



ROHINI

COLLEGE OF ENGINEERING AND TECHNOLOGY

Approved by AICTE and affiliated to Anna University Chennai (An ISO Certified Institution)

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CBM352 Human Assist Devices

UNIT-II CARDIAC ASSIST DEVICES

2.3 Prosthetic Cardiac Valves

Prosthetic cardiac valves are artificial devices implanted in the heart to replace damaged or diseased natural heart valves. The heart has four valves — the aortic valve, mitral valve, tricuspid valve, and pulmonary valve — and each valve plays a crucial role in ensuring one-way blood flow through the heart. There are two main types of prosthetic cardiac valves: mechanical valves (made of non-biological material) and biological valves (made of biological tissue).

2.3.1 Mechanical Heart Valves:

Material: Mechanical valves are made of durable materials, such as metal (e.g., pyrolytic carbon) or synthetic materials.

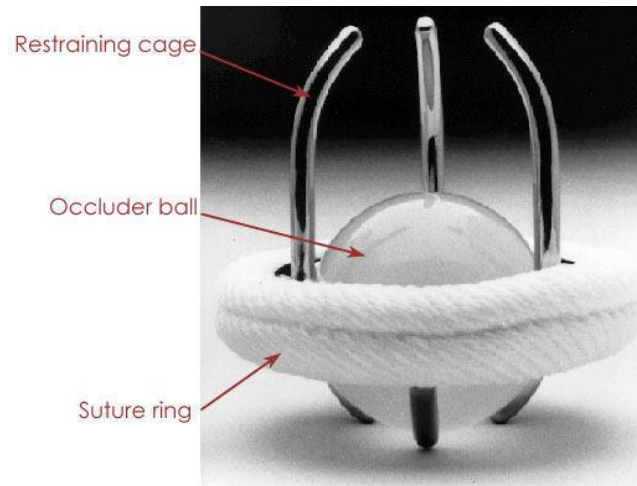
Longevity: They are long-lasting and durable, often lasting for decades.

Anticoagulation: Patients with mechanical valves typically need to take lifelong anticoagulant (blood-thinning) medications to prevent blood clots, as the mechanical valves can trigger clot formation.

Three basic types of mechanical valve design exist: bileaflet, monoleaflet, and caged ball valves

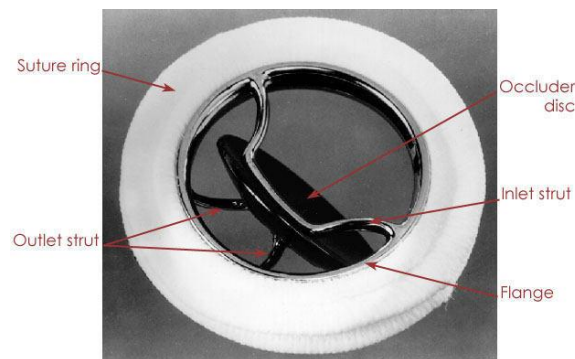
Caged Ball Valves

Caged ball valves, which consist of a silastic ball with a circular sewing ring and a cage formed by 3 metal arches, are no longer implanted. However, several thousands of patients still have caged ball valves, and these patients require follow-up.



Monoleaflet Valves:

Monoleaflet valves are composed of a single disk secured by lateral or central metal struts. The opening angle of the disk relative to valve annulus ranges from 60° to 80° , resulting in 2 distinct orifices of different sizes.



Bileaflet Valves:

Bileaflet valves are made of 2 semilunar disks attached to a rigid valve ring by small hinges. The opening angle of the leaflets relative to the annulus plane ranges from 75° to 90° , and the open valve consists of 3 orifices: a small, slit-like central orifice between the 2 open leaflets and 2 larger semi-circular orifices laterally.



Advantages of Mechanical Heart Valves

The main advantage of mechanical heart valve replacements is durability.

- Mechanical heart valves are made from very durable materials including titanium, carbon compounds and teflon. While the average tissue valve (porcine, bovine, equine) is estimated to last between 10-15 years, reports suggest that mechanical valves can last 30 years or more after implant.
- That said, for some younger patients, a mechanical heart valve can be a suitable replacement for the diseased valve.

Disadvantages of Mechanical Heart Valves

There are a few disadvantages, or considerations, that should be noted about mechanical heart valves.

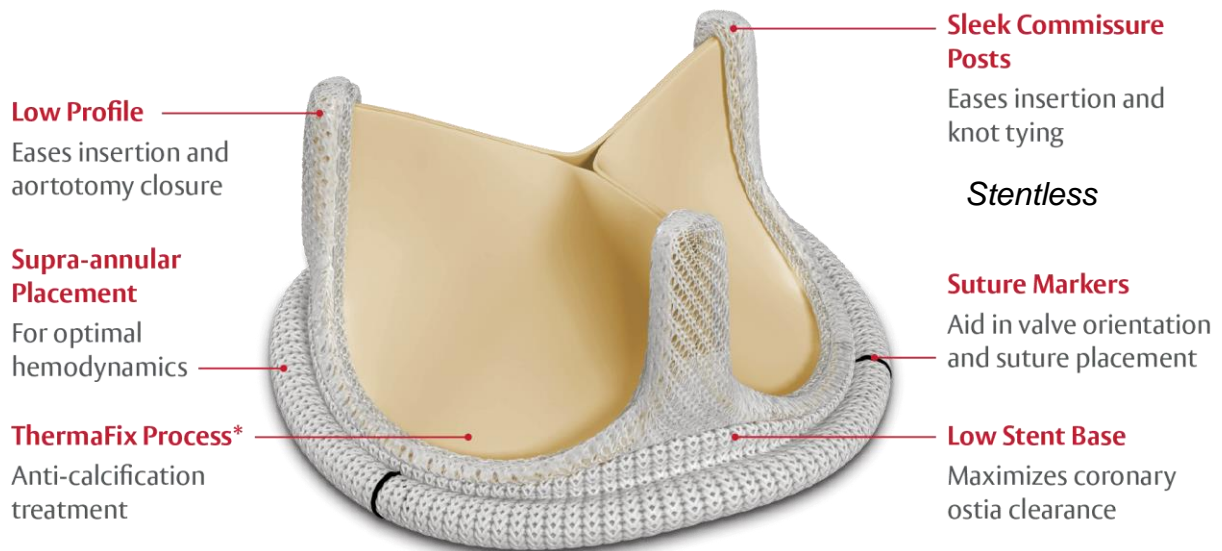
- i. First, to reduce the risk of clotting, patients are required to use blood thinners (e.g. Coumadin, Warfarin) for the balance of their lives.
- ii. Second, due to the mechanical nature of the valve, some patients can hear their valves "click" while opening-and-closing in their hearts.
- iii. Third, with the ongoing interest and use of transcatheter valve replacements, it is not possible to replace a mechanical valve should complications occur years after implant.

Selecting a heart valve replacement is a very important decision for the patient, their family and friends. I encourage you to research this choice given your age, health history, lifestyle and risk factors.

2.3.2 biological Heart valves:

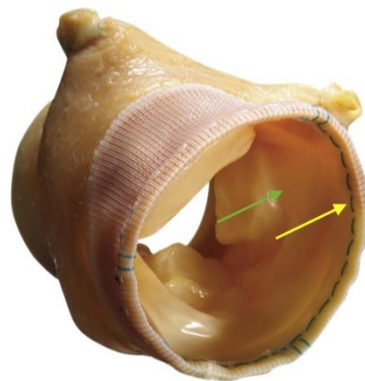
Stented Bioprostheses

The design of bioprostheses purports to mimic the anatomy of the native aortic valve. Porcine bioprosthetic valves consist of 3 porcine aortic valve leaflets cross-linked with glutaraldehyde and mounted on a metallic or polymer supporting stent. Pericardial valves are fabricated from sheets of bovine pericardium mounted inside or outside a supporting stent.



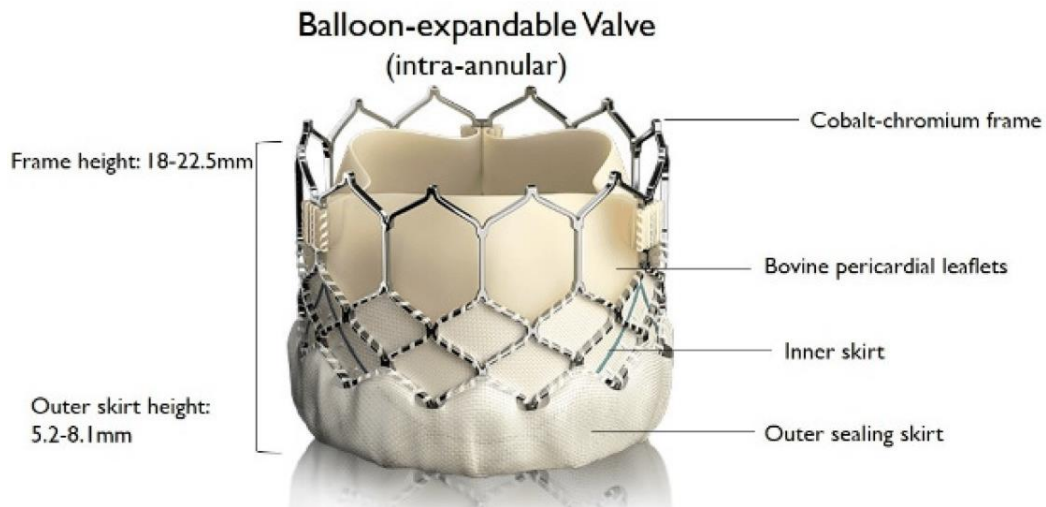
Stentless Bioprostheses:

In an effort to improve valve hemodynamics and durability, several types of stentless bioprosthetic valves have been developed. Stentless bioprostheses are manufactured from whole porcine aortic valves or fabricated from bovine pericardium.



Percutaneous Bioprostheses:

Percutaneous aortic valve implantation is emerging as an alternative to standard aortic valve replacement (AVR) in patients with symptomatic aortic stenosis considered to be at high or prohibitive operative risk. The valves are usually implanted using a percutaneous transfemoral approach. To reduce the problems of vascular access and associated complications, a transapical approach through a small thoracotomy may also be used. At present, the procedure appears promising, but it remains experimental and is currently undergoing further investigation.



Advantages of Biological Heart Valves:

- i. No Lifelong Anticoagulation
- ii. Closer to Natural Physiology
- iii. Lower Risk of Valve Thrombosis
- iv. Suitability for Older Patients
- v. Potential for Growth in Pediatric Patients
- vi. Shorter Recovery Time

It's important to note that the choice between biological and mechanical heart valves depends on individual patient characteristics, including age, lifestyle, overall health, and the specific requirements of the patient. Additionally, ongoing advancements in valve technology may influence the considerations for valve selection. Healthcare professionals work closely with patients to make personalized recommendations based on their unique circumstances and preferences.
