

# Multidetector CTA with venography was more sensitive for diagnosing pulmonary embolism than CTA alone

Stein PD, Fowler SE, Goodman LR, et al. Multidetector computed tomography for acute pulmonary embolism. *N Engl J Med*. 2006;354:2317-27.

**Clinical impact ratings:** Hospitalists ★★★★★☆ Hematol/Thrombo ★★★★★★ Pulmonology ★★★★★☆

## QUESTION

In patients with suspected acute pulmonary embolism (PE), what are the diagnostic performances of multidetector computed tomographic angiography (CTA) and CTA plus multidetector CT venography (CTV)?

## METHODS

**Design:** Blinded comparison of CTA and CTA-CTV with a composite reference test (Prospective Investigation of Pulmonary Embolism Diagnosis II [PIOPED II] trial).

**Setting:** 7 clinical centers in the United States and 1 in Canada.

**Patients:** Of the original 7284 patients  $\geq$  18 years of age with suspected acute PE, 3262 were eligible, 1090 were enrolled, and 824 (the study group, mean age 52 y, 62% women, 64% white) had CT and received a reference diagnosis. Exclusion criteria included inability to complete testing within 36 hours, renal insufficiency, history of long-term anticoagulant use, critical illness, allergies to contrast agents, myocardial infarction in the previous month, pregnancy, inferior vena caval filter in situ, upper extremity deep venous thrombosis, ventricular fibrillation, shock or hypotension, and planned thrombolytic therapy in the next 24 hours.

**Description of tests:** CTA and CTV were done with 4-, 8-, or 16-row multidetector scanners. For CTV, deep veins were scanned from the inferior vena cava confluence at the level of the iliac crest through the popliteal

veins. Criteria for diagnosis of PE by CTA were failure of contrast material to fill the entire lumen because of a central filling defect, a partial filling defect surrounded by contrast material on a cross-sectional image, contrast material between the central filling defect and the artery wall on an in-plane longitudinal image, and a peripheral intraluminal filling defect that forms an acute angle with the artery wall. Criterion for diagnosis of deep venous thrombosis by CTV was a complete or partial central filling defect. For CTA-CTV, PE was diagnosed if either test was positive and ruled out when both were negative. **Diagnostic standard:** A composite reference test of clinical assessment using the Wells rule, ventilation-perfusion lung scanning, venous compression ultrasonography of lower extremities, and pulmonary digital-subtraction angiography (DSA) to diagnose or rule out PE. Conventional DSA was only used when diagnosis of PE was inconclusive by other tests.

**Outcomes:** Sensitivity, specificity, positive and negative predictive values, and likelihood ratios.

## MAIN RESULTS

192 patients (23%) were diagnosed with PE by the composite reference test. CTA-CTV had higher sensitivity than CTA alone but both had similar specificity (Table). CTA and CTA-CTV were inconclusive in 51 and 87 patients, respectively.

## CONCLUSION

In patients with suspected acute pulmonary embolism, multidetector computed tomographic angiography (CTA) in combination with venous-phase multidetector CT venography was more sensitive than CTA alone for diagnosing pulmonary embolism.

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## Test characteristics of multidetector computed tomographic angiography (CTA) and CTA plus venous-phase multidetector CT venography (CTV) for diagnosing pulmonary embolism\*

Test	Sensitivity† (95% CI)	Specificity† (CI)	PPV†	NPV†	+LR‡ (CI)	-LR‡ (CI)
CTA	83% (76 to 92)	96% (93 to 97)	86%	95%	20 (13 to 29)	0.18 (0.13 to 0.25)
CTA-CTV	90% (84 to 93)	95% (92 to 96)	85%	97%	18 (13 to 26)	0.12 (0.08 to 0.18)

\*PPV = positive predictive value; NPV = negative predictive value. Diagnostic terms defined in Glossary.

†Based on exclusion of inconclusive results.

‡Calculated from data in article with inconclusive results included.

## COMMENTARY

The study by Stein and colleagues is an important addition to a growing body of data on the performance of multidetector CT for diagnosing PE. The study design was rigorous and used adequate diagnostic reference criteria and broad inclusion criteria. Although the population consisted mainly of patients in the emergency department and excluded those with massive PE, there is little reason to believe that this significantly reduced the generalizability of the results.

Specificity of multidetector CTA was high (96%), but the observed sensitivity of 83% was somewhat disappointing, even though it was higher than that of single-detector CT (70%). So, is multidetector CTA accurate enough to rule out PE? The answer is yes, if combined with clinical assessment. The PIOPED II study confirmed the validity of the Wells score for clinical probability assessment and the critical role of pretest probabilities for interpreting CT results. For example, most false-negative results were observed in patients with high clinical probability of PE when compared with those with low clinical probability (40% vs 4%).

CTV had increased sensitivity (90%), but is it more useful? It only increases the negative predictive value from 95% to 97% in the overall population and its effect is even more marginal in patients with low or intermediate clinical probability. Recent studies (1, 2) showed that risk for thromboembolism at 3 months is very low in patients left untreated because of a negative result on multidetector CT. Therefore, the added dose of radiation by CTV is probably not justified. In summary, multidetector CTA is accurate enough to rule out PE, at least in patients with low or intermediate clinical probability of PE.

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## References

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