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Excluding pulmonary embolism with helical (spiral) computed tomography: Evidence is catching up with enthusiasm

Clive Kearon

Advances in computed tomography (CT) technology have enabled imaging of the pulmonary arteries with injection of contrast medium into an arm vein. This technique, which involves continuous imaging with a rotating gantry as the patient is moved through the scanner, is usually referred to as "helical," "spiral" or "continuous-volume" CT, and it is now widely used to diagnose pulmonary embolism. Enthusiasts have proposed that helical CT is accurate enough to "rule in" or "rule out" pulmonary embolism in most patients. These claims have been based on the results of mostly small studies that reported high accuracy of helical CT in the diagnosis of pulmonary embolism when compared with an established diagnostic standard, usually ventilation–perfusion lung scanning and conventional pulmonary angiography. However, until recently, the methodologic limitations of studies evaluating helical CT in the diagnosis of pulmonary embolism have cast doubt on this technique's accuracy and led to uncertainty as to how helical CT should be used in clinical practice.[1,2]

Using the estimated accuracy of helical CT and extrapolations from experience with ventilation–perfusion scanning, I recently recommended in *CMAJ* how helical CT should be used to diagnose pulmonary embolism.[3] The results of 2 recent, well-designed studies of helical CT in the management of patients with suspected pulmonary embolism[4,5] strengthen those recommendations and allow the role of helical CT for the exclusion of pulmonary embolism to be extended. These studies tested the safety of withholding anticoagulant therapy on the basis of negative results of both helical CT for embolism and ultrasound examinations of the legs for proximal deep-vein thrombosis. Single-detector helical CT scanners, rather than more modern multidetector scanners that have better spatial resolution, were used in both studies.

In France, Musset and colleagues[4] performed a standardized clinical assessment of pulmonary embolism probability, helical CT of the pulmonary arteries and bilateral ultrasonography of the proximal deep veins of the legs (including the calf-vein trifurcations) in 1041 patients with suspected pulmonary embolism. Anticoagulant therapy was withheld from 507 patients on the basis of a combination of low or moderate clinical probability of pulmonary embolism and negative results of both helical CT and ultra-

sonography; during 3 months of follow-up, venous thromboembolism developed in 9 patients (1.8%; 95% confidence interval [CI] 0.8%–3.3%).

In the Netherlands, van Strijen and associates[5] performed helical CT in 510 patients with suspected pulmonary embolism. If the results were negative for pulmonary embolism and did not reveal a clear alternative diagnosis, ultrasonography of the proximal veins of the legs was performed. If those results were normal, ultrasonography was repeated after 4 and 7 days. Of the 130 patients in whom helical CT revealed an alternative diagnosis, 2 (1.5%, 95% CI 0.2%–5.6%) had venous thromboembolism during 3 months of follow-up. Of the 246 patients in whom ultrasonography was repeated, none had ultrasonographic abnormalities on day 4 or 7, and only 1 patient (0.4%, 95% CI 0.0%–2.2%) had venous thromboembolism during 3 months of follow-up.

On the basis of the findings in these 2 studies, I believe that it is safe to consider pulmonary embolism excluded if the results of helical CT of the pulmonary arteries and ultrasonography of the proximal deep veins of the legs are negative for embolism and thrombosis, respectively, provided the clinical probability of embolism is low or moderate. Because pulmonary embolism was found in 5% of the patients who had a high clinical probability but negative results of both helical CT and ultrasonography,[4] I recommend further testing for such patients.[3] It is important to note that negative results of helical CT alone do not exclude pulmonary embolism in patients with a low or moderate clinical probability; ultrasonography should also be performed to look for proximal deep-vein thrombosis in the legs. If helical CT reveals a clear alternative diagnosis, it may be safe to exclude pulmonary embolism without ultrasonography; however, in my opinion, there is still insufficient evidence to support such a recommendation.

Major advantages of helical CT over ventilation–perfusion scanning are that fewer examinations — 10%(4,5) v. 60%(3) — are technically inadequate or "nondiagnostic" and that helical CT identifies an alternative diagnosis that may influence clinical management in about 25% of patients.[5] The main disadvantage of helical CT is that, unlike ventilation–perfusion scanning, a negative result does not exclude pulmonary embolism.[1–4] However, the new French and Dutch studies indicate that ultrasonography of the proximal deep veins of the legs in patients with helical CT scans negative for pulmonary embolism overcomes this limitation in most patients.

Although the French study found that helical CT abnormalities confined to subsegmental pulmonary arteries were nondiagnostic, neither study systematically tested the positive predictive value for pulmonary embolism of helical CT abnormalities or of abnormal ultrasound examinations when combined with negative helical CT scans. The Second Prospective Investigation of Pulmonary Embolism Diagnosis (PIOPED 2) is evaluating the accuracy of helical CT and ancillary investigations in the diagnosis of pulmonary embolism in more than 1000 patients. This study, funded by the US National Institutes of Health, should bring us closer to an answer to these questions.

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