Elevated Cardiac Troponin Levels in Patients With Submassive Pulmonary Embolism

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**Background:** Cardiac troponins are reliable markers of myocardial injury that are being used increasingly in patients presenting with undifferentiated chest pain or dyspnea to diagnose an acute coronary syndrome. If elevated cardiac troponin levels also occur in patients with pulmonary embolism because of right ventricular dilation and myocardial injury, such patients could be misdiagnosed. We performed a prospective cohort study to determine the prevalence of elevated cardiac troponin I (cTnI) levels in patients with submassive pulmonary embolism.

**Methods:** Consecutive patients with objectively confirmed submassive pulmonary embolism and no previous history of ischemic heart disease, other cardiac disease, or renal insufficiency were included. Creatine kinase and cTnI levels were measured within 24 hours of clinical presentation on 2 occasions 8 to 12 hours apart.

**Results:** Of 24 patients with submassive pulmonary embolism, 5 (20.8%) had elevated cTnI levels of 0.4 µg/L or higher (95% confidence interval, 7.1-42.2%). One of these patients had a cTnI level higher than 2.3 µg/L that was suggestive of myocardial infarction.

**Conclusion:** Pulmonary embolism should be considered in the differential diagnosis of patients presenting with undifferentiated chest pain or dyspnea and an elevated cardiac troponin level.

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CARDIAC troponins, which include cardiac troponin I (cTnI) and cardiac troponin T (cTnT), are highly sensitive and specific markers of myocardial injury that are being used increasingly in the assessment of patients presenting with undifferentiated chest pain or dyspnea to diagnose an acute coronary syndrome. Cardiac troponins are more sensitive and specific markers of myocardial ischemia than the creatine kinase myocardial isoenzyme and, in general, are not influenced by acute skeletal muscle injury. However, elevated cardiac troponin levels also occur in patients with renal insufficiency and/or nonischemic cardiac conditions, such as severe congestive heart failure, myocarditis, and infiltrative cardiomyopathy. Massive pulmonary embolism, defined as pulmonary embolism associated with systemic hypotension, cardiogenic shock, or respiratory failure, is another condition that results in myocardial injury and elevated creatine kinase levels, probably as a result of acute right ventricular dilation and strain that is caused by a large embolus. However, because cardiac troponins are highly sensitive to minor myocardial injury that occurs in patients with unstable angina, it is biologically plausible that elevated cardiac troponins might also occur in patients with submassive pulmonary embolism who are hemodynamically stable. In support of this contention, prospective cohort studies have found that 40% to 55% of patients with pulmonary embolism have right ventricular dilation documented by echocardiography, which might result in transient right ventricular strain and myocardial injury. If elevated cardiac troponin levels occur frequently in patients with submassive pulmonary embolism, this could result in the misdiagnosis of patients presenting with undifferentiated chest pain or dyspnea. Therefore, we performed a prospective cohort study to determine the prevalence of elevated cTnI levels in patients with submassive pulmonary embolism.

**RESULTS**

**PATIENTS**

During the 15-month study period, 26 patients were identified with submassive pul-
PATIENTS AND METHODS

PATIENTS

Consecutive patients with submassive pulmonary embolism who were diagnosed at St Joseph’s Hospital, Hamilton, Ontario, between March 1, 1999, and May 30, 2000, were considered for this study. Patients were included if pulmonary embolism was confirmed by a high-probability ventilation-perfusion lung scan, pulmonary angiography, spiral computed tomography of the chest, or a nondiagnostic lung scan and deep vein thrombosis confirmed by findings from a duplex ultrasound or venogram. Patients were excluded if they had massive pulmonary embolism associated with systemic hypotension (ie, systolic blood pressure <90 mm Hg), cardiogenic shock, respiratory failure that required mechanical ventilation, a history of confirmed ischemic heart disease, congestive heart failure or cardiomyopathy, or renal insufficiency (ie, serum creatinine level >150 mmol/L).

Of the 24 patients with submassive pulmonary embolism, 5 (20.8%) had an elevated cTnI level of 0.4 µg/L or higher, and myocardial infarction was defined by a cTnI level higher than 2.3 µg/L. An elevated creatine kinase level was defined as higher than 220 U/L in men and higher than 150 U/L in women. A quantitative immunofluorescent enzyme assay was used to measure cTnI, and creatine kinase was measured by an enzymatic rate reaction assay (both assays by Abbott Diagnostics, Abbott Park, Ill). The prevalence of an elevated cTnI level in patients with submassive pulmonary embolism was expressed as a proportion, with a corresponding 95% confidence interval.

OUTCOMES

Of the 24 patients with submassive pulmonary embolism, 5 (20.8%) had an elevated cTnI level of 0.4 µg/L or higher (95% confidence interval, 7.1-42.2). In one of these patients, the cTnI level higher than 2.3 µg/L was suggestive of myocardial infarction, and another patient had an elevated creatine kinase level of 890 U/L (normal, <220 U/L). The clinical characteristics of the 5 patients with elevated cTnI levels are provided in the Table. At presentation, one of these patients had transient hypotension that resolved following the administration of intravenous fluids, and 2 patients had a right ventricular strain pattern on the 12-lead electrocardiogram. No patient with normal cTnI levels had electrocardiographic evidence of right ventricular strain.

In this small study of 24 patients with submassive pulmonary embolism, 5 (20.8%) had elevated cTnI levels. This finding is clinically relevant because pulmonary embolism and acute coronary syndromes are common diseases that can present with nonspecific and overlapping clinical features. The potential for misdiagnosis, which may be influenced by elevated troponin levels, was illustrated in a recent report in which a patient with presenting symptoms caused by pulmonary embolism was initially considered to have a myocardial infarction because of elevated cTnT levels and suggestive electrocardiographic findings.15

To our knowledge, 2 other prospective cohort studies have investigated the prevalence of elevated cardiac troponin levels in patients with pulmonary embolism.16,17 In these studies, the study populations seemed to have more extensive pulmonary embolism than our patients. In the first study,16 elevated cTnT levels oc-

### Table: Clinical Characteristics of Patients With Pulmonary Embolism and Elevated Cardiac Troponin I Levels

<table>
<thead>
<tr>
<th>Patient Age, y/</th>
<th>Method of PE</th>
<th>Hypotension†</th>
<th>Clinical RV Failure</th>
<th>cTnI, µg/L</th>
<th>CK, U/L</th>
<th>Associated Conditions</th>
<th>Anticoagulant Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>35/F</td>
<td>VQ lung scan</td>
<td>Transient</td>
<td>No</td>
<td>1.9, 1.5</td>
<td>860</td>
<td>Obesity, ankle fracture</td>
<td>UFH</td>
</tr>
<tr>
<td>66/M</td>
<td>VQ lung scan</td>
<td>No</td>
<td>No</td>
<td>9.9, 11.1</td>
<td>890</td>
<td>None</td>
<td>SK</td>
</tr>
<tr>
<td>60/M</td>
<td>VQ lung scan</td>
<td>No</td>
<td>No</td>
<td>0.8, 1.5</td>
<td>198</td>
<td>None</td>
<td>LMWH</td>
</tr>
<tr>
<td>74/M</td>
<td>VQ lung scan</td>
<td>No</td>
<td>No</td>
<td>0.4, 0.6</td>
<td>78</td>
<td>Seizures, hypertension</td>
<td>UFH</td>
</tr>
<tr>
<td>69/M</td>
<td>VQ lung scan</td>
<td>No</td>
<td>No</td>
<td>1.9, 1.3</td>
<td>80</td>
<td>None</td>
<td>LMWH</td>
</tr>
</tbody>
</table>

*PE indicates pulmonary embolism; RV, right ventricular; cTnI, cardiac troponin I; CK, creatine kinase; VQ, ventilation-perfusion; UFH, unfractionated heparin; SK, streptokinase; and LMWH, low-molecular-weight heparin.
†Systolic blood pressure lower than 90 mm Hg.
‡Levels of the 2 tests performed within 24 hours of presentation.
§The higher level of the 2 tests performed.
curred in 18 (32%) of 56 patients with pulmonary embolism. However, 17 patients (30%) were classified as having massive pulmonary embolism and 11 (20%) had a previous myocardial infarction. Such patients were excluded from our study. In the second study, elevated cTnI levels occurred in 2 (7%) of 29 patients with pulmonary embolism. Although details about the patients’ clinical presentation were not provided, 7 patients presented with cardiogenic shock or syncope, 6 patients received thrombolytic therapy, and 4 patients underwent pulmonary thrombectomy, thereby suggesting a more unstable clinical presentation than the patients in our study.

There are potential limitations of this study. First, patients were not investigated to determine if they had subclinical coronary artery disease that would have predisposed them to myocardial ischemia when pulmonary embolism occurred. However, even if some patients did have underlying coronary artery disease, this would not change our conclusion that pulmonary embolism should be considered in patients with undifferentiated chest pain or dyspnea and elevated cTnI levels. Second, we did not investigate the prognostic significance of elevated cTnI levels in patients with pulmonary embolism, as elevated troponins might identify patients who are at increased risk of death. Third, this study was small and we cannot exclude that the prevalence of elevated cTnI levels in patients with pulmonary embolism may be as high as 42% or as low as 7%. Additional studies are needed in large heterogeneous populations with pulmonary embolism to provide accurate estimates of the prevalence and clinical importance of elevated cTnI levels in such patients.

In the meantime, clinicians should be aware of conditions such as pulmonary embolism that are associated with elevated cardiac troponin levels in the absence of an acute coronary syndrome. Pulmonary embolism should be considered in the differential diagnosis of patients presenting with undifferentiated chest pain or dyspnea and an elevated cTnI level.

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REFERENCES