Hybrid Imaging in the Evaluation of a Patient With TIA and AWMI

Johann Christopher¹, PLN Kapardhi², Apoorva Thakre¹

Case Report

A 52-year-old male patient with no prior history of smoking, diabetes mellitus, or hypertension presented with an episode of dizziness and right-sided weakness. He did not have associated chest pain or shortness of breath. His clinical examination revealed normal vitals with no clinical signs of heart failure and he had grade-4 weakness of left upper and lower limbs. The electrocardiogram revealed the qS pattern in V1 to V4 with a mild ST coving pattern (Figure 1). 2D echocardiogram (ECHO) revealed regional wall motion abnormalities (RWMA) in the left anterior descending artery (LAD) territory with left ventricle (LV) dysfunction and an LV apical mass. Carotid Doppler was normal and magnetic resonance imaging (MRI) of the brain was performed. Diffusion-weighted imaging showed multiple foci of restriction in the right frontal and parietal lobes suggestive of acute infarcts (Figure 2a). Magnetic resonance angiography revealed no major cerebral vessel abnormalities (Figure 2b). He was diagnosed to have an acute ischemic stroke secondary to cardiac emboli and was managed conservatively with guideline-based therapy in an inpatient environment with gradual recovery. In view of the abnormal electrocardiogram and ECHO, a detailed cardiac evaluation was mandated. In the backdrop of the COVID-19 pandemic, it was decided by the multidisciplinary team to evaluate the cardiac status in a noninvasive manner to minimize the risk to the health care team. He underwent coronary computed tomography angiography (CTA) as a definitive initial cardiac evaluation. The CTA was performed with retrospective gating and weight-adjusted iodinated contrast after heart rate control. The coronaries revealed a total occlusion of the LAD with faint distal opacification (Figure 3). The occluded site had a complex morphology with calcification (Figure 4a), large normal diagonal (Figure 4b), and normal left circumflex coronary artery and right coronary artery vessels (Figure 4c). In addition to the coronary data, RWMA, left ventricular ejection fraction, LV volume, and mass and scar quantification were determined using appropriate software (Figures 5a, c). RWMA was suggestive of LAD territory involvement. There was a large LV apical mass with calcification (Figure 5b). In view of the apical mass and viability being critical diagnostic issues, a cardiac MRI was performed for definitive diagnosis. MRI showed mildly dilated LV with moderately reduced systolic function. LVEF was 38%. Akinesia was noted in the basal and mid-antero septal segments, with thinning and akinesia of apical anterior and septal segments including the true apex. The mass at the apex was confirmed to be a thrombus based on its tissue characteristics (Figure 6b). Transmural myocardial delayed enhancement was noted in the mid- and distal anterior and septal segments suggesting a large LAD territory infarct with nonviable myocardium (Figures 6a, c). The right ventricle was normal in size and function. The findings of both computed tomography (CT) and MRI were analyzed by the heart team. Coronary angiogram was performed to confirm the finding and to ascertain a favorable anatomy for a chronic total occlusion (CTO) intervention. The coronary angiography (CAG) (Figures 7a, c) confirmed the CTA finding and as expected a total cutoff of LAD was seen with no antegrade collaterals (Figure 7b) and an unfavorable indo japanese chronic total occlusion society (IJCTO) score. As the patient presented late with evolved anterior wall myocardial infarction (MI), nonviable LAD territory, he was not considered for revascularization. The patient was treated with guideline-based therapy including antiplatelets, anticoagulants, statin, angiotensin receptor neprelysin inhibitor (ARNI), B-blocker, and diuretics, and was discharged on oral anticoagulant and advised to maintain an international normalized ratio of 2 to 3.

Figure 1. EKG: Q Waves in Leads V3 to V6; T Inversion in II, III, avF
Figure 2. (a) Diffusion-Weighted Imaging (axial) Shows Multiple Foci of Restriction in the Right Frontal and Parietal Lobes Suggestive of Acute Infarcts. (b) Magnetic Resonance Angiography does not Show Any Sign of Proximal Large Arterial Occlusion.

Figure 3. Volume Rendered Image (VRT) Image Depicting Occluded Left Anterior Descending Coronary Artery

Figure 4. (a) Maximal Intensity Projection (MIP) Image Depicting Occluded Left Anterior Descending Coronary Artery (b) MIP Image Depicting Large Diagonal Prior to Occlusion (c) MIP Image Depicting Mild Disease in Right Coronary Artery

Figure 5. Computed Tomography Angiogram (CTA) Images Depicting Scarred Anterior Septum and Apical Thrombus (a) 4 Chamber View, (b) Apical short-axis view (SAX) Image, (c) 3 Chamber View

Figure 6. Cardiac Magnetic Resonance Images Depicting Scarred Anterior Septum and Apical Thrombus (a) 4 Chamber View, (b) Apical short-axis view (SAX) Image, (c) 3 Chamber View

Figure 7. (a) CAG AP CAUDAL View Depicting Normal Left Circumflex Coronary Artery Vessel, (b) CAG AP CRANIAL View Depicting Occluded Left Anterior Descending Coronary Artery Vessel, (c) CAG LAO CRANIAL View Depicting Normal Right Coronary Artery

Discussion

In a COVID-19 environment, it is mandatory that the safety of health care workers is of paramount importance. In this regard, the use of cardiac CTA in patients with stroke and acute coronary syndrome will certainly minimize the risk of COVID-19 exposure in health care personnel. Cardiac CT is a reliable alternative imaging modality to transesophageal echocardiography (TEE) for the evaluation of cardioembolic sources in patients with ischemic stroke, avoiding the discomfort and risks associated with TEE. Cardiac CT is a well-established but not widely used technique for imaging cardioembolic sources. Cardiac CT provides high-quality noninvasive images of the heart, great vessels, and coronary vasculature. Cardiac CT has good diagnostic capability for detecting intracardiac thrombi and coronary stenosis. However, cardiac CT imaging has fundamental disadvantages, including radiation dose and use of iodinated contrast medium. On the basis of the current evidence, cardiac CT is not recommended for use in the initial evaluation of intracardiac structures or risk assessment in stroke patients. Cardiac CT screening for CAD in unselected asymptomatic individuals after ischemic stroke cannot be recommended, and the current guidelines remain valid until results from future large trials on the optimization of management and outcomes of stroke patients stratified by cardiac CT are available.
Cardiac magnetic resonance imaging (CMRI) is an alternative modality to evaluate a patient suspected of having had an embolic stroke. CMRI can also be used in the evaluation of potential sources of emboli, such as left atrial appendage (LAA) thrombi, LV thrombi, cardiac masses, or aortic plaque. Several studies reported that CMRI has high reproducibility and high sensitivity in detecting LAA thrombus compared with TEE. Also, compared with cardiac CT, CMRI has the advantages of absence of radiation exposure and the avoidance of iodinated contrast media. However, CMRI also has several disadvantages compared with CT: the examination time is much longer and is much more expensive.

LV thrombus is a potential complication of MI, the incidence being 15% to 40% after anterior infarction. TTE is the most commonly used method of identifying LV thrombus and the sensitivity and accuracy increase markedly with the addition of contrast agents. TTE is superior to TEE in the assessment of the LV apex given its proximity to this structure in relation to the chest wall. CTA and CMRI are both excellent in the assessment of LV thrombus. CTA typically depicts a thrombus as a low-attenuation area surrounded by infarcted myocardium. Cine imaging can also help in discrimination, because the surrounding myocardium may be thinned or have accompanying regional wall abnormality. Using a threshold of less than 65 HU, Bittencourt et al in a study of 31 patients found that cardiac CTA had 94% sensitivity and 97% specificity for the accurate detection of LV thrombus. CMRI is also well-suited to the evaluation of LV thrombus. Cine imaging with steady-state free precession is needed to assess filling defects and associated regional wall abnormalities. Late gadolinium enhancement with the use of inversion recovery sequences is key in the accurate assessment of thrombi. The presence of a low-attenuation area with surrounding high-attenuation myocardium (eg, suggestive of a scar) aids in the delineation of the tissue-thrombus interface. Weinsaft et al confirmed the diagnostic utility of cardiovascular MRI, particularly with late gadolinium enhancement, in the detection of LV thrombi.

This case illustrates the synergistic role of cardiac CTA and CMR in the evaluation of patients with CVA secondary to a cardioembolic source. There is a benefit of screening for underlying CAD in this clinical context which is almost 40% as per varying studies. While the cost-effectiveness can be questioned, the amount of information that it brings to the table makes it an extremely robust tool to guide the clinician to proceed in an accurate and safe manner. The roles of synergistic imaging are certainly not in the guidelines as of date. The tools and expertise are readily available. It is then imperative for the clinician to explore the full gamut of technology and come up with an accurate, safe, and cost-effective solution for such cases.

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**Declaration of Conflicting Interests**
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