

ECG In Evaluation for Pulmonary Thromboembolism- Occam's Razor or Hickam's Dictum?

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The electrocardiogram (ECG) is a simple, universally available tool in emergency departments used in evaluation of acute chest pain. Among the differential diagnosis, Acute Pulmonary Thromboembolism (PTE) is important to recognize as the diagnosis carries serious therapeutic and prognostic implications.

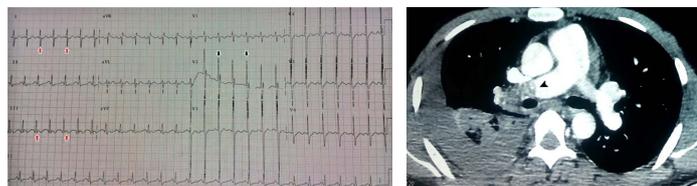
A 28-year-old male presented to the emergency department with acute onset shortness of breath and chest pain for two days and two episodes of haemoptysis. He had sustained a road traffic accident with fracture of both bones of right leg one month back for which he had undergone open reduction and internal fixation. On examination, he was tachycardic (pulse rate-152/min) and tachypnoeic (respiratory rate-26/min) with normal blood pressure (116/78 mm of Hg) and oxygen saturation (96%) on breathing ambient air. His right lower limb was warm and swollen with tenderness along the femoral vein. The electrocardiogram (ECG) showed sinus tachycardia, right ventricular strain, right bundle branch block pattern and S₁Q₃T₃ pattern [Table/Fig-1] suggestive of PTE. Compression ultrasound scan of right lower limb revealed echogenic contents in right femoro-popliteal veins indicative of Deep Vein Thrombosis (DVT). Computed tomographic angiogram of pulmonary arteries showed hypodense filling defect suggestive of thrombus involving the right main pulmonary artery [Table/Fig-2], extending into its descending branch. A 2-dimensional echocardiogram showed mild tricuspid regurgitation and mild right ventricular dilatation. Since the patient was haemodynamically stable, thrombolysis was not attempted. He was started on subcutaneous enoxaparin at 1 mg/kg/dose twice daily along with oral anticoagulation with warfarin. Patient improved and was discharged. On follow-up at one month, patient is asymptomatic for DVT or PTE and INR is in therapeutic range.

Common ECG abnormalities in PTE include sinus tachycardia and T wave inversions in precordial leads and a ventricular fibrillation (VF), right bundle branch block pattern, S₁Q₃T₃ pattern, QR pattern in V1, QS pattern in precordial leads, ST-elevation in precordial leads and low voltage in limb leads. Classic changes like S₁Q₃T₃ pattern tend to occur with more severe forms of PTE and correlate well with mortality [1]. S₁Q₃T₃ pattern is a marker of acute cor-pulmonale and can occur with conditions like severe bronchospasm and pneumothorax [2].

Composite scores based on ECG in PTE can help in patient management. Using a 21-point scale, a score ≤ 3 in predicted normal right ventricular function [3]. QR in V1, ST-depression in V4-V6 and ST-elevation in lead III and V1 are associated with in-hospital mortality [1].

This case illustrates the classical ECG findings of PTE and the importance of an easily available, simple diagnostic test in diagnosing a life threatening condition. The classical signs in ECG can be used as a decision tool for further imaging and can also be used as an indicator for early referral of a patient especially in resource poor settings.

To conclude, ECG in PTE can show a spectrum of changes from being normal to having multiple suggestive abnormalities. The ECG changes in PTE are not specific and similar changes may result from wide array of causes conferring to the principle of Hickam's dictum. In general, the number of abnormalities on ECG correlates well with pulmonary artery pressures and the severity of PTE. Even though ECG can give a clue to the diagnosis of PTE, its actual role lies in prognostic assessment and hence can be used as a decision tool for further imaging and investigations especially in resource poor settings.



[Table/Fig-1]: A 12-lead electrocardiogram (ECG) showing sinus tachycardia (heart rate- 150/min), right bundle branch block pattern (black arrows), T-inversion in aVF and typical S₁Q₃T₃ pattern (red arrows) suggestive of pulmonary thromboembolism.

[Table/Fig-2]: Axial computed tomographic angiogram section of pulmonary arteries showing hypodense filling defect (arrowhead) suggestive of thrombus involving the right main pulmonary artery.

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