

Excluding Pulmonary Embolism Without Diagnostic Imaging

Wells PS, Anderson DR, Rodger M, et al. Excluding pulmonary embolism at the bedside without diagnostic imaging: management of patients with suspected pulmonary embolism presenting to the emergency department by using a simple clinical model and D-dimer. *Ann Intern Med* 2001;135:98–107.

Study Overview

Objective. To determine the safety and effectiveness of a clinical model combined with D-dimer assay in excluding pulmonary embolism in patients presenting to the emergency department.

Design. Prospective cohort study. Primary analysis was by intention-to-treat. A secondary analysis was performed on the subset of patients in whom the algorithm was correctly applied.

Setting and participants. Consecutive patients presenting to 1 of 4 participating medical centers in Canada with symptoms suspicious for pulmonary embolism and shortness of breath or chest pain. Patients were excluded if they had no symptoms of pulmonary embolism within 3 days of presentation, were anticoagulated for greater than 24 hours, had an expected survival time of less than 90 days, had a suspected upper extremity deep vein thrombosis, had a contraindication to contrast media, were in a geographic area that precluded follow-up, were pregnant, or were younger than 18 years.

Intervention. Patients were seen by 1 of 43 emergency department physicians. The probability of pulmonary embolism was determined through the use of a clinical model described by the authors in a previous publication [1]. Points were assigned based on history and physical information obtained from the patients. Pretest probability was categorized into low, moderate, and high based on the overall score obtained from the model. All patients had D-dimer assays (SimpliRED, AGEN Biomedical, Ltd., Brisbane, Australia) performed after the results of the clinical model were documented.

Main outcome measures. The main outcome was pulmonary embolism. A pulmonary embolism was diagnosed if a patient had an abnormal result on lower extremity compression ultrasound or pulmonary angiogram, a high-probability result on ventilation-perfusion scan, or a venous thromboembolic event over 3 months of follow-up. If none of these

events occurred during the 3 months of follow-up, a pulmonary embolism was considered excluded.

Main results. 946 patients were eligible; 16 patients were lost to follow-up. The final cohort of 930 patients had a mean age of 50.5 years (SD \pm 18.4) and a mean symptom duration of 3.2 days (SD \pm 5.2). A pulmonary embolism was diagnosed in 9.3% (86/930) of the cohort during the study period. In the intention-to-treat analysis, a pulmonary embolism was diagnosed in 37.5% (24/64) of patients with a high pretest probability, 16.2% (55/339) of patients with a moderate pretest probability, and 1.3% (7/527) with a low pretest probability. 849 patients had the diagnosis of pulmonary embolism excluded based on the clinical model and D-dimer assay. Of these patients, 1 in the low pretest probability group, 3 in the moderate pretest probability group, and 1 in the high pretest probability group had a confirmed pulmonary embolism during the follow-up period. A secondary analysis was performed on the 89.4% (759/849) of the cohort that had the diagnosis of pulmonary embolism excluded using the clinical algorithm correctly. In this subset, 1 patient developed a pulmonary embolism. No imaging tests were necessary in 47% of the cohort.

Conclusion. Using a clinical model and D-dimer test to exclude pulmonary embolism in patients presenting to the emergency department is safe and reduces the need for diagnostic imaging.

Commentary

Overall, this was a well-designed study. Because the clinical manifestations of pulmonary embolism overlap with other disease states, providers frequently must rely on radiographic studies to exclude this diagnosis. Wells et al's study lends

This month's "Outcomes Research in Review" was edited by Pedro J. Caraballo, MD, Department of Medicine, Albany Medical College, Albany, NY; Benoit Tonneau, MD, Department of Medicine, Albany Medical College; Harvey J. Murff, MD, Department of Medicine, Brigham and Women's Hospital, Boston, MA; and Stephen D. Persell, MD, Department of Medicine, Brigham and Women's Hospital.

support to the use of a clinical algorithm along with D-dimer measurement to exclude pulmonary embolism prior to radiologic diagnostic testing. Overall, this approach was safe, with relatively few events missed, and it reduced the number of diagnostic imaging tests required.

However, there were difficulties using the algorithm. The algorithm was used incorrectly in 10% of the patients seen. Furthermore, 7 pulmonary embolisms (8.1%) were diagnosed by clinicians utilizing tests that were not indicated by the clinical model. The authors attribute this to a misuse of the algorithm, suggesting that the physician had initially given the patient a lower score than clinically indicated. The algorithm was considered incorrectly applied based on ordered follow-up tests. Interrater reliability of the clinical model was not determined, and some of the questions within the model are subjective. Thus, it is difficult to truly discern how often the model was used correctly. Regardless, it is comforting that 4 of the 5 missed thromboembolic events occurred when physi-

cians had inappropriately utilized diagnostic imaging based on the algorithm.

Applications for Clinical Practice

The use of a clinical algorithm to determine pretest probability along with D-dimer assay is a safe means to exclude the diagnosis of pulmonary embolism for patients presenting to the emergency department. This diagnostic approach reduced the number of diagnostic tests required during the workup of pulmonary embolism.

– Review by Harvey J. Murff, MD

References

1. Wells PS, Anderson DR, Rodger M, et al. Derivation of a simple clinical model to categorize patients probability of pulmonary embolism: increasing the model's utility with the SimpliRED D-dimer. *Thromb Haemost* 2000;83:416-20.

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