

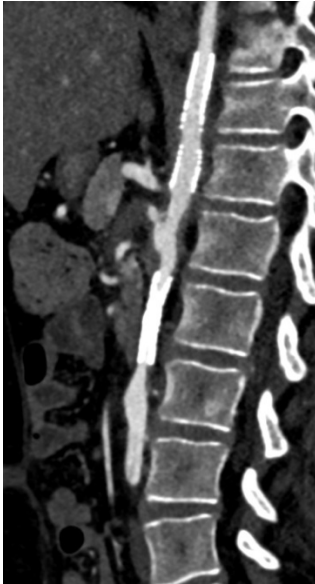
Vascular
Body Imaging Postgraduate Course - May 15, 2018
SAM References

Vasculitis, Including Vessel Walling Imaging

Geetika Khanna, MD, MS

Eric J. Crotty, MD

1. Which of the following imaging findings is indicative of ACTIVE inflammation in vasculitis?



- A. Vessel wall thickening
- B. Vessel lumen narrowing
- C. Beaded dilation
- D. Fusiform dilation

Correct Answer: A

Rationale: Signs of vessel active inflammation include: vessel wall thickening, T2-weighted hyperintensity at MRI, early postcontrast enhancement, and hypermetabolism on FDG-PET. Answers B, C, and D are incorrect. The changes in vessel lumen size such as stenosis, dilation, beading, dissection, etc. are the consequences of vessel wall inflammation. However, these findings are irreversible and persist even after the active inflammation has subsided.

Reference:

- Pediatric vasculitis: recognizing multisystemic manifestations at body imaging. Radiographics. 2015 May-Jun.

2. Which of the following vasculitis has angiographic abnormalities as a requirement for diagnosis?

- A. Kawasaki disease
- B. IgA vasculitis (Henoch-Schönlein Purpura)
- C. Takayasu arteritis
- D. Granulomatosis with polyangiitis (Wegener's granulomatosis)

Correct Answer: C

Rationale: Per the EULAR/PRoS endorsed consensus criteria for the classification of childhood vasculitides, Takayasu Arteritis requires conventional, CT, or MR angiographic abnormalities. Childhood polyarteritis nodosa requires either biopsy OR angiographic abnormalities.

Reference:

- EULAR/PReS endorsed consensus criteria for the classification of childhood vasculitides. Ozen S, Ruperto N, Dillon MJ et al. *Ann Rheum Dis*. 2006 Jul;65(7):936-41.

3. Which of the following statements is true regarding pediatric vasculitides?

- A. Kawasaki Disease is the most common pediatric vasculitis
- B. Coronary artery aneurysms usually remain unchanged over time
- C. Takayasu arteritis is a larger vessel vasculitis
- D. Ultrasound is the modality of choice for imaging large vessel vasculitides

Correct Answer: C

Rationale: Takayasu Arteritis is a large vessel vasculitis. Answer A is incorrect. HSP is the most common childhood vasculitis. Answer B is incorrect. Coronary artery aneurysms usually decrease in size over time. However, the coronary arteries remain abnormal in appearance and may develop calcification and stenoses and follow up is required. Answer D is incorrect. Large vessel vasculitides can involve anatomical areas that may be difficult to evaluate with ultrasound. The ability of MRI to correlate with disease activity makes it the preferable over DSA and CT for evaluation.

References:

- Coronary Artery Aneurysms in Kawasaki Disease: Risk Factors for Progressive Disease and Adverse Cardiac Events in the US Population Friedman et al *J Am Heart Assoc*. 2016 Sept 15;5(9)
- Pediatric Vasculitis: Recognizing Multisystemic Manifestations at Body Imaging Khanna G, Sargar K, Baszis K *RadioGraphics* 2015 May-Jun;35(3):849-65

Imaging of Vasculopathy/Aortopathy

Prakash M. Masand, MD

Eric J. Crotty, MD

4. The best MRI sequence to measure the aortic root dimensions in a patient with aortopathy is:

- A. Three-dimensional contrast-enhanced MR angiography
- B. Respiratory-triggered T2-weighted (black blood sequence)
- C. Cine gradient recalled echo (GRE)
- D. In- and opposed-phase sequence

Correct Answer: C

Rationale: Dilated aortic roots occur in patients with congenital heart disease (CHD), bicuspid aortic valve (BAV), or with connective tissue disease. When severe, root dilation can lead to significant morbidity and mortality. Decisions regarding aortic valve/root replacement are based on root size, rate of change over time, and the degree of aortic stenosis and regurgitation, so accurate quantification of root size and progression is vital to patient management. Cardiovascular MRI provides more reproducible and accurate measurement of aortic root than echocardiography, but the optimal imaging sequences are the ones that allow measurement in systole (for maximum aortic root dimension). Cine GRE sequence along with the 3D SSFP ECG-gated in systole produce measurements that are ~1.6 mm larger than contrast-enhanced MRA and are therefore preferred.

References:

- Slesnick.T et al. Optimizing quantification of aortic root dilation in children and young adults. *Journal of Cardiovascular Magnetic Resonance*; Jan 2010.
- Linda M.de Heer et al. Aortic root dimension changes during systole and diastole: evaluation with ECG-gated multidetector row computed tomography. *Int J Cardiovasc Imaging* (2011) 27:1195-1204

5. The risk of aortic dissection is the least for which of the following aortopathies:

- A. Conotruncal defects, like Tetralogy of Fallot and truncus arteriosus
- B. Bicuspid aortopathy
- C. Marfan syndrome
- D. Loeys-Dietz syndrome

Correct Answer: A

Rationale: Although the risk of thoracic aortic dissection and rupture is well-known in bicuspid aortic valve, the risk of aortic dissection in other congenital heart diseases, particularly conotruncal lesions like tetralogy of Fallot (TOF), truncus arteriosus, D-transposition of the great arteries (D-TGA), and double-outlet right ventricle is exquisitely rare. In the provided reference, there was no increased occurrence of thoracic aortic dissection in conotruncal congenital heart disease above what would be expected in the normal population.

References:

- Frischhertz. B et al. Thoracic aortic dissection and rupture in conotruncal cardiac defects: A population-based study. International Journal of Cardiology, April 2015: Vol 184 ; 521-527
- Waldemar F. Carlo et al. Aortic root dilation in patients with truncus arteriosus. Congenital Heart Disease, June 2011: Vol 6; 228-233

6. Which of the following statements is true regarding Loeys-Dietz syndrome (LDS)?

- A. LDS does not involve branches of the aorta
- B. Aortic dissection and rupture occurs earlier in the course of Loeys-Dietz Syndrome and also at smaller aneurysm sizes than other inherited connective tissue aortopathies
- C. It is associated with an increased incidence of ventricular septal defects.
- D. Patients with Loeys-Dietz Syndrome have a high rate of mortality in comparison to patients with Ehlers-Danlos syndrome while undergoing cardiovascular surgery or interventional radiology procedures

Correct Answer: B

Rationale: Aortic dissection and rupture occurs earlier in the course of Loeys-Dietz Syndrome and also at smaller aneurysm sizes than other inherited connective tissue aortopathies.

References:

- Frischhertz. B et al. Thoracic aortic dissection and rupture in conotruncal cardiac defects: A population-based study. International Journal of Cardiology, April 2015: Vol 184 ; 521-527
- Waldemar F. Carlo et al. Aortic root dilation in patients with truncus arteriosus. Congenital Heart Disease, June 2011: Vol 6; 228-233

7. Which of the following statements is true regarding the inherited vasculopathies?

- A. They each have very distinctive phenotypes.
- B. The aortic root is abnormal in a minority of patients with Loeys-Dietz syndrome
- C. Increased vertebral tortuosity combined with a dilated aortic root has been shown to be a strong predictor of adverse outcomes.
- D. Ehlers-Danlos syndrome has a predisposition for involvement of the aortic root

Correct Answer: C

Rationale: An increased vertebral arterial index in combination with a dilated aortic has been shown to be a strong predictor of adverse outcome. Extreme arterial tortuosity is a more prominent feature of Loeys Dietz Syndrome than the other aortopathies.

References:

- Frischhertz. B et al. Thoracic aortic dissection and rupture in conotruncal cardiac defects: A population-based study. International Journal of Cardiology, April 2015: Vol 184 ; 521-527
- Waldemar F. Carlo et al. Aortic root dilation in patients with truncus arteriosus. Congenital Heart Disease, June 2011: Vol 6; 228-233

Venography in the Post-Ablavar Era

Cynthia K. Rigsby, MD, FACR

Carl Arnold Merrow, MD

8. What is the half-life of ferumoxytol in humans?

- A. 1 hour
- B. 15 hours
- C. 24 hours
- D. 45 hours

Correct Answer: B

References: Feraheme package insert <http://www.feraheme.com>. Accessed Jan 28, 2018.

9. Direct thrombus MR imaging relies on which component of clot for visibility?

- A. Oxyhemoglobin
- B. Deoxyhemoglobin
- C. Methemoglobin
- D. Hemosiderin

Correct Answer: C

Rationale: Direct thrombus visualization by MRI uses one of several T1-weighted noncontrast sequences to detect the T1-shortening properties of methemoglobin. Answers A, B, and D are incorrect. These components are either nonexistent within thrombus or lack sufficient T1 shortening to be visible on T1W pulse sequences.

References:

- Xie G, Chen H, He X, Liang J, Deng W, He Z, Ye Y, Yang Q, Bi X, Liu X, Li D, Fan Z. Black-blood thrombus imaging (BTI): a contrast-free cardiovascular
- magnetic resonance approach for the diagnosis of non-acute deep vein thrombosis. J Cardiovasc Magn Reson. 2017 Jan 18;19(1):4.
- Karande GY, Hedgire SS, Sanchez Y, Baliyan V, Mishra V, Ganguli S, Prabhakar AM. Advanced imaging in acute and chronic deep vein thrombosis. Cardiovasc Diagn Ther. 2016 Dec;6(6):493-507.

10. Which method of venous MR imaging requires intravenous contrast administration?

- A. Time of flight
- B. Balanced steady-state free precession
- C. Direct thrombus imaging
- D. Ultrafast volume interpolated T1-weighted gradient echo

Correct Answer: D

Rationale: Intravenous contrast material is required for T1 shortening of flowing venous blood in order to create bright signal when using an ultrafast volume interpolated T1-weighted gradient echo sequence. Without intravenous contrast material, the flowing venous blood will be of intermediate to low signal intensity and will not provide sufficient visualization of the vessel lumen as compared to the vessel wall and other soft tissues. Answers A, B, and C are incorrect. A and B do not require contrast administration to create an appearance of

bright blood within veins. C relies on intrinsic T1 shortening properties of methemoglobin within thrombus to create bright signal within clot.

References:

- Cline B, Hurwitz LM, Kim CY. MR Venography of the Central Veins of the Thorax. Top Magn Reson Imaging. 2017 Aug;26(4):167-174.
- Arnoldussen CWKP, Lam Y, Ito N, Winkens B, Kooi ME, Wittens CHA, Wildberger JE. Gadobutrol versus gadofosveset-trisodium in MR venography of the lower extremities. Eur Radiol. 2017 Dec;27(12):4986-4994.

Lymphatic MR Imaging

David M. Biko, MD

Rajesh Krishnamurthy, MD

11. What is the approximate timing of the passage of contrast material on central MR lymphangiography following the intranodal injection of 0.1 mmol/kg of a gadolinium contrast agent into the groin of a normal patient?

- A. Venous system via the thoracic duct in 3-4 minutes
- B. Venous system via the thoracic duct in 5-10 minutes
- C. Venous system via the thoracic duct in 20-30 minutes
- D. Venous system via the thoracic duct in 30-45 minutes

Correct Answer: B

Rationale: Following intranodal injection of gadolinium, contrast usually opacifies the retroperitoneal lymphatics within 2 minutes, the cisterna chyli in 3 to 6 minutes, and venous system via the thoracic duct in 5 to 10 minutes.

Reference:

- Chauvin GB, Amaral, JG, Temple M, Itkin M. MR Lymphangiography in Children: Technique and Potential Applications. Radiographics 2017;37(6):1775-90.

12. Following total cavopulmonary anastomosis (Fontan operation), increased production of lymph occurs from:

- A. Decreased branch pulmonary artery size
- B. Decreased exercise tolerance
- C. Increased central venous pressure
- D. Increased cardiac output

Correct Answer: C

Rationale: Lymph production increases with increasing central venous pressure. The increased central venous pressure causes decreased lymphatic return and also increased lymphatic production due to rise in capillary pressure resulting in increased capillary filtration and extravascular fluid.

References:

- Witte MH, Dumont AE, Clauss RH, Rader B, Levine N, Breed ES. Lymph Circulation in Congestive Heart Failure Effect on External Thoracic Duct Drainage. Circulation 1969;39(6):723-33.
- Brace RA, Valenzuela GJ. Effects of outflow pressure and vascular volume loading on thoracic duct lymph flow in adult sheep. American Journal of Physiology 1990;258:R240-4.