Frequency of spontaneous detection of pulmonary arterial thrombi in unenhanced chest computed tomography in patients diagnosed with pulmonary embolism

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TO THE EDITOR,

Pulmonary embolism (PE) is the third most frequent cardiovascular disease, and can be lethal in the acute phase or cause significant late repercussions, such as chronic hypertensive pulmonary embolism. From a clinical point of view, the symptoms of acute PE are extensive, including asymptomatic presentation, dyspnea at rest, chest pain, and episodes of syncope.[1] Given the variability of manifestations of acute presentation, even in face of clinical suspicion, alternative diagnoses can be obtained after angiography by multidetector computed tomography (CT angiography or CTA). CTA is considered the method of choice for the imaging diagnosis of PE, being identified as a safe method for excluding PE in tests with satisfactory technical quality, reaching a negative predictive value of 95%.[1-3] Considering the limitations of the clinical diagnosis of PE and possible contraindications regarding the injection of iodized contrast medium, unenhanced chest CT scans are often performed to assess patients with non-specific acute cardiopulmonary symptoms, making the detection of indirect signs of PE crucial to raise the need for complementary tests that confirm the diagnosis in a timely manner.

The aim of the present study was to evaluate the frequency and characteristics of thrombi visualized in unenhanced chest CT scans in patients with PE confirmed by CTA.

A retrospective, cross-sectional, observational study was carried out using chest CT angiographies performed using a protocol for PE between January 2010 and December 2014 in a tertiary care hospital in Brazil. The tests that were carried out included an unenhanced phase, as part of the institution's protocol, followed by a contrast-enhanced phase, using an intravenous infusion of low-osmolarity non-ionic iodinated contrast. Initially, two examiners (with 19 and 10 years of experience, respectively) independently assessed the angiographies for pulmonary embolism, with positive results being selected for analysis. Afterward, two different examiners (with 2 and 10 years of experience, respectively) were given access to the selected PE-positive tests and were asked to search for signs of thrombi in the unenhanced CT. In this stage, the examiners evaluated the unenhanced CTs blindly in relation to the location of the thrombi, seeking their identification in the unenhanced scans. The presence of images compatible with infarction in the lung parenchyma was also assessed.

A total of 993 consecutive CT angiographies were selected, with positive scans for PE being found in 164 patients (16.5%). Of these, 64 were excluded for various reasons (inadequate protocol or data loss), leaving 100 patients with positive angiographies for PE, which constituted the sample for this evaluation. Among the 100 participating patients, 72 were female, and the mean age was 51.4 years. Thrombi in central branches (pulmonary trunk, main pulmonary arteries, or descending interlobar branches) were characterized in 44 patients.

In 17 patients (17%), it was possible to detect the presence of images compatible with thrombi (TSC+) in the unenhanced assessment; the remaining patients (TSC-) were used as a control group for statistical analysis purposes. In 13 patients (76.5%), the thrombi were hyperattenuating, while in 4 patients (23.5%), they were hypoattenuating. Among these patients, in the unenhanced phase, exclusively central thrombi were observed in 15 individuals (88.2%); in 1 patient (5.9%), it was possible to observe central and segmental branch thrombi, and in 1 patient (5.9%), an isolated segmental branch thrombus was identified. Regarding the location of the thrombi observed in the unenhanced scans, the most affected vessels were the right descending interlobar artery (13 patients), followed by the homolateral main pulmonary artery (7 patients), and the left descending interlobar branch (4 patients); it is noteworthy that, eventually, the same patient had thrombi that could be detected in more than one site. Density measurement was possible in all these patients, and, on average, the spontaneously hyperattenuating thrombi had a density of 71.1 HU (Min 58 HU / Max 87 HU), while the hypoattenuating thrombi presented a mean density of 26.7 HU (Min 11 HU / Max 36 HU).

In the multivariate analysis, when comparing groups TSC+ and TSC-, a significant association was found between the spontaneous visualization of thrombi in the pulmonary arterial system and the presence of a central thrombus (OR: 30.81; CI: 3.80-249.69).

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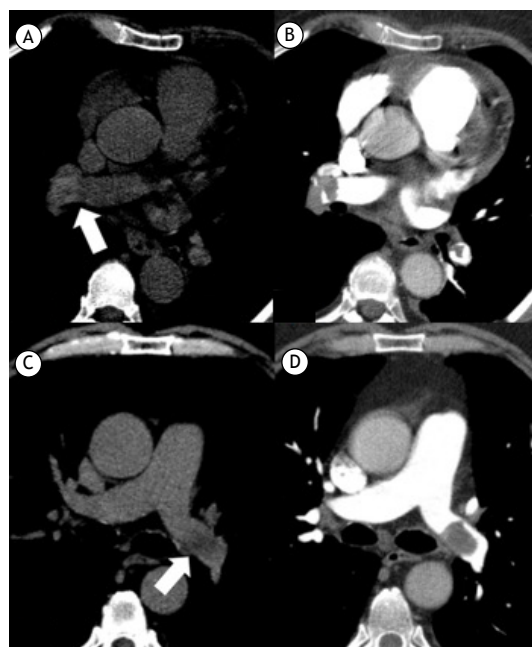4. Universidade Federal do Rio de Janeiro, Rio de Janeiro (RJ), Brasil.

Figure 1. (A and B) Axial chest images in an adapted mediastinal window [window center (WL) = 93; window width (WW) = 284)] without administration of contrast medium in A, and CT angiography in B. Hyperattenuating image in the right descending interlobar artery, with a density of 80 HU (arrow in A), confirmed as a thrombus in the CT angiography in B. (C and D) Axial chest images in an adapted mediastinal window without administration of contrast medium in C (WL = 67; WW = 211), and CT angiography in D. Hypoattenuating image in the left pulmonary artery, with a density of 11 HU (arrow in C), confirmed as a thrombus in the CT angiography in D.

It was noteworthy that, among the patients in the TSC+ group, approximately half (47%) had no images attributable to infarction in the lung parenchyma. It is important to highlight that, occasionally, spontaneous thrombus perception may be the only indirect sign for suspected pulmonary embolism in unenhanced chest CT scans.

The present study included the largest series of CTAs positive for pulmonary embolism among those using similar methodologies to which we had access. It was possible to identify thrombi in unenhanced CTs in 17% of the scans, most of which were centrally located. A statistically significant association was observed between the visualization of thrombi in the unenhanced scans and the presence of central thrombi, corroborating previous studies.[4-8] Although recent studies show that the presence of a central embolism does not represent an independent risk factor for increased mortality, the central location has been related to right ventricular dysfunction, recurrence of venous embolism after anticoagulation withdrawal, and unfavorable clinical evolution, thus emphasizing the importance of recognizing this condition.[9-10]

In the TSC+ group, hyper- and hypoattenuating thrombi were observed in relation to regional blood density. Comparing the frequency of the findings described in the present study and in Cobelli et al.,[5] the frequency of hyperattenuating thrombi was greater herein (76% vs. 47%), whereas the frequency of hypoattenuating thrombi was similar (23% in both). The mean attenuation of the hyperattenuating and hypoattenuating thrombi was quite similar between the current study and the one conducted by Cobelli et al.[5] (71.1 HU vs. 74.2 HU for hyperattenuating thrombi and 26.7 HU vs. 27.7 HU for hypoattenuating thrombi, respectively).

Our study had some limitations. The interobserver variation in the identification of thrombi in the unenhanced scans was not measured since it was not part of the objective. Among the tests excluded due to data loss, most were positive for embolism according to the reports, an aspect that, in addition to reducing the sample, limited the assessment of the accuracy of thrombus identification in the unenhanced CT scans for detection of pulmonary embolism.

AUTHOR CONTRIBUTIONS

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