Aortic Root Replacement: Should the valve be fixed or spared?

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Despite the frequency of aortic valve (AV) surgery, techniques for AV repair have been adopted more slowly by surgeons when compared to repair techniques for the mitral valve. Undoubtedly the fact that the majority of AV operations are performed to relieve stenosis explains higher rates of AV replacement and reduced opportunities for repair experience. However there is growing recognition that many patients with isolated aortic regurgitation (AR), that is AR without significant stenosis, may be approached with repair techniques. Furthermore, it has been shown that AV repair offers durable results, relatively comparable to valve replacement, without prosthesis-associated complications. This is true for patients with both tri-leaflet and bicuspid valves. The realization that the integrity of the entire aortic root (which includes the ventriculo-aortic junction [aortic annulus], the valve, the sinuses, and sinotubular junction) is important in determining the outcome following repair has also undoubtedly contributed to repair success.

Mechanisms of Aortic Regurgitation

A classification system, similar to that used for mitral regurgitation, has been developed to describe AR. In general, type I mechanisms involve aortic root dilatation or cusp perforation, type II mechanisms involve excessive cusp motion or prolapse, and type III mechanisms involve restricted cusp motion.

Classification of Aortic Regurgitation by Mechanism

<table>
<thead>
<tr>
<th>AR Type</th>
<th>Mechanism</th>
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<tbody>
<tr>
<td>Type IA</td>
<td>Sinotubular junction dilatation</td>
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<tr>
<td>Type IB</td>
<td>Sinus of Valsalva dilatation</td>
</tr>
<tr>
<td>Type IC</td>
<td>Aortic annular dilatation</td>
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<tr>
<td>Type ID</td>
<td>Perforated cusp</td>
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</tbody>
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Type II

Excessive cusp motion / prolapse

Type III

Cusp restriction (calcified, thickened, rheumatic)

While patients often present to the operating room already having undergone extensive imaging evaluation of the aortic valve and root, intraoperative TEE is critical in surgical planning. Prior to
intervention, the echocardiographer should confirm the presence of AR and its mechanism(s). Careful measurement of the aortic root, including the ventriculo-aortic junction (VAJ), the sinuses and the sinotubular junction should be performed.

Not uncommonly a patient will be found to have more than one cause of AR, such as cusp prolapse together with annular dilatation. Multiple repair techniques are then used to address multiple problems, such as cusp plication or resuspension together with subcommissural annuloplasty. All types of AR may be treated successfully with repair, though the literature would suggest that the long term success with repair of type III disease (restricted, thickened, calcified) is lower than with the other two types.

**TEE Assessment following Aortic Valve Repair**

Several echocardiographic features have been demonstrated to predict successful repair and freedom from reoperation. These include a coaptation point that is above the VAJ (or aortic annulus) and the absence of mild or greater residual AR. In addition, a cusp coaptation distance of at least 4 mm is preferred.

Also, an effective cusp height of at least 8 mm is predictive of a successful outcome. Effective cusp height is measured as the distance from the plane of the VAJ to the tip of the coapting cusps.
**Echo Features Suggestive of Successful Aortic Repair**

- Cusp coaptation point above the aortic annular plane
- Less than mild residual AR
- Coaptation distance > 4 mm
- Effective coaptation height > 8 mm

**Valve-sparing Root Replacement**

For patients with aortic root dilatation with a relatively normal or reparable AV, valve-sparing root replacement offers an attractive option to the Bentall procedure (AV + root replacement with a composite graft and coronary reimplantation). Two types of valve-sparing root replacement are popular, root remodeling and AV reimplantation. Root remodeling involves excision of the dilated sinuses with preservation of the crown-shaped aortic valve commissures. A graft is scalloped or cut to fit the excised sinuses and sewn directly to the crown-shaped aortic commissural area. AV reimplantation also involves excision of the native sinuses with preservation of the crown-shaped aortic commissural regions. However, in the reimplantation technique, a tubular graft is sewn to the roughly circular aortic annular region with the native AV contained within, and sewn to, the inside of the synthetic graft.

Some experts believe the AV reimplantation technique provides better results in younger patients, those with aortic dilatation in the setting of genetic syndromes, and those with larger aortic annular (>28 mm) diameters. On the other hand, root remodeling can provide good results to older patients whose aortic dilatation is not part of a genetic syndrome and whose aortic annulus is not dilated.

Valve-sparing techniques are probably best avoided in the patients with calcified or sclerotic valves or those with stress fenestrations. Such patients may have better results with composite valve and root replacements.

**Suggested Reading**