Pulmonary Embolism
(v 3.0)

Clinical Director

Signed..................................

Name: Mr R Steyn

Date.....................................
### Meta Data

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### Revision History

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<thead>
<tr>
<th>Version No.</th>
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<tr>
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1. Overview/Introduction

Pulmonary thrombo-embolic disease (PE) is a relatively common condition that carries significant morbidity and mortality risk to patients but often is under or over diagnosed. Few investigations are required to make diagnosis and adequately assess severity and guide on treatment. Different national and international medical bodies such as the British Thoracic Society, British Society of Obstetrics and Gynaecology and American Association of Chest Physicians have produce where available an evidence based guidelines to streamline management of PE. The current Trust guidelines are now out dated and required update which is produced in this document. The updated treatment algorithms were developed through collaborative work between respiratory medicine, acute medicine, haematology, radiology with further discussion with colleagues in other disciplines such as obstetrics and gynaecology. The guidelines were also presented / discussed and agreed in two thoracic meetings at Heartlands. As ever guidelines are a tool to assist treating physicians managing patients in a consistent and evidence based manner but the ultimate decision in management lies with treating physicians.

2. Flow Chart

Suspected Pulmonary Embolism in Haemodynamically Unstable Patients (Systolic BP <90mmHg) - See Appendix 1
Suspected Pulmonary Embolism in Haemodynamically Stable Patients (Systolic BP >90mmHg) - See Appendix 2

3. Objectives of the Guideline

The objectives of these guidelines are to improve the investigations and treatment of patients presenting with pulmonary thromboembolic disease within HEFT. The use of these algorithms is seen essential to ensure proper utilisation of resources so patients are adequately assessed and unnecessary investigations are avoided, and at the same time accuracy of diagnosis is improved leading to better patients outcomes.

4. Body of Guideline

Pulmonary Thromboembolism

Clinical features

Pulmonary thromboembolism (PE) continues to present a diagnostic challenge due to the non-specific nature of signs and symptoms. Most patients with PE are breathless and/or tachypnoeic. Other clinical features include:

- Collapse
- Pleuritic chest pain
- Haemoptysis

When PE is suspected, the diagnosis must be confirmed or excluded by further testing because PE is only present in about one third of those in whom it is suspected.
Classification

PE can be classified according to size as:

- Massive (manifests as haemodynamic instability)
- Submassive (patient haemodynamically stable on presentation however there is potential for haemodynamic instability predictable by signs of right-ventricular strain)
- Non-massive (haemodynamically stable and no signs of right ventricular strain)

Haemodynamically stable patients need to undergo risk stratification in order to identify patients who need to be closely monitored due to the potential for deterioration in their clinical condition.

Risk stratification

A process used to determine which subgroups may be at the highest risk of clinical deterioration and therefore may benefit the most from more intense monitoring or perhaps even the administration of thrombolytic therapy.

Initial assessment: the haemodynamically unstable patient

- These patients require assessment and management using the ABCDE approach
- Ensure early involvement of senior doctors
- Follow the algorithm

Initial assessment: the haemodynamically stable patient

- Take a history and identify risk factors for PE
- Examine the patient
- Carry out baseline investigations: arterial blood gas, ECG, CXR, routine haematology and biochemistry
- Assess clinical probability

Clinical probability

- All patients with possible pulmonary embolism who are haemodynamically stable should have clinical probability assessed and documented

Investigations

D-dimer

- False positives are common
- Inappropriate use can lead to your patient receiving unnecessary treatment and further investigations
- Blood D-dimer assay should only be considered following assessment of clinical probability
- D-dimer assay should not be performed in those with high clinical probability of PE
- The ability of a negative D-dimer assay to reliably exclude PE depends on the sensitivity of the assay used by the laboratory. The assay currently in use at Heart of England Foundation Trust has a low sensitivity. This means:
A negative D-dimer test reliably excludes PE in patients with low clinical probability (Wells <2) and imaging is not required. A negative D-dimer test cannot reliably exclude PE in those with intermediate clinical probability. Therefore the further management of these patients needs to be discussed with a consultant who will decide whether the patient requires imaging.

**Imaging**

Imaging should be performed within 1 hour in massive PE, and ideally within 24 hours in non-massive PE.

**Isotope lung scanning**

Isotope lung scanning may be considered as the initial imaging investigation providing:

1. Available on-site
2. CXR is normal
3. There is no significant symptomatic concurrent cardiopulmonary disease
4. A non-diagnostic result is always followed by further imaging

Analogous to D-dimer testing, where isotope lung scanning is normal, PE is reliably excluded but a significant minority of high probability results are false positive.

**Leg ultrasound**

In patients with co-existing clinical DVT, leg ultrasound as the initial imaging test is often sufficient to confirm venous thromboembolism.

**CTPA**

According to BTS guidelines 2003, CTPA is the recommended initial lung imaging modality for non-massive PE.

**Echocardiography**

Echocardiography is diagnostic in massive PE.

**Renal impairment**

Radiologists will refuse to perform CTPA in patients with a serum creatinine level >150mmol/L. In these situations, request a ventilation/perfusion scan instead.

**Treatment**

- Thrombolysis is the first-line treatment for massive PE.

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### Thrombolysis

**Absolute contraindications**

- History of intracranial hemorrhage
- Known intracranial neoplasm, arteriovenous malformation, or aneurysm
- Significant head trauma
- Active internal bleeding
- Known bleeding diathesis
- Intracranial or intraspinal surgery within 3 months
- Cerebrovascular accident within 2 months

**Relative contraindications**

- Recent internal bleeding
- Recent surgery or organ biopsy
- Recent trauma, including cardiopulmonary resuscitation
- Venepuncture at non-compressible site
- Uncontrolled hypertension
- High risk of left heart thrombosis
- Diabetic retinopathy
- Pregnancy
- Age >75 yr

*Although absolute contraindications should be carefully assessed, some of these (except concurrent intracranial hemorrhage) might not be “absolute” in the most extreme circumstances of massive PE.*
• Acute PE without associated right ventricular dysfunction or hemodynamic instability can be readily managed with standard anticoagulation.
• The appropriate therapy for submassive PE remains an area of contention, and definitive data proving mortality benefit in this setting are lacking. These patients need to be monitored closely and if necessary thrombolysed.

**Important points**

• Heparin should be given to patients with intermediate or high clinical probability before imaging.
• Unfractionated heparin (UFH) should be considered where rapid reversal of effect may be needed.
• Otherwise, low molecular weight heparin should be considered as preferable to UFH, having equal efficacy and safety and being easier to use.
• Consider reducing dose of LMWH if GFR<30ml/hour with monitoring of anti-factor Xa or use UFH.
• Oral anticoagulation should only be commenced once venous thromboembolism has been reliably confirmed.
• The target INR should be 2.0–3.0; when this is achieved, heparin can be discontinued.

**Oral anticoagulation: Treatment duration**

The standard duration of oral anticoagulation is:

• 4–6 weeks for temporary risk factors
• 3 months for first idiopathic
• At least 6 months for other

The risk of bleeding should be balanced with that of further venous thromboembolism.

**Inferior vena caval filters**

Inferior vena caval filters are mainly used where anticoagulation is contraindicated or unsuccessful in preventing recurrence of PE from continuing DVT.

**Other**

• Testing for thrombophilia should be considered in patients aged under 50 with recurrent PE or in those with a strong family history of proven VTE.
• Investigations for occult cancer are only indicated in idiopathic VTE when it is suspected clinically, on chest radiography, or on routine blood tests.

**Pregnancy**

For the management of patients during pregnancy or the puerperium please refer to the [Venous Thromboembolism in Pregnancy & Puerperium](#) guideline issued by Obstetrics and Gynaecology.

5. **Reason for Development of the Guideline**

These guidelines are developed as the previous set required update and in view of new national and international guidelines releases and recent local audits suggesting need for more streamlined approach to treatment of pulmonary embolism.
6. Methodology

A committee led by A H Mansur (chest physician) and included representation from acute medicine (Dr P Dyer and Dr T Chakravorty), haematology (Dr N Smith), and Dr S Rishi (Foundation year 2 doctor). The guideline was developed from existing published guidelines through committee members consultants and review of current literature. Once the general frame of the guideline is agreed, these were further discussed and agreed at two thoracic meetings and with radiology department. The guideline was approved by other disciplines such as obstetrics and gynaecology (Miss K Barber).

7. Implementation

In addition to posting guidelines on intranet, presentation of the guidelines in various meetings such as grand round and individual departmental meetings as well as production of posters that could be put in acute medical departments and accident and emergency departments.

8. Monitoring

We recommend an audit to be conducted in 3 months after launch of guideline to assess adherence to guideline and patients outcomes. These could include percentage use of pre-text clinical probability of PE and use of that to guide use of D-Dimer testing and subsequent imaging such as CT angiography and ventilation / perfusion scans. Outcomes of severity assessment from above tested could be measured and mode of therapy and other outcomes such as length of hospital stay, complications of PE and mortality.

Although D Dimer testing is seen to carry high negative predictive value (i.e. negative test virtually excludes diagnosis), there are different versions available and the committee felt the need to monitor sensitivity of currently used D Dimer kits and need to move from current bedside kit to laboratory based measurements.

9. Application of the Guideline

All health care professional (doctors and nurses) particularly those in accident and emergency, acute medical assessments units and in medical or surgical wards including obstetrics and gynaecology.

10. References

Appendix 1

Suspected Pulmonary Embolism in Haemodynamically Unstable Patients (Systolic BP <90mmHg)

Suspected PE in haemodynamically unstable patient (including persistent hypotension alone)

Cardiac arrest
Periarrest

Resuscitation & immediate senior help (RMO1 & acute medicine consultant, on-call chest registrar) and inform oncall chest consultant ASAP

URGENT CTPA/portable echocardiogram within 1hour

IMMEDIATE Thrombolysis with Alteplase*
50mg (in 50ml water for injections) IV bolus

Response
Failure to respond

Transfer to HDU/ITU

IV unfractionated heparin (no bolus needed) can be given during alteplase administration

Monitor closely for signs of bleeding

- Once APTT stable (APTT ratio 1.5-2.5 on 2 consecutive occasions) & platelet count within normal range, add warfarin
- Once INR ≥2.0 for 48hrs, stop heparin

Discuss with respiratory consultant on-call
Options: emergency direct thrombolysis/catheter thrombo- embolectomy/pulmonary embolectomy

*Alternative to alteplase: Streptokinase: 1.5MU in 100ml sodium chloride 0.9% over 2 hours (preferred regimen). Can also be administered as detailed in Appendix 3.

IV Unfractionated heparin with/after thrombolysis:
- Infuse initially at 18U/kg/hour
- For information on administration, infusion rates and monitoring of APTT please refer to the guideline Management of DVT Treatment Option B – Unfractionated Heparin.
- Monitor platelet count

Direct Signs of PE on ECHO:
- Thrombi in right atrium, right ventricle, or pulmonary artery
- Thrombi in left atrium if patent foramen ovale

Indirect signs of PE on ECHO:
- Right ventricular dysfunction – dilatation, free wall hypokinesia, paradoxical septal wall motion
- Systolic pressure gradient between right atrium and right ventricle, of >30mm Hg
Appendix 2

Suspected Pulmonary Embolism in Haemodynamically Stable Patients (Systolic BP >90mmHg)

**Wells pre-test Probability Score**

- **Suspected DVT** 3.0
- An alternative diagnosis is less likely than PE 3.0
- Heart rate >100 beats per minute 1.5
- Immobilization or surgery in the previous four weeks 1.5
- Previous DVT or PE 1.5

**Score <2 (PE unlikely)**
- Seek alternative diagnosis

**Score 2-6 (intermediate)**
- D-Dimer
  - Negative: DISCUSS WITH SENIOR
  - Positive: LMWH: enoxaparin 1.5mg/kg/day sc
  - No PE: Stop LMWH
  - PE confirmed: Further risk stratify: Troponin T

**Score >6 (PE likely)**
- LMWH: enoxaparin 1.5mg/kg/day sc
- Consider using UFH if GFR <30ml \ hour
- CTPA with comment on right ventricular (RV) function in case of PE

**Unfractionated heparin (UFH):**
- Initial IV bolus (5,000U or 75U/kg)
- Then continuous infusion initially at 18U/kg/hour
- For information on administration, infusion rates and monitoring of APTT please refer to the guideline Management of DVT Treatment Option B – Unfractionated Heparin.
- Monitor platelet count

**Evidence of RV dysfunction**
- Start UFH & discuss with respiratory consultant on-call

**No evidence of RV dysfunction**
- Add warfarin & once INR ≥2.0 for 48h, stop LMWH

**TnT should be measured if PE is confirmed on CTPA. Positive TnT ≥10units**

Monitor closely & consider thrombolysis (CONSULTANT DECISION):
- Alteplase 10mg IV over 2mins then 90mg (1.5mg/kg if weight <65kg) IV infusion over 2hrs
- Follow by UFH once APTT ratio <2 (no bolus needed)
- Once APTT stable (APTT ratio 1.5-2.5 on 2 consecutive occasions) & platelet count within normal range, add warfarin. Once INR ≥2.0 for 48hrs, stop UFH.

ALL CTPA requests MUST include the risk stratification score and where applicable the D-Dimer score.