Clinical Outcomes in Patients With Suspected Acute Pulmonary Embolism and Negative Helical Computed Tomographic Results in Whom Anticoagulation Was Withheld

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Background: Helical computed tomography (CT) techniques for the diagnosis of pulmonary embolism have been refined over the past decade. Helical CT is widely used in the diagnosis of pulmonary embolism despite the lack of well-designed trials supporting this approach. Although helical CT correlates well with pulmonary angiography in detecting central emboli, critics argue that it misses more distal embolic events. It is unknown, however, whether distal emboli are clinically significant. If undetected distal emboli are significant, we reasoned that venous thromboembolic events should occur more often in patients with negative helical CT results who were not receiving anticoagulation.

Methods: We performed a retrospective analysis of 433 sequential helical CT scans ordered for clinical suspicion of pulmonary embolism from March 9, 1999, until April 30, 2002. We excluded 119 studies (27%) that were positive for pulmonary embolism, then excluded 57 others of patients who had received anticoagulation throughout the study period. We then contacted patients and families, and reviewed hospital records and death summaries to determine whether the patients had developed any venous thromboembolic events during the 3-month period following their negative helical CT.

Results: Follow-up was completed on 239 (98.4%) of 243 patients. Venous thromboembolic events developed in 4 (1.7%; 95% confidence interval, 0.0%-3.2%). In the 3-month follow-up period, 33 patients died, 1 of a probable pulmonary embolism (0.4% of the study group; 95% confidence interval, 0.0%-1.2%).

Conclusions: Our data support helical CT as a safe, definitive, minimally invasive test that is associated with a low 3-month risk of venous thromboembolism, and may be comparable to results of negative pulmonary angiography or low-probability ventilation-perfusion scan.

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A CUTE SYMPTOMATIC pulmonary embolism (PE) is common in the United States, with 50 000 to 175 000 events occurring annually. However, the prevalence of disease in those suspected of having PE in major trials ranges from 26% to 34%, such that symptoms suggestive of PE may arise as often as 675 000 times annually. The accurate diagnosis of PE is vital. Tests with poor sensitivity might deny a patient effective therapy with anticoagulants, which lowers mortality from 30% to 8%, while tests with poor specificity might expose patients without disease to a 10% risk of bleeding complications with anticoagulant therapy.

Because the clinical diagnosis of PE is neither sensitive nor specific, physicians must rely on a variety of invasive and non-invasive studies for more definitive diagnosis. Ventilation-perfusion (V/Q) scintigraphy is commonly used as a first-line test. Normal V/Q scans have a high negative predictive value, allowing anticoagulation to be safely withheld, whereas high-probability scans have a high predictive value when pretest probability is high. However, these 2 diagnostic results occur in fewer than one quarter of all patients in major trials. Interobserver variability is as high as 25% for low- and intermediate-probability results even among expert readers, making interpretation of the results challenging for clinicians.

Pulmonary arteriography has historically been considered the gold standard for the diagnosis of pulmonary emboli. Ample evidence of its negative predictive value has been reported. However, physicians are generally reluctant to request it, even when indicated, because of its inherent risks (combined major and minor complications in 6.5%, and death in 0.5%). Interobserver variability is also common with arteriography, and is inversely proportional to the size of the ves-
sels studied.\(^9\)\(^,\)\(^14\) In the Prospective Investigation of Pulmonary Embolism Detection (PIOPED) study, 2 expert examiners agreed on the presence of emboli in 81% of all cases, and in only 66% of cases with subsegmental emboli.\(^7\) Quinn et al\(^15\) found that 3 angiographers agreed on the diagnosis of subsegmental emboli in only 13% of cases.

With the appropriate assay and discrimination level, D-dimer analysis has been shown to have good sensitivity for PE.\(^16\) D-dimer assays have a high negative predictive value (94%-98%) when the suspicion for PE is low.\(^17\),\(^18\) Subsequent studies in patients with cancer and in emergency department triage settings, however, found less consistent results (negative predictive value, 80%-81%).\(^19\),\(^20\) Specificity is low (20%), and decreases with increasing age. Such factors limit the exclusion of PE based on D-dimer analysis alone to fewer than one quarter of suspected cases.\(^21\)

Helical computed tomography (CT) has gained acceptance over the past decade as a minimally invasive examination for detection of PE.\(^22\)\(^,\)\(^24\) D-dimer assays have a high negative predictive value (94%-98%) when the suspicion for PE is low.\(^17\),\(^18\) The examination is generally well tolerated, complicated only occasionally by contrast allergy and contrast nephropathy. Currently, the technical limitations of helical CT hamper visualization of subsegmental emboli, limiting its overall sensitivity to as low as 53% in one study.\(^23\) Studies assessing helical CT for evaluation of PE, however, have used a variety of techniques and criteria for determining the presence of thrombus, resulting in a wide array of reported sensitivities.\(^22\)\(^-\)\(^23\)

The importance of isolated subsegmental emboli not apparent on helical CT has recently been questioned.\(^24\)\(^,\)\(^25\) If isolated subsegmental emboli are clinically unimportant, then failed detection might not result in further embolic events, and the risks of anticoagulation might outweigh the benefits. If they are important harbingers of future events, however, false-negative results might result in untoward outcomes for untreated patients. Given the lack of a gold standard for the diagnosis of peripheral emboli and varied reports on their incidence (5%-30%),\(^3\)\(^,\)\(^15\),\(^36\) clinical outcomes may be the best measure for determining the validity of a test for excluding the diagnosis of PE.

We sought to assess the clinical outcome of consecutive patients referred for helical CT in the evaluation of PE at 3 or more months, and to specifically determine if negative results on helical CT portend a 3-month outcome free of venous thromboembolic events.

**METHODS**

The institutional review board of The Reading Hospital approved this research protocol, and verbal consent was obtained before requests for information from patients and family were made.

**CT PROCEDURE**

All patients were evaluated by the standard CT imaging protocol for PE detection used by The Reading Hospital and Medical Center. Helical CT scans were performed on 1 of 2 GE High-Speed CT/I scanners or on a GE LightSpeed Plus scanner (General Electric Medical Systems, Milwaukee, Wis). A peak enhancement curve was obtained at the right pulmonary artery level during an initial test injection of 15 mL of iohexol (Omnipaque 240) at a rate of 3 to 4 mL/s. Imaging was then performed at the predetermined peak opacification time during the administration of 150 mL of contrast at 3 to 4 mL/s. Helical acquisition was performed from caudal to cephalad, from the lowest portion of the diaphragm to 2 cm above the aortic arch. In each case, the single breath hold technique was used. A 3-mm section thickness was used, with a pitch of 1:1 to 2:1 mm (depending on the patient's ability to breath hold). A typical scan took 15 seconds or less using 120 kV and 280 mA. Reconstruction was performed at 1.5 mm, and image review was performed at interactive workstations. All interpreting radiologists were board certified and had extensive CT experience at this busy community hospital, which performs over 34,000 CT scans each year. Unlike other studies performed at tertiary care institutions,\(^22\),\(^25\),\(^26\),\(^28\),\(^29\),\(^31\)\(^,\)\(^32\) the interpreting radiologists were active practicing community radiologists and not full-time academic thoracic imaging specialists.

**SELECTION OF PATIENTS**

The hospital's radiology information system was interrogated for all chest CT reports including the words "pulmonary embolism" and "clot" for the 2 years before the initiation of the study. Each extracted report was reviewed by a vascular-interventional radiologist (R.D.) to identify studies that, by clinical indication and imaging technique, were performed specifically for the evaluation of suspected PE. Reports were then collected sequentially from the day of the study inception forward for all requests made for helical CT to rule out PE (Figure). Based upon the contemporaneous final report of the interpreting radiologist, our radiologist study member deemed each study "positive," "negative," or "indeterminate." Positive and indeterminate scans were eliminated from further review.

The charts of patients who had negative CT scans were then reviewed in an attempt to determine the pretest probability of disease. Patients were considered to be "low," "moderate," or "high" probability based on the criteria of Wells et al\(^37\) for determining pretest probability, using symptoms, signs, and other end points collected from patient records. Outpatients for whom clinical data were not available were classified as "low" probability. Data were also collected on other studies performed for PE diagnosis, such as V/Q scan, serum D-dimer level, lower extremity venous Doppler ultrasound, and pulmonary arteriography. Patients taking warfarin or other anticoagulants (other than antiplatelet drugs) for any extended period were not enrolled in the study, although their reason for anticoagulation was recorded.
Attempts were made to locate all patients at 3 or more months following the negative study result to determine outcomes. Hospital records were reviewed, and patients or their families or caregivers were contacted. All deaths were reviewed by at least 3 study reviewers to determine if PE may have occurred based on all available evidence.

### SOLICITATION OF OUTCOMES

A total of 433 sequential cases with clinically suspected PE were referred for helical CT during the study time frame (Figure). Fourteen patients (3.2%) were excluded because the report indicated that the CT study was indeterminate and further testing was needed. One hundred nineteen patients (27.4%) were determined to have positive studies and were similarly excluded from further review. Of these positive studies, the largest affected vessel was a third order (lobar) or larger in 97 of reports (82%). The distribution of emboli in positive helical scans was as follows: pulmonary trunk, 1 (1%); pulmonary artery, 25 (21%); lobar, 71 (60%); segmental, 8 (7%); subsegmental or smaller vessel, 6 (5%); and no mention made of involved vessel, 8 (7%).

Of the remaining 300 examinations found to be negative for PE on helical CT, 57 (19%) were excluded because the patients were receiving long-term anticoagulation during the 3-month follow-up study period. The most common reasons for use of anticoagulation were atrial fibrillation, 15 cases; recent deep venous thrombosis, 13 cases; perioperative anticoagulation, 9 cases, recurrent pulmonary embolism, 5 cases, to maintain Hickman catheter, 5 cases, artificial heart valve, 4 cases, congestive heart failure, 4 cases, acute myocardial infarction, 1 case, cerebrovascular accident, 1 case, and peripartum with history of pulmonary embolism, 1 case. In addition, patients with suspected PE were referred for helical CT scans despite negative findings on CT. One of these 2 patients later underwent pulmonary angiography with negative results; anticoagulation was discontinued but this patient was not enrolled in the study.

### PATIENT DEMOGRAPHICS

In the remaining 243 patients with negative helical CT results for PE and not receiving anticoagulation, clinical records were obtained and reviewed for 233 (96%). Patient referral sources included the emergency department (163 cases, 68%), inpatient floor (51 cases, 21%), the outpatient setting (18 cases, 7%), and the intensive care unit (8 cases, 3%). Mean age for our patient population was 59 years (SD, 19 years; range, 19-93 years). Data were analyzed for clinical pretest likelihood of PE using the Wells et al\(^3\) clinical model. This population had an average of 1.51 respiratory points (dyspnea, pleurisy, nonretrosternal and nonpleuritic chest pain, oxygen saturation <92% and corrects <40%, hemoptysis, and pleural rub). Ninety-eight (41%) had 1 or more risk factors for PE (complete bed rest >3 days, fracture of lower extremity, strong family history, cancer with ongoing or palliative treatment, postpartum, previous deep vein thrombosis or PE). For 10 of the 18 outpatient studies, no clinical records were available; they were presumed by the study investigators to have had low clinical suspicion for PE.

### RESULTS

A total of 433 sequential cases with clinically suspected PE were referred for helical CT during the study time frame (Figure). Fourteen patients (3.2%) were excluded because the report indicated that the CT study was indeterminate and further testing was needed. One hundred nineteen patients (27.4%) were determined to have positive studies and were similarly excluded from further review. Of these positive studies, the largest affected vessel was a third order (lobar) or larger in 97 of reports (82%). The distribution of emboli in positive helical scans was as follows: pulmonary trunk, 1 (1%); pulmonary artery, 25 (21%); lobar, 71 (60%); segmental, 8 (7%); subsegmental or smaller vessel, 6 (5%); and no mention made of involved vessel, 8 (7%).

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### PRETEST CLINICAL SUSPICION AND ANCILLARY STUDIES

By Wells et al\(^3\) clinical criteria for pretest probability, 158 (69%) of the 239 enrolled patients were classified as low probability for PE, 65 (27%) were moderate probability, and 19 (8%) were high pretest probability. Ventilation-perfusion scans were performed on 50 (21%) of the study group. Thirty-four (68%) of 50 were read as intermediate probability; only 4 patients had diagnostic results (3 normal or near normal, 1 high probability).

### 3-MONTH FOLLOW-UP

Follow-up was accomplished at 3 or more months on 239 (98%) of the enrolled. Of 4 patients to follow-up, 3 had low and 1 had intermediate pretest probability. Follow-up was via telephone contact with the patient in 150 cases (63%), by direct relation and caregiver in 42 cases (17%), or by review of subsequent hospital records in 44 cases (19%). Thirty-three patients (13.8%) died during the follow-up period. When charts with a fatal 3-month outcome were reviewed for cause of death and potential for missed PE by 3 reviewers, 1 of the 33 deaths was determined to be highly suspicious for PE. The causes of death are listed in Table 2.

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### Table 1. Indications for Anticoagulation in Excluded Patients

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial fibrillation</td>
<td>15</td>
</tr>
<tr>
<td>Recent deep vein thrombosis undergoing treatment</td>
<td>13</td>
</tr>
<tr>
<td>Perioperative anticoagulation for orthopedic surgery</td>
<td>9</td>
</tr>
<tr>
<td>Recurrent pulmonary embolism</td>
<td>5</td>
</tr>
<tr>
<td>To maintain Hickman catheter</td>
<td>5</td>
</tr>
<tr>
<td>Artificial heart valve</td>
<td>4</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>4</td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td>1</td>
</tr>
<tr>
<td>Cerebrovascular accident</td>
<td>1</td>
</tr>
<tr>
<td>Peripartum with history of pulmonary embolism</td>
<td>1</td>
</tr>
<tr>
<td>Suspected acute pulmonary embolism</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 2. Causes of Death in Study Patients

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>No. of Days After Helical CT Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung cancer</td>
<td>14, 42, 44, 54, 72</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1, 2, 3, 8, 20</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1, 1, 9, 21</td>
</tr>
<tr>
<td>Disseminated carcinoma</td>
<td>5, 11, 24, 79, 90</td>
</tr>
<tr>
<td>Leukemia/lymphoma</td>
<td>6, 25, 26, 70</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>32, 38</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>32</td>
</tr>
<tr>
<td>Acute respiratory distress syndrome</td>
<td>23</td>
</tr>
<tr>
<td>Alzheimer dementia</td>
<td>37</td>
</tr>
<tr>
<td>Anoxic encephalopathy</td>
<td>37</td>
</tr>
<tr>
<td>Amyotrophic lateral sclerosis</td>
<td>47</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>6</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>24</td>
</tr>
</tbody>
</table>

Abbreviation: CT exam, computed tomographic examination.
VENOUS THROMBOEMBOLIC EVENTS FOUND

Venous thromboembolic events were discovered in 4 (1.7%) of the 239 patients enrolled in our study. Of these 4 patients, 2 had deep vein thrombosis and 2 had pulmonary emboli. Three of the 4 patients died during the study period, one as a result of PE. The first patient had a negative helical CT and negative lower extremity Doppler examination results at the time PE was suspected. Twenty-nine days later into her hospitalization that included a 20-day ventilator wean and bed rest, she developed leg symptoms and a deep vein thrombosis was confirmed by duplex ultrasound. A second patient admitted for fever and dyspnea had a negative helical CT as part of her initial evaluation and this presentation, we presumed PE was the likely diagnosis efforts. Given the recent deep vein thrombosis on admission. A subsequent helical CT scan was positive 2 days later and anticoagulation was instituted. The patient died of hemorrhagic pancreatitis 32 days after admission. At autopsy there was evidence of multiorgan involvement with helical CT negative for PE. Twenty-nine days later into her hospitalization that included a 20-day ventilator wean and bed rest, she developed leg symptoms and a deep vein thrombosis was confirmed by duplex ultrasound. A second patient admitted for fever and dyspnea had a negative helical CT as part of her initial evaluation and was found to have Proteus mirabilis sepsis secondary to diverticulitis. Subsequently, a peripherally inserted central catheter placed 5 days into admission was found to be associated with venous thrombosis by Doppler examination on hospital day 9. Her condition worsened on day 11, and a conservative course of care was undertaken at the request of her family. She died on hospital day 11 with sepsis listed as the cause of death and no autopsy was performed. A third patient admitted with pancreatitis had a negative helical CT on admission. A subsequent helical CT scan was positive 12 days later, and anticoagulation was instituted. The patient died of hemorrhagic pancreatitis 32 days after admission. At autopsy there was evidence of organized microemboli in the lungs but multiorgan system failure was deemed to be the cause of death.

A fourth patient admitted for Escherichia coli sepsis was found to have a negative helical CT on admission and negative duplex ultrasound studies. Twenty-one days into the hospitalization, deep vein thrombosis was discovered on Doppler ultrasonography of the lower extremities. Intravenous heparin was administered; however, the patient was found to have pulseless electrical activity 2 days later and died despite resuscitation efforts. Given the recent deep vein thrombosis and this presentation, we presumed PE was the likely cause of death, although no autopsy was performed.

HEMICAL CT OUTCOMES

Based upon our institutional experience, a negative helical CT portends an excellent prognosis for the absence of future venous thromboembolic events in the absence of anticoagulant therapy (4/239, 1.7% event rate; 1/238, 0.4% death rate). These results are consistent with other reported outcomes data (Table 3). These studies similarly followed up patients with negative outcomes on helical CT, for 3 or more29,38,39,41,42,44 or 6 or more months40,43 and found an excellent prognosis for future venous thromboembolic events. All studies cited excluded patients receiving anticoagulant therapy. Five studies were prospective29,38,40,43 and 3 were retrospective analyses.38,40,43 Only 1 of the 8 studies directly commented on pretest likelihood of PE,20,2 others recorded PE risk factors.39,41 However, the 31.3% combined prevalence of positive studies for PE is similar to the prevalence to the 31% to 35% seen in the major angiography trials3,9,10 leading us to believe the groups have a comparable prevalence of pulmonary embolic disease in their studied population.

OUTCOMES USING OTHER EXAMINATION MODALITIES

These findings compare favorably to negative findings from other PE diagnostic modalities. Four studies of 3- to 12-month outcomes after negative pulmonary arteriograms reveal 16 (1.2%) venous thromboembolic events in 1372 cases not treated with anticoagulation, with 6 deaths as a result of PE (0.4%).9,12 The prevalence of positive studies in the angiography trials (31%-35% vs 32%) is similar to that of the helical CT trials (31%-35% vs 32%), which makes it less likely that CT outcomes saw a significantly healthier population.3,9,10 These angiography trial outcomes are comparable to outcomes data for helical CT, but there are fewer risks of complications, lower dye load, and far lower expense ($750 vs $4250) for helical CT compared with pulmonary angiography.45

Studies of outcomes for patients with negative V/Q scans have consistently shown that this group can have
anticoagulation safely withheld. Hull et al found a combined 7 (0.6%) venous thromboembolism events in 1101 patients followed up for 3 months. These cohorts likely represent a generally healthier group than our study population. Sixty-eight percent of their studies were performed on outpatients, and their average age was 50 years. Only 33 (3.0%) of the patients died during the follow-up period. In our series, of the 50 patients who also had V/Q scans, only 3 had normal or near-normal results, suggesting that we studied a generally sicker cohort.

Even low-probability V/Q scans, however, are not as predictive of good outcomes. Goodman et al found that venous thromboembolic events occurred in 5 (3.1%) of 162 nonanticoagulated patients in 3 months. Garg et al found 5 (3.7%) venous thromboembolic events, 3 of which proved fatal, in a 3-month review of 132 nonanticoagulated patients. Hull et al posed a strategy involving combining serial leg ultrasonography in patients with nondiagnostic V/Q scans and adequate cardiopulmonary reserve. The 3-month outcome in the group without anticoagulation included 12 events in 627 patients (2.7%). High interobserver variability for low- and intermediate-probability V/Q scans (0.70) also makes this test result difficult to apply clinically. Our results suggest that outcomes of negative helical CT results compare favorably with low-probability V/Q scans, with reported higher interobserver correlation for helical CT (0.75-0.91).

**POTENTIAL LIMITATIONS OF OUR DATA**

The data in our study could be limited by a slightly lower prevalence of PE in our population. We found a 27% rate of positive studies, compared with 31% to 35% rate of positive scans in 3 major angiography trials. Of those with positive scans, 82% were of third-order or higher arteries, where specificity is greater than 90%. Therefore, we believe they represent true-positive results. Furthermore, it is possible that our patient population of negative helical CT scans may represent a self-selected healthier population than those with positive scans whose outcomes may have been excellent irrespective of the scan result. We attempted to define this population’s risk further by capturing pretest probability data and results from other studies. Most of our patients had a low clinical pretest probability of PE; however, only 4 (8%) of the 50 patients who also had V/Q tests had normal or near-normal results. Furthermore, our 3-month all-cause mortality was similar to that of the major angiography trials (13.8% vs 16.2%) in their 3- to 12-month follow-up, suggesting a comparable level of comorbid illness.

We elected to exclude patients already receiving anticoagulation therapy for other diagnoses. We decided that outcomes of this cohort would best test the negative predictive value of helical CT. We reasoned that if helical CT had an unacceptably high false-negative rate, this nonanticoagulated cohort would be likely to have more recurrent events than a comparable group receiving anticoagulation for other reasons. If use of anticoagulants selected out a slightly sicker population, we may have introduced a selection bias toward healthier patients. This strategy of excluding anticoagulated patients has been used by other authors attempting to determine outcomes of negative helical CT studies. Our 3-month follow-up mortality rate of 13.8% is comparable to that of a cohort of patients treated for venous thromboembolism with anticoagulants (17%), suggesting a similar rate of acute and chronic illness compared with our study group.

We chose 3 months as the follow-up interval for our PE outcomes. Other authors seeking PE outcomes chose this same interval. Carson et al found in 399 patients that 98% of PE recurrences and 80% of fatalities occurred in the first week after diagnosis of PE. Goodman et al noted that the average time to PE recurrence in their group was 21 days. Swensen et al found venous thromboembolism recurrences between 5 and 30 days only in their 90-day follow-up. Given these data, we surmised that events later than 3 months after study were most likely unrelated to the event precipitating the helical CT request.

A potential limitation of this study would exist if there were patients among those who died whose cause of death was an undiagnosed PE. We studied a sick population that had a relatively high mortality rate in the 3-month study window (33/239, 13.8%), and we chose to enroll even patients who would not otherwise have been expected to live through the 3-month period to best capture sequential data. Despite these factors, our 3-month mortality rate compares favorably with other similar large series (Swensen et al, 11.6%; Goodman et al, 17.2%) that did not exclude the sickest patients, and is lower than what would be expected in a similar population with treated PE (17.4% death rate in the International Cooperative Pulmonary Embolism Registry). Follow-up of a similar cohort of negative pulmonary angiograms reveals a comparable all-cause mortality of 16.2% (112/691).

Finally, our data, like all data collected retrospectively in a cohort trial, are limited by the absence of a control group and the biases inherent in collecting data retrospectively.

**CONCLUSIONS**

It has been reported at a large teaching hospital that 92% of patients with low-probability scans and 78% with indeterminate findings get no further evaluation, yet 20% of the former and 35% of the latter receive anticoagulation. Helical CT is a safe, minimally invasive technique with a high rate of diagnostic results that appears to be a reliable test for the prediction of the absence of future embolic events, and additionally may be a test that can resolve nondiagnostic results from other testing modalities. Our study is the first outcomes data to be collected in a community hospital setting that did not use full-time academic thoracic radiologists, and thus represents the setting in which most internists practice. These data compare favorably to those collected in purely academic settings, suggesting that with experienced radiology departments, these results may be applied to nonacademic settings.

We believe that a negative helical CT portends a 3-month outcome comparable to that seen in patients with negative pulmonary angiography and low-probability V/Q scan, and may be used to safely withhold anticoagulation in patients with adequate cardiopulmonary reserve. How-
ever, given that no data exist for helical CT for selected patients. Our data and those of other cohort studies reveal a uniformly favorable prognosis in these patients (Table 3). We conclude that the time has come for a large, multicenter trial similar to the PIOPED design incorporating helical CT and other testing modalities in a prospective manner to strengthen the available evidence regarding the efficacy of helical CT in the diagnosis of PE.

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