Stenting in transverse aortic arch hypoplasia

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PHENOTYPES OF COARCTATION

1. Waist lesion – infolding of aortic wall

Courtesy: Andrew Cook
2. Diaphragm – Fibrous ring

Tubular hypoplasia

Courtesy: Andrew Cook
Surgical treatment

Resection and extended arch repair in infants

Aortic arch in coarctation

- Coarctation of aorta is not a simple lesion

- Limited growth potential of segments:
  - hypoplasia or angulation of aortic arch or isthmus

Aortic coarctation

- Coarctation anatomy is variable in adults
- Unknown incidence of cystic medial necrosis – especially in adults

Transverse aortic arch hypoplasia

- Most of cases with transverse arch hypoplasia present in the neonatal period or early infancy
- Some adults present later
- Very often, transverse arch hypoplasia has been unmasked after treatment of the conventional coarctation
- This may be in the form of residual gradient or abnormal BP response to exercise
Post surgical coarctation patient with hypertension

Transverse arch likely to be a limiting factor

Balloon dilation or stenting adults with native aortic coarctation

- 54 consecutive adult patients
- 32 pts had BD, 22 had stent implantation
- Significantly greater gradient reduction after stents
- 2 (6%) small aneurysm after BD
- All stent procedures successful
- Anatomy (discrete coarctation) and use of stents were associated with a residual gradient <10mm Hg
- **To achieve this gradient, hypoplastic isthmus or tubular coarctation should be treated with primary stenting**

Zabal et al, 2003
Native aortic coarctation

Primary bare CP stent is effective. But what about the transverse arch?

Native aortic coarctation with isthmus hypoplasia – covered stent implantation

16 yrs old, primary covered CP stent
Mismatch between distal arch and proximal arch and descending aorta
Native aortic coarctation – stent implantation

16 yrs old, primary CP stent implantation
Complex coarctation

Palmaz stent

Palmaz Genesis stent

C-P stent

Intrastent

Jostent Wavemax
Stent implantation in transverse aortic arch

- Utilises elastic properties of the aortic wall to increase the diameter of coarctation segment
  - minimizes trauma to the aortic wall
  - decreases intimal tear/flap formation
- Long-term relief of coarctation gradient at follow up
- Predictable results

Transverse aortic arch hypoplasia - issues for stenting

- Types of stents:
  - Bare or covered
  - Closed cell or open cell
- Anatomy:
  - Expansile vessel
- Complications of procedure
  - Stent migration
  - Possibility of dissection
- Persistence of abnormal BP response on exercise
Technique of stent implantation in transverse aortic arch

• Technique similar to coarctation stenting

• Selection of the balloon catheter and stent:
  – balloon diameter - similar to the diameter of the aorta (either isthmus or transverse arch, whichever is greater)
  – balloon length - similar to the length of the stent whenever possible

Stent implantation technique

Balloons:
  – BIB (“balloon in balloon”) catheter is preferable for stent implantation in aorta (other high pressure balloons can also be used)

Stents
  • Manually crimped stents
  • Palmaz Genesis or Intrastents Maxi LD stents (preferable to use open cell stents)
  • Choice of the stent depends on its properties and need to expand to diameter of adult aorta
Stent implantation technique

- Use dilute contrast (25% contrast + 75% saline) for balloon inflation
- Rapid RV pacing essential for stabilisation of balloon position during inflation
- When using BIB balloon, inflate the inner balloon with inflator to pressure recommended by the manufacturer
- Perform angiography through the long sheath to check stent position
- Adjust position of the stent if needed, before inflating outer balloon

Stenting of transverse aortic arch
Stenting of transverse aortic arch

Stenting of transverse aortic arch
Stenting of transverse aortic arch

*Rapid RV pacing essential*

Stenting of transverse aortic arch after previous stenting of native coarctation
Transverse arch hypoplasia

Stenosis between LCCA and LSA

Use an open cell stent eg Intrastent LD Max

Transverse arch hypoplasia

Open cell stent eg Intrastent LD Max
Transverse arch hypoplasia

Open cell stent eg Intrastent LD Max

Stent implantation in transverse arch hypoplasia

Main complications:

- Dissection is rare
- Stent migration or malposition:
  - implant the migrated stent below coarctation in the descending aorta
  - if stent migrates to the ascending aorta - more difficult
  - if interventional techniques fail, surgery is recommended
Stenting of hypoplastic aortic segments with mild pressure gradients

20 pts with arterial hypertension and hypoplastic segment of aorta
• Gradient before 16 ± 6 mmHg
• Gradient after stent 3 ± 4 mmHg

Follow-up - 2.2 yrs
– 10 pts no antihypertensive medications
– 10 pts residual medication (better blood pressure control)

Boshoff D et al. Stenting of hypoplastic aortic segments with mild pressure gradients and arterial hypertension. Heart 2006

Stenting for aortic coarctation
Effects on BP

• 43 pts, median age 17 yrs (range 8 – 45 yrs)
• Exercise test, ambulatory BP, echo, cardiac catheterisation
• Gradient reduced from median of 22 mm Hg to 1 mm Hg
• No complications
• BP reduced from mean of 144 mm Hg to 128 mm Hg
• 68% of all pts were normotensive
• Arterial hypertension persisted in the remainder

Eicken, Hess et al, 2006
Surgical treatment for aortic coarctation – effect on BP response

• Coarctation surgery end-to-end (43 pts) and extended repair (32 pts)
• Exercise testing and MRI assessment
• Gothic arch, crenal arch, rounded arch
• Exercise induced hypertension more frequent 15 yrs after surgery in those:
  – With gothic arch 83%
  – With crenal arch 25%
  – With normal round arch 21%
• Angulated gothic arch associated with abnormal BP response

Ou, Bonnet et al, 2006

Stenting in transverse aortic arch

• Use bare metal stents e.g Genesis, CP rather than covered
• Use open cell stents e.g Intrastent Maxi LD
• Stenting of hypoplastic transverse arch has a role in management of coarctation and residual hypertension
• Technique needs further assessment