Combined computed tomographic (CT)-angiography and indirect CT-venography for the diagnosis of pulmonary embolism: Is more scanning better?

Mathias T. Grebe
Department of Cardiology and Angiology, Medical Clinic I, University Hospital Giessen and Marburg, Giessen, Germany

Pulmonary embolism (PE) is a life-threatening disease that presents an ongoing challenge to medical professionals. Clinical diagnosis of PE is difficult; in only about one third of patients in whom it is suspected PE is present (1). Therefore, the clinical diagnosis has to be confirmed or excluded by further testing. In this issue of Thrombosis and Haemostasis you will find an article by Nchimie et al. (2) (see article beginning page 566), which not only gives us interesting insights into the distribution of underlying deep vein thrombosis (DVT) in patients with PE, but additionally raises the question which diagnostic tests should be performed nowadays in patients with suspected PE.

In the 1960s, pulmonary angiography with direct injection of contrast media into the pulmonary artery became available as the first reliable diagnostic test and became the gold standard for the diagnosis of PE (3). Some years later ventilation and perfusion scanning (V/Q scans) was introduced into clinical medicine (4). Being a non-invasive test with minimal complications, it widely replaced pulmonary angiography, although the sensitivity and specificity of V/Q scans remained uncertain until the PIOPED study established its role in the diagnostic work-up of suspected PE in 1990 (1). This landmark study also established the role of clinical risk assessment in the diagnostic strategy for the diagnosis of PE.

Single detector contrast computed tomographic pulmonary angiography (CTA) became available as a diagnostic test for PE in the early 1990s (5). CT scanning is more rapidly available than V/Q scans in most emergency departments and CTA became increasingly popular among clinicians, although similar to V/Q scans in the 1970s and 1980s, the sensitivity and specificity of CTA had not been conclusively determined. In the following years sensitivities of about 70% for the diagnosis of PE with single detector CTA were reported (7), which was clearly not satisfactory. To improve sensitivity of CTA, multiple diagnostic strategies combining CTA with clinical risk assessment, compression ultrasound of the legs, D-dimer testing or CT-venography (CTV) have been proposed. In the last years, multi-detector CT scanning became available. The recently published PIOPED II study (6), another rigorously designed prospective landmark study, reported an excellent specificity of 96% and a sensitivity of 83% for CTA in the diagnosis of PE with multi-detector CT. Specificity dropped to 95%, but sensitivity rose to 90% if CTA was combined with indirect CTV.

However, the absolute gain owing to CTV was modest: only 14 additional patients with PE from 824 patients were identified. This was reflected by an only small increase in the negative predictive value, which was 95% with CTA alone and 97% with CTA and CTV. Moreover, when combined with clinical risk assessment according to the Wells score (7), no substantial advantage of combined CTA and CTV over CTA alone could be detected (8).

Concern still remains about patients with false negative test results on CTA. Should CTV be routinely performed additionally to CT in the diagnostic work up of suspected PE?

Usually patients tested false negative for PE on CTA have small, peripheral subsegmental emboli that can be better detected by V/Q scans. The clinical significance of small clots is not clear (9). In prospective outcome studies, in which patients with suspected PE were managed according to CTA results alone or in combination with D-dimer testing, the rate of venous thromboembolic events in a three-month period was low (<3%), and the results of these studies suggest that those small subsegmental thrombi may not require anticoagulant treatment (10–13) and therefore may not need to be diagnosed.

Moreover, in patients tested negative for PE on CTA but tested positive for DVT on CTV, false positive DVT rates of 25% to 80% have been calculated (14–16).

In this group of patients treatment decisions on the basis of CTV alone would result in a potentially harmful overtreatment.

Also, performing additional CTV after CTA exposes the patient to additional median cumulative effective radiation doses of 8.3–9.3 mSv (2), which is roughly equivalent to approximately 100 chest x-rays with both PA and lateral views (8). Compression ultrasound (CUS) has been shown to be an excellent diagnostic
tool for the diagnosis of DVT which will give us the same information as CTV without any additional radiation exposure. This is especially relevant, since isolated iliocal vein thrombosis (which could be overlooked with CUS) is extremely rare, as the study by Nchimi et al. (2) demonstrates, and CUS is substantially cheaper than CTV (8).

The concept of combined CTA and CTV in the diagnostic work up of suspected PE is certainly attractive: a time-saving “one-stop-shop” for the visualisation of both, PE and its source in only one diagnostic study. But the addition of CTV to CTA for the evaluation of suspected PE does not seem to improve the diagnostic yield of CTA enough to justify its routine use. For the majority of patients with suspected PE a strategy combining clinical risk assessment, D-dimer testing and multi-detector CTA with additional testing only in patients with discordant clinical probability and CTA-imaging results is safe and seems to be superior in terms of radiation exposure and cost effectiveness.

References