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Original Article

Use of Computed Tomography Scan to Rule Out Phantom Thrombus in the Left Atrial Appendage

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ABSTRACT

Objective: The aim of study was to evaluate the utility of CT scan with delayed acquisition protocol to exclude LAA thrombus. The occurrence of left atrial appendage (LAA) thrombus is a frequent complication of atrial fibrillation (AF) and increases the thromboembolic risk. Transesophageal echocardiography (TEE) is considered the gold standard to ensure that this chamber is thrombus-free. Multidetector computed tomography (CT) scan has some advantages, such the possibility to get 3D reconstruction and explore other structures in relationship with the LAA. However, there is a lack of specificity in case of false positive images with filling defects due to slow velocities in the LAA. **Methods and Results**: Thirty-four patients with suspected thrombus by a previous CT scan or transesophageal echocardiogram were included in the study. In all of patients, complete LAA filling was observed, with sensitivity, specificity and negative predictive value of 100% to differentiate circulatory stasis from thrombus. **Conclusion:** Performing a CT scan with delayed acquisition protocol and in prone position are safe techniques to discard false thrombus.

KEYWORDS: Atrial fibrillation; Thrombus; Left atrial appendage; Computed tomography.

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INTRODUCTION

The occurrence of thrombus in the left atrial appendage (LAA) is a frequent complication of atrial fibrillation (AF), increases systemic and cerebral thromboembolic risk, and is a contraindication to perform percutaneous procedures in the left atrium (LA), so it must be ruled out before performing them[1].

The LAA is the source of clots in almost 90% in patients with AF[2]. Transesophageal echocardiography (TEE) is considered the gold standard to ensure that this chamber is thrombus-free, but it is a semiinvasive study, with different degrees of discomfort, sometimes requiring anesthetic support and, in really few cases, perforation of the esophagus have been reported[1,3–8].

By the other hand, multidetector computed tomography (CT) scan has some advantages, such as the possibility to get 3D reconstruction and explore other structures in relationship with the LAA, but it has the risk of contrast toxicity and radiation exposure, and lack of specificity, in case of false positive images, with filling defects due to slow velocities in the LAA. Several protocols were used to increase positive and negative predictor value (PPV, NPV), such as delayed acquisitions sequences, different position of the body (prone position), and use of Hounsfield unit (HU) density[9–23].

PATIENTS AND METHODS

From May 2017 to January 2020, 34 patients were enrolled., of which 26 were male, between 41–84 years old (mean age = 68), referred for AF ablation and/or LAA occlusion (LAAO). All of them suspected to have a thrombus by a previous CT scan or transesophageal echocardiogram.

Procedure

A 64-detector-row CT scanner (Toshiba Multislice Aquilion 64; Toshiba Medical Systems, Otawara, Japan) was used from 2017 to May 2019 and, after that, an Aquilion Prime Cannon/Toshiba 80/160. Slices thickness were done every 0.5 mm and 0.3 s. With Aquilion 64 system, the electrocardiogram (ECG) was simultaneously recorded for retrospective gating, and a prospective volumetric iterative reconstruction was made with the Aquilion Prime. 80 – 100 kV, 80 – 150 ml of contrast, 4,5- 5 mSv for all the three sequences (about 1.5 each), depending of the BMI with the last MDCT scan, instead 15 +/- 3 mSv with the first MDCT.

First, a conventional gated CT was done; if a filling defect in the LAA was seen, a second sequence would start three minutes later, with a second bolus of 40 cc of contrast and delayed acquisition with six cuts every three seconds, with the ROI in ascendant aorta, and compared with LAA not only the visual impression but the HU, and a third sequence (same protocol than the first one), with the patient in prone position was done, with a low Rx exposure and contrast dose protocol.

RESULTS

Complete filling in the second and third sequence was observed in all of the patients, and AF ablation, LAA closure or both were done without thromboembolic complications neither during the procedure nor at a follow-up of 3 to 28 months. This protocol allowed us to differentiate circulatory stasis from thrombus with a sensitivity, specificity and negative predictive value of 100%.

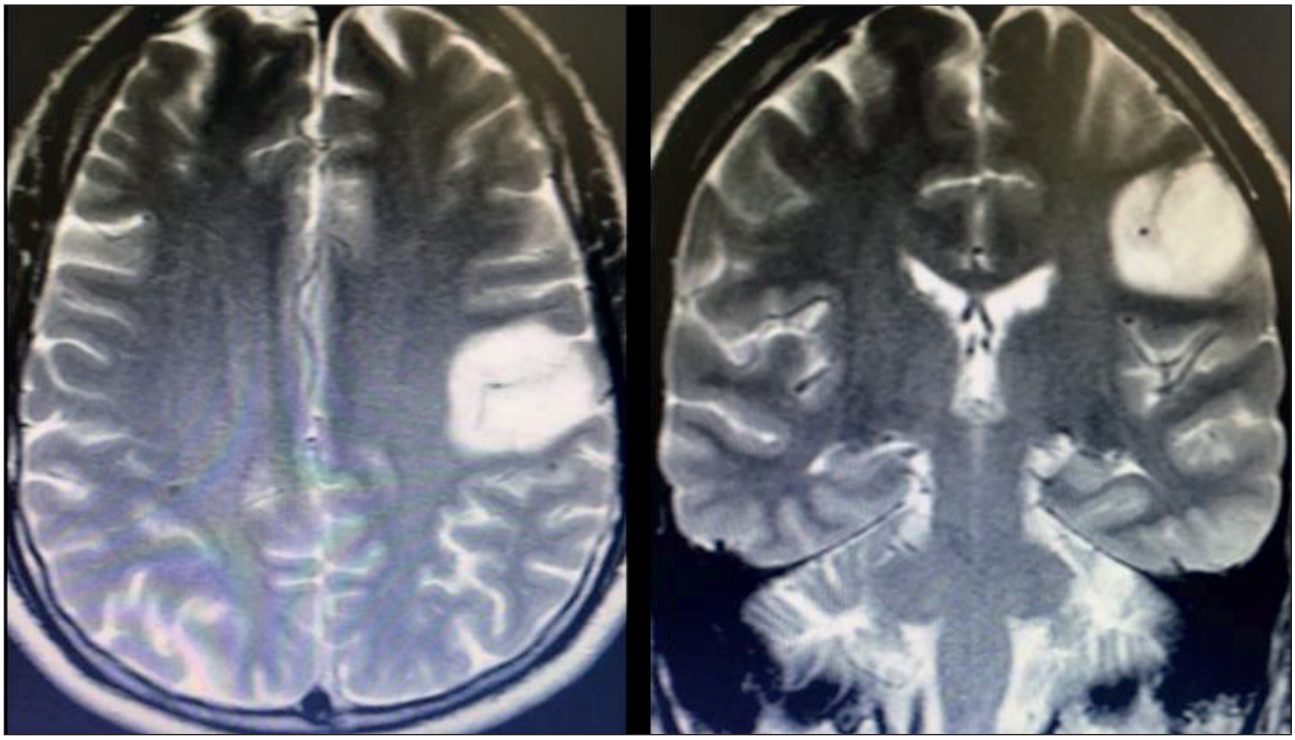

Figure 1. Magnetic resonance image from a male patient with 43 years old, permanent atrial fibrillation and restrictive cardiomyopathy. 40 minutes of symptoms onset. Next images are from the same patient performed at the same day.

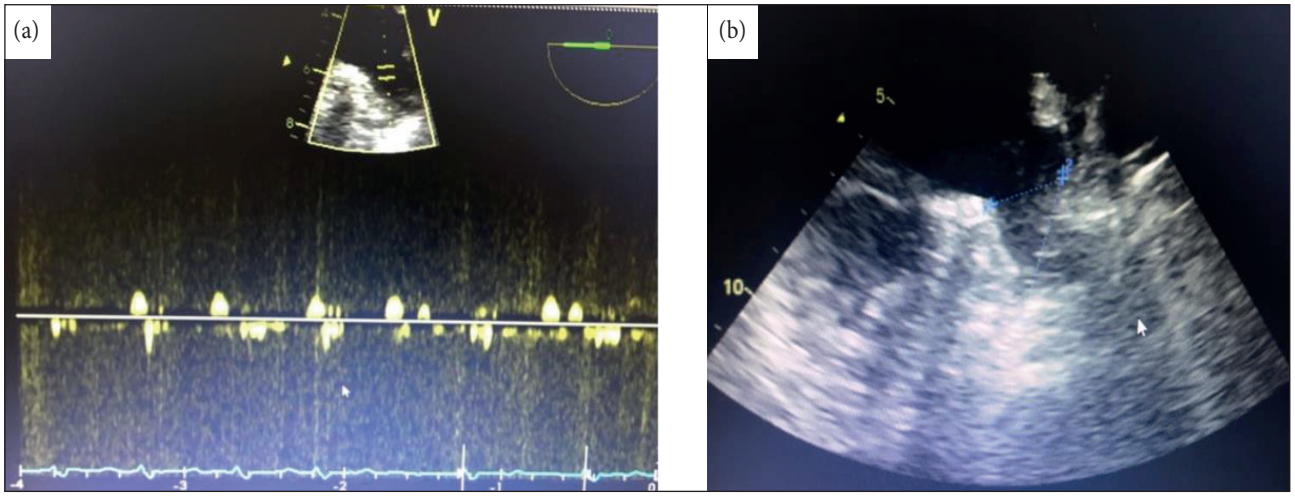

Figure 2. Transesophageal echocardiogram: (a) with Doppler velocity of left atrial appendage (LAA), (b) with "smoke", spontaneous contrast in the left atrium (LA) and LAA, and sparklier image inside LAA.

Figure 3. Computed tomography (CT): (a) first sequence with a filling defect in the LAA, (b) second delayed sequence showing complete filling of the LAA, (c) third sequence in prone position, showing complete filling of the LAA.

DISCUSSION

Intracavitary LA/LAA filling defects can be seen due to thrombus presence or for inadequate mixing of blood and contrast, giving a false positive image of a clot. Altered flow with reduced velocities are not infrequent in patients with AF; moreover, if they have ventricular disfunction[12,24,25].

A filling defect was defined as an area of low attenuation seen in the LA or LAA, different of pectinate muscles or another structure. These defects were classified in low, moderate or high risk using the homoneity of the low attenuation zone, border aspect and HU value, the highest risk being those homogeneous, less than 100 HU and well-defined border; and the opposite, nonhomogeneous aspect, an indefinite border and more than 100 HU for the low risk studies[10,26].

While there are different protocols using delayed acquisitions (single vs double bolus, different times ranging from 30 to 180 seconds), when they are used, the diagnostic accuracy clearly improved, reducing the number of false positive CT[10,13–18].

Studies in prone position were published to have similar PPV and NPV, such as delayed acquisition protocols[19,21]. This research only found one study combining both techniques[22], but not in the same three steps that were used in this work if a filling defect was seen in the first scan.

The two mayor concerns about CT are the use of iodinate contrast agent and the amount of ionizing radiation to these patients are exposed, both can be reduced using new systems, adjusting dose and using prospective volumetric reconstruction, because the radiation source is active only in a short segment of R–R interval, saving a big amount of the dose[27].

CONCLUSION

Left atrial appendage thrombus has a severe risk of thromboembolic complications and is a contraindication to percutaneous access to the left atrium. Performing a multidetector CT scan with a delayed acquisition protocol and in prone position are safe techniques to rule out false thrombus. More studies are needed to validate these findings.

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