Aortic Replacement in Bicuspid Disease: How to Match the Procedure to the Patient

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Aortic Replacement in Bicuspid Disease: How to Match the Procedure to the Patient

No Disclosures

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Variable Phenotype: BAV and Aneurysms

Type I

Type II

Type III

Courtesy of Thoralf M. Sundt III, MD, Mayo Clinic
Ascending Aortic Replacement in Bicuspid Disease

Overview

- Proximal Extent
- Distal Extent
- Cannulation
- Cerebral Protection
- Hemostasis
- Results
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Reduction Aortoplasty (Non-Reinforced)?

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Reduction Aortoplasty (Reinforced)?

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Proximal Extent

*Reduction Aortoplasty?*

- Non-reinforced not indicated
- Reinforced may be indicated in high risk patient with intact root and competent aortic valve
  - late complications (i.e. rupture) can still occur
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Proximal Extent
1. Valve non-diseased/competent, root intact (sinuses not effaced, normal diameter), aneurysm starts at or distal to STJ
   - Intent: *replace aorta*

2. Valve incompetent but not terribly diseased, root architecture distorted (sinuses effaced, normal diameter), aneurysm starts at or distal to STJ

- Intent: replace aorta and restore valve competence
  - central jet/normal coaptation: no valve repair
  - Eccentric jet/abnormal coaptation: valve may need repair

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Proximal Extent

VSR vs. CVG vs. SVG?

1. VSR (valve sparing root)

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Proximal Extent

VSR vs. CVG vs SVG?

1. VSR (valve sparing root)
   - Dilated aorta and root plus non/mildly diseased (+/- regurgitant) AV
   - Need to have experience with VSRs (VSR for BAV are more difficult!)
     - remodeling vs. reimplantation
     - coronary arteries
     - need to know some aortic valve repair techniques
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Proximal Extent

VSR vs. CVG vs SVG?

2. CVG (composite valve graft)
   - Dilated aorta, sinuses effaced, valve needs to be replaced
   - Mechanical valve replacement, usually
   - If pt wants bioprosthesis:
     - sew tissue valve to dacron graft
     - use porcine root
     - replace the aortic root as with a re-implantation (David) VSR, replace the valve with a bioprosthesis
     - avoids a redo root if the valve fails!
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Proximal Extent

VSR vs. CVG vs SVG?

3. SVG (separate valve graft)
   - Dilated aorta, sinuses not effaced, root appears preserved, valve needs to be replaced
   - If unsure about the integrity of the root but unwilling to do a formal root replacement, don’t forget the Wheat procedure!

3. **SVG (separate valve graft)**

   - Must limit manipulation of the sino-tubular junction with forceps while doing the valve replacement
   - This anastomosis is easier with mechanical valve replacement than with bioprosthetic valve replacement

Miller DC, *et al.* JTCVS 1980;79:388-401
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*Proximal Extent*

*Homograft Aortic Root Replacement*
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Proximal Extent

Homograft Aortic Root Replacement

O’Brien et al., J Thorac Cardiovasc Surg 1997;113:311
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Proximal Extent

Homograft Aortic Root Replacement

Calcification
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Proximal Extent

Ross Procedure?
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Proximal Extent

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Proximal Extent

Ross Procedure?
Ascending Aortic Replacement in Bicuspid Disease

Proximal Extent

Ross Procedure?

- Classically has not been recommended for aortic aneurysm associated with BAV
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Proximal Extent

Ross Procedure?

de Sa M et al. JTCVS 1999;118:588-94.
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Proximal Extent

Ross Procedure?

6 years postop

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Proximal Extent

Ross Procedure?

- Classically has not been recommended for aortic aneurysm associated with BAV
- However, new inclusion techniques for pulmonary autograft may prompt surgeons to re-visit this option
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Proximal Extent

Ross Procedure?

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Distal Extent
I replace at least the hemiarch in (just about) ALL patients

Why replace the hemiarch with BAV Disease?

1. Embryologic

- Ascending aorta (+ most/all of arch) develops from neural crest tissue in contrast to the rest of the aorta (mesoderm)
- BAV aneurysms by and large stop at the innominate artery/proximal-mid hemiarch
- Reasonable to postulate that “non-aneurysmal” ascending aorta may dilate later if left alone
- Replacement including hemiarch will exclude most tissue with an embryologic predisposition to disease

Why replace the hemiarch with BAV Disease?

2. Technical

- Easier to sew to a round tube than a compressed one (especially posteriorly)
- Needle microtears and potential for more bleeding
- A clamped ascending replacement is an unsatisfying operation – probably not sewing to normal aorta
- Clamping inherently diseased aorta may damage it further – increased propensity for reoperation?
- Ability to tailor different sized grafts e.g. for a valve sparing root replacement
Why replace the hemiarch with BAV Disease?

3. It is safe and (usually) does not add a lot of XCL/CPB time.
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Cannulation
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**Cannulation**

- Distal ascending aorta but in a place easy to control
- Small cannula
- Double purse string adds level of comfort
- If aorta too large to clamp with this strategy, cool, circ arrest, do distal anastomosis first, cannulate and clamp graft, complete the proximal part of the operation while rewarming (another reason to replace the hemiarch in all pts!)
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*Cerebral Protection*
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Cerebral Protection

1. Hemiarch replacement
   - 20ºC, 1 g methylprednisolone, 15 mg/kg sodium thiopental, ice packs to head
   - I do not use perfusion adjuncts if I anticipate that my circ arrest time at this temperature will be < 25 min
   - MUSC: 143 pts in 8 years (2002-2009), avg circ arrest time 11 minutes, 1% stroke rate, 1.9% transient neurologic dysfunction rate
Axillary Artery Selective Antegrade Cerebral Perfusion (SACP)
- “gold standard” SACP strategy
- Excellent for longer circ arrest times
- Most pts have intact circle of Willis
- Unclutters the operative field
- Avoids direct great vessel ostial cannulation (dissect, embolize)
BUT....

- Extra incision
- Must divide significant amounts of Pec Major and Minor muscles
- Risk of brachial plexus injury
- “Subclavian artery is the second worst artery in the body” (D.C. Miller, MD)

2. Full Arch Replacement
   - 20°C, 1 g methylprednisolone, 15 mg/kg sodium thiopental, ice packs to head
   - I do use perfusion adjuncts here, usually axillary SACP
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Hemostasis
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Hemostasis

1) Preventive steps:
   1) Sew to normal aorta
   2) Keep microtears to a minimum (surgical adhesives?)
   3) Fix all surgical bleeding before coming off CPB

2) Rewarm fully (≥ 36.5ºC)

3) Reverse heparin, pack tightly and wait a good 5 min

4) Remove packs, look for and correct residual polypropylene deficiency

5) Give blood products as dictated by lab results

6) Use blood and body warmers

7) Recombinant activated factor VIIa can have an impressive effect in coagulopathic pts

8) The “baffle” can save your patient’s life!
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Hemostasis

Ascending Aortic Replacement in Bicuspid Disease

Hemostasis

1) Preventive steps:
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7) Recombinant activated factor VII a can have an impressive effect in coagulopathic pts

8) The “baffle” can save your patient’s life!

9) Rarely, pack tightly and stabilize in ICU with open chest for 24 h if still coagulopathic/edematous
Results
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Results


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Conclusion

- BAV-associated aneurysms are common, hence must have a clear strategy for proximal repair
- Advocate hemiarch distal replacement
- Central cannulation in most pts
- Axillary SACP can be very valuable
- Hemostasis is usually not a huge issue
- Long term results dependent on comorbidities