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Full Length Article

Incidental pulmonary embolism in cancer patients: Interobserver agreement on the diagnosis and extent with a focus on distal clots

S.M. Bleker [a,*], L.F.M. Beenen [b], M. Di Nisio [a,c], N. van Es [a], H.R. Büller [a], N. Kraaijpoel [a], A. Rutten [d]

[a] Department of Vascular Medicine, Academic Medical Center, Amsterdam, The Netherlands
[b] Department of Radiology, Academic Medical Center, Amsterdam, The Netherlands
[c] Department of Medical, Oral and Biotechnological Sciences, G. D'Annunzio University, Chieti, Italy
[d] Department of Radiology, Antoni van Leeuwenhoek Ziekenhuis, Amsterdam, The Netherlands

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ABSTRACT

Background: The incidence of incidental pulmonary embolism (IPE) in cancer patients is increasing. There is scant information on the interobserver agreement among radiologists about the diagnosis of distal incidental clots and the actual radiologic extension of IPE.
Methods: A total of 88 contrast-enhanced computed tomography (CT) scans of cancer patients with IPE were reassessed blindly by two expert thoracic radiologists. First, 62 scans were reassessed and the interobserver agreement on most proximal extent of IPE was calculated between the two expert radiologists as well as between the initial and expert reading, using the kappa statistic. The sample was enriched with 26 additional scans for a total of 30 segmental and 29 subsegmental IPE to determine the interobserver agreement on distal clots.
Results: The level of agreement regarding the most proximal extent of IPE between the expert radiologists was very good (kappa 0.84; 95% CI, 0.73–0.95) and poor between the original radiologist and expert radiologists (kappa 0.39; 95% CI, 0.22–0.56). In the patients with segmental or subsegmental IPE on initial reading, the expert radiologists agreed with the segmental location in 12 out of 30 patients (40%) and with the subsegmental location in 17 out of 29 patients (59%). The interobserver agreement between the expert radiologists was good (kappa 0.68; 95% CI, 0.46–0.90) and moderate (kappa 0.48; 95% CI, 0.25–0.71), respectively.
Conclusions: While the interobserver agreement between radiologists on the most proximal location of IPE in cancer patients appears to be fairly good, it decreases significantly for more distally located incidental clots.

1. Introduction

Cancer patients frequently undergo contrast-enhanced computed tomography (CECT) scanning for disease staging and for monitoring of the effects of treatment. Advancements in CT techniques over the past decades have drastically improved pulmonary arterial visualization [1,2]. As a consequence, incidental pulmonary embolism (IPE) is increasingly detected in cancer patients, with a prevalence ranging from 1% to 5% [3,4]. The true prevalence of IPE may even be higher, since the contrast enhancement of the pulmonary arteries on oncological CECT scans is suboptimal for PE detection, especially for clots in the more distally located segmental and subsegmental arteries [5]. In addition, inattentional blindness of the observer may occur, since PE evaluation is not the primary goal of the scan [6]. Several studies which reassessed routine CT scans of cancer patients for IPE have reported false-negative rates ranging from 30% to 75% [5,7–9]. At the same time, a risk of false positive readings has been reported for distally located, symptomatic PE, and this may be worse for distally located IPE [10].

The clinical significance of IPE in cancer patients is not clear. Several retrospective studies suggest that the risk of recurrent venous thromboembolism (VTE) is similar in patients with IPE as compared to those with symptomatic PE [11–13]. Subsegmental IPE seems associated with a better prognosis than more proximal IPE [14], although data have been conflicting [15,16]. Current guidelines suggest that IPE should receive similar treatment as for symptomatic PE [17,18]. Therefore, it is relevant to correctly ascertain the diagnosis in order to avoid unnecessary exposure to anticoagulant therapy.

Although interobserver agreement among radiologists for symptomatic PE has increased over the years due to the introduction of multi-detector CT scans, concordance still remains suboptimal for subsegmental symptomatic PE [2,19–25]. Studies reporting on interobserver agreement for IPE in cancer patients are scarce, and no data exist on the interobserver agreement regarding the most proximal extent of IPE [5,26].

The objectives of the present study were to (1) evaluate the interobserver agreement on the most proximal extent of IPE between two

* Corresponding author at: Department of Vascular Medicine, Academic Medical Center, Meibergdreef 9, 1105, AZ, Amsterdam, The Netherlands.
E-mail address: s.m.bleker@amc.uva.nl (S.M. Bleker).

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expert thoracic radiologists, and subsequently between original and expert reading, and to provide a detailed description of the anatomical characteristics of IPE in cancer patients, and (2) evaluate the interobserver agreement on the diagnosis of segmental and subsegmental clots between expert radiologists and between original and expert radiologists.

2. Methods

A total of 88 CT scans from cancer patients with IPE were reassessed.

2.1. Part 1

First, 62 consecutive CT scans from all patients included between April 2012 and November 2014 in three centers participating in an ongoing observational study on the management of IPE in cancer patients were reassessed (NCT01727427; Fig. 1). In this international, prospective cohort, adult cancer patients with prospectively identified IPE are followed for 12 months for recurrent VTE, bleeding, and all-cause mortality. IPE is defined as one or more clots in the pulmonary artery tree detected on imaging performed for reasons other than a clinical suspicion of PE. For patients included in this registry, the local radiologist detailed the exact location of the IPE, and number of pulmonary arterial branches affected.

For the present study, baseline characteristics, including age, sex, and type of cancer, were collected. We recorded whether a computed tomography pulmonary angiogram (CTPA) was performed to confirm PE, and whether the presence of concomitant deep vein thrombosis (DVT) of the legs was verified by compression ultrasonography.

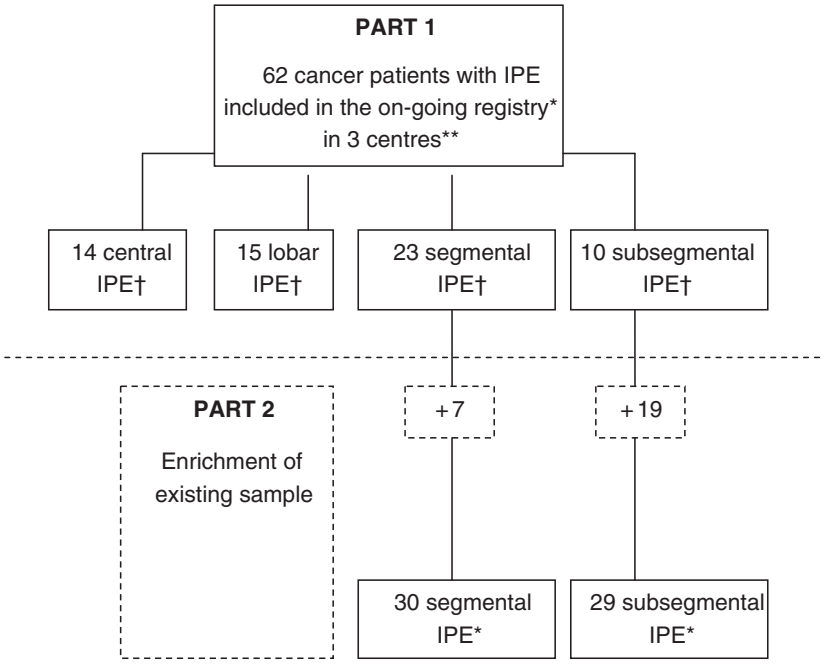
Two radiologists (LB and AR) with extensive experience in thoracic imaging, independently reassessed the thoracic images of all CT scans. Images were reviewed at least 6 months after the test date to minimize recall bias. Reassessment was performed on a dedicated picture archiving and communication system (PACS) workstation (Impax 6.5, Agfa HealthCare NV, Mortsel, Belgium) using multiplanar reformats when needed. The window setting was left to the discretion of the reader. Readers were unaware of prior interpretation.

The radiologists assessed the following items: image quality (rated on a Likert scale from 1 to 5, corresponding to inadequate to excellent), contrast opacification of the subsegmental arteries (rated on a Likert scale from 1 to 5, corresponding to inadequate to excellent), confidence of the diagnosis of IPE (rated on a Likert scale from 1 to 5, corresponding to definitive no PE to definite PE), pulmonary arterial CT density in the pulmonary trunk in Hounsfield units (HU), the extent of PE (central, lobar, segmental, subsegmental, or no PE), and the number of thrombi (single or multiple). Central and lobar PE were collectively classified as "proximal PE" and segmental and subsegmental as "distal PE".

The agreement between the two expert thoracic radiologists regarding the most proximal extension of the IPE, as well as the interobserver agreement between the original radiologist and the expert radiologists, were evaluated. A consensus reading between the radiologists was performed in case of disagreement. After the first consensus reading there was no remaining discordance; hence, the involvement of a third radiologist was not needed. The result of the consensus meeting was used as the reference to calculate the interobserver agreement between the expert radiologists and original radiologist.

2.2. Part 2

Interobserver agreement is expected to be lower for the diagnosis of distal IPE, similar to the setting of symptomatic PE [10]. In order to evaluate the interobserver agreement between the expert thoracic radiologists and between the original and expert radiologists, in the second part of the study we enriched the sample with 26 additional scans from consecutive patients with segmental and subsegmental IPE according to the original reading (Fig. 1). Both patients included in the prospective cohort study ($n = 33$) as well as patients who were excluded due to a life expectancy of less than three months or anticoagulant



* NCT01727427
** One academic and one non-academic center from the Netherlands, and one academic center from Italy
† According to the original reading
IIPE: incidental pulmonary embolism

Fig. 1. Flow diagram of part 1 and part 2 of the current study.