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A better approach to the diagnosis of PE

A simple diagnostic algorithm is all that's needed to safely and effectively reduce our reliance on CT pulmonary angiography to diagnose PE.

PRACTICE CHANGER

Do not order computed tomography pulmonary angiography when evaluating patients for suspected pulmonary embolism unless: (1) the patient has a D-dimer concentration ≥ 1000 ng/mL; or (2) the patient has a D-dimer concentration ≥ 500 ng/mL, PLUS: (A) clinical signs of deep vein thrombosis, (B) hemoptysis, or (C) you think pulmonary embolism is the most likely diagnosis.

STRENGTH OF RECOMMENDATION

A: Based on a prospective, multicenter, cohort study of 3616 patients with clinically suspected pulmonary embolism.[1]

van der Hulle T, Cheung WY, Kooij S, et al. Simplified diagnostic management of suspected pulmonary embolism (the YEARS study): a prospective, multicentre, cohort study. *Lancet*. 2017;390:289-297.

ILLUSTRATIVE CASE

Penny E is a 48-year-old woman with a history of asthma who presents with wheezing and respiratory distress. There are no clinical signs of deep vein thrombosis or hemoptysis. Pulmonary embolism (PE) is not your most likely diagnosis, but it is included in the differential, so you order a D-dimer concentration and it returns at 700 ng/mL. Should you order computed tomography pulmonary angiography (CTPA) to evaluate for PE?

PE is the third most common type of cardiovascular disease after coronary artery disease and stroke, with an estimated incidence in the United States of 1-2 people/1000 population and a 30-day mortality rate between 10% and 30%.[2] Improved adherence to a clinical decision support system has been shown to significantly decrease the number of diagnostic tests performed and the number of diagnostic failures.[3]

The use of a diagnostic algorithm that includes the Wells' criteria and a D-dimer concentration can exclude PE without CTPA in 20% to 30% of patients.[4] However, due to the complexity of the algorithm and insufficient time in busy emergency departments, adherence to recommended diagnostic strategies is variable.[5]

Further, it is common for a D-dimer test to be obtained before clinical assessment by a provider.[6] A fixed cutoff D-dimer concentration of 500 ng/mL is commonly used despite an absolute reduction of 11.6% (95% confidence interval [CI], 10.5-12.9) in the need for CTPA using an age-adjusted D-dimer concentration threshold (age × 10 ng/mL for patients > 50 years).[7]

Three items of the original Wells' criteria—clinical signs of deep vein thrombosis, hemoptysis, and whether PE is the most likely diagnosis—are the most predictive for PE.[8] The development of a more efficient algorithm based on these 3 items that uses differential D-dimer concentration thresholds could retain sensitivity and decrease unnecessary CTPAs. Decreasing CTPAs would avoid contrast-induced nephropathy and decrease cancers associated with radiation expo-

sure.[9-11] Significant cost savings could also be achieved, as the estimated cost of one CTPA is $648, while a D-dimer concentration is estimated to cost $14.[12]

STUDY SUMMARY

Simplified algorithm diagnoses PE with fewer CTPAs

The YEARS study was a prospective cohort study conducted in 12 hospitals in the Netherlands that included 3616 patients with clinically suspected PE.[1] After excluding 151 patients who met exclusion criteria (life expectancy < 3 months, ongoing anticoagulation treatment, pregnancy, and contraindication to CTPA), investigators managed 3465 study patients according to the YEARS algorithm. This algorithm called for obtaining a D-dimer concentration in all patients and assessment using the YEARS clinical decision rule, consisting of 3 items assessed by an attending physician: clinical signs of deep vein thrombosis, hemoptysis, and whether PE was the most likely diagnosis. PE was considered excluded if a patient had no positive YEARS items and a D-dimer concentration < 1000 ng/mL or if the patient had one or more YEARS items and a D-dimer concentration < 500 ng/mL. The primary outcome was venous thromboembolism (VTE) events at 3 months' follow-up once PE was excluded. The secondary outcome was the number of required CTPAs using the YEARS decision rule compared with the number that would have been required if the Wells' diagnostic algorithm had been implemented.

Of the 1743 patients who had none of the 3 YEARS items, 1320 had a D-dimer concentration below the 1000 ng/mL threshold. Fifty-five of the 423 who had a D-dimer ≥ 1000 ng/mL had confirmed PE by CTPA. In the 1722 patients who had at least 1 YEARS item, 1391 had a D-dimer concentration ≥ 500 ng/mL threshold; 401 of those 1391 had PE confirmed by CTPA.

Eighteen of the 2964 patients who had PE ruled out by the YEARS algorithm at baseline were found to have symptomatic VTE during the follow-up period (0.61%; 95% CI, 0.36-0.96), with 6 patients (0.20%; 95% CI, 0.07-0.44) sustaining a fatal PE. The 3-month incidence of VTE in patients who did not have CTPA was 0.43% (95% CI, 0.17-0.88), which is similar to the 0.34% (0.036-0.96) reported in a previous meta-analysis of the Wells' rule algorithm.[13] Overall, fatal PE occurred in 0.3% (95% CI, 0.12-0.78) of patients in the YEARS cohort vs 0.6% (0.4-1.1) in a meta-analysis of studies using standard algorithms.[14]

Using an intention-to-diagnose analysis, 1611 (46%) patients did not have a CTPA indicated by the YEARS algorithm compared with 1174 (34%) using the Wells' algorithm, for an absolute difference of 13% (95% CI, 10-15) and estimated cost savings of $283,176 in this sample. The per-protocol analysis also had a decrease of CTPA examinations in favor of the YEARS algorithm, ruling out 1651 (48%) patients—a decrease of 14% (95% CI, 12-16) and an estimated savings of $309,096.

WHAT'S NEW

High-level evidence says 14% fewer CTPAs

The YEARS study provides a high level of evidence that a new, simple diagnostic algorithm can reliably and efficiently exclude PE and decrease the need for CTPA by 14% (absolute difference; 95% CI, 12-16) when compared with using the Wells' rule and fixed D-dimer threshold of < 500 ng/mL.

CAVEATS

No adjusting D-dimer for age

The YEARS criteria does not consider an age-adjusted D-dimer threshold, which has been shown to further decrease CTPA use.[6] This does not preclude the use of YEARS criteria; applying age-adjusted D-dimer thresholds would have led to an absolute reduction of 8.7% (95% CI, 6.4-11) in CTPAs.[7]

CHALLENGES TO IMPLEMENTATION

None to speak of

We see no challenges to the implementation of this recommendation. **JFP**

> The new diagnostic algorithm reduced the use of CT pulmonary angiography by 14% and produced a cost savings of $309,096.

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