Complications of Prosthetic Valves

Replacement of damaged cardiac valves with prostheses is a common and often lifesaving mode of therapy. There are two types of valvular prostheses:

- *Mechanical valves*. These consist of different configurations of rigid nonphysiologic material, such as caged balls, tilting disks, or hinged semicircular flaps (bi-leaflet tilting disk valves).
- *Tissue valves* (*bioprostheses*). Porcine aortic valves or bovine pericardium are preserved in a dilute glutaraldehyde solution and then mounted on a prosthetic frame. Alternatively, frozen human valves from deceased donors (called cryopreserved "homografts") can also be used. Tissue valves are flexible and function similarly to natural semilunar valves. However, the chemical treatment of the animal valves cross-links the valvular proteins, especially collagen, and renders the tissue nonviable. Similarly, the freezing and thawing of human homografts may also render them largely nonviable.

Approximately 60% of substitute valve recipients develop a serious prosthesis-related problem within 10 years after the surgery. The complications that occur depend on which type of valve has been implanted (Table 12-10 and Fig. 12-28).

- *Thromboembolism* is the major consideration with mechanical valves (Fig. 12-28*A*); this may take the form of either thrombotic occlusion of the prosthesis or emboli released from thrombi formed on the valve. Because blood flow in all mechanical devices is nonlaminar, foci of turbulence and stasis are produced by prostheses that predispose to thrombus formation. The risk of such complications necessitates long-term anticoagulation in all individuals with mechanical valves, with the attendant risk of hemorrhagic stroke or other forms of serious bleeding.
- *Structural deterioration* rarely causes failure of mechanical valves in current use. However, virtually all bioprostheses eventually become incompetent due to calcification and/or tearing (Fig. 12-28*B*).
- *Infective endocarditis* is a potentially serious complication of any valve replacement. The vegetations of prosthetic valve endocarditis are usually located at the prosthesis-tissue interface, and often cause the formation of a ring abscess, which can eventually lead to a paravalvular regurgitant blood leak. In addition, vegetations may directly involve the tissue of bioprosthetic valvular cusps. The major organisms causing such infections are staphylococcal skin contaminants (e.g., *S. epidermidis*), *S. aureus,* streptococci, and fungi.
- Other complications include paravalvular leak due to inadequate healing, obstruction due to overgrowth of fibrous tissue during healing, valve-orifice disproportion (where the effective valve area is too small for the needs of the patient, leading to a relative stenosis), intravascular hemolysis due to high shear forces, or excessive noise owing to hard contacts of moving rigid parts.

Table 12-10 Complications of Cardiac Valve Prostheses

Thrombosis/thromboembolism
Anticoagulant-related hemorrhage
Prosthetic valve endocarditis
Structural deterioration (intrinsic)
Wear, fracture, poppet failure in ball valves, cuspal tear, calcification
Other forms of dysfunction
Inadequate healing (paravalvular leak), exuberant healing (obstruction), hemolysis

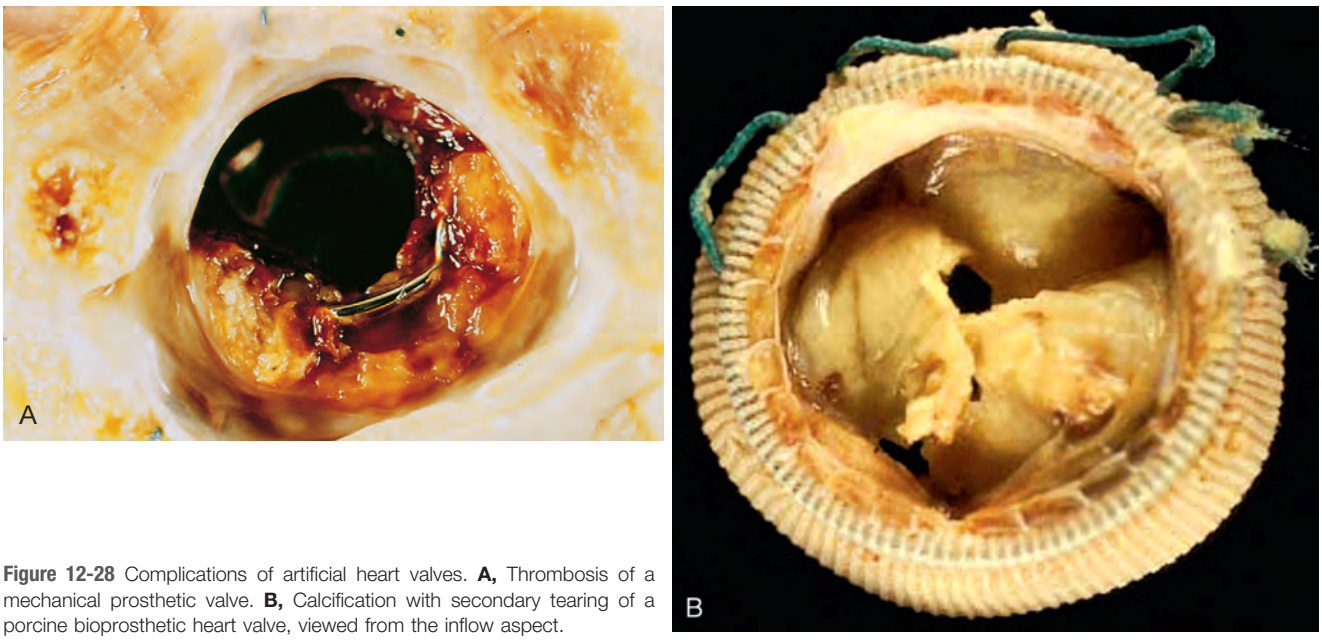

Figure 12-28 Complications of artificial heart valves. **A,** Thrombosis of a mechanical prosthetic valve. **B,** Calcification with secondary tearing of a porcine bioprosthetic heart valve, viewed from the inflow aspect.