Contemporary Diagnostic Algorithm for the Hemodynamically Stable Patient With Suspected Pulmonary Embolism

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No single diagnostic test has sufficient accuracy when used alone to confirm or rule out pulmonary embolism (PE). This even applies to pulmonary angiography, the historical gold standard in PE diagnosis. Therefore, modern diagnostic strategies for PE rely on combinations of noninvasive tests such as plasma D-dimer measurement, lower limb venous compression ultrasonography, ventilation-perfusion lung scan, and/or helical computed tomography, the results of which should be interpreted in the context of the clinical likelihood of PE. Pulmonary angiography is rarely necessary. Clinical probability of PE can be assessed with fair accuracy, either implicitly or by clinical prediction rules. Management studies, in which patients deemed not to have PE are left untreated and followed up to assess their 3-mo thromboembolic risk, have become the benchmark for validation of diagnostic algorithms. Cost-effectiveness analysis allows the evaluation and comparison of the various diagnostic sequences. The existing evidence shows that implementation of evidence-based diagnostic algorithms is feasible and may increase quality of care.

Key Words: Deep venous thrombosis; D-dimer; lower limb venous ultrasonography; ventilation-perfusion scintigraphy; helical computed tomography; pulmonary angiography; clinical assessment; diagnosis; cost-effectiveness.

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INTRODUCTION

Over the past 15 yr, an increasing number of tests have become available to diagnose pulmonary embolism (PE). For example, the North American Prospective Investigation On Pulmonary Embolism Diagnosis (PIOPED) study definitively established the criteria for interpreting the results of ventilation-perfusion (V/Q) scintigraphy (1). Plasma D-dimer measurement is now a validated and widely accepted first-line test for ruling out PE, provided it is used in combination with clinical probability and in the appropriate clinical setting (2–4). Lower limb venous compression ultrasonography is a useful adjunct because of its high specificity for proximal deep venous thrombosis (DVT), the most frequent source of PE (5). Finally, the development of helical computed tomography (CT) represents, without question, a revolution in our diagnostic armamentarium (6,7).

The recent technical advances in imaging of the pulmonary vasculature probably permit correct diagnosis of PE in numerous centers not equipped with nuclear medicine facilities, because these institutions no longer need to transfer patients with clinically suspected PE for further diagnostic evaluation. In addition, thoracic imaging itself may be less frequently required owing to preselection of patients by means of clinical probability and D-dimer testing (see Chapter 1). On the other hand, a less favorable consequence is the increasing number and complexity of proposed diagnostic algorithms for PE, which make it very difficult for the clinician to understand and adopt a clear management strategy. In fact, this confusion may even result in the use of inappropriate criteria for diagnosing or ruling out PE (3,8–10), therefore entailing the risk of unnecessarily submitting some patients to the risks of anticoagulant treatment or others to the mortality of untreated PE. Moreover, the diagnostic tests themselves are in constant change and evolution. For example, the large number of D-dimer assays currently available may lead some clinicians to believe that all tests possess similar diagnostic sensitivity and specificity, which is clearly not the case (11).

Helical CT has evolved from 3- to 5-mm-thick slices, using first-generation single-row detectors (12), to 1-mm-thin slices with contemporary multirow CT scanners (13), and the diagnostic performance of CT keeps improving at a rapid pace, generating the need for frequent updating of the clinical algorithms based on this procedure.

The characteristics of the individual diagnostic tests for PE are reviewed in Chapters 1, 2, and 3 of this book. The aim of the present chapter is to provide a guide for combining those tests in a rational and cost-effective manner, reviewing validated diagnostic strategies. Importantly, suspected PE in patients with shock or hemodynamic instability is a distinct clinical situation, and it warrants a specific diagnostic approach, which will be discussed in the following chapter. The strategies discussed in this chapter are thus restricted to the hemodynamically stable patient.

ARE DIAGNOSTIC STRATEGIES FOR PE NECESSARY?

Characteristics of Noninvasive Tests

The individual characteristics of diagnostic tests for PE are summarized in Table 1. Pulmonary angiography has been considered to have almost ideal sensitivity and specificity for PE. Therefore, it was, until recently, the only test capable of both ruling in and ruling out PE as a single procedure. However, it is invasive (14), costly (15), and, because it is rarely performed, the expertise for interpreting angiographic findings is rapidly decreasing except in specialized centers. Moreover, it cannot even be considered a true