Utility of Iodine Quantification for Cardiac CT with Gemstone Spectral Imaging

By Jin Hur, MD, PhD, Department of Radiology, Department of Cardiovascular Radiology, Research Institute of Radiological Science, Severance Hospital, Yonsei University College of Medicine, Republic of Korea

Introduction

Patients with stroke and atrial fibrillation (AF) frequently have concomitant potential cardiac sources of embolism and are at increased risk of recurrent embolism, despite anticoagulation.[1,2] Thrombi of the left atrium (LA) and left atrial appendage (LAA) are common sources of stroke; and because these conditions are treatable, their detection could markedly affect patient care.

Currently, transesophageal echocardiography (TEE) is considered the reference standard for the detection of intracardiac thrombus. However, TEE requires special skills for proper performance and it is a relatively invasive test, usually performed with the patient under conscious sedation.

At the Severance Hospital, Yonsei University College of Medicine in Korea, we utilize Revolution™ HD with Gemstone™ Spectral Imaging (GSI) to detect intracardiac thrombus. The diagnostic value of iodine quantification on GSI enables us to differentiate between non-enhancing lesions, such as thrombus, and enhancing lesions, such as circulatory stasis or a mass.

Case 1
Patient history

A man in his 40s with stroke and mitral valvular disease referred to cardiac CT with GSI to evaluate cardioembolic sources.

Acquisition

Scan mode: Helical, plus, GSI preset 1
Acquisition: 80 kV and 140 kV, fast kV switching
Rotation speed, sec: 0.5
Slice thickness, mm: 0.625
Pitch: 1.375
Reconstruction type: Standard
CTDI, mGy: 12.72
DLP, mGy-cm: 292.23

Findings

Axial monochromatic image at 70 keV (Figure 1A) shows an oval filling defect in the left atrial appendage.

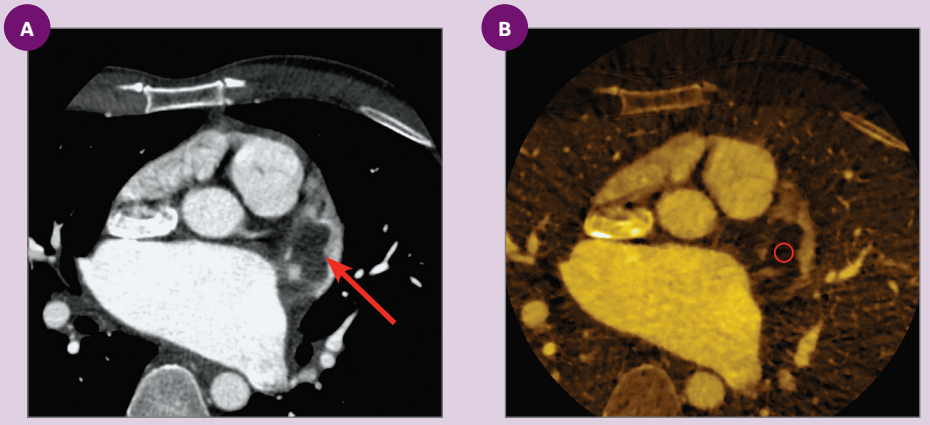

Figure 1. Case 1, patient with stroke and mitral valve disease. (A) Monochromatic image at 70 keV; (B) MD iodine map.

On the material density (MD) iodine map (Figure 1B), the mean iodine concentration within the ROI was 6.36 (100 ug/cm^3). The patient was diagnosed with left atrial appendage thrombus and underwent left atrial appendage thrombectomy and mitral valve replacement.

Case 2
Patient history

A man in his 60s referred to cardiac CT with GSI for the evaluation of an intracardiac lesion.

Acquisition

Scan mode: Axial cardiac, GSI preset 65
Acquisition: 80 kV and 140 kV, fast kV switching
Rotation speed, sec: 0.35
Slice thickness, mm: 0.625
Reconstruction type: Standard
CTDI, mGy: 22.3
DLP, mGy-cm: 312

Findings

Axial monochromatic image at 70 keV (Figure 2A) shows an oval filling defect in the right atrium. On the MD iodine map (Figure 2B), the mean iodine concentration within the ROI was 24.81. The lesion was pathologically confirmed after surgical resection as a myxoma.

Discussion

Accurate diagnosis of cardiac thrombus and tumor is important because these masses provide a substrate for embolic events, but are treated differently according to their etiology. Cardiac MRI is often used for cardiac mass evaluation; however, these cases show that iodine concentration data obtained from the GSI MD iodine map is a feasible quantitative parameter for differentiating cardiac myxoma from thrombus, because the mean iodine concentration differs between myxoma and thrombus (24.81 versus 6.36). Iodine quantification can be more accurate for visualizing tumor characteristics than the HU value that single energy CT can provide.[3,4] In this case, GSI was a reliable tool to differentiate a myxoma from thrombus.

The accuracy of the iodine concentration on GSI was impressive. With this value, I can differentiate thrombus from intracardiac mass and avoid an additional delayed-enhanced CT scan. There is the added benefit that I can obtain a non-contrast image with one GSI CT scan, which is very helpful to differentiate calcium and enhancement on chest nodules, and the potential to avoid the use of contrast. ■

References

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3. Hur, Jin, et al. "Cardioembolic stroke: dual-energy cardiac CT for differentiation of left atrial appendage thrombus and circulatory stasis." Radiology, 2012; 263(3):688-695.
4. Hong YJ, et al. Dual-energy cardiac computed tomography for differentiating cardiac myxoma from thrombus. Int J Cardiovasc Imaging, Dec. 30, 2014; Suppl 2:121-8.

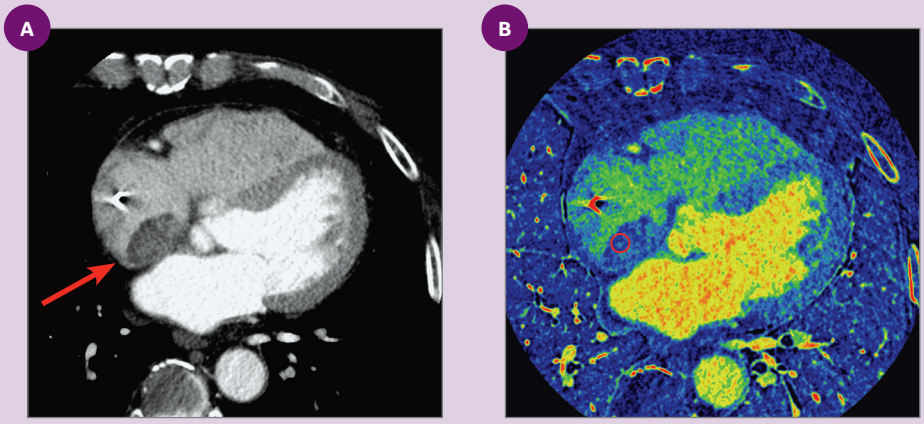

Figure 2. Case 2, patient with intracardiac lesion. (A) Monochromatic image at 70 keV; (B) MD iodine map with color.