

Right-Sizing Testing for Pulmonary Embolism: Recognizing the Risks of Detecting Any Clot

Steven M. Green, MD, Donald M. Yealy, MD

From the Department of Emergency Medicine, Loma Linda University Medical Center and Children's Hospital, Loma Linda, CA (Green); and the Department of Emergency Medicine, University of Pittsburgh, Pittsburgh, PA (Yealy).

0196-0644/\$-see front matter

Copyright © 2012 by the American College of Emergency Physicians.

doi:10.1016/j.annemergmed.2011.12.014

A **podcast** for this article is available at www.annemergmed.com.

SEE RELATED ARTICLES, P. 517 AND 521.

[Ann Emerg Med. 2012;59:524-526.]

In this issue of *Annals*, we present seemingly contrasting information about the search to identify individuals with acute pulmonary embolism. Our goal is to make sense of this discordance and offer a pragmatic and patient-centered approach.

The systematic review and meta-analysis of the pulmonary embolism rule-out criteria (PERC) by Singh et al¹ assesses almost 14,000 patients from the 11 best-quality studies performed in 6 countries. The authors observed that the frequency of missed pulmonary embolism in patients meeting all 8 PERC criteria was 0.3%. This 1 in 300 result is as close to ideal as is possible in medicine, allowing us to identify patients for whom D-dimer testing and imaging can be avoided altogether.

Because some individuals have previously advocated D-dimer testing for low-risk pulmonary embolism patients,² this is an important advance. Adding D-dimer testing can almost never help detect a pulmonary embolism in PERC-negative patients, it increases care time and resource use absent a benefit, and it may add harm. Experts estimate that 1 radiation-induced cancer will result from every 2,000 computed tomography (CT) pulmonary angiograms, with half of such cancers ultimately fatal.³ Similarly, 1 contrast-induced renal failure will occur for every 200 such studies, with half of such events ultimately fatal.³ Simply put, pulmonary embolism testing in PERC-negative patients will almost always lead to more harm than benefit.

Also in this issue, Hennessey et al⁴ reported a case of a 42-year-old woman presenting to an emergency department (ED) with chest pain, with apparently very low pulmonary embolism risk, whether applying the Wells score, revised Geneva criteria, PERC, or unstructured clinical judgment. An inadvertently ordered D-dimer result was abnormal, and the subsequent CT pulmonary angiography revealed a saddle embolus; the “needle in the haystack” was found. So how do we resolve this paradox? Is PERC effective or isn't it? Can we avoid extensive testing seeking pulmonary embolism in low-risk patients? This case

report underscores how subtle and variable the manifestations of pulmonary embolism can be. It also confirms that even the best of us are doomed to periodically miss this diagnosis despite our best efforts.

The understandable but misguided practice change based on this case report would be to order more D-dimer tests and CT pulmonary angiograms. Case reports often highlight anomalies but should not alone necessarily change practice or thinking. This patient's innocuous course before arrival in the ED underscores that clots—big and small—may not always present classically, impair functioning, or cause immediate death. Beyond that, we know that emboli frequently lyse spontaneously without directed therapy.⁵ Like virtually all other conditions, pulmonary embolism diagnosis is challenging in some patients, and any approach will fail on occasion.

We think the right assimilation of these 2 disparate reports is simple: Apply your best clinical judgment, with or without validated bedside tools such as PERC, and then test only when these guide you in that direction. The prevalence of pulmonary embolism in Swiss and French patients from the current meta-analysis ranged from 21% to 25%.¹ In contrast, the prevalence of pulmonary embolism in US patients ranged from 2% to 12%,¹ diluted because we tested so many more minimal-risk patients. Yet overall mortality from pulmonary embolism is not lower in the United States despite the testing.⁶

Why have US physicians tested much more often for pulmonary embolism? We have been taught that all pulmonary emboli are harmful and lurk, ready to incite death.⁵ Those reports do not represent current conditions,^{3,6,7} yet the fear lingers. Many pulmonary embolism patients have a low risk of poor outcomes,^{3,5,7} yet we treat like we test: everyone gets the full 6 to 12 months of potentially dangerous anticoagulation despite widely variable risk/reward ratios. Future research already planned may help us tailor therapy for pulmonary embolism detected in patients with low-risk presentations or smaller clot burdens.^{3,8}

Our tort system encourages litigation after unexpected poor outcomes, and fear of being sued leads us to overlook the adverse consequences and costs of our “search in all despite the low yield” approach.⁹ We overtest despite knowing that our patients want us to act in their best interests and to make careful

decisions for them such as we might make for ourselves. This relentless search—“defensive medicine”—makes us treat our patients differently than we would treat ourselves and order far more tests for them.^{9,10} As observed earlier, this exposes many patients to risk absent any benefit. One estimate is that the current US model of testing might ultimately cause 6 times as many deaths as lives saved.³

So how can emergency physicians make the paradigm shift to testing substantially less for pulmonary embolism? Follow our simple 7-step program.

SEVEN-STEP PROGRAM FOR REDUCING TESTING FOR PULMONARY EMBOLISM

Step 1: Accept That You Cannot Identify All Pulmonary Emboli

As amply displayed by the case report in this issue,⁴ emergency physicians must abandon any pretense that they can identify all pulmonary emboli on a first visit. Each of us will miss pulmonary emboli, and on rare occasions the outcome will be poor despite the well appearance. Resign yourself to a more pragmatic and utilitarian approach.

Step 2: Recognize That Any Strategy That Seeks to Detect All Pulmonary Emboli Does More Harm Than Good

As discussed, aggressive testing is not beneficial overall but simply shifts the net risks from the few patients with disease to the many without.^{3,6}

Step 3: Risk-Stratify and Reduce Your Testing

Identify low-risk patients and don't initiate a diagnostic evaluation for pulmonary embolism. PERC is a well-validated tool for this purpose.¹ PERC-negative patients aren't just low risk but also ultralow risk. Identifying true zero risk is not achievable, even with testing.

Don't like the validated decision aids? No problem. Because PERC simply mimics unstructured clinical judgment, there is every reason to believe that the gestalt of a skilled emergency physician will similarly identify patients whose lower risk of pulmonary embolism does not warrant the risks of a diagnostic evaluation.^{11,12}

Step 4: Try “Watchful Waiting”

In the ED, our mindset is to make correct diagnoses on the spot, whereas most other physicians assess the likelihood of disease longitudinally. Emergency physicians need to gain more comfort delaying evaluations for pulmonary embolism and other diagnoses, a strategy sometimes nicknamed “watchful waiting”¹³ or “masterful inactivity.”¹⁴

To avoid unnecessary risks of testing, a feasible alternative for “on-the-fence” patients might simply be a 24-hour recheck either in the ED or with their regular physician. By then, the lack of disease may have become obvious, and if the patient is unimproved you can always test at this second visit. Patient satisfaction with watchful waiting can be just as high as with immediate testing.¹³

We currently do this safely in low-risk venous thrombosis, the common pulmonary embolism companion.

Step 5: Document Your Medical Decisionmaking

The no-testing strategy can be readily documented on the medical record: “Given the known potential harms of a diagnostic evaluation for pulmonary embolism, my clinical judgment for this patient is that those risks currently outweigh the likely benefits.” If using watchful waiting, then add: “Instead, I have asked the patient to be rechecked in 24 hours (or earlier if worse) to reassess this risk, either in the ED or with his or her regular physician.”

Step 6: Be Less Afraid of Litigation

Adverse malpractice verdicts occur commonly when physicians fail to meet a reasonably well-defined standard of care *and* when more than a single opportunity is lost. Our recommendations resolve both of these directly. When that standard is murky, when the diagnosis is inapparent, and when the risks of testing are very real (as with pulmonary embolism), those judging our care will likely understand and support the physician who is attempting to act in the patient's best interests. Moreover, our patients will know we cared for them, especially if we share our knowledge and concern for their immediate and long-term safety and well-being.

Step 7: Spread the Word

Educate your trainees, partners, and colleagues about tailored decisionmaking and the pitfalls of testing “at any cost.” Track such testing in your continuous quality improvement programs. Ensure that your local ED logistics effectively facilitate return visits for watchful waiting.

So that's the news, both bad and good. That we cannot consistently diagnose this protean disease safely is bad news. However, it is good news that the current scientific evidence supports a strategy of using clinical judgment to substantially reduce testing for pulmonary embolism. We will not always be right with individual patients, but aggressive testing for all only shifts who receives what bad event; it does not decrease harm universally.

Supervising editor: Michael L. Callaham, MD

Funding and support: By *Annals* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist.

Dr. Callaham was the supervising editor on this article. Dr. Green and Dr. Yealy did not participate in the editorial review or decision to publish this article.

Address for correspondence: Steven M. Green, MD, steve@viridissimo.com.

REFERENCES

1. Singh B, Parsaik A, Agarwal D, et al. Diagnostic accuracy of pulmonary embolism rule-out criteria: a systematic review and meta-analysis. *Ann Emerg Med.* 2012;59:517-520.
2. Sinert R, Foley M. Clinical assessment of the patient with a suspected pulmonary embolism. *Ann Emerg Med.* 2008;52:76-79.
3. Newman DH, Schriger DL. Rethinking testing for pulmonary embolism: less is more. *Ann Emerg Med.* 2011;57:622-627.
4. Hennessey A, Setyono DA, Lau WB, et al. A patient with a large pulmonary saddle embolus eluding both clinical gestalt and validated decision rules. *Ann Emerg Med.* 2012;59:521-523.
5. Calder KK, Herbert M, Henderson SO. The mortality of untreated pulmonary embolism in emergency department patients. *Ann Emerg Med.* 2005;45:302-310.
6. Wiener RS, Schwartz LM, Soloshin S. Time trends in pulmonary embolism in the United States: evidence of overdiagnosis. *Arch Intern Med.* 2011;171:831-837.
7. Aujesky D, Obrosky DS, Stone RA, et al. A prediction rule to identify low-risk patients with pulmonary embolism. *Arch Intern Med.* 2006;166:169-175.
8. Aujesky D, Roy PM, Verschuren F, et al. Outpatient versus inpatient treatment for patients with acute pulmonary embolism: an international, open-label, randomised, non-inferiority trial. *Lancet.* 2011;378:41-48.
9. Studdert DM, Mello MM, Sage WM, et al. Defensive medicine among high-risk specialist physicians in a volatile malpractice environment. *JAMA.* 2005;293:2609-2617.
10. Ubel PA, Angott AM, Zikmund-Fisher BJ. Physicians recommend different treatments for patients than they would choose for themselves. *Arch Intern Med.* 2011;171:630-634.
11. Courtney DM, Kline J, Kabrhel C. Clinical features from the history and physical examination that predict the presence or absence of pulmonary embolism in symptomatic emergency department patients: results of a prospective, multicenter study. *Ann Emerg Med.* 2010;55:307-315.
12. Schriger DL, Newman DH. Medical decision making: let's not forget the physician. *Ann Emerg Med.* 2012;59:219-220.
13. van Bokhoven MA, Koch H, van der Weijden T, et al. Influence of watchful waiting on satisfaction and anxiety among patients seeking care for unexplained complaints. *Ann Fam Med.* 2009;7:112-120.
14. Meistrup-Larsen KI, Sørensen H, Johnsen NJ, et al. Two versus seven days penicillin treatment for acute otitis media. A placebo controlled trial in children. *Acta Otolaryngol.* 1983;96:99-104.

Did you know?

You can personalize the new *Annals of Emergency Medicine* Web site to meet your individual needs.

Visit www.annemergmed.com today to see what else is new online!