Bentall Procedure in 2016: Valve and Conduit Choice, Techniques, Tips and Tricks

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Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

<table>
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<th>Affiliation/Financial Relationship</th>
<th>Company</th>
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A technique for complete replacement of the ascending aorta

HUGH BENTALL AND ANTONY DE BONO
From the Royal Postgraduate Medical School, London, and Hammersmith Hospital

A technique for complete replacement of the aortic valve and ascending aorta in cases of aneurysm of the ascending aorta with aortic valve ectasia is described. The proximal aortic root was too attenuated to afford anchorage to the aortic prosthesis, so this was sutured to the ring of a Starr valve and the prostheses were inserted en bloc. The orifices of the coronary arteries were anastomosed to the side of the aortic prosthesis.

Aneurysmal dilatation of the ascending aorta is often associated with ectasia of the aortic valve ring and presents clinically as aortic incompetence. In Marfan’s syndrome or cystic medial necrosis this may develop with dramatic suddenness in an ostensibly healthy individual. The dilatation of the valve ring makes repair or replacement with other than a prosthetic valve difficult. The aneurysm, which is either a true dilatation or dissection, is best treated by excision and replacement with a tubular prosthesis, as the wall is invariably thickened. This is not difficult provided that the aorta distal to the aneurysm and proximal to the arch is suitable for anastomosis.

Proximally, in most cases, the aortic prosthesis can be sutured to a rim of aorta, leaving the coronary orifices undisturbed, while a valve prosthesis is placed in the usual sub-coronary position (Cooley, Bloodwell, Beall, Hallman, and De Bakey, 1960).

However, it sometimes happens that the root of the aorta is so involved in the disease process that the wall is too attenuated to be sutured to the proximal end of the aortic prosthesis. In this situation the management of the coronary ostia is the main concern of the surgeon.

CASE REPORT

A man aged 33 years had been in excellent health until a few months before admission, when his wife noticed a loud cardiac murmur and he developed signs and symptoms of gross aortic regurgitation. Angiocardiography showed a large aneurysmal dilatation of the ascending aorta, not involving the vessels of the arch but associated with free aortic regurgitation. He was in inexcusable cardiac failure with an effective cardiac output of 1.8 l/min/m².

OPERATION A mid-axial thoracotomy revealed a large globular dilatation of the ascending aorta. Its bulging intimal wall was so thin that blood could be seen seeping within. Figure 1 gives an idea of the attenuation of the wall.

Total cardiopulmonary bypass was established, and, after cross-clamping the aorta distal to the aneurysm, the aorta was opened, and the coronaries were cannulated and perfused in the usual way. The aortic valve ring was much dilated and the wall was extremely thinned down to the ring.

It was clear that it would not be possible to join the aortic wall above the coronary ostia to an aortic prosthesis. It was therefore decided to suture the tube prosthesis directly to the ring of a Starr valve. A No. 13 Starr valve was sutured to one end of a cramped Teflon aortic prosthesis, as shown in Figure 2. The aortic cusps, having been excised, sutures were placed in the aortic ring and through the Starr valve ring. These were tied, fixing the Starr valve and the attached Teflon tube.

At this stage the coronary cannulae were outside the lumen of the aortic replacement. Holes were cut in the aortic prosthesis at the site of the coronary orifices, which were then re-cannulated, the tube through the lumen of the tube (Fig. 3). The aortic wall was sutured to the perimeter of the holes in the Teflon tube, thus reincorporating the coronary ostia within the new aorta.

The distal anastomosis was then completed, leaving a vertical slit (Fig. 3 (5)) through which the coronary cannulae were removed and air was evacuated. This was then closed with a clamp while the aortic clamp was released and retrograde coronary perfusion was started again without any delay. The wall of the aneurysm was closed over the prosthesis.

The patient made an uneventful recovery and remains well after nine months.

FIG. 2. Starr valve has been sutured to aortic prosthesis; sutures have been placed in aortic ring before fixing the combined prostheses.

FIG. 3. Combined prostheses in situ. Insets 1 to 4 show details of holes fashioned in the side wall of the Teflon tube to reincorporate the coronary ostia within the lumen of the new ascending aorta. Inset 5 shows the vertical slit in the prosthesis.
Options of Proximal Reconstruction in 2016
Aortic Root Replacement: The Gold Standard - Versatile

- Aneursym
- Dissection
- Intramural hematoma
- Pseudoaneurysm
- Endocarditis / Infection
Root Replacement in 271 Marfans Patients: 232 Mechanical Composites
24 year experience

- Zero 30 day elective mortality
  - 21% had mitral procedures as well
- 2 (0.7%) early mortality (both in emergent cohort = 5.6%)
- 67% Actuarial survival at 20 years
  - Permanent CVA: 5
- VERY LOW thromboembolic rates
- 83% Actual survival at 20 years (43/271)

Washington DC AATS 2007
No Differences MHCA / ACP vs DHCA / RCP

Mortality 1%
Stroke <2%
AKI (R,I or F) <15%
New HD <1%
Mechanical vs Bioprosthetic

**PRO : Excellent durability**

**CON : Life-long anticoagulation and risk of bleeding**

**PRO : No anticoagulation**

**CON : Limited durability requiring reoperation**
Guidelines for Choice of Prosthesis

Nishimura, RA et al.
2014 AHA/ACC Valvular Heart Disease Guideline
2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease
A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines
Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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*developed in collaboration with the american association for thoracic surgery, american society of echocardiography, society for cardiovascular angiography and interventions, society of cardiovascular anesthesiologists, and society of thoracic surgeons
11.1.2. Intervention: Recommendations
See Table 23 for a summary of recommendations for prosthetic valve choice.

<table>
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<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
<th>References</th>
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<tr>
<td>Choice of valve intervention and prosthetic valve type should be a shared decision process</td>
<td>I</td>
<td>C</td>
<td>N/A</td>
</tr>
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<td>A bioprosthesis is recommended in patients of any age for whom anticoagulant therapy is contraindicated, cannot be managed appropriately, or is not desired</td>
<td>I</td>
<td>C</td>
<td>N/A</td>
</tr>
<tr>
<td>A mechanical prosthesis is reasonable for AVR or MVR in patients &lt;60 y of age who do not have a contraindication to anticoagulation</td>
<td>IIa</td>
<td>B</td>
<td>(534-536)</td>
</tr>
<tr>
<td>A bioprosthesis is reasonable in patients &gt;70 y of age</td>
<td>IIa</td>
<td>B</td>
<td>(537-540)</td>
</tr>
<tr>
<td>Either a bioprosthetic or mechanical valve is reasonable in patients between 60 y and 70 y of age</td>
<td>IIa</td>
<td>B</td>
<td>(541, 542)</td>
</tr>
<tr>
<td>Replacement of the aortic valve by a pulmonary autograft (the Ross procedure), when performed by an experienced surgeon, may be considered in young patients when VKA anticoagulation is contraindicated or undesirable</td>
<td>IIb</td>
<td>C</td>
<td>N/A</td>
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AVR indicates aortic valve replacement; COR, Class of Recommendation; LOE, Level of Evidence; MVR, mitral valve replacement; N/A, not applicable; and VKA, vitamin K antagonist.
Bentall Options

- Mechanical
- Full porcine root
- Pericardial / Porcine Valve Conduit
- Homograft
- Autograft (Ross)
Mechanical Valve Conduit

LivaNova

St Jude
Root Procedural Tips

• Aggressive Mobilization of the aortic root complex
  – Deep dissection to level of annulus
  – Adequate coronary mobilization
  – Intra annular implantation
  – Orientation of the coronary buttons
Medtronic Freestyle Stentless

- Entire aortic root and adjacent aorta removed
- Porcine
- Removal of stents to allow for better hemodynamics
- Medtronic, Minneapolis, MN
- Size: A - 19-29mm
Durability of Porcine Bioroots in Younger Patients With Aortic Root Pathology: A Propensity-Matched Comparison With Composite Mechanical Roots

Nimesh D. Desai, MD, PhD, Fenton McCarthy, MD, William Moser, CRNP, Wilson Y. Szeto, MD, Ahmad Zeeshan, MD, Danielle Brown, MD, Y. Joseph Woo, MD, Alberto Pochettino, MD, Patrick Moeller, BS, and Joseph E. Bavaria, MD

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Ann of Thorac Surg 2011
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Freedom from Reop

Freedom from any Bleeding
Pericardial / Porcine Valve Conduit

Magna

Epic

Trifecta

Mitroflow
Mitroflow Pericardial Bio Conduit
Reoperation Pericardial Valve conduit
TAVR Valve in Valve
Outcomes of Aortic Root Replacement After Previous Aortic Root Replacement: The “True” Redo Root

Arminder S. Jassar, MBBS, Nimesh D. Desai, MD, PhD, Dale Kobrin, BA, Alberto Pochettino, MD, Prashanth Vallabhajosyula, MD, Rita K. Milewski, MD, Fenton McCarthy, MD, Jon Maniacci, BS, Wilson Y. Szeto, MD, and Joseph E. Bavaria, MD

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Background. Aortic reoperations are technically challenging. This study evaluated outcomes after “true” redo root replacement classified by cause. Methods. Patients who underwent redo root replacement due to degenerative or late infection were included in this study. Results. Overall mortality was 4% (n = 28) in the de novo group and 5% (n = 6) in the redo group (p = 0.43) (degenerative group, 3%; infection group, 9%; p = 0.19). The infection group had an increased incidence of renal failure, sepsis, and an increased hospital length of stay. The degenerative group and the de novo group had a similar risk of perioperative death and major complications. The 5-year survival was 86.3% ± 1.3% in the de novo group (p = 0.053 ± 7.7%; p < 0.001). Multivariate analysis indicated that degenerative failure or late infection can be performed with low perioperative morbidity and death. The presence of infection increases the risk of complications and worsens survival. However, redo root replacement for degenerative failure can be performed with similar short-term complication risk and midterm survival as de novo root replacement.

Redo Root / Previous Homograft
Proximal Reconstruction
Previous Homograft
Proximal Reconstruction
Previous Homograft
Aortic Root Abscess with Contained Rupture: Previous Root / Hemiarch
Dehisced / Infected Mechanical Prosthesis
Pre Emptive Axillary cannulation
Redo Total Arch with MHCA / ACP
Root Abscess
Reconstruction of Left atrium and A-M Continuity
Redo Root with Homograft
MIS Aortic Root / Arch Reconstruction

Partial sternotomy

Right thoracotomy
Aortic root replacement (Modified Bentall) with hemiarch replacement under MHCA with ACP

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