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European Journal of Radiology 64 (2007) 54–64

EJR
EUROPEAN JOURNAL OF RADIOLOGY

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Review

MDCT of acute thrombotic and nonthrombotic pulmonary emboli

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Received 11 June 2007; accepted 28 June 2007

Abstract

Acute pulmonary embolism (PE) remains a common clinical challenge. MDCT pulmonary angiography has become the first line imaging study in the diagnosis of PE because of its speed, accuracy, low-interobserver variability, and ability to provide alternative diagnoses. This review article highlights the role of MDCT in the evaluation of acute thrombotic PE in the era of PIOPED 2. MDCT findings of acute PE and some potential pitfalls are covered as well as some of the controversies in imaging young and pregnant patients. MDCT findings of acute non-thrombotic PE are also covered. This latter group may be occult on the angiographic portion of the study but may declare themselves through secondary findings. Their findings and potential mimics are included so that the interpreting radiologist can make the most of a CT to rule out PE.

Keywords: MDCT; Pulmonary thromboembolism; Septic emboli; Fat emboli

Contents

1. Introduction

Pulmonary embolism (PE) is a commonly encountered, clinically challenging entity. Pulmonary embolism (PE) is currently the third most common cause of cardiovascular death after myocardial infarction and stroke [1]. Over 500,000 cases are diagnosed annually in the US alone. PE may be responsible for >10% of all in-hospital deaths [2]. Diagnosis of pulmonary embolism remains a clinical challenge because of the non-specific symptoms. Much has been written on the role of the use clinical criteria (e.g., Wells criteria) and the D-dimer assay for the pretest likelihood of acute PE [3]. Because this part of the workup often precedes the radiologist's clinical involvement, the pretest determination of the likelihood for acute PE will not be covered here.

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doi:10.1016/j.ejrad.2007.06.032

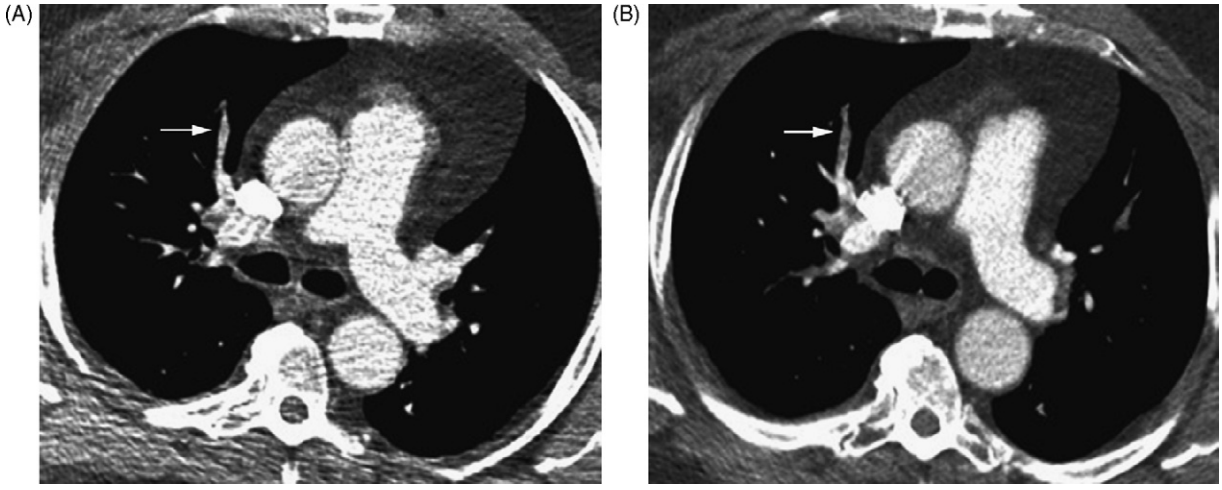

Fig. 1. 52-year-old woman with shortness of breath. Original CTPA was performed on a 4-row MDCT and questioned the presence of a small PE (arrow in A). Because the clinical history was somewhat confusing, the study was repeated the next day on a 16-row scanner. The PE is much more easily seen on the 16-row scanner (arrow in B).

In recent years, MDCT has helped in this diagnostic dilemma by providing a non-invasive, fairly accurate test with the ability to provide alternative diagnoses [1,4]. With low-interobserver variability and increased speed, MDCT has become the first-line in PE imaging in many centers. When positive, anticoagulation or filter placement is initiated and when negative, PE is felt to be absent. Yet, not all emboli will be visualized on the angiographic portion of these studies. Certain microemboli may not directly be seen but tend to present with secondary signs which should alert the radiologist to think about these entities in the right clinical situation. In this article, we will review the role of MDCT in the diagnosis of acute thrombotic PE, and non-thrombotic PE.

2. Acute thrombotic PE

Much has been written on the single detector CT evaluation for acute thrombotic PE [1,5]. With sensitivities quoted from 60 to 100% and specificities from 81 to 100%, CT pulmonary angiography (CTPA) evaluation has ranged from "not being able to stand up to the challenge" to "the development of a new first-line standard" [1,4].

MDCT has continued to evolve the technique. Clearly, more channels have resulted in better visualization of the segmental and subsegmental arteries [1,6]. With thinner collimations and faster scan times, higher spatial and temporal resolution can be achieved (Fig. 1). Smaller studies have shown higher sensitivity (96%) and specificity (98%) for PE detection when 4-row MDCT is used [7].

2.1. PIOPED 2

Recently, data from PIOPED 2 has been published that confirms these results [8]. In this multicenter trial, 1090 patients were enrolled. Eight hundred and twenty four went on to get a CTPA and a confirming test. Fifty-one patients (6%) had an inadequate CTPA. 192 of the remaining 773 patients (24%) who underwent both studies had PE. Sensitivity for PE was 83% and specificity was 96%. CT venography (CTV) was also performed in this study. Of the 824, 87 patients had an inadequate CTV (11%). Of the remaining 737 patients, the combined sensitivity for PE of the CTA-CTV was 90% and the specificity was 95%. These results led the PIOPED 2 investigators to conclude that MDCT CTA-CTV was more accurate than CTPA alone for the diagnosis of PE (Table 1).

This study suggested that when the clinical scenario is discordant with the CTPA, further imaging might be warranted. It should be noted that the reference test in this study was a V/Q and if the CTPA was discordant with the V/Q or if the V/Q was read as low or intermediate, another test was relied on: either a positive lower extremity US (without prior history of DVT) or negative US, low probability V/Q and low clinical probability using Wells criteria, or positive DSA. These results were primarily based on 4-row MDCT results.

A weakness of the study was the use of clinical probability as a decision point. At our institution, Wells' criteria are not routinely used. In fact, a recent analysis of all PE studies performed at our institution in a 3-month period (2006) only 3% was positive for PE. This number approaches the 3.4% prevalence of PE seen on routine helical CT performed for other reasons [9]. These numbers highlight the difficulty in clinically diagnosing PE and the acceptance of this study by our non-radiology colleagues in the evaluation of dyspnea. In fact, a recent survey of 240 clinicians from 44 states in the US showed that 86% preferred CTPA as the initial study for the evaluation of suspected acute PE [10]. This preference comes from its availability (24 h, usually close to patient areas), the ability to make alternative diagnoses and the few number of indeterminate studies.

Table 1
Positive and negative predictive values of CTA combined with CTV from PIOPED 2 (modified from [8])

Clinical probability	High	Intermediate	Low
CT positive predictive value%	96	92	58
CT negative predictive value%	82	92	97