Left Atrium
Anatomy and Pathology by MDCT

Jim Adams, MD, FACC
Postablation pulmonary vein stenosis

- Moderate stenosis of a left pulmonary vein *(arrow)*.
- Many expert electrophysiologists recommend routine scanning examinations of patients even if they are asymptomatic at least once after the procedure, because stenting is difficult in cases of complete occlusion and because some patients experience pulmonary infarction with permanent sequelae.

Asymptomatic patient who underwent radiofrequency ablation for atrial fibrillation 3 months before the scan
A patient who had previously undergone radiofrequency ablation of atrial fibrillation and presented several weeks later with dyspnea and cough. A CT done at the time demonstrated severe stenosis of both veins. The patient underwent successful stenting and is now asymptomatic.

• Image demonstrates stents deployed in the left and right superior pulmonary veins (arrows).
• The distal end of the left superior vein stent has evidence of mild intimal hyperplasia.
• CT is useful evaluating potential complications associated to vascular stenting.
• Detecting in-stent restenosis is difficult with small coronary stents, however, due to partial volume effect and streaking artifacts caused by the metal.
CTA in the EP Lab

**Question:** Clot or No Clot?

A. Thrombus is present

B. No thrombus is demonstrated.

A patient undergoing evaluation before radiofrequency ablation of atrial fibrillation.
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**Answer:** Clot or No Clot?  B

A. Thrombus is present

B. No thrombus is demonstrated.
- There is reduced attenuation in the left atrial appendage. The borders of the less attenuated region are not well defined and there is variability in attenuation between the tip (100 HU) and the body (150 HU) of the appendage.
- Cine-CT demonstrated variability in appearance throughout the cardiac cycle.
- TEE revealed left atrial appendage sludge (spontaneous echo contrast; smoke) without definitive thrombus.
- Cardiac CT has high sensitivity for the detection of left atrial appendage thrombi, but reduced specificity
- Often difficult to differentiate slow flow versus actual thrombus.
Preprocedure evaluation for arrhythmia ablation

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Congenital absence of right pulmonary veins with hypoplastic rt. pulm. artery.
Congenital Absence of the Right Pulm. Veins
Primum ASD
Secundum ASD
PFO Valve
Case: Secundum ASD
Case: Secundum ASD
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In the axial source image of the dual-source CT scan, the huge left atrial dilatation and the atrial thrombus can be visualized.
The two-chamber view multiplanar reformation image of the dual-source CT scan shows the huge left atrial dilatation and left atrial thrombus.
Left Atrial Thrombus?
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Left Atrial Thrombus?
tissue characterization of cardiac thrombus
Noncontrast (A), early-phase (B), and delayed-phase contrast (C) enhanced CT images showing left atrial thrombus (asterisk) with associated vascular flow channel (arrow). All temporal phase images showed homogenous tissue attenuation within the actual thrombus. Absence of thrombus contrast enhancement was confirmed according to Hounsfield unit density (55-60) among noncontrast, early-phase contrast, and late-phase contrast CT. Representative ROI for HU sampling denoted by green circles on corresponding images.

LA indicates left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle; AO, aorta.
Early-phase contrast-enhanced CT (A) and transesophageal echocardiography (B) images displaying thrombus in corresponding orientations. Note that areas of echocardiography-evidenced flow (arrows) on echocardiography corresponded to atrial flow channels on CT, which were distinct from the actual thrombus.
Representative histopathology specimen obtained from resected left atrial mass (hematoxylin and eosin stain). Note the prominent fibrin (asterisk) and granulation tissue (arrow) within the mass, consistent with the diagnosis of organizing thrombus.
Partial anomalous pulmonary venous return

Introduction

Partial anomalous pulmonary venous return (PAPVR) is a rare condition that can be discovered incidentally or lead to significant right heart overload if untreated.

This patient presented with symptoms and signs of an atrial septal defect (ASD), but whose initial evaluation was remarkable only for pulmonic stenosis by Doppler echocardiography.

Computed tomography (CT) eventually assisted with making the diagnosis of an anomalous LUL vein that was surgically corrected.
A left anterior oblique maximum intensity projection shows the anomalous drainage of the left upper lobe by a vertical vein to the innominate vein and central venous system. PA, pulmonary artery; SVC, superior vena cava.
Volume-rendered images showing the anomalous drainage by the innominate vein into the right atrium. The left lower lobe venous drainage can be seen entering the left atrium.
Scimitar syndrome

The “Scimitar syndrome” and cardiac computed tomography
Ambarish Gopal, MD, Matthew J. Budoff, MD*
Journal of Cardiovascular Computed Tomography (2007) 1, 58–59
July 2007
Scimitar syndrome

Volume rendered 3-dimensional images of the heart showing the pulmonary veins. IVC, inferior vena cava; LA, left atrium; LIPV, left inferior pulmonary vein; LSPV, left superior pulmonary vein; RIPV, right inferior pulmonary vein; RSPV, right superior pulmonary vein.
Mid-diastolic images of coronary CT angiography in different views, including short axis (SAX), axial, two chamber (2ch), and three chamber (3ch), show a membranous diaphragm in the left atrium (LA) extending from the anterior wall of the LA near the orifice of the right superior pulmonary vein (RSPV) to the junction of the left atrial appendage (LAA) and the left superior pulmonary vein (LSPV).

This membrane with a 2-cm central perforation separates the pulmonary venous compartment (PVC) of the LA from the main body of the LA. RA indicates right atrium; IVC, inferior vena cava; Ao, aorta; SVC, superior vena cava; LV, left ventricle; RV, right ventricle.
Transthoracic echocardiography images corresponding to the axial (upper) and three chamber (lower) views of the MDCT confirmed the presence of a thin membrane in the left atrium (arrows). No hemodynamic effect was shown on Doppler examination. LA, left atrium; RSPV, right superior pulmonary vein; LSPV, left superior pulmonary vein; LV, left ventricle; RV, right ventricle; Ao, aorta; PVC, pulmonary venous compartment.
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Use of Multidetector CT in Supraventricular Arrhythmias
Right Atrium

- **Right Atrial Appendage**
  - Broad based, pyramidal structure
  - Blunt tip
  - Less likely to have thrombus than LAA
Right Atrial Assessment by CTA in Pre-Ablation Planning for Suprventricular Arrhythmias

Parameters for RA Assessment

1. Cavotricuspid Isthmus
   A. Size
   B. Anatomic variants
2. Coronary sinus location, size
3. Eustachian ridge/Crista Terminalis
4. Sub-Eustachian pouch
5. Right atrial size and function (EF)
Right Atrium

- **Right Atrial Appendage**
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- **Terminal Sulcus**
  Sulcus/groove in posterolateral aspect of the RA
  Opposite externally to the internal Crista Terminalis
Right Atrium

- **Crista Terminalis**
  - Fibromuscular ridge formed by the junction of the sinus venosus and primitive right atrium
  - Location of the **sinus node**
  - Gives rise to **pectinate muscles**, largest s called the **septum spurium** or the **sagittal bundle**
  - can have lipomatous hypertropy and mimic RA mass
  - Site of origin of ‘inappropriate sinus tachycardia’
Tricuspid Annulus and Cavotricuspid Isthmus

- Reentry circuit goes around the Tricuspid Annulus (black arrows)

- Ablation target is Cavotricuspid Isthmus (red arrows), the area between the inferior part of the tricuspid annulus and the IVC
Cavotricuspid Isthmus

- Reentry circuit goes around the **Tricuspid Annulus** (black arrows).

- Ablation target is **Cavotricuspid Isthmus** (red arrows), the area between the inferior part of the tricuspid annulus and the IVC.

- Note **Subeustachian Pouch**, below the tricuspid annulus and CTI, and which can interfere with ablation (white arrow).
**Cavotricuspid Isthmus**

- Narrowest site of the reentry circuit in the TA
- Target site for ablation
- Can be highly variable in width
Cavotricuspid Isthmus

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- Target site for ablation
- Can be highly variable in width
Sub-Eustachian or Sub-Thebesian Pouch

- Deep diverticulum in Cavotricuspid Isthmus
- Common finding (>80% of pts. in one study)
- Average depth 3 mm., and rarely > 5mm
- Can interfere with ablation energy delivery

Cabrera, Circ, 2006
Question: Cardiac CTA provides right atrial anatomic information necessary for successful RF catheter ablation for supraventricular tachyarrhythmias by showing all of the following except:

A. Size and location of the cavotricuspid isthmus
B. Size and location of the subeustachian pouch
C. Size and location of the crista terminalis
D. Size and location of the small cardiac vein
E. All of the above are correct
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