Diagnostic Imaging Pathways - Pulmonary Embolism (Haemodynamically Unstable)

Population Covered By The Guidance

This pathway provides guidance on the imaging of haemodynamically unstable adult patients with suspected pulmonary embolism.

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Quick User Guide

Move the mouse cursor over the PINK text boxes inside the flow chart to bring up a pop up box with salient points.
Clicking on the PINK text box will bring up the full text.
The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

Pathway Diagram

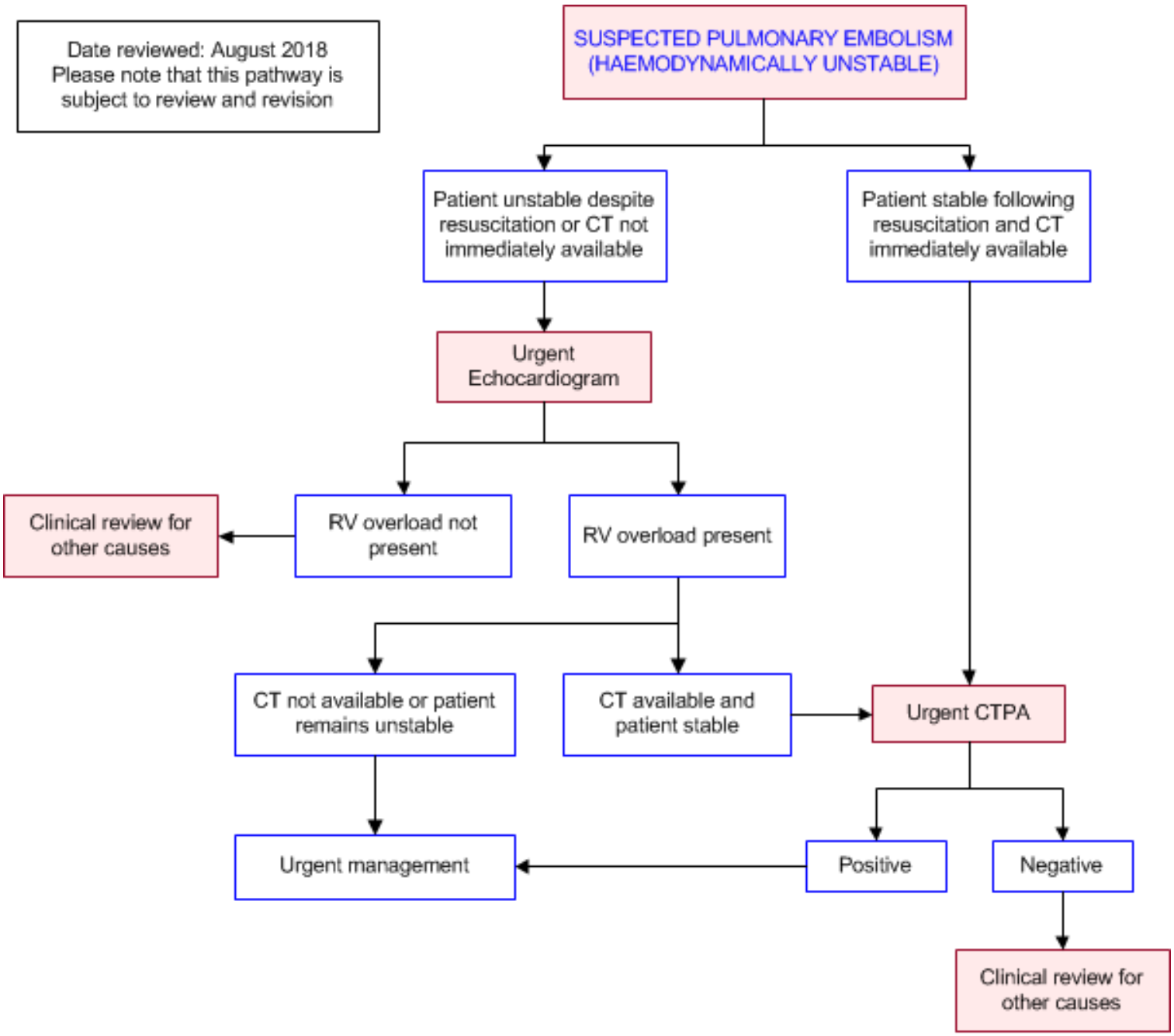


Image Gallery

Note: These images open in a new page

1

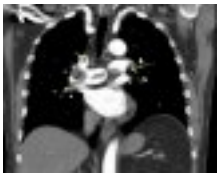
Hampton's Hump

Image 1 (Plain Radiograph): There is a peripheral wedge shaped opacity representing pulmonary infarction and atelectasis secondary to a pulmonary embolus (arrow). This radiographic sign is referred to as Hampton's Hump.

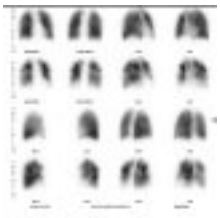
2a **Bilateral Pulmonary Embolism**

Image 2a and 2b (Computed Tomography): Axial and reconstructed images of bilateral pulmonary arterial emboli (arrows)

2b



3



Bilateral Pulmonary Embolism

Image 3 (Ventilation Perfusion Scan): The ventilation series demonstrates uniform distribution of tracer throughout both lung fields. The perfusion series demonstrates generalised reduced tracer uptake in the right lung with multiple segmental and subsegmental perfusion defects throughout both lung fields. These findings have a high probability for recent pulmonary embolism.

Teaching Points

- Suspected PE in the setting of haemodynamic instability is immediately life threatening and requires urgent investigation and treatment
- CT pulmonary angiography (CTPA) is a highly sensitive and specific test which can directly demonstrate PE through filling defects within contrast filled pulmonary arteries down to the segmental level. Although CTPA involves ionising radiation, the urgency of the situation justifies its use as a first line investigation if it is immediately available and if the patient is stable following resuscitation
- ECG-synchronised CTPA provides better assessment of ventricular function
- Haemodynamic measurements should always be recorded during pulmonary angiography to estimate the severity of PE and assist in diagnosing alternative cardiopulmonary disorders
- If the patient remains unstable following resuscitation or if CTPA is not available, bedside transthoracic echocardiography (TTE) is the most useful test. It can demonstrate signs of acute pulmonary hypertension secondary to PE and also assess for cardiac causes of shock
- A negative bedside TTE cannot exclude PE
- Transoesophageal echocardiogram (TOE) may be considered in specific clinical scenarios. Presence of a mobile right heart thrombus often indicates bilateral central pulmonary emboli
- Treatment includes systemic thrombolysis or catheter directed thrombolysis. Alternatively, catheter thromboembolectomy or surgical embolectomy can be considered in patients with contraindications to thrombolysis

Suspected Pulmonary Embolism (Haemodynamically Unstable)

- Pulmonary embolism (PE) refers to obstruction of the pulmonary artery or one of its branches by material (e.g. thrombus, tumour, air, or fat) that originated elsewhere in the body 1
- Hemodynamically unstable PE is suspected in the presence of hypotension: 1
    - Systolic blood pressure 15 minutes, or
    - Hypotension that requires vasopressors or inotropic support and is not explained by other

causes such as sepsis, arrhythmia, left ventricular dysfunction from acute myocardial ischemia or infarction, or hypovolemia

Echocardiogram

- Bedside transthoracic echocardiography (TTE) is a useful test in suspected haemodynamically unstable PE:
  - TTE can detect indirect signs of pulmonary hypertension and right ventricular overload such as: 2
    - Increased right ventricular size
    - Decreased right ventricular function
    - Tricuspid regurgitation
  - TTE can also detect a right heart thrombus in transit
- Transoesophageal echocardiogram (TOE) may allow direct visualisation of thrombus in the pulmonary arteries 3
- Reported sensitivity ranges from 60-70%. In the setting of haemodynamic instability, the absence of echocardiographic signs of right ventricular overload or dysfunction practically excludes PE as a cause of the instability 2,4
- Echocardiography may also assist in the differential diagnosis of shock by detecting pericardial tamponade, acute valvular dysfunction, severe global or regional LV dysfunction, aortic dissection and hypovolaemia 2,5
- Echocardiography is currently not recommended in the diagnostic approach to haemodynamically stable, normotensive patients 3

Computed Tomography Pulmonary Angiography (CTPA)

- Computed tomography pulmonary angiography (CTPA) is the primary imaging modality for evaluating acute pulmonary embolism (PE) if there is no contraindication to contrast agents 6-8
- PE is demonstrated by the presence of a filling defect within contrast filled pulmonary arteries
- The Prospective Investigation of Pulmonary Embolism Diagnosis II (PIOPED II) trial reported a sensitivity of 83% and specificity of 96% using mainly 4-row MDCT without consistent use of bolus tracking contrast administration. Discordant CTPA and pre-test clinical risk stratification required further investigation. The negative predictive value of high risk patients with a negative CTPA was only 60% and the positive predictive value of patients at low risk with a positive CTPA was 58%. Relatively high rates (6%) of studies were non-diagnostic 9
- Modern MDCTs provide better resolution, sensitivity and specificity in detecting PE to segmental or sub-segmental levels with lower ionising radiation doses 10-14
- A systematic review of 49 studies with 13,162 patients found that increased right ventricular to left ventricular (RV/LV) diameter ratio measured on transverse CT images conferred the strongest risk for PE related mortality compared to other CT parameters 15
- ECG-synchronized CTPA provides better assessment of ventricular function. A prospective cohort study of 113 patients found both decreased right ventricular ejection fraction (RVEF) and increased RV/LV diameter ratio conferred high risk for PE related mortality in ECG-synchronised CTPA 16
- CT is also able to provide information on alternative diagnoses that may mimic PE 6,17,18
- Limitations: 19
  - Radiation exposure
  - Risk of contrast allergy and contrast induced nephropathy
  - Subject to interpretive pitfalls such as respiratory motion artefact, streak artefact and

problems related to patient body habitus 11,20

References

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. Download the document

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