Post-operative imaging for long term complications on left ventricular outflow obstructions

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Disclosures

- No financial disclosure
- Off-label use of Gadolinium for cardiac MR Angiography
Overview

- Post-operative imaging MRI protocols
- Cases of long term post-op complications
MRI protocols for LVOTO
(Aortic stenosis, follow-up coarctation)

- Axial black blood (double inversion recovery, PD weighted fast/turbo spin-echo, or T1)
- Cine b-SSFP
  - Vertical long axis
  - Left ventricle outflow tract (LVOT)
  - Short axis
- 3-D whole heart imaging MRA (3D b-SSFP)
MRI protocols for LVOTO
(Aortic stenosis, follow-up coarctation)

- Time resolved gadolinium (Gd) enhanced MRA
- Flow analysis
  - Aorta
  - Pulmonary artery (PA)
  - AV valves
- Delayed enhancement (optional)
MRI protocol (single ventricle physiology-HLHS)

- Axial black blood (double inversion recovery, PD weighted fast/turbo spin-echo, or T1)
- Cine b-SSFP
  - Axial
  - LVOT
  - Short axis
- 3D isotropic whole heart imaging MRA (non-Gd MRA)
MRI protocol (single ventricle physiology-HLHS)

- Gd enhanced time resolved MRA
- Flow Analysis
  - Aorta
  - SVC
  - IVC
  - Shunts (Sono, central, BT)
- Delayed enhancement (optional)
Left ventricle outlet obstructions

- Congenital Aortic stenosis
- Aortic coarctation
- Interrupted aortic arch
- Hypoplastic left heart syndrome (HLHS) *Shone’s complex
Surgical procedures for aortic stenosis

- Balloon dilation
- Ross and Ross-Konno procedures
- Patch enlargement of supravalvular aortic stenosis
Aortic stenosis

- Despite early enthusiasm about the Ross procedure, concerns exist about late ascending aortic dilatation and progressive regurgitation leading to pulmonary homograft replacement.

s/p Ross procedure
s/p Ross procedure
Ross-Kono procedure

- The autograft demonstrated durability without development of aortic stenosis or progressive dilation and a low incidence of developing progressive aortic insufficiency. Enlargement of the aortic annulus appear to parallel somatic growth in most instances.

John W. Brown, MD, Mark Ruzmetov, MD, PhD, Palaniswamy Vijay, MPH, PhD, Mark D. Rodefeld, MD, and Mark W. Turrentine, MD
s/p Ross-Kono procedure
Coarctation-late complications

- Pseudoaneurysms
- Re-coarctation
- Stents
  - Fractures
  - Outgrowth
  - Outgrowth
  - Displacement
Re-coarctation s/p conduit
Coarctation s/p conduit
CT for stent evaluations
CT for stent evaluations
IAA

- Late complications
  - Arch gradient
  - LV Outflow obstruction
  - L bronchial obstruction
Pseudoaneurysm
Pseudoaneurysm
Conduits
Conduits
HLHS-late complications

- Norwood
- Bidirectional superior cavopulmonary connection (BCPC)
- Total cavopulmonary connection (TCPC)
- Hybrid
Norwood

- Complications following Norwood procedure that can be detected by CMR include
  - valvular regurgitation
  - branch pulmonary artery narrowing
  - Blalock-Taussig or right ventricle-to-pulmonary artery shunt malfunction (pseudoaneurysm formation, stenosis, and occlusion)
  - aortic arch and great vessel stenosis
BCPC complications

- Complications following BCPC creation that may be detected by CMR include
  - Complications of Norwood AND
  - BCPC pathway narrowing
  - systemic venous-to-systemic venous collateral vessel formation
TCPC complications

- **Cardiac**
  - Complications include Norwood and BCPC complications AND
  - Fontan circuit thromboembolism
  - Stenosis of Fontan circuit
  - Development of systemic venous-to-pulmonary venous connections
- **Extra-cardiac**
Fontan circuit stenosis

Fredenburg T B et al. Radiographics 2011;31:453-463
Fontan thromboembolism

Complications of Hybrid Procedures
Complications of Hybrid Procedures
Complications of Hybrid Procedures
Complications of Hybrid Procedures
Complications of Hybrid Procedures
Conclusion

- Imaging is important in assessing early to long term complications in all post-operative patients with left outflow tract obstructive conditions.
- The protocols and sequences should be tailored for the specific lesions for complete evaluations.
- Dynamic CTAs help in confirming vascular mass effect on airways, in post-op patients with respiratory distress.