Cardiac CT in Electrophysiology Intervention

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Disclosures

Nothing to disclose
Introduction

• Cardiac electrophysiology is a evolving specialty that has seen rapid advances in recent years.
• Radiofrequency catheter ablation is now a standard therapy for a growing range of atrial and ventricular arrhythmias, including atrial fibrillation.
• Implantable cardiac devices are being increasingly used in the management of congestive cardiac failure and cardiac arrhythmias.
Introduction

• Concurrently, there has been much progress in the field of cardiac imaging.
• Modern multidetector row cardiac CT now provides submillimetre spatial resolution and a temporal resolution of less than 100 ms, making it ideally suited for evaluation of cardiac anatomy.
• Cardiac CT images can now be imported into electroanatomic mapping software and merged with information obtained during EP procedures.
• Electrophysiologists are increasingly requesting cross-sectional imaging in advance of many procedures.
Applications of cardiac CT in pulmonary vein isolation

Pre-Procedural
1. Number of pulmonary veins and their anatomical configuration.
2. Dimensions of pulmonary vein ostia.
3. Left atrium dimensions and morphology.
4. Exclude left atrial appendage thrombus.
5. Pulmonary vein anomalies.
6. Visualisation of the inter-atrial septum.
7. Position of the oesophagus.

During the procedure
1. Positioning of catheters
2. Visualisation of left atrium and pulmonary vein ostia.
3. Assist with trans-septal puncture.

Post-procedural
1. Pulmonary vein stenosis.
2. Oesophageal injury.
3. Scar formation.
Axial CT demonstrating the anatomical configuration of the left atrium and pulmonary veins.

(AAo, ascending aorta; DAo, descending aorta; LA, left atrium; LIPV, left inferior pulmonary vein; LSPV, left superior pulmonary vein; RIPV, right inferior pulmonary vein; RSPV, right superior pulmonary vein; LPA, left pulmonary artery; RPA, right pulmonary artery; SVC, superior vena cava)
Axial CT demonstrating an accessory right middle pulmonary vein with a separate ostium.

(AAo, ascending aorta; LA, left atrium; RMPV, right middle pulmonary vein; RIPV, right inferior pulmonary vein; RA, right atrium; RV, right ventricle; LV, left ventricle).
Axial (A) and sagittal oblique (B) CT demonstrating an accessory pulmonary vein draining the superior segment of the right lower lobe (arrow).

(AAo, ascending aorta; LA, left atrium; RPA, right pulmonary artery; RA, right atrium; RV, right ventricle; LV, left ventricle; RSPV, right superior pulmonary vein).
Axial CT demonstrating drainage of both the left superior and inferior pulmonary veins to a common ostium.

(LA, left atrium; LPV, left pulmonary vein; Dao, descending aorta).
Right anterior oblique CT reconstruction demonstrating the superior and inferior vena cavae and the right cardiac chambers.

(AAo, ascending aorta; RA, right atrium; RV, right ventricle; SVC, superior vena cava; IVC, inferior vena cava; RVOT, right ventricular outflow tract)
Sagittal oblique (A), coronal oblique (B) and four chamber views (C) demonstrating the inter-atrial septum and the expected location of the fossa ovalis (arrow).
Anatomical (grey) and electrical (blue) datasets which can be merged to aid in guiding ablation procedures. Also visualised are a multipolar electrode catheter (long arrow) and an ablation catheter (short arrow).
Sagittal (A) and axial (B) images demonstrating the proximity of the left atrium to the oesophagus (thick arrows), coronary sinus (thin arrow) and left circumflex artery (curved arrow). Four-pointed stars illustrate the expected location of the branches of the phrenic nerve. Multipoint star represents the expected location of the vagus nerve. (LA, left atrium)
A: Fluoroscopic image acquired during pulmonary vein isolation procedure demonstrating contrast injection into the left superior pulmonary vein. An ablation catheter is also visualised in the expected location of the left inferior pulmonary vein ostium (arrow). B: Axial CT image demonstrating a stenosis of the left superior pulmonary vein (arrow). (LA, left atrium; LAA, left atrial appendage; RVOT, right ventricular outflow tract; AAo, ascending aorta)
A: Fluoroscopic image demonstrating a focal high-grade stenosis at the left superior pulmonary vein ostium due to previous ablation (arrow).

B: Venography post venoplasty and stenting demonstrating patency of the ostium. Transoesophageal echocardiography probe is also visualised in the oesophagus.)
Applications of cardiac CT in left atrial appendage occlusion

• **Pre-Procedural**
  1. Size and morphology of the left atrial appendage.
  2. Left atrial appendage thrombus.
  3. Size and position of the left atrial appendage ostium.

• **Post-procedural**
  1. Confirm correct positioning of device.
  2. Evaluate for peridevice leak.
Right anterior oblique views, contrast enhanced CT demonstrating the left atrial appendage projecting from the left atrium.

(LA, left atrium; LAA, left atrial appendage; LV, left ventricle).
Axial (A) and coronal oblique (B) images demonstrating a low attenuation filling defect in the left atrial appendage (arrows) consistent with thrombus.

(LA, left atrium; Aao, ascending aorta; SVC, superior vena cava; PT, pulmonary trunk; RPA, right pulmonary artery)
Axial early arterial phase (A) image demonstrating an apparent filling defect in the left atrial appendage which did not persist on the 60 second delayed phase (B) consistent with pseudothrombus secondary to contrast admixture.

(LA, left atrium; SVC, superior vena cava; Aao, ascending aorta)
Applications of cardiac CT in device implantation

- **Pre-procedural**
  - 1. Detection of myocardial scar.
  - 2. Evaluation of mechanical dyssynchrony.
  - 4. Confirmation of subclavian vein patency.

- **Post-procedural**
  - 1. Confirm correct positioning of leads.
  - 2. Evaluate for lead perforation.
A: Sagittal oblique image demonstrating the coronary sinus (arrow) draining into the right atrium. B: Three dimensional volumetric reconstruction demonstrating the coronary sinus (arrow) in the atrioventricular groove.

(RA, right atrium; LA, left atrium; LV, left ventricle)
Short axis two chamber view demonstrating a transmural infarct in the mid anteroseptum (left anterior descending artery territory) with myocardial thinning (arrows). Streak artefact from an RV pacing lead also evident.

(RV, right ventricle; LV, left ventricle).
Suggested reading
