

# Spectrum of clinical presentations of pulmonary embolism: a review article

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## Abstract

Pulmonary embolism causes significant morbidity and mortality. It is difficult to diagnose on physical examination due to various types of its presentation which may range from asymptomatic to cardiovascular collapse. The presentation depends on the burden of pulmonary emboli, presence of patient's co-morbid condition and cardiopulmonary functional status. This article reviews the literature and provides a information regarding variable spectrum of presentations of pulmonary embolism in clinical practice. But clinical signs and symptoms alone cannot confirm or exclude the pulmonary embolism diagnosis, but can increase the suspicion to a clinician to proceed rapidly for laboratory or radiologic testing. So, clinical knowledge is very essential for rapid assessment which is important to save the patient.

**Keywords:** Pulmonary embolism, mortality, presentation, assessment

## I. Introduction

Pulmonary embolism is a serious clinical condition due to restriction of blood flow in lung as a result of blockage of pulmonary artery by migration of clots to distant site. It is found in 60 to 112 of every 100,000 individuals<sup>1</sup>. It is responsible for the third most common cause of cardiovascular mortality and 100,000 to 180,000 deaths annually<sup>2,3</sup>. It results in major global disease burden<sup>4</sup>. It presents severe manifestation along the spectrum of venous thromboembolic disease<sup>5</sup>. The mortality rates of unrecognized and untreated cases are 30% , whereas the average mortality of recognized and treated cases is 8%.<sup>6</sup> Clinical assessment of hemodynamic tolerance is the chief part of risk stratification in patients with acute pulmonary embolism. The presence of shock defined as systolic blood pressure 90 mmHg or a drop 40 mmHg for 15 min constitutes the high-risk category. These patients need rapid diagnosis and special management<sup>7</sup>. In the remaining normotensive patients, defined as the non-high-risk category, assessment of right ventricular dysfunction or injury by imaging and/or cardiac biomarkers has to be done. Non-high risk patients without evidence of right ventricular dysfunction or injury can be called as low risk pulmonary embolism category. The presence of right ventricular dysfunction or injury indicates intermediate risk in normotensive patients with pulmonary embolism.

Multiple factors can increase possibility of developing deep vein thrombosis and pulmonary embolism. The most common inherited conditions are factor V Leiden and prothrombin gene mutation (G20210A) with prevalence of approximately 4% to 5% and 2% to 4%, respectively<sup>8,9</sup>. The most common acquired risk factors are increasing age, venous insufficiency, obesity, smoking, rheumatologic conditions, cardiovascular disease, previous history of venous thromboembolism and antiphospholipid antibody syndrome. With increasing age, naturally circulating anticoagulants (protein C and protein S) decrease more than procoagulation factors over time, creating an increased prothrombotic state. This mechanism along with increased venous stasis in the lower extremities increases incidence in the elderly population. As per data from the Nurses' Health Study, obese subjects (body mass index >35) have a 6-fold increase in risk compared to normal-weight subjects<sup>10</sup>. This same study also showed that hypertension and cigarette smoking increase risk of idiopathic pulmonary embolism<sup>11,12</sup>.

Provoking risk factors increase significant risk that can resolved after elimination of that factor. Common provoking factors are cancer, exogenous hormone use, pregnancy, postpartum state, limb immobility, recent trauma or surgical procedure and indwelling catheters. In patients taking oral contraceptives, risk increases to 3 to 4 fold<sup>13</sup>. The increased risk during pregnancy is in the first trimester. It continues through the postpartum period<sup>14</sup>. Prolonged limb immobility typically about 72 hours potentiates the risk of development of thromboembolism<sup>15</sup>.

## II. Materials and methods

Importance is given in this article to suspect pulmonary embolism as early as possible to do fast management. Because the mortality rate can exceed 58% in acute conditions presenting as hemodynamic shock<sup>16</sup>. Most of deaths happen within 1 hour of presentation<sup>17</sup>. It is such a serious condition that can damage part of lung because of lack of blood flow owing to pulmonary hypertension. It also damages other organs in body because of a lack of oxygen in blood. Large size or multiple numbers of blood

clot can cause death<sup>18</sup>. Case fatality rate may be less than 1% to 60%<sup>19</sup>. A fair number of standard informative articles are studied. This review article is prepared based on knowledge and clinical experience.

### III. Clinical presentation and discussion

The diagnosis or exclusion of pulmonary embolism is a challenge for emergency physicians. There may be no symptoms or may have features of many other common diagnoses. Diagnostic testing is also complicated, as biomarker like D-dimer is frequently false positive and computed tomography pulmonary angiography carries risks of radiation and contrast dye exposure. Therefore the emergency physicians need to be thoughtful about this diagnosis<sup>20</sup>.

The clinical presentation can vary from one person to another. Common signs and symptoms of pulmonary embolism include the following:

1. Shortness of breath
2. Sharp, knife-like chest pain while taking a deep breath
3. Coughing
4. Haemoptysis
5. Tachycardia
6. Dizziness or syncope

Any of these symptoms along with pain or swelling of leg increase the likelihood of pulmonary embolism. Pulmonary embolism presenting with syncope is not easy to diagnose. Because syncope is a relatively easy clinical symptom having variable etiologies. It presents as symptom in only 6% patients with pulmonary embolism<sup>21</sup>.

**Massive pulmonary embolism:** It is a clinical condition characterized by unstable hemodynamics. It is associated with poor prognosis and the mortality of even treated patients is in the range of 30–50%. It may lead to sudden death (occurring in approx. 10% of cases of massive pulmonary embolism). Two out of three such patients die within 2 hour of the event. It also results in the development of cardiogenic shock with hypotension, oliguria, confusion, cold extremity, sweating, pale skin and occasionally cyanosis. These patients may require ventilatory support.

**Submassive pulmonary embolism (intermediate risk pulmonary embolism):** In its clinical course, patient may be normotensive. Echocardiography can diagnose signs of right ventricular dysfunction. If this dysfunction is there, mortality of patients increases to about twice that of stable patients without right ventricular dysfunction.

**Minor pulmonary embolism (low-risk pulmonary embolism):** A characteristic feature of this condition is the absence of hypotension, shock or signs of right ventricular dysfunction and myocardial injury. It typically presents with tachypnea (24 breaths/min and more) and tachycardia. It may be silent or may present as a small increase in body temperature.

Clinical characteristics of patients with suspected pulmonary embolism in the emergency department is shown below (study by Pollack et al<sup>22</sup>. [Fig-1 below])

Feature	PE confirmed (n = 1880)	PE not confirmed (n = 528)
Dyspnoea	50%	51%
Pleuritic chest pain	39%	28%
Cough	23%	23%
Substernal chest pain	15%	17%
Fever	10%	10%
Haemoptysis	8%	4%
Syncope	6%	6%
Unilateral leg pain	6%	5%
Signs of DVT (unilateral extremity swelling)	24%	18%

DVT = deep vein thrombosis.

(Fig-1)

More recently, both the Wells and the revised Geneva rule are simplified to increase their application into clinical practice (Table-1 and 2). Whichever it is used, the proportion of patients with confirmed pulmonary embolism can be expected to be around 10%

in the low probability category, 30% in the moderate-probability category and 65% in the high-clinical probability category in three-level classification (low, moderate, or high clinical probability of pulmonary embolism). When the two-level classification (pulmonary embolism likely or unlikely) is considered, the proportion of patients with confirmed pulmonary embolism in the pulmonary embolism unlikely category is around 12%<sup>23</sup>.

### Clinical prediction rules for pulmonary embolism

Items	Clinical decision rule points	
	Original version <sup>15</sup>	Simplified version <sup>17</sup>
<b>Wells rule</b>		
Previous PE or DVT	1.5	1
Heart rate $\geq 100$ b.p.m.	1.5	1
Surgery or immobilization within the past four weeks	1.5	1
Haemoptysis	1	1
Active cancer	1	1
Clinical signs of DVT	3	1
Alternative diagnosis less likely than PE	3	1
<b>Clinical probability</b>		
Three-level score		
Low	0-1	N/A
Intermediate	2-6	N/A
High	$\geq 7$	N/A
Two-level score		
PE unlikely	0-4	0-1
PE likely	$\geq 5$	$\geq 2$

(Table-1)

Revised Geneva score	Clinical decision rule points	
	Original version <sup>15</sup>	Simplified version <sup>18</sup>
Previous PE or DVT	3	1
Heart rate 75-94 b.p.m. $\geq 95$ b.p.m.	3 5	1 2
Surgery or fracture within the past month	2	1
Haemoptysis	2	1
Active cancer	2	1
Unilateral lower limb pain	3	1
Pain on lower limb deep venous palpation and unilateral oedema	4	1
Age $> 65$ years	1	1
<b>Clinical probability</b>		
Three-level score		
Low	0-3	0-1
Intermediate	4-10	2-4
High	$\geq 11$	$\geq 5$
Two-level score		
PE unlikely	0-5	0-2
PE likely	$\geq 6$	$\geq 3$

b.p.m.= beats per minute; DVT = deep vein thrombosis; PE = pulmonary embolism.

(Table-2)

The history, clinical examination, chest xray, electrocardiogram and arterial blood gas analysis are often useful to suggest the presence or absence of pulmonary embolism<sup>24</sup>.

#### Confirmation of pulmonary embolism:

In patients with a high pre-test probability, a positive result with spiral computed tomography, ultrasonography, echocardiography or magnetic resonance angiography or a high probability ventilation perfusion lung scan are associated with a post-test probability of over 85% to diagnose pulmonary embolism.

Patients with a moderate pre-test probability require additional radiological test after a positive echocardiography result. In patients with a low pre-test probability, the post-test probability is below 85% for all tests. Further investigations would be needed to confirm pulmonary embolism (fig 6).

#### Exclusion of pulmonary embolism:

In patients with a low clinical probability, negative test results for d-dimers or with spiral computed tomography or magnetic resonance angiography or a normal or low probability lung scan are associated with a post-test probability of below 5%. At this situation, additional testing would not be needed to rule out pulmonary embolism. Conversely, patients with a negative

echocardiography result and a normal venous ultrasonography result would require additional testing to rule out pulmonary embolism<sup>25</sup>.

#### IV. Conclusion

Immediate diagnosis of pulmonary embolism may be missed since the clinical signs and symptoms are non-specific. Once clinical presentation raises the possibility of pulmonary embolism in an individual patient, further objective testing should not be done in late. Clinical knowledge is very essential for prompt action. In most patients, diagnosis is suspected on the basis of dyspnoea, chest pain, pre-syncope or syncope, haemoptysis. Hypotension and shock are less commonly found, but these are important clinical presentations. Syncope is infrequent, but may present in absence of haemodynamic instability. Chest pain is a frequent symptom of pulmonary embolism and is caused by pleural irritation from pulmonary infarction. It may be a typical angina character that may reflect right ventricular ischaemia with differential diagnosis of acute coronary syndrome or aortic dissection. Dyspnoea may be acute and severe in central pulmonary embolism. In small peripheral pulmonary embolism, it is often mild, transient. In patients with pre-existing heart failure or pulmonary disease, worsening dyspnoea may be the only symptom of pulmonary embolism.

#### V. References

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