegrate tissue, primarily valve cusps and leaflets, and result in regurgitation. The enzymes are organism specific with regard to their tissue specificity and efficiency.

When tissue disintegration involves the valve annulus, the infection invades extravascular areas; this has been termed “invasive disease.” Invasive disease develops in stages: cellulitis, abscess, abscess cavity, and, finally, pseudoaneurysm formation. Invasion is defined by its location and extent of spread outside the valve annulus, described by the percentage of the circumference of the annulus involved and the depth and size of the cavities. Internal fistulas, perforations, and heart block constitute the specific consequences of invasion.

IE pathologic features can be further characterized by the involved valve: whether the valve is native (ie, normal, diseased, or diseased and repaired) or prosthetic, and by

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Abbreviations and Acronyms

IE = infectious endocarditis
 PVE = prosthetic valve endocarditis

activity (ie, active or remote—active unless sterile after treatment or spontaneously).

With this understanding of IE, we have developed a form for coding the pathologic features (Appendix E1), with the definitions provided in Appendix E2. The coding was determined using all available information but mainly the operative findings and pre- and intraoperative transesophageal

echocardiographic findings. We have proposed an extensive coding schema, in part to obtain detailed information that might in time be consolidated into a simpler form. In the present atlas, we have proposed broad concepts based on the consolidation of the data obtained. We have also proposed this schema as a starting point for the future development of consensus around the pathologic features of IE.

ATLAS

The concepts in the atlas are generally self-explanatory. Only some salient factors have been explained here.

Concept 1

Vegetations on endothelial defects or injuries are the primary manifestation of IE (Figure 1 and Figure series E1).

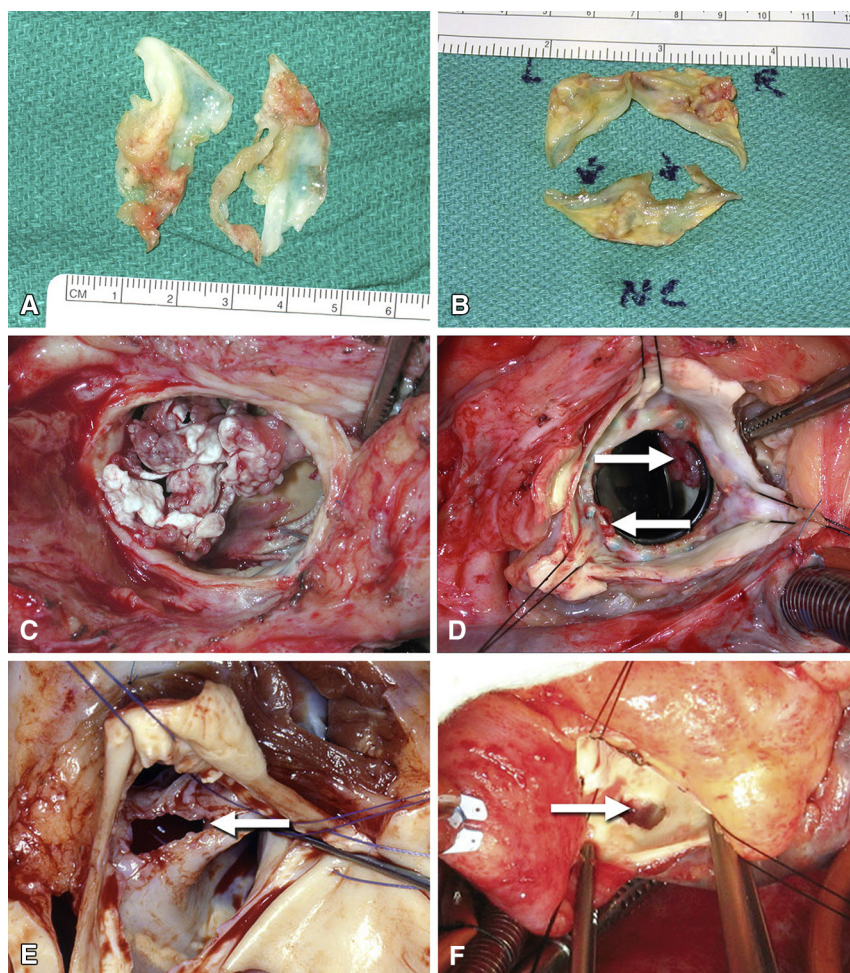


FIGURE 1. Vegetations on endothelial defects or injuries are the primary manifestation of infective endocarditis. A, View of active aortic valve endocarditis (native valve; NVE) showing excised aortic valve cusps with vegetations and cusp disintegration. B, View of remote NVE showing excised aortic valve cusps with healed vegetations but residual cusp defects (arrows). L, Left; NC, noncoronary; R, right. C, Infected bioprosthesis with large vegetations, which confers a high embolic risk. D, Infected mechanical valve with vegetations (arrows) above and below prosthesis attached to junction of valve and tissue covering of the sewing ring at multiple sites. E, Kissing lesion with perforation of anterior mitral valve leaflet (arrow). These lesions are often amenable to autologous pericardial patch repair after debridement, as shown. F, Uncommon kissing lesion showing mycotic aneurysm in posterior wall of ascending aorta (arrow) above aortic valve in a patient who had a large mobile vegetation.

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