

Table 1. Clinical prediction scores for PE

| Wells rule                                        |          |            |
|---------------------------------------------------|----------|------------|
|                                                   | Original | Simplified |
| Clinical signs and symptoms DVT                   | 3        | 1          |
| Tachycardia (>100/min)                            | 1.5      | 1          |
| Immobilization or surgery in the previous 4 weeks | 1.5      | 1          |
| Previous PE or DVT                                | 1.5      | 1          |
| Haemoptysis                                       | 1        | 1          |
| Malignancy                                        | 1        | 1          |
| An alternative diagnosis is less likely than PE   | 3        | 1          |
| <b>Clinical probability</b>                       |          |            |
| Low                                               | 0–1      | NA         |
| Intermediate                                      | 2–6      | NA         |
| High                                              | ≥7       | N/A        |
| PE unlikely                                       | ≤4       | ≤1         |

**Geneva rule**

|                                                                |      |     |
|----------------------------------------------------------------|------|-----|
| Previous PE or DVT                                             | 3    | 1   |
| Heart rate                                                     |      |     |
| 75–94 b.p.m.                                                   | 3    | 1   |
| ≥95 b.p.m.                                                     | 5    | 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                                                           | ≥11  | ≥5  |
| Two-level score                                                |      |     |
| PE-unlikely                                                    | 0–5  | 0–2 |
| PE-likely                                                      | ≥6   | ≥3  |

Gibson NS, et al. Further validation and simplification of the Wells clinical decision rule in pulmonary embolism. *Thromb Haemost.* 2008;**99**:229–34 with permission from Schattauer.

Klok FA, et al. Simplification of the revised Geneva score for assessing clinical probability of pulmonary embolism. *Arch Intern Med.* 2008;**168**:2131–6 with permission from American Medical Association.

**PERC criteria**

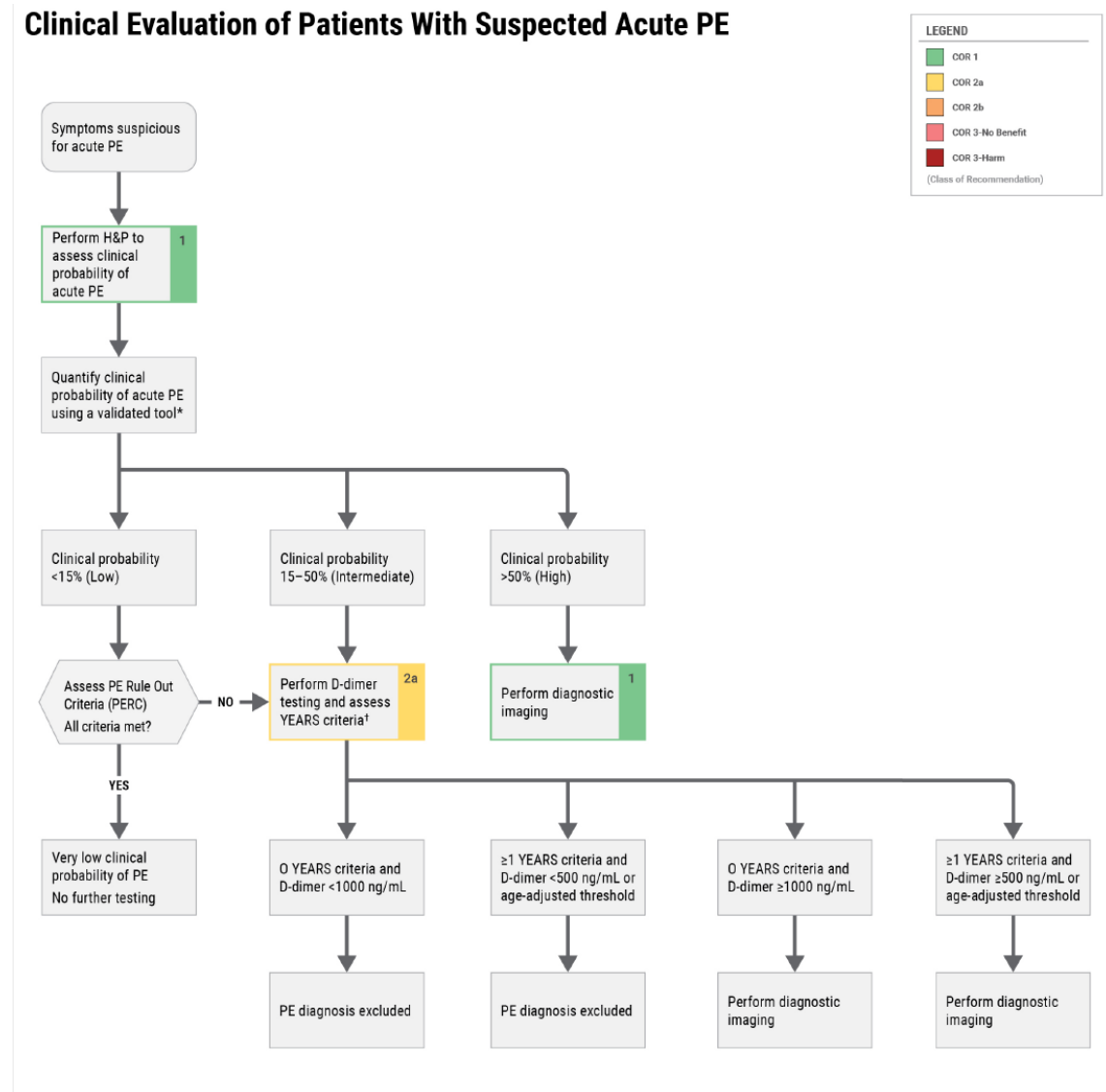
- (1) age 50 years or older
- (2) pulse rate of at least 100/min
- (3) pulse oximetry oxygen saturation of less than 95%
- (4) unilateral leg swelling;
- (5) hemoptysis
- (6) recent surgery or trauma
- (7) prior PE or DVT
- (8) exogenous estrogen use

**Table 2. AHA/ACC 2026 GL on PE. Clinical assessment**

|           |             |                                                                                                                                                                                                                                                                                                                      |
|-----------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | <b>A</b>    | 1. In patients presenting with symptoms suggestive of acute PE, a targeted history and comprehensive physical examination is recommended to assist in determining the clinical pretest probability of acute PE. <sup>1,2</sup>                                                                                       |
| <b>2a</b> | <b>B-R</b>  | 2. In adult patients undergoing evaluation for PE and who have a low or intermediate clinical probability of PE (<50%) by risk assessment, an age-adjusted D-dimer value below the threshold (age × 10 µg/L for fibrinogen equivalent units assays) effectively excludes PE and the need for imaging. <sup>2-5</sup> |
| <b>2a</b> | <b>B-R</b>  | 3. In adult patients with suspected PE, the YEARS algorithm* can be useful to identify which patients do not need imaging to rule out a PE. <sup>2,3,6,7</sup>                                                                                                                                                       |
| <b>2b</b> | <b>B-NR</b> | 4. In pregnant adults, it may be reasonable to use pregnancy-adapted YEARS criteria to identify patients who do not need imaging for PE. <sup>8-10</sup>                                                                                                                                                             |

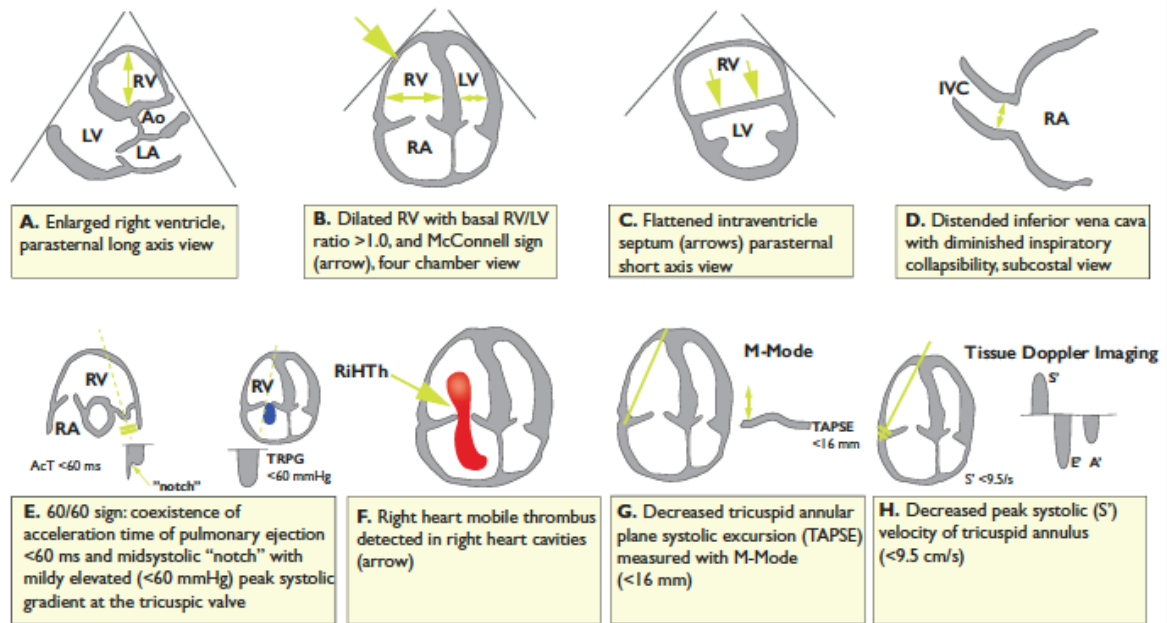
\*YEARS algorithm: A D-dimer threshold of 500 µg/L in patients who have ≥1 of the following: 1) clinical signs of DVT; 2) hemoptysis; and/or 3) PE as the most likely diagnosis. A D-dimer threshold of 1000 µg/L is used for patients who have no YEARS criteria.

## Clinical Evaluation of Patients With Suspected Acute PE



**Figure 1. AHA/ACC 2026 GL on PE.** Clinical Evaluation of Patients With Suspected Acute PE.

\*Indicates validated tools such as the Wells score, revised Geneva score, or clinical gestalt. †YEARS criteria include clinical signs of DVT, hemoptysis, or PE is the most likely diagnosis. Use of an age-adjusted D-dimer is an alternative to the use of the YEARS criteria. For pregnant patients, the pregnancy-adapted YEARS criteria should be used. DVT indicates deep vein thrombosis; and PE, pulmonary embolism.



**Figure 2. ESC 2019 GL on PE** Graphic representation of transthoracic echocardiographic parameters in the assessment of right ventricular pressure overload.

A0 = peak late diastolic (during atrial contraction) velocity of tricuspid annulus by tissue Doppler imaging; AcT = right ventricular outflow Doppler acceleration time; Ao = aorta; E0 = peak early diastolic velocity of tricuspid annulus by tissue Doppler imaging; IVC = inferior vena cava; LA = left atrium; LV = left ventricle; RA = right atrium; RiHTh = right heart thrombus (or thrombi); RV = right ventricle/ventricular; S0 = peak systolic velocity of tricuspid annulus by tissue Doppler imaging; TAPSE = tricuspid annular plane systolic excursion; TRPG = tricuspid valve peak systolic gradient.

**Table 3. AHA/ACC 206 GL on PE.** Optimal Methods of RV Dysfunction Assessment on Echocardiogram

|                                            | Recommended Technique for Assessment                                                                                                                                                       | Definition of Parameter                                                                                 |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| RV dimension                               | 1) End-diastole from a right ventricle-focused apical 4-chamber view<br>2) Apical 4-chamber view                                                                                           | 1) EDD >30 mm <sup>31,37,42,51</sup><br>2) RV basal EDD >42 mm <sup>44,51</sup>                         |
| RV/LV                                      | End-diastolic ratio (apical or subcostal view)                                                                                                                                             | RV/LV >0.9 <sup>37,42,51</sup>                                                                          |
| TAPSE <sup>42</sup>                        | Measures the distance of systolic excursion of the RV annular segment in cm, on M-mode, along a longitudinal plane, from a standard apical 4-chamber view from end-diastole to end-systole | TAPSE <1.6 cm is abnormal <sup>42,44,51</sup>                                                           |
| Doppler evidence of pulmonary hypertension | Tissue Doppler imaging                                                                                                                                                                     | Pulmonary acceleration time <90 ms, or the presence of an RV/atrial gradient >30 mm Hg <sup>31,51</sup> |
| Tricuspid systolic velocity                | Apical or subcostal 4-chamber view                                                                                                                                                         | Tricuspid systolic velocity >2.6 m/sec <sup>31,51</sup>                                                 |

EDD indicates end-diastolic diameter; LV, left ventricle; RV, right ventricle; and TAPSE, tricuspid annular plane systolic excursion.

**Table 4. ESC 2019 GL on PE. Imaging tests for diagnosis of pulmonary embolism**

|                              | Strengths                                                                                                                                                                                                                                                                                                                                                    | Weaknesses/limitations                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Radiation issues <sup>a</sup>                                                                                                                                             |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CTPA</b>                  | <ul style="list-style-type: none"> <li>● Readily available around the clock in most centres</li> <li>● Excellent accuracy</li> <li>● Strong validation in prospective management outcome studies</li> <li>● Low rate of inconclusive results (3–5%)</li> <li>● May provide alternative diagnosis if PE excluded</li> <li>● Short acquisition time</li> </ul> | <ul style="list-style-type: none"> <li>● Radiation exposure</li> <li>● Exposure to iodine contrast:               <ul style="list-style-type: none"> <li>○ limited use in iodine allergy and hyperthyroidism</li> <li>○ risks in pregnant and breastfeeding women</li> <li>○ contraindicated in severe renal failure</li> </ul> </li> <li>● Tendency to overuse because of easy accessibility</li> <li>● Clinical relevance of CTPA diagnosis of subsegmental PE unknown</li> </ul> | <ul style="list-style-type: none"> <li>● Radiation effective dose 3–10 mSv<sup>b</sup></li> <li>● Significant radiation exposure to young female breast tissue</li> </ul> |
| <b>Planar V/Q scan</b>       | <ul style="list-style-type: none"> <li>● Almost no contraindications</li> <li>● Relatively inexpensive</li> <li>● Strong validation in prospective management outcome studies</li> </ul>                                                                                                                                                                     | <ul style="list-style-type: none"> <li>● Not readily available in all centres</li> <li>● Interobserver variability in interpretation</li> <li>● Results reported as likelihood ratios</li> <li>● Inconclusive in 50% of cases</li> <li>● Cannot provide alternative diagnosis if PE excluded</li> </ul>                                                                                                                                                                             | <ul style="list-style-type: none"> <li>● Lower radiation than CTPA, effective dose ~2 mSv<sup>b</sup></li> </ul>                                                          |
| <b>V/Q SPECT</b>             | <ul style="list-style-type: none"> <li>● Almost no contraindications</li> <li>● Lowest rate of non-diagnostic tests (&lt;3%)</li> <li>● High accuracy according to available data</li> <li>● Binary interpretation ('PE' vs. 'no PE')</li> </ul>                                                                                                             | <ul style="list-style-type: none"> <li>● Variability of techniques</li> <li>● Variability of diagnostic criteria</li> <li>● Cannot provide alternative diagnosis if PE excluded</li> <li>● No validation in prospective management outcome studies</li> </ul>                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>● Lower radiation than CTPA, effective dose ~2 mSv<sup>b</sup></li> </ul>                                                          |
| <b>Pulmonary angiography</b> | <ul style="list-style-type: none"> <li>● Historical gold standard</li> </ul>                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>● Invasive procedure</li> <li>● Not readily available in all centres</li> </ul>                                                                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>● Highest radiation, effective dose 10–20 mSv<sup>b</sup></li> </ul>                                                               |

<sup>a</sup> In this section, effective radiation dose is expressed in mSv [dose in mSv = absorbed dose in mGy \_ radiation weighting factor (1.0 for X-rays) \_ tissue weighting factor]. This reflects the effective doses of all organs that have been exposed, that is, the overall radiation dose to the body from the imaging test. Compare with Table 19 on Pregnancy, in which the absorbed radiation dose is expressed in mGy to reflect the radiation exposure to single organs or to the foetus.

<sup>b</sup> For comparison, the whole-body effective dose of a chest X-ray examination is 0.1 mSv

CTPA = computed tomographic pulmonary angiography; mGy = milligray; mSv = millisieverts; PE = pulmonary embolism; SPECT = single-photon emission computed tomography; V/Q = ventilation/perfusion (lung scintigraphy).

**Table 5. AHA/ACC 2026 GL on PE. Diagnostic Testing**

|           |             |                                                                                                                                                                                                                                                                                                |
|-----------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | <b>A</b>    | 1. In patients presenting with symptoms and signs suggestive of acute PE, imaging is recommended for those who are deemed high probability (>50% probability of PE) by a validated clinic risk prediction score or an elevated D-dimer level in order to confirm or exclude PE. <sup>1-7</sup> |
| <b>1</b>  | <b>A</b>    | 2. In patients undergoing imaging evaluation for suspected PE, a positive CTPA or high probability ventilation/perfusion (V/Q) scan is sufficient to diagnose PE. <sup>1,2,4,8-11</sup>                                                                                                        |
| <b>1</b>  | <b>B-R</b>  | 3. In patients undergoing imaging evaluation, a CTPA is recommended in preference to a V/Q scan to confirm the diagnosis of acute PE. <sup>4,5,9,12</sup>                                                                                                                                      |
| <b>2a</b> | <b>B-NR</b> | 4. In pregnant patients presenting with symptoms, YEARS criteria suggestive of acute PE, and a normal chest x-ray, imaging evaluation with low-radiation dose CTPA is reasonable over low-dose perfusion scintigraphy. <sup>13,14</sup>                                                        |
| <b>2a</b> | <b>B-R</b>  | 5. In patients undergoing evaluation for PE, V/Q single-photon emission computed tomography (SPECT) is reasonable in preference to a planar V/Q scan as a diagnostic study. <sup>8,10</sup>                                                                                                    |
| <b>2a</b> | <b>B-R</b>  | 6. In patients with suspected acute PE who cannot undergo a CTPA, it is reasonable to perform a V/Q scan in preference to contrast-enhanced magnetic resonance angiography (MRA) to improve the diagnostic yield. <sup>15-19</sup>                                                             |
| <b>2b</b> | <b>B-NR</b> | 7. In patients with confirmed acute PE, obtaining lower extremity venous duplex ultrasound examination may be reasonable in patients with clinical findings suggestive of DVT or if the presence of DVT will change management or inform prognosis. <sup>5,20-26</sup>                         |

|                                                 |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3: No Benefit</b>                            | <b>B-NR</b> | 8. In patients with suspected PE and a negative CTPA or normal V/Q SPECT, venous duplex ultrasonography is not useful for further PE diagnostic evaluation. <sup>4,5,8-10,27-29</sup>                                                                                                                                                                                                                                                                                                                                               |
| <b>3: No Benefit</b>                            | <b>B-NR</b> | 9. In patients with suspected acute PE, an echocardiogram is not recommended to confirm or refute the diagnosis of PE. <sup>30,31</sup>                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>3: No Benefit</b>                            | <b>B-R</b>  | 10. In patients with suspected acute PE, computed tomographic venography of the inferior vena cava (IVC) and lower extremity veins is not recommended as a routine adjunct to CTPA to diagnose venous thrombosis. <sup>2,5,32</sup>                                                                                                                                                                                                                                                                                                 |
| <b>Reporting Findings on Diagnostic Imaging</b> |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>1</b>                                        | <b>B-R</b>  | 11. In patients presenting with an acute PE who undergo CTPA, reporting the numerical right ventricle (RV)/left ventricle (LV) ratio (measured by internal diameter assessed on axial or reformatted 4D-chamber view) is recommended over subjective quantification for risk stratification. <sup>33-37</sup>                                                                                                                                                                                                                       |
| <b>1</b>                                        | <b>B-NR</b> | 12. In patients with acute PE who undergo transthoracic echocardiography, RV dysfunction should be assessed and reported by the following parameters: RV/LV end-diastolic ratio; RV end-diastolic diameter; tricuspid annular plane systolic excursion (TAPSE); estimated right ventricular systolic pressure; RV free wall hypokinesis with sparing of the apex (McConnell's sign); tricuspid systolic velocity; paradoxical septal motion; and IVC respirophasic collapse to assist with risk stratification. <sup>31,38-44</sup> |
| <b>2b</b>                                       | <b>B-NR</b> | 13. In patients with acute PE, reporting of chronic features* on CTPA may be useful to identify patients at risk for chronic clinical sequelae of PE, including post-PE CTEPD. <sup>45-48</sup>                                                                                                                                                                                                                                                                                                                                     |

\*Examples include intravascular webs, pulmonary artery retraction or dilation, bronchial artery dilation, RV hypertrophy, and intraventricular septal flattening.

**Table 6. ESC 2019 GL on PE. Recommendations for diagnosis****Suspected PE with haemodynamic instability**

Bedside echocardiography or emergency CTPA (depending on availability and clinical circumstances) in suspected high-risk PE, as indicated by the presence of haemodynamic instability I C

i.v. anticoagulation with UFH, including a weight-adjusted bolus injection, to be initiated without delay in patients with suspected high-risk PE. I C

**Suspected PE without haemodynamic instability**

Use validated criteria for diagnosing PE I B

Initiation of anticoagulation without delay in patients with high or intermediate clinical probability of PE while diagnostic workup is in progress. I C

**Clinical evaluation**

It is recommended that t

Diagnostic strategy based on clinical probability, assessed either by clinical judgement or by a validated prediction rule. I A

**D-dimer**

Plasma D-dimer measurement, preferably using a highly sensitive assay, in outpatients/emergency department patients with low or intermediate clinical probability, or those that are PE-unlikely, to reduce the need for unnecessary imaging and irradiation. I A

As an alternative to the fixed D-dimer cut-off, a negative D-dimer test using an age-adjusted cut-off (age  $\geq$  10 mg/L, in patients aged  $>50$  years) for excluding PE in patients with low or intermediate clinical probability, or those that are PE-unlikely. IIa B

As an alternative to the fixed or age-adjusted D-dimer cut-off, D-dimer levels adapted to clinical probability<sup>a</sup> to exclude PE. IIa B

D-dimer measurement is not recommended in patients with high clinical probability, as a normal result does not safely exclude PE, even when using a highly sensitive assay. III A

**CTPA**

Reject the diagnosis of PE (without further testing) if CTPA is normal in a patient with low or intermediate clinical probability, or who is PE-unlikely. I A

Accept the diagnosis of PE (without further testing) if CTPA shows a segmental or more proximal filling defect in a patient with intermediate or high clinical probability. I B

Reject the diagnosis of PE (without further testing) if CTPA is normal in a patient with high clinical probability or who is PE-likely. IIa B

Further imaging tests to confirm PE in cases of isolated subsegmental filling defects. IIb C

CT venography is not recommended as an adjunct to CTPA. III B

**V/Q scintigraphy**

Reject the diagnosis of PE (without further testing) if the perfusion lung scan is normal. I A

Accept the diagnosis of PE (without further testing) if the V/Q scan yields high Probability for PE. IIa B

A non-diagnostic V/Q scan as exclusion of PE when combined with a negative proximal CUS in patients with low clinical probability, or who are PE-unlikely. IIa B

**V/Q SPECT**

V/Q SPECT for PE diagnosis. IIb B

**Lower-limb CUS**

Accept the diagnosis of VTE (and PE) if a CUS shows a proximal DVT in a patient with clinical suspicion of PE. I A

Further testing to confirm PE if CUS shows only a distal DVT. IIa B

If a positive proximal CUS is used to confirm PE, assessment of PE severity to permit risk-adjusted management. IIa C

**MRA**

MRA is not recommended for ruling out PE. III A

a D-dimer cut-off levels adapted to clinical probability according to the YEARS model (signs of DVT, haemoptysis, and whether an alternative diagnosis is less likely than PE) may be used. According to this model, PE is excluded in patients without clinical items and D-dimer levels <1000 mg/L, or in patients with one or more clinical items and D-dimer levels <500 mg/L.

CT = computed tomographic; CTPA = computed tomography pulmonary angiography/angiogram; CUS = compression ultrasonography; DVT = deep vein thrombosis; i.v. = intravenous; MRA = magnetic resonance angiography; PE = pulmonary embolism; SPECT = single-photon emission computed tomography; UFH = unfractionated heparin; V/Q= ventilation/perfusion (lung scintigraphy); VTE = venous thromboembolism.

**Table 7. ESC 2019 GL on PE.** Definition of haemodynamic instability, which delineates acute high-risk pulmonary embolism (one of the following clinical manifestations at presentation)

| (1) Cardiac arrest                     | (2) Obstructive shock <sup>68–70</sup>                                                                       | (3) Persistent hypotension                                                                                                                     |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Need for cardiopulmonary resuscitation | Systolic BP < 90 mmHg or vasopressors required to achieve a BP ≥90 mmHg despite adequate filling status      | Systolic BP < 90 mmHg or systolic BP drop ≥40 mmHg, lasting longer than 15 min and not caused by new-onset arrhythmia, hypovolaemia, or sepsis |
|                                        | And                                                                                                          |                                                                                                                                                |
|                                        | End-organ hypoperfusion (altered mental status; cold, clammy skin; oliguria/anuria; increased serum lactate) |                                                                                                                                                |

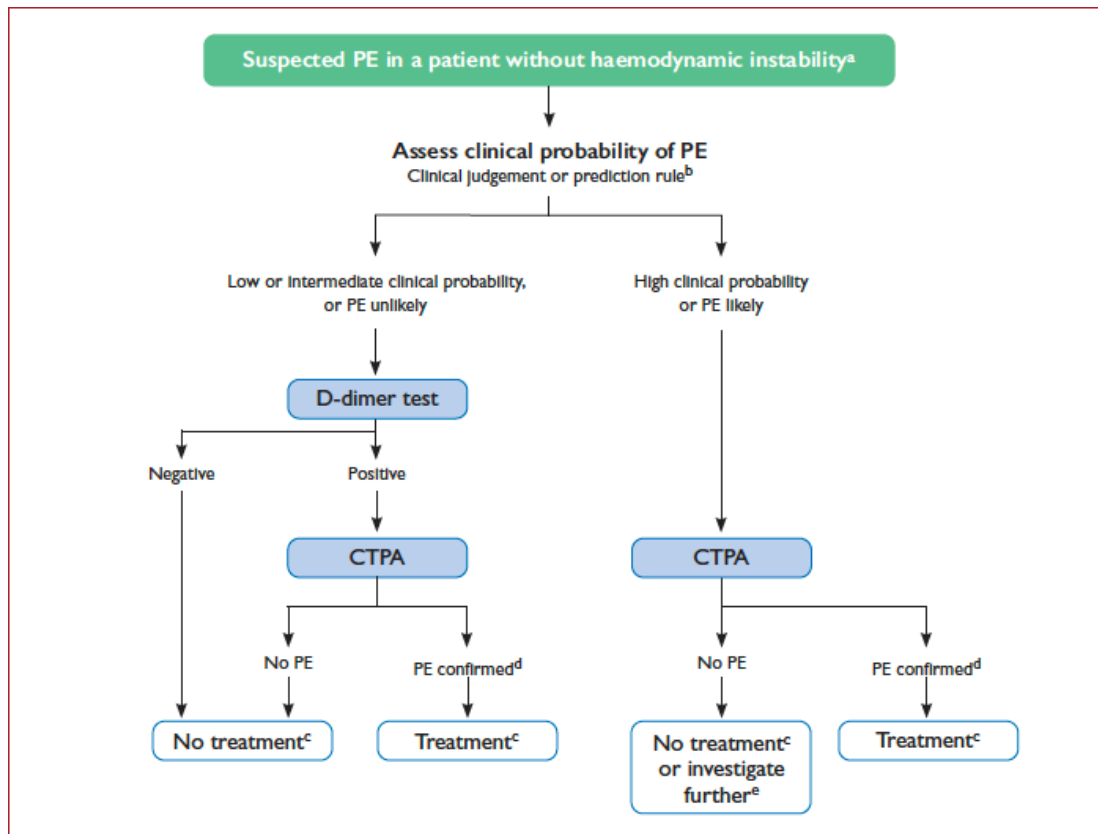
**Table 8. ESC 2019 GL on PE. Recommendations for prognostic assessment**

|                                                                                                                                                                                                           |       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Initial risk stratification of suspected or confirmed PE, based on the presence of haemodynamic instability, to identify patients at high risk of early mortality.                                        | I B   |
| Further stratification of patients with acute PE into intermediate- and low-risk Categories, in patients without haemodynamic instability                                                                 | I B   |
| Use of clinical prediction rules integrating PE severity and comorbidity, preferably the PESI or sPESI, for risk assessment in the acute phase of PE, in patients without haemodynamic instability.       | IIa B |
| Assessment of the RV by imaging methods <sup>a</sup> or laboratory biomarkers <sup>b</sup> , even in the presence of a low PESI or a negative sPESI.                                                      | IIa B |
| In patients without haemodynamic instability, use of validated scores combining clinical, imaging, and laboratory PE-related prognostic factors to further stratify the severity of the acute PE episode. | IIb C |

a Transthoracic echocardiography or computed tomography pulmonary angiography.

b Cardiac troponins or natriuretic peptides.

PE = pulmonary embolism; PESI = Pulmonary Embolism Severity Index; RV = right ventricle; sPESI = simplified Pulmonary Embolism Severity Index.



**Figure 4. ESC 2019 GL on PE.** Diagnostic algorithm for patients with suspected pulmonary embolism without haemodynamic instability.

a The proposed diagnostic strategy for pregnant women with suspected acute PE is discussed below.

b Two alternative classification schemes may be used for clinical probability assessment, i.e. a three-level scheme (clinical probability defined as low, intermediate, or high) or a two-level scheme (PE unlikely or PE likely). When using a moderately sensitive assay, D-dimer measurement should be restricted to patients with low clinical probability or a PE-unlikely classification, while highly sensitive assays may also be used in patients with intermediate clinical probability of PE due to a higher sensitivity and negative predictive value. Note that plasma D-dimer measurement is of limited use in suspected PE occurring in hospitalized patients.

c Treatment refers to anticoagulation treatment for PE.

d CTPA is considered diagnostic of PE if it shows PE at the segmental or more proximal level.

e In case of a negative CTPA in patients with high clinical probability, investigation by further imaging tests may be considered before withholding PE-specific treatment.

CTPA= computed tomography pulmonary angiography/angiogram; PE = pulmonary embolism.

**Table 9. ESC 2019 GL on PE. Classification of pulmonary embolism severity and the risk of early (in-hospital or 30 day) death**

| Early mortality risk |                   | Indicators of risk                    |                                                                                           |                                            |                                               |
|----------------------|-------------------|---------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------------|
|                      |                   | Haemodynamic instability <sup>a</sup> | Clinical parameters of PE severity and/or comorbidity: PESI class III–V or sPESI $\geq$ I | RV dysfunction on TTE or CTPA <sup>b</sup> | Elevated cardiac troponin levels <sup>c</sup> |
| High                 |                   | +                                     | (+) <sup>d</sup>                                                                          | +                                          | (+)                                           |
| Intermediate         | Intermediate–high | -                                     | + <sup>e</sup>                                                                            | +                                          | +                                             |
|                      | Intermediate–low  | -                                     | + <sup>e</sup>                                                                            | One (or none) positive                     |                                               |
| Low                  |                   | -                                     | -                                                                                         | -                                          | Assessment optional; if assessed, negative    |

a One of the following clinical presentations: cardiac arrest, obstructive shock (systolic BP <90 mmHg or vasopressors required to achieve a BP  $\geq$  90 mmHg despite an adequate filling status, in combination with end-organ hypoperfusion), or persistent hypotension (systolic BP <90 mmHg or a systolic BP drop  $\geq$  40 mmHg for >15 min, not caused by new-onset arrhythmia, hypovolaemia, or sepsis).

b Prognostically relevant imaging (TTE or CTPA) findings in patients with acute PE, and the corresponding cut-off levels, are graphically presented in Figure

c Elevation of further laboratory biomarkers, such as NT-proBNP  $\geq$  600 ng/L, H-FABP  $\geq$  6 ng/mL, or copeptin  $\geq$  24 pmol/L, may provide additional prognostic information. These markers have been validated in cohort studies but they have not yet been used to guide treatment decisions in randomized controlled trials.

d Haemodynamic instability, combined with PE confirmation on CTPA and/or evidence of RV dysfunction on TTE, is sufficient to classify a patient into the high-risk PE category. In these cases, neither calculation of the PESI nor measurement of troponins or other cardiac biomarkers is necessary.

e Signs of RV dysfunction on TTE (or CTPA) or elevated cardiac biomarker levels may be present, despite a calculated PESI of I–II or an sPESI of 0. Until the implications of such discrepancies for the management of PE are fully understood, these patients should be classified into the intermediate-risk category.

BP = blood pressure; CTPA = computed tomography pulmonary angiography; H-FABP = heart-type fatty acid-binding protein; NT-proBNP = N-terminal pro B-type natriuretic peptide; PE = pulmonary embolism; PESI = Pulmonary Embolism Severity Index; RV = right ventricular; sPESI = simplified Pulmonary Embolism Severity Index; TTE = transthoracic echocardiogram.

**Table 10. AHA/ACC 2026 GL on PE. Risk Assessment Using Clinical Scores.**

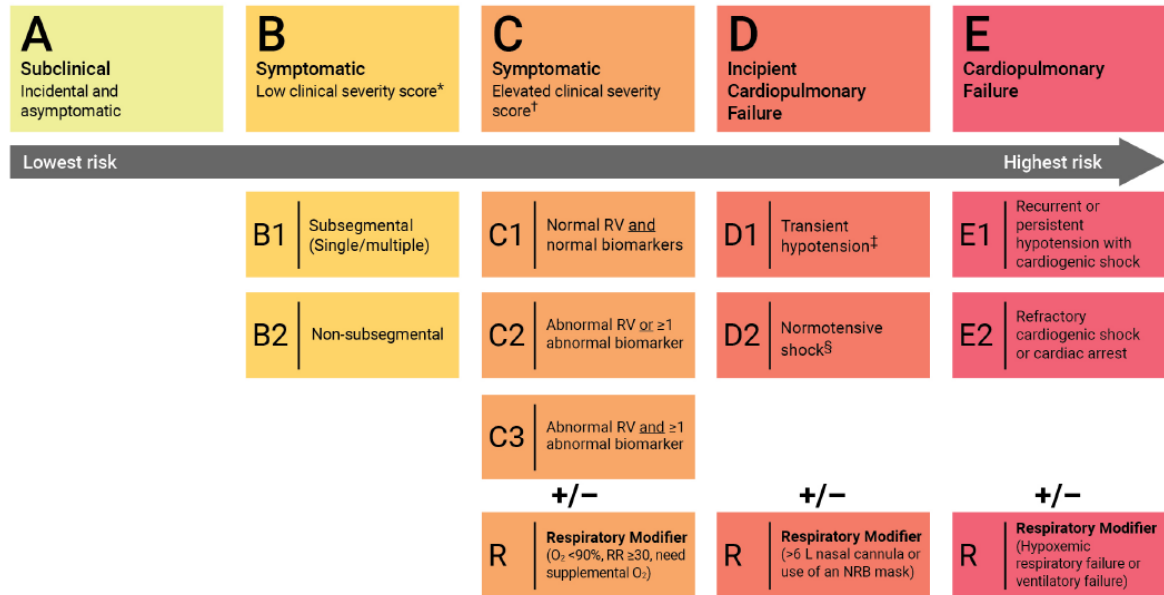
|           |             |                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | <b>B-R</b>  | 1. In patients diagnosed with acute PE in AHA/ACC PE Categories A and B, use of the Hestia, PESI, and/or sPESI risk scores is recommended to identify patients with a low risk for short-term adverse outcomes. <sup>1-4</sup>                                                                                                                                                    |
| <b>2a</b> | <b>B-NR</b> | 2. In hemodynamically stable patients diagnosed with acute PE in AHA/ACC PE Categories C and D, using a validated PE-specific risk score is reasonable to identify patients with a higher risk for short-term adverse outcomes. <sup>5-8</sup>                                                                                                                                    |
| <b>2b</b> | <b>B-NR</b> | 3. In hemodynamically stable patients diagnosed with acute PE in AHA/ACC PE Categories C and D, the National Early Warning Score (NEWS) and its updated version, NEWS2, may be reasonable alternatives to a PE-specific risk score to identify patients with a higher risk for short-term adverse outcomes who may require monitoring for clinical deterioration. <sup>9-12</sup> |

**Table 11. AHA/ACC 2026 GL on PE. Acute PE Clinical Risk Prediction Scores Used in the Acute Care Setting**

| Risk Score Name | Risk Score Components                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Range of Risk Score      | Risk Categories and Definitions                                                                                                                                                                                  |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PESI            | Age<br>Male (10 pts)<br>History of cancer (30 pts)<br>History of heart failure (10 pts)<br>Chronic lung disease, (10 pts)<br>Heart rate $\geq 110$ bpm (20 pts)<br>Systolic blood pressure $< 100$ mm Hg (30 pts)<br>Respiratory rate $\geq 30$ bpm (20 pts)<br>Temperature $< 36^{\circ}\text{C}$ (20 pts)<br>Altered mental status (60 pts)<br>Oxygen saturation $< 90\%$ (20 pts)<br>Calculate score by adding age (in years) and points by risk factor                                                                                                                                                                                                                                                                                                                     | Class I to V             | Class I (lowest risk): $\leq 65$ pts<br>Class II: 66-85 pts<br>Class III: 86-105 pts<br>Class IV: 106-125 pts<br>Class V: (highest risk) $\geq 126$ pts                                                          |
| sPESI           | Age $> 80$ yrs<br>History of cancer<br>Chronic cardiopulmonary disease<br>Systolic blood pressure $< 100$ mm Hg<br>Heart rate $\geq 110$ bpm<br>Arterial oxygen saturation $< 90\%$<br>Calculate score by adding 1 pt for each of the risk factors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Low or High              | 0 points: Low risk of 30-day mortality<br>$\geq 1$ point: High risk of 30-day mortality                                                                                                                          |
| Bova Score      | Systolic blood pressure 90-100 mm Hg (2 pts)<br>Cardiac troponin elevation (2 pts)<br>Right ventricular dysfunction (2 pts)<br>Heart rate $\geq 110$ bpm (1 pt)<br>Calculate score by adding pts for each of the risk factors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 to 7                   | Stage I (lowest risk): 0-2 pts<br>Stage II: 3-4 pts<br>Stage III (highest risk): $> 4$ pts                                                                                                                       |
| Hestia Criteria | Is the patient hemodynamically unstable?<br>Is thrombolysis or embolectomy necessary?<br>Does the patient have active bleeding or a high risk of bleeding?<br>Does the patient require $> 24$ hours of oxygen to maintain oxygen saturation $> 90\%$ ?<br>Is pulmonary embolism diagnosed during anticoagulant treatment?<br>Does the patient have severe pain requiring intravenous pain medication for $> 24$ h?<br>Are there medical or social reasons for hospitalization $> 24$ hours (eg, infection, cancer, lack of support system)?<br>Does the patient have a creatinine clearance of $< 30$ mL/min?<br>Does the patient have severe liver impairment?<br>Is the patient pregnant?<br>Does the patient have a documented history of heparin-induced thrombocytopenia? | Negative versus Positive | If answers to all criteria are "No," the Hestia rule is negative; consider outpatient management.<br><br>If answer to $\geq 1$ of the criterion is "Yes," the Hestia rule is positive; consider hospitalization. |
| CPES Score      | Elevated cardiac troponin<br>Elevated B-type natriuretic peptide<br>Moderately or severely reduced RV function<br>Central thrombus burden (saddle PE)<br>Concomitant deep vein thrombosis<br>Heart rate $\geq 100$ bpm<br>Calculate score by assigning 1 pt for each of the factors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0 to 6                   | 0-5 pts: Lower risk for normotensive shock (cardiac index $\leq 2.2$ L/min/m <sup>2</sup> )<br>6 pts: Higher risk for normotensive shock                                                                         |
| Shock Index     | Heart rate divided by systolic blood pressure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Continuous               | Lower scores associated with lower risk<br><br>Lack of consensus on which cut-points to use for PE risk stratification                                                                                           |
| NEWS and NEWS2  | Respiratory rate, oxygen saturation, temperature, systolic blood pressure, heart rate, level of consciousness, and need for supplemental oxygen<br><br>Points are assigned based on individual measurements in each category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0 to 20                  | NEWS2 $\geq 9$ : High risk <sup>12,21</sup>                                                                                                                                                                      |

CPES indicates Composite Pulmonary Embolism Shock; NEWS, National Early Warning Score; PE, pulmonary embolism; PESI, Pulmonary Embolism Severity Index; RV, right ventricle; and sPESI, simplified PESI.

## AHA/ACC Acute PE Clinical Categories



**Figure 5. AHA/ACC 2026 GL on PE. AHA/ACC Acute PE Clinical Categories.**

When patients meet the respiratory modifier status criteria, then add “R” to the category description (eg, C3R, D2R).

\*Low Clinical Severity Score includes PESI ≤85 or sPESI =0 or Bova ≤ 4.

†Elevated Clinical Severity Score includes PESI >85 or sPESI ≥1 or Bova > 4.

‡Systolic blood pressure <90 or decrease >40 mm Hg lasting <15 min or responding to IV fluids.

§Any: Lactate >2 mmol/L, acute kidney injury, urine output <0.5 mL/kg/hr, mental status change, cardiac index <2.2 L/min/m<sup>2</sup>, mean arterial pressure <60 mm Hg, increased shock score/stage (SCAI stage, CPES score).

ACC indicates American College of Cardiology; AHA, American Heart Association; CPES, Composite Pulmonary Embolism Shock; IV, intravenous; NC, nasal cannula; NRB, nonrebreather; O<sub>2</sub>, oxygen; PE, pulmonary embolism; PESI, Pulmonary Embolism Severity Index; RR, respiratory rate; RV, right ventricle; and sPESI, simplified PESI.

Table 12. AHA/ACC 2026 GL on PE.

**Acute PE Hemodynamic Assessment**

|           |             |                                                                                                                                                                                                                                |
|-----------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2a</b> | <b>B-NR</b> | 1. In patients with acute PE in AHA/ACC PE Category D2, evaluating for the presence of normotensive shock* can be useful to identify patients at increased risk for clinical deterioration and in-hospital death. <sup>1</sup> |
| <b>2a</b> | <b>B-NR</b> | 2. In patients with acute PE in AHA/ACC PE Category C3, a MAP <80 mm Hg may be useful to identify patients who may require escalation of therapy. <sup>2</sup>                                                                 |

\*Normotensive shock is defined as isolated hypoperfusion without hypotension identified with any of the following markers: serum lactate >2 mmol/L, urine output <720 mL in 24 hours, creatinine increase ≥0.3 mg/mL in 24 hours, cardiac index ≤2.2 L/min/m<sup>2</sup> from peripheral arterial and mixed venous oxygenation saturation values.

**Biomarkers for Risk Stratification**

|          |             |                                                                                                                                                                                                                                                                                                                                                         |
|----------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | <b>B-NR</b> | 1. In patients with acute PE and an elevated clinical severity score without features of hypotension or shock (ie, AHA/ACC PE Category C), measurement of at least 1 cardiac biomarker (ie, troponin, brain natriuretic peptide [BNP]) is recommended to assist with risk stratification for short-term complications and/or mortality. <sup>1-11</sup> |
| <b>1</b> | <b>B-NR</b> | 2. In patients with acute PE (ie, AHA/ACC PE Categories C to E) who are undergoing evaluation at an acute care facility, measurement of lactate (either venous or arterial) is recommended to assist with risk stratification for short-term complications and/or mortality. <sup>12-18</sup>                                                           |

**Right Ventricular Imaging for Biomarkers for Risk Stratification**

|           |             |                                                                                                                                                                                                                                                                 |
|-----------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | <b>A</b>    | 1. In patients with acute PE and an elevated clinical severity score but without evidence of shock (ie, AHA/ACC PE Categories C-D), RV imaging is recommended for short-term risk stratification. <sup>1-4</sup>                                                |
| <b>2a</b> | <b>B-NR</b> | 2. In patients with acute PE and an elevated clinical severity score but without evidence of persistent hypotension or shock (ie, AHA/ACC PE Categories C-D), use of echocardiography over CT is preferred for short-term risk stratification. <sup>1,5-8</sup> |

**Quantification of Thrombus Burden for Short-Term Risk Stratification**

|                      |             |                                                                                                                                                                                 |
|----------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3: No Benefit</b> | <b>B-NR</b> | 1. In patients with acute PE in AHA/ACC PE Categories A-C, quantification of angiographic thrombus burden for short-term risk stratification is not recommended. <sup>1-4</sup> |
|----------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Table 13. ESC 2019 GL on PE Acute therapy of haemodynamically stable patients****Recommendations for acute-phase treatment of intermediate- or low-risk pulmonary embolism****Initiation of anticoagulation**

Initiation of anticoagulation without delay in patients with high or intermediate clinical probability of PE,<sup>a</sup> while diagnostic workup is in progress. I C

LMWH or fondaparinux (over UFH) for most patients if anticoagulation is initiated parenterally, I A

A NOAC in preference to a VKA in patients eligible for NOAC (apixaban, dabigatran, edoxaban, or rivaroxaban) when oral anticoagulation is started I A

When patients are treated with a VKA, overlapping with parenteral anticoagulation until an INR of 2.5 (range 2.0-3.0) is reached. I A

NOACs are not recommended in patients with severe renal impairment,<sup>b</sup> during pregnancy and lactation, and in patients with antiphospholipid antibody syndrome. III C

**Reperfusion treatment**

Rescue thrombolytic therapy for patients with haemodynamic deterioration on anticoagulation treatment. I B

As an alternative to rescue thrombolytic therapy, surgical embolectomy<sup>c</sup> or percutaneous catheter-directed treatment for patients with haemodynamic deterioration on anticoagulation treatment. IIa C

Routine use of primary systemic thrombolysis is not recommended in patients with intermediate- or low-risk PE.<sup>a, d</sup> III B

CrCl = creatinine clearance; INR = international normalized ratio; LMWH = low-molecular weight heparin; NOAC(s) = non-vitamin K antagonist oral anticoagulant(s); PE = pulmonary embolism; UFH = unfractionated heparin; VKA = vitamin K antagonist.

a See above for definition of the PE severity and PE-related risk.

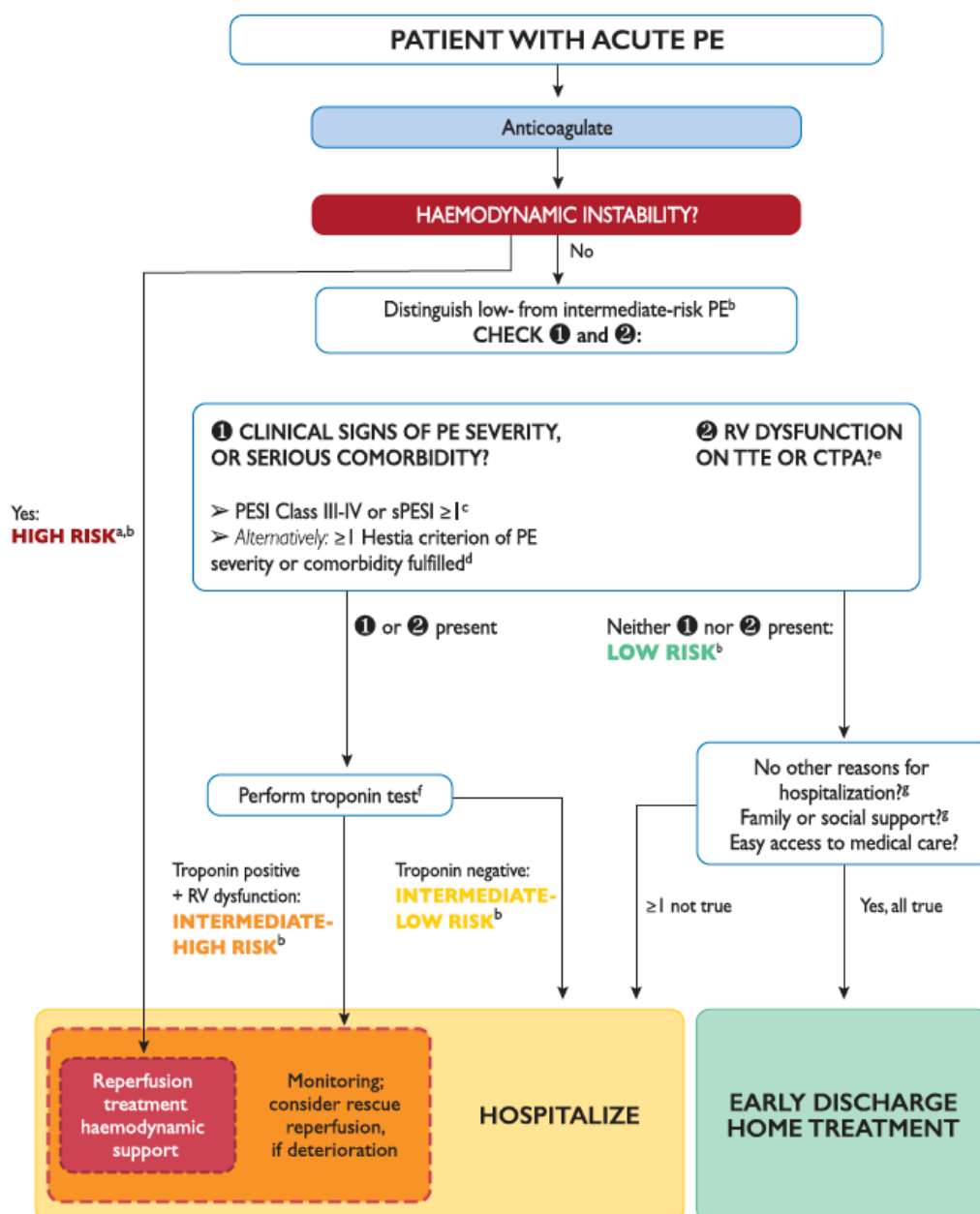
b Dabigatran is not recommended in patients with CrCl <30 mL/min. Edoxaban should be given at a dose of 30 mg once daily in patients with CrCl of 15 - 50 mL/min and is not recommended in patients with CrCl <15 mL/min. Rivaroxaban and apixaban are to be used with caution in patients with CrCl 15 - 29 mL/min, and their use is not recommended in patients with CrCl <15 mL/min.

c If appropriate expertise and resources are available on-site.

d The risk-to-benefit ratios of surgical embolectomy or catheter-directed procedures have not yet been established in intermediate- or low-risk PE.

**Recommendations for early discharge and home treatment**

Carefully selected patients with low-risk PE for early discharge and continuation of treatment at home, if proper outpatient care and anticoagulant treatment can be provided. IIa A



**Figure 6. ESC 2019 GL on PE.** Risk-adjusted management strategy for acute pulmonary embolism.

a See also emergency management algorithm shown in the online Supplementary Data of the ESC GL.

b Refer to Table above for definition of high, intermediate-high-, intermediate-low-, and low-risk PE.

c Cancer, heart failure and chronic lung disease are included in the PESI and sPESI.

d See Supplementary Data of the ESC GL for the Hestia criteria.

e Prognostically relevant imaging (TTE or CTPA) findings in patients with acute PE, are graphically presented in Figure above.

f A cardiac troponin test may already have been performed during initial diagnostic work-up.

g Included in the Hestia criteria.

CTPA= computed tomography pulmonary angiography/angiogram; PE= pulmonary embolism; PESI= Pulmonary Embolism Severity Index; RV = right ventricular; sPESI = simplified Pulmonary Embolism Severity Index; TTE= transthoracic echocardiogram.

**Table 14. AHA/ACC 2026 GL on PE. Acute Management****Suitability for Outpatient Management of PE**

|           |            |                                                                                                                                                                                                                                                                              |
|-----------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2a</b> | <b>B-R</b> | 1. In patients diagnosed with acute PE in a clinic or an ED, it is reasonable to use a decision tool* to identify suitability for outpatient treatment. <sup>1</sup>                                                                                                         |
| <b>2a</b> | <b>B-R</b> | 2. In select patients diagnosed with acute PE in AHA ACC PE Categories A and B in a clinic or ED, outpatient treatment† is a reasonable option compared with hospitalization, when the rate of 90-day adverse outcomes is low and it aligns with patient goals. <sup>2</sup> |

\*Decision tool options include the Hestia rule, the PESI, and the sPESI.

†Patients suitable for discharge from the outpatient or emergency setting must have immediate access to anticoagulant medication and rapid, reliable, expert follow-up in place.

**Triage and Placement in the Hospital**

|           |             |                                                                                                                                                                                                                                                                                                                  |
|-----------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | <b>C-EO</b> | 1. In patients with acute PE who are receiving thrombolytic therapy (systemic or CDL), placement in a unit that can provide close monitoring, such as an intensive care unit (ICU) or intermediate level of care unit, is recommended to monitor for adverse events.                                             |
| <b>2a</b> | <b>B-R</b>  | 2. In patients admitted to the hospital with acute PE who undergo mechanical thrombectomy (MT) and are hemodynamically stable, admission to a level of care that can provide continuous telemetry and nursing care familiar with the postprocedural complications of the device used is reasonable. <sup>1</sup> |

**Interhospital Transfers**

|                |             |                                                                                                                                                                                                                                                                        |
|----------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2b</b>      | <b>C-LD</b> | 1. For patients with acute PE who exhibit high-risk features* but are hemodynamically stable (AHA/ACC PE Categories C3-D), transferring to a center that can provide advanced therapies† may be considered to ensure access to appropriate interventions. <sup>1</sup> |
| <b>3: Harm</b> | <b>C-EO</b> | 2. Unstable patients with acute PE (AHA/ACC PE Category E) should not be transferred to another medical center before stabilizing their condition.                                                                                                                     |

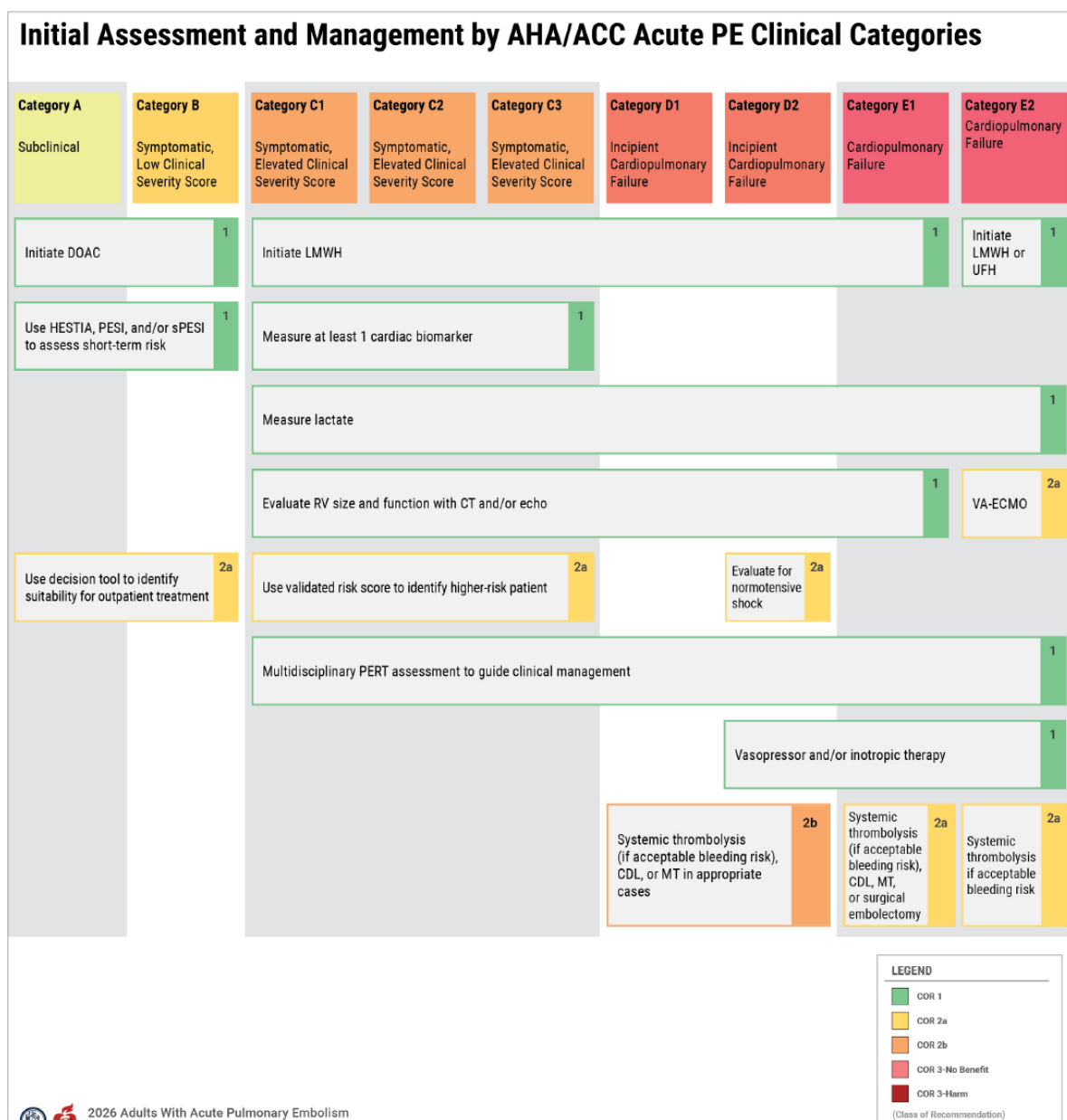
\*High-risk features include RV dysfunction and elevated cardiac biomarkers.

†Advanced therapy examples: surgical embolectomy, CDL, MT, ECMO, and placement of an IVC filter.

**Pulmonary Embolism Response Team**

|          |             |                                                                                                                                                                                                                                |
|----------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | <b>B-NR</b> | 1. In patients with acute PE who are at increased risk of adverse outcomes (ie, AHA/ACC PE Categories C-E)*, a multidisciplinary PERT assessment is recommended to improve in-hospital clinical care delivery. <sup>1-18</sup> |
|----------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

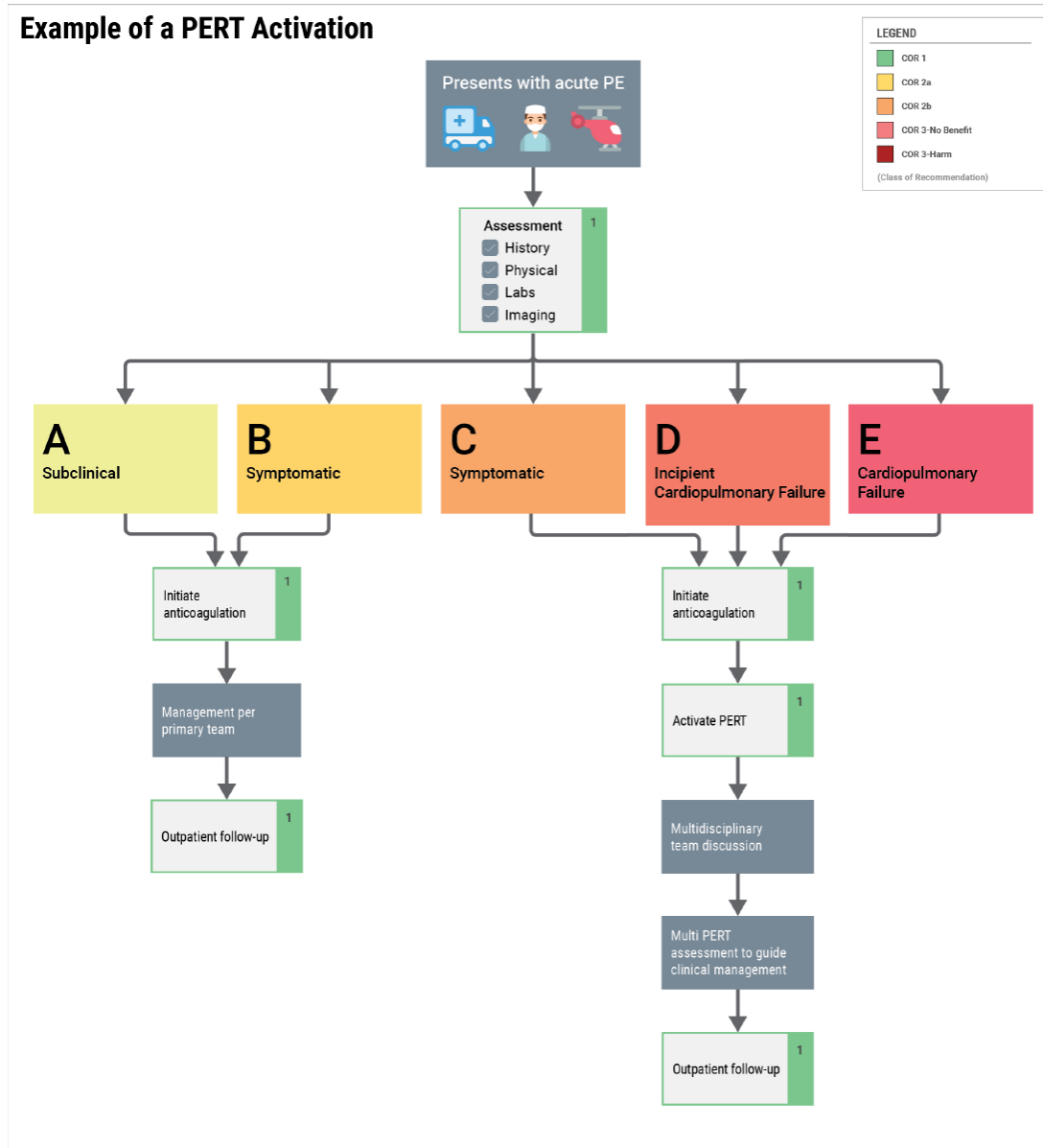
\*AHA/ACC PE Categories A or B with multiple comorbidities may also benefit from a PERT (eg, Category B with intracranial hemorrhage).



**Figure 7. AHA/ACC 2026 GL on PE. Initial Assessment and Management by AHA/ACC Acute PE Clinical Categories.**

Initial assessment and management of acute PE by category with associated COR 1 and 2a recommendations along with select COR 2b recommendations. Additional COR 2b recommendations that are not included in this figure may be appropriate in select clinical cases.

ACC indicates American College of Cardiology; AHA, American Heart Association; CDL, catheter-directed thrombolysis; COR, class of recommendation; CT, computed tomography; DOAC, direct oral anticoagulant; ECMO, extracorporeal membrane oxygenation; LMWH, low-molecular-weight heparin; MT, mechanical thrombectomy; PE, pulmonary embolism; PERT, PE response team; PESI, Pulmonary Embolism Severity Index; RV, right ventricle; sPESI, simplified PESI; UFH, unfractionated heparin; and VA, venoarterial.



**Figure 8. AHA/ACC 2026 GL on PE.** Example of a PERT Activation.

The model and process of PERT activation. When a PE is diagnosed, the designated in-house PERT physician is paged, pertinent clinical information is gathered, and the severity of the case is assessed. If necessary, members of a multidisciplinary team discuss the case via phone, virtual meeting, or in person. Diagnostic and treatment options are discussed, recommendations are generated, and appropriate resources are mobilized. Upon discharge, patients follow up in a multidisciplinary clinic. COR indicates class of recommendation; PE, pulmonary embolism; PERT, pulmonary embolism response team.

Table 15. AHA/ACC 2026 GL on PE. Medical Therapy

## Anticoagulation Therapy

|                                                           |      |                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                                         | B-R  | 1. In patients with acute PE who do not have an absolute contraindication to anticoagulation therapy, anticoagulation therapy should be initiated to reduce the risk of recurrent VTE and death. <sup>1</sup>                                                                    |
| 1                                                         | B-R  | 2. In patients with acute PE in AHA/ACC Categories C1-E1 who require parenteral anticoagulant therapy initially, LMWH is recommended over UFH to reduce recurrent VTE and major bleeding. <sup>2</sup>                                                                           |
| 1                                                         | B-R  | 3. In patients with acute PE who are eligible for oral anticoagulation, DOACs are recommended over vitamin K antagonists (VKAs), unless contraindicated, to prevent recurrent VTE and reduce major bleeding. <sup>3,4</sup>                                                      |
| 2a                                                        | C-EO | 4. In patients with suspected acute PE in AHA/ACC PE Category C2 or higher and in whom the bleeding risk is low, it may be beneficial to administer therapeutic anticoagulation when imaging is delayed or not immediately accessible.                                           |
| <b>Anticoagulation Therapy and Special Considerations</b> |      |                                                                                                                                                                                                                                                                                  |
| <b>Obesity</b>                                            |      |                                                                                                                                                                                                                                                                                  |
| 2a                                                        | B-NR | 5. In patients with obesity (body mass index [BMI] >30 kg/m <sup>2</sup> ) and acute PE who are receiving oral anticoagulant therapy, treatment with a DOAC (unless contraindicated) over a VKA is reasonable to prevent recurrent PE and reduce major bleeding. <sup>5-10</sup> |
| 2b                                                        | B-NR | 6. In patients with class III obesity (BMI >40 kg/m <sup>2</sup> ) and acute PE who are receiving LMWH therapy, reducing the dose of LMWH may be reasonable to reduce the risk of bleeding. <sup>11,12</sup>                                                                     |
| <b>Thrombotic Antiphospholipid Antibody Syndrome</b>      |      |                                                                                                                                                                                                                                                                                  |
| 1                                                         | A    | 7. In patients with acute PE and established thrombotic antiphospholipid antibody syndrome, a VKA is recommended in preference to a DOAC for the prevention of venous and arterial thrombosis. <sup>13-16</sup>                                                                  |
| 2b                                                        | B-R  | 8. In patients with acute PE determined to have only a single anticardiolipin antibody or a $\beta$ 2-glycoprotein antibody, a DOAC might be a reasonable alternative to a VKA to prevent recurrent PE. <sup>13-15</sup>                                                         |
| <b>Primary or Metastatic Brain Tumor</b>                  |      |                                                                                                                                                                                                                                                                                  |
| 2b                                                        | C-LD | 9. In patients with primary or metastatic brain tumors and acute PE who are otherwise eligible for oral anticoagulation, a DOAC may be considered over LMWH to reduce the risk of ICH. <sup>17-19</sup>                                                                          |
| <b>Chronic Kidney Disease</b>                             |      |                                                                                                                                                                                                                                                                                  |
| 1                                                         | A    | 10. In patients with mild-to-moderate (stage 2-3) chronic kidney disease (CKD) and acute PE who require oral anticoagulant therapy, a DOAC is recommended over a VKA to reduce major bleeding. <sup>20-22</sup>                                                                  |

|                                                              |      |                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2b                                                           | B-NR | 11. In patients with severe kidney disease (stage 4-5) or endstage kidney disease on hemodialysis and confirmed PE who require oral anticoagulant therapy, it is uncertain whether apixaban is better than VKA to reduce major bleeding. <sup>23,24</sup>                                                                                             |
| <b>Pregnancy</b>                                             |      |                                                                                                                                                                                                                                                                                                                                                       |
| 1                                                            | C-LD | 12. In patients who are pregnant, have acute PE, and can receive anticoagulation, either LMWH or UFH are recommended to prevent recurrent VTE. <sup>25</sup>                                                                                                                                                                                          |
| 3: Harm                                                      | C-LD | 13. In patients who are pregnant and have acute PE, DOACs and warfarin are potentially harmful and may result in miscarriages or fetal anomalies. <sup>26</sup>                                                                                                                                                                                       |
| <b>Breastfeeding</b>                                         |      |                                                                                                                                                                                                                                                                                                                                                       |
| 1                                                            | C-LD | 14. In patients with acute PE who are breastfeeding and require anticoagulation, LMWH, UFH, or warfarin are recommended over a DOAC, to prevent potential bleeding in the infant. <sup>26,27</sup>                                                                                                                                                    |
| <b>Chronic Liver Disease</b>                                 |      |                                                                                                                                                                                                                                                                                                                                                       |
| 2a                                                           | C-LD | 15. In patients with Child-Pugh class A chronic liver disease and acute PE, treatment with a DOAC instead of a VKA is reasonable to reduce bleeding. <sup>28</sup>                                                                                                                                                                                    |
| 2b                                                           | C-LD | 16. In patients with Child-Pugh class B chronic liver disease and acute PE, treatment with a DOAC instead of a VKA may be reasonable to reduce bleeding risk. <sup>28</sup>                                                                                                                                                                           |
| 3: Harm                                                      | C-LD | 17. In patients with Child-Pugh class C chronic liver disease and acute PE, treatment with a DOAC instead of a VKA is not recommended due to potential for increased bleeding. <sup>28</sup>                                                                                                                                                          |
| <b>Anticoagulation Therapy and Endovascular Procedures</b>   |      |                                                                                                                                                                                                                                                                                                                                                       |
| 1                                                            | C-LD | 18. In patients with acute PE undergoing CDL, concurrent therapeutic anticoagulation (LMWH or UFH) or subtherapeutic anticoagulation (UFH) is recommended over no anticoagulation to prevent recurrent PE. <sup>3,29</sup>                                                                                                                            |
| 1                                                            | B-NR | 19. In patients with acute PE who have undergone an endovascular procedure or received thrombolytic therapy, initial parenteral anticoagulation with LMWH is preferred over UFH to provide reliable therapeutic anticoagulation and reduce the risk of recurrent VTE. <sup>30-32</sup>                                                                |
| 2a                                                           | C-LD | 20. In patients with acute PE likely to undergo endovascular procedures for PE management, LMWH is reasonable over UFH to provide more effective anticoagulation. <sup>29</sup>                                                                                                                                                                       |
| <b>Anticoagulation Monitoring and Special Considerations</b> |      |                                                                                                                                                                                                                                                                                                                                                       |
| 1                                                            | C-LD | 21. In patients with acute PE in whom LMWH is monitored, measuring a peak anti-Xa level 3 to 5 hours after an LMWH dose once a steady state is reached ( $\geq 3$ doses) is recommended in preference to checking trough or random levels in order to most accurately identify if the patient is within the expected therapeutic range. <sup>33</sup> |
| 2a                                                           | C-LD | 22. In patients with acute PE who have severe CKD (CrCl of $<30$ mL/min) and are being treated with LMWH, it is reasonable to monitor anti-Xa levels to guide dose adjustment in order to reduce bleeding risk. <sup>34,35</sup>                                                                                                                      |
| 2b                                                           | C-LD | 23. In pregnant patients treated with LMWH for acute PE, the usefulness of monitoring the peak anti-Xa level at least once per trimester is not well established to guide dose adjustment and reduce bleeding and/or thromboembolic risk. <sup>36,37</sup>                                                                                            |

|                      |             |                                                                                                                                                                                                                                                                         |
|----------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2b</b>            | <b>C-LD</b> | 24. In patients who weigh >150 kg or have a BMI of >40 kg/m <sup>2</sup> and are receiving LMWH for treatment of acute PE, the benefit of monitoring anti-Xa levels is not established to avoid supratherapeutic levels of LMWH after initial therapy. <sup>34,38</sup> |
| <b>2b</b>            | <b>C-LD</b> | 25. In patients with acute PE treated with LMWH in the ICU, the benefit of monitoring anti-Xa levels is not established to avoid supratherapeutic and/or subtherapeutic levels. <sup>39</sup>                                                                           |
| <b>3: No Benefit</b> | <b>A</b>    | 26. In most patients with acute PE treated with weight-based LMWH, laboratory monitoring of anti-Xa level and dose adjustment is not indicated to reduce recurrent VTE or bleeding. <sup>40-45</sup>                                                                    |

### Hemodynamic Pharmacotherapy

|           |             |                                                                                                                                                                                                                                                                                                |
|-----------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | <b>C-LD</b> | 1. For patients with cardiogenic shock due to acute PE (AHA/ACC PE Categories D2-E2), the use of vasopressors and/or inotropes is recommended to improve cardiac output and systemic perfusion. <sup>1-4</sup>                                                                                 |
| <b>2b</b> | <b>C-LD</b> | 2. In patients with acute PE in AHA/ACC PE Categories D1-2 in whom there are concerns for reduced preload based on clinical assessment, the use of volume management with normal saline or other volume expanders may be considered to improve cardiac output and blood pressure. <sup>5</sup> |
| <b>2b</b> | <b>B-R</b>  | 3. For patients with acute PE in AHA/ACC PE Categories C2-E, the use of inhaled pulmonary vasodilators may be considered to reduce RV afterload. <sup>6-8</sup>                                                                                                                                |

### Sedation and Ventilatory Strategies

|                |             |                                                                                                                                                                                                                                                                                               |
|----------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>       | <b>C-LD</b> | 1. In patients with acute PE in AHA/ACC PE Categories C-E who require sedation for intubation, hemodynamic supportive therapies (vasopressors, inotropes, and/or venoarterial [VA]-ECMO) should be available to support the patient in the event the patient becomes unstable. <sup>1-3</sup> |
| <b>2a</b>      | <b>C-LD</b> | 2. For patients with acute PE and moderate-severe hypoxia, use of heated high-flow nasal cannula (HFNC) oxygenation rather than standard nasal cannula oxygenation can be beneficial to improve oxygenation. <sup>4,5</sup>                                                                   |
| <b>3: Harm</b> | <b>C-LD</b> | 3. In patients with acute PE in AHA/ACC PE Categories C-E, deep sedation and mechanical ventilation should not be performed, unless clinically indicated, in order to avoid hemodynamic collapse. <sup>1-3</sup>                                                                              |

**Mechanical Circulatory Support**

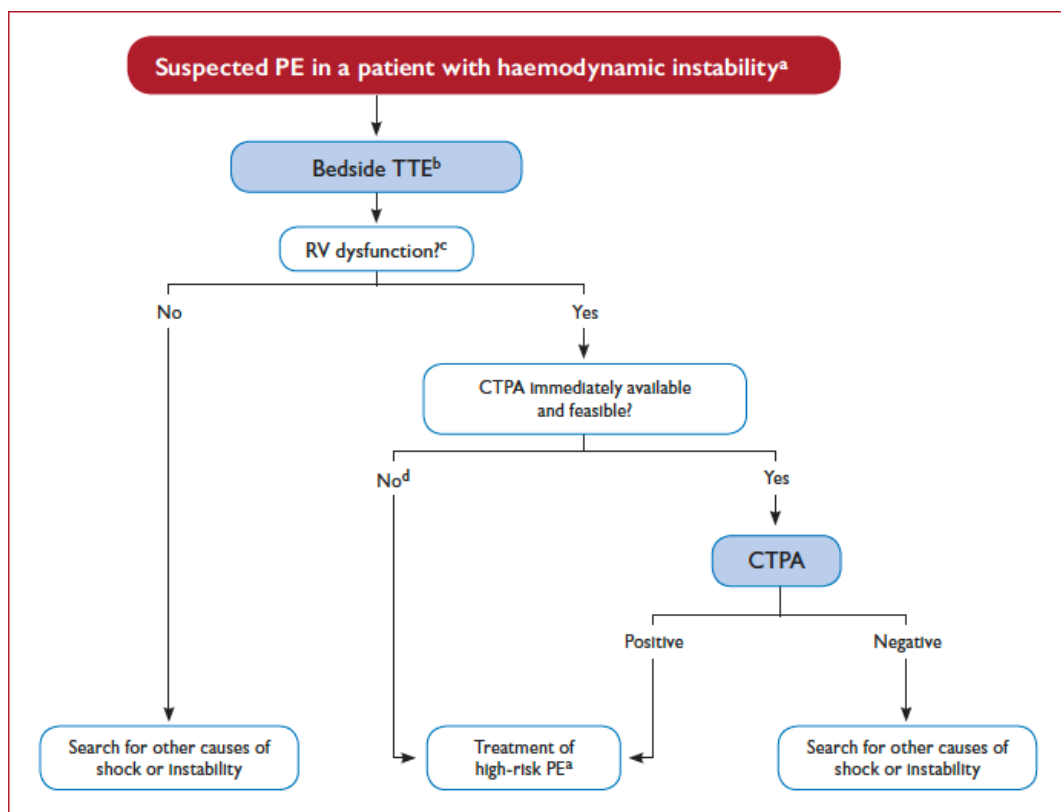
|           |             |                                                                                                                                                                                                                                                                                     |
|-----------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | <b>B-NR</b> | 1. In patients with known or suspected acute PE on VA-ECMO, continuation of parenteral systemic anticoagulation is recommended in the absence of bleeding to prevent further thrombotic or embolic complications. <sup>1,2</sup>                                                    |
| <b>2a</b> | <b>B-NR</b> | 2. In patients with acute, refractory cardiogenic shock as a result of known or suspected acute PE (AHA/ACC PE Category E2), it is reasonable to institute VA-ECMO, provided appropriate resources are available, to stabilize hemodynamics and improve oxygenation. <sup>3-6</sup> |
| <b>2b</b> | <b>C-LD</b> | 3. In patients with acute PE in AHA/ACC PE Category E2 who are placed on VA-ECMO support, the usefulness of additional advanced therapies is not well established. <sup>7-9</sup>                                                                                                   |

**Table 16. Inferior Vena Cava Filters****ESC 2019 GL on PE. Recommendations for inferior vena cava filters**

|                                                                                          |       |
|------------------------------------------------------------------------------------------|-------|
| IVC filters in patients with acute PE and absolute contraindications to anticoagulation. | IIa C |
| IVC filters in cases of PE recurrence despite therapeutic anticoagulation.               | IIa C |
| Routine use of IVC filters is not recommended.                                           | III A |

**AHA/ACC 2026 GL on PE. Inferior Vena Cava Filter**

|                |             |                                                                                                                                                                                                                                                                                                              |
|----------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>       | <b>B-R</b>  | 1. In patients with acute PE who cannot tolerate anti-coagulation but in whom an IVC filter is deemed necessary, retrievable IVC filters are recommended over permanent filters to reduce the short-term incidence of recurrent PE while minimizing long-term adverse outcomes. <sup>1,2</sup>               |
| <b>1</b>       | <b>C-LD</b> | 2. In patients with retrievable IVC filters, retrieval should be attempted as soon as the risk of PE has sufficiently decreased and anticoagulation tolerated in order to minimize the risk of long-term filter-related complications. <sup>3</sup>                                                          |
| <b>2a</b>      | <b>B-R</b>  | 3. In patients with acute PE who cannot tolerate anti-coagulation, IVC filters can be useful to reduce the short-term incidence of recurrent PE. <sup>1,2,4-7</sup>                                                                                                                                          |
| <b>2a</b>      | <b>C-LD</b> | 4. In patients with indwelling IVC filters, the use of a structured follow-up program is reasonable to increase retrieval rates and detect complications. <sup>5-8</sup>                                                                                                                                     |
| <b>2b</b>      | <b>C-LD</b> | 5. In patients with acute PE in AHA/ACC PE Categories D-E, and who are undergoing advanced interventions such as systemic thrombolysis, CDL, MT, or surgical embolectomy, the benefit of IVC filter placement is uncertain to reduce the short-term incidence of recurrent PE and mortality. <sup>9-11</sup> |
| <b>2b</b>      | <b>C-LD</b> | 6. In patients with recurrent PE despite optimal therapeutic anticoagulation who are in AHA/ACC PE Categories B-E, IVC filter placement may be considered to reduce the short-term incidence of additional recurrent PE. <sup>1,2,4,12</sup>                                                                 |
| <b>3: Harm</b> | <b>A</b>    | 7. In patients with acute PE who are therapeutically anticoagulated, routine IVC filter placement should not be performed. <sup>5-8</sup>                                                                                                                                                                    |



**Figure 9. ESC 2019 GL on PE.** Diagnostic algorithm for patients with suspected high-risk pulmonary embolism presenting with haemodynamic instability.

a See above for definition of haemodynamic instability and high-risk PE.

b Ancillary bedside imaging tests may include TOE, which may detect emboli in the pulmonary artery and its main branches; and bilateral venous CUS, which may confirm DVT and thus VTE.

c In the emergency situation of suspected high-risk PE, this refers mainly to a RV/LV diameter ratio  $>1.0$ .

d Includes the cases in which the patient's condition is so critical that it only allows bedside diagnostic tests. In such cases, echocardiographic findings of RV dysfunction confirm high-risk PE and emergency reperfusion therapy is recommended.

CTPA= computed tomography pulmonary angiography; CUS = compression ultrasonography; DVT= deep vein thrombosis; LV = left ventricle; PE= pulmonary embolism; RV = right ventricle; TOE= transoesophageal echocardiography; TTE = transthoracic echocardiogram.

**Table 17. ESC 2019 GL on PE Acute therapy of haemodynamically unstable patients.****Recommendations for acute-phase treatment of high-risk pulmonary embolism<sup>a</sup>**

|                                                                                                                                                                       |       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Anticoagulation with UFH, including a weight-adjusted bolus injection, to be initiated without delay in patients with high-risk PE.                                   | I C   |
| Systemic thrombolytic therapy for high-risk PE.                                                                                                                       | I B   |
| Surgical pulmonary embolectomy for patients with high-risk PE, in whom thrombolysis is contraindicated or has failed. <sup>b</sup>                                    | I C   |
| Percutaneous catheter-directed treatment should be considered for patients with high-risk PE, in whom thrombolysis is contraindicated or has failed. <sup>b</sup>     | IIa C |
| Norepinephrine and/or dobutamine in patients with high-risk PE.                                                                                                       | IIa C |
| ECMO in combination with surgical embolectomy or catheter-directed treatment, in patients with PE and refractory circulatory collapse or cardiac arrest. <sup>b</sup> | IIb C |

<sup>a</sup> See above for definition of high-risk PE. After haemodynamic stabilization of the patient, continue with anticoagulation treatment as in intermediate- or low-risk PE.

<sup>b</sup> If appropriate expertise and resources are available on-site.

ECMO = extracorporeal membrane oxygenation; PE = pulmonary embolism; UFH = unfractionated heparin.

**Recommendations for multidisciplinary pulmonary embolism teams**

|                                                                                                                                                                                                   |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Set-up of a multidisciplinary team and a programme for the management of high- and (in selected cases) intermediate-risk PE, depending on the resources and expertise available in each hospital. | IIa C |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|

**Table 18. ESC 2019 GL on PE. Thrombolytic regimens, doses, and contraindications**

| Molecule      | Regimen                                                                         | Contraindications to fibrinolysis                                                                                                                                                                                                                                                                                             |
|---------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| rtPA          | 100 mg over 2 h                                                                 | <b>Absolute</b><br>History of haemorrhagic stroke or stroke of unknown origin<br>Ischaemic stroke in previous 6 months<br>Central nervous system neoplasm<br>Major trauma, surgery, or head injury in previous 3 weeks<br>Bleeding diathesis<br>Active bleeding                                                               |
|               | 0.6 mg/kg over 15 min (maximum dose 50 mg) <sup>a</sup>                         |                                                                                                                                                                                                                                                                                                                               |
| Streptokinase | 250 000 IU as a loading dose over 30 min, followed by 100 000 IU/h over 12–24 h | <b>Relative</b><br>Transient ischaemic attack in previous 6 months<br>Oral anticoagulation<br>Pregnancy or first post-partum week<br>Non-compressible puncture sites<br>Traumatic resuscitation<br>Refractory hypertension (systolic BP >180 mmHg)<br>Advanced liver disease<br>Infective endocarditis<br>Active peptic ulcer |
| Urokinase     | Accelerated regimen: 1.5 million IU over 2 h                                    |                                                                                                                                                                                                                                                                                                                               |
|               | 4400 IU/kg as a loading dose over 10 min, followed by 4400 IU/kg/h over 12–24 h |                                                                                                                                                                                                                                                                                                                               |
|               | Accelerated regimen: 3 million IU over 2 h                                      |                                                                                                                                                                                                                                                                                                                               |

<sup>a</sup> This is the accelerated regimen for rtPA in pulmonary embolism; it is not officially approved, but it is sometimes used in extreme haemodynamic instability such as cardiac arrest.

BP = blood pressure; IU = international units; rtPA, recombinant tissue-type plasminogen activator.

**Table 19. ESC 2019 GL on PE. Treatment of right ventricular failure in acute high-risk pulmonary embolism**

| Strategy                                                                     | Properties and use                                                                                                          | Caveats                                                                                                                                                                                 |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Volume optimization</b>                                                   |                                                                                                                             |                                                                                                                                                                                         |
| Cautious volume loading, saline, or Ringer's lactate, ≤500 mL over 15–30 min | Consider in patients with normal–low central venous pressure (due, for example, to concomitant hypovolaemia)                | Volume loading can over-distend the RV, worsen ventricular interdependence, and reduce CO <sup>239</sup>                                                                                |
| <b>Vasopressors and inotropes</b>                                            |                                                                                                                             |                                                                                                                                                                                         |
| Norepinephrine, 0.2–1.0 µg/kg/min <sup>240</sup>                             | Increases RV inotropy and systemic BP, promotes positive ventricular interactions, and restores coronary perfusion gradient | Excessive vasoconstriction may worsen tissue perfusion                                                                                                                                  |
| Dobutamine, 2–20 µg/kg/min <sup>241</sup>                                    | Increases RV inotropy, lowers filling pressures                                                                             | May aggravate arterial hypotension if used alone, without a vasopressor; may trigger or aggravate arrhythmias                                                                           |
| <b>Mechanical circulatory support</b>                                        |                                                                                                                             |                                                                                                                                                                                         |
| Veno–arterial ECMO/extracorporeal life support <sup>251,252,258</sup>        | Rapid short-term support combined with oxygenator                                                                           | Complications with use over longer periods (>5–10 days), including bleeding and infections; no clinical benefit unless combined with surgical embolectomy; requires an experienced team |

<sup>a</sup> Epinephrine is used in cardiac arrest.

CO = cardiac output; BP = blood pressure; ECMO = extracorporeal membrane oxygenation; RV = right ventricle/ventricular.

**Table 20. AHA/ACC 2026 GL on PE. Advanced Management**

|           |             |                                                                                                                                                                                                                                                                                        |
|-----------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2a</b> | <b>C-LD</b> | 1. In patients with acute PE in AHA/ACC PE Categories C3-E2 who have evidence of free-floating right atrial and/or RV clot-in-transit, the utilization of advanced therapies over anticoagulation alone is reasonable to reduce the risk of clinical deterioration. <sup>1</sup>       |
| <b>2b</b> | <b>B-R</b>  | 2. In patients with acute PE in AHA/ACC PE Categories C2-D2 and without contraindications to thrombolysis, and in whom advanced therapy is being considered, the usefulness of either CDL or MT over the other is uncertain for reduction in mortality or major bleeding. <sup>2</sup> |

**Summary of Advanced Therapy Recommendations (COR LOE\*)**

| AHA/ACC PE Risk Outcomes Category | Systemic Lysis              | CDL                         | MT                          | Surgery           |
|-----------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| A-C1                              | 3-Harm A                    | 3-NB C-EO                   | 3-NB C-EO                   | 3-NB C-EO         |
| C2                                | 3-Harm B-R                  | 2b C-LD (unclear)           | 2b C-LD (unclear)           | 3-NB C-EO         |
| C3                                | 2b C-LD (unclear)           | 2b C-LD (unclear)           | 2b C-LD (unclear)           | 3-NB C-EO         |
| D1-2                              | 2b C-LD (may be considered) | 2b B-NR (may be considered) | 2b B-NR (may be considered) | 2b C-LD (unclear) |
| E1                                | 2a C-LD                     | 2a C-LD                     | 2a B-NR                     | 2a B-NR           |
| E2                                | 2a C-LD                     | N/A                         | N/A                         | 3-NB B-NR         |

ACC indicates American College of Cardiology; AHA, American Heart Association; CDL, catheter-directed thrombolysis; COR, Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; MT, mechanical thrombectomy; NB, no benefit; NR, nonrandomized; R, randomized.

### Systemic Thrombolysis

|                |             |                                                                                                                                                                                                                                                                                             |
|----------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2a</b>      | <b>C-LD</b> | 1. In patients with acute PE in AHA/ACC PE Categories E1-2 and acceptable bleeding risk, in whom advanced therapy is being considered, systemic thrombolysis and anticoagulation is reasonable over anticoagulation alone to reduce mortality and recurrent PE. <sup>1-3</sup>              |
| <b>2b</b>      | <b>C-LD</b> | 2. In patients with acute PE in AHA/ACC PE Categories D1-2 and an acceptable bleeding risk, in whom advanced therapy is being considered, systemic thrombolysis and anticoagulation may be considered over anticoagulation alone to prevent further clinical deterioration. <sup>1,4</sup>  |
| <b>2b</b>      | <b>C-LD</b> | 3. In patients with acute PE in AHA/ACC PE Category C3 and acceptable bleeding risk, in whom advanced therapy is being considered, the use of systemic thrombolysis and anticoagulation over anticoagulation alone to prevent further clinical deterioration is uncertain. <sup>1,4,5</sup> |
| <b>2b</b>      | <b>C-LD</b> | 4. In patients with acute PE being treated with systemic thrombolysis, lower dose systemic thrombolytics may be considered to reduce the risk of bleeding. <sup>6-10</sup>                                                                                                                  |
| <b>3: Harm</b> | <b>B-R</b>  | 5. In patients with acute PE in AHA/ACC PE Categories A1-C2, systemic thrombolysis should not be used over anticoagulation alone due to increased risk of major bleeding and ICH. <sup>5,11,12</sup>                                                                                        |

**Catheter-Directed Thrombolysis**

|                      |             |                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2a</b>            | <b>C-LD</b> | 1. In patients with acute PE in AHA/ACC PE Category E1, CDL plus anticoagulation is reasonable to prevent further clinical deterioration and early mortality. <sup>1,8</sup>                                                                                                                                                                                                                            |
| <b>2b</b>            | <b>B-NR</b> | 2. In patients with acute PE in AHA/ACC PE Categories D1-2 in whom advanced therapy is being considered, CDL plus anticoagulation may be considered to prevent further clinical deterioration. <sup>2</sup>                                                                                                                                                                                             |
| <b>2b</b>            | <b>C-LD</b> | 3. In patients with acute PE in AHA/ACC PE Categories C2-3, the benefit of CDL plus anticoagulation compared with anticoagulation alone to prevent short-term fatal/nonfatal clinical deterioration, and improve long-term mortality, functional capacity, and quality of life is unclear. <sup>3</sup>                                                                                                 |
| <b>2b</b>            | <b>C-LD</b> | 4. In patients with acute PE in AHA/ACC PE Categories D1-E1 in whom thrombolysis is being considered, the efficacy of CDL over systemic thrombolysis to reduce short-term fatal/nonfatal clinical deterioration, and improve long-term survival, functional capacity, and quality of life is unclear, but CDL may be considered over systemic thrombolysis to reduce major bleeding risks. <sup>4</sup> |
| <b>3: No Benefit</b> | <b>B-NR</b> | 5. In patients with acute PE who are undergoing CDL, a reduced thrombolytic dose of <5 mg of alteplase per PA is not recommended over a standard dose of 5 to 10 mg of alteplase per PA to reduce the risk of bleeding and/or reduce the rate of fatal or nonfatal clinical deterioration. <sup>3,5</sup>                                                                                               |
| <b>3: No Benefit</b> | <b>C-EO</b> | 6. In patients with acute PE in AHA/ACC PE Categories A-C1, CDL is not recommended over anticoagulation alone for improving clinical outcomes or symptoms.                                                                                                                                                                                                                                              |

### Mechanical Thrombectomy

|                      |             |                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2a</b>            | <b>B-NR</b> | 1. In patients with acute PE in AHA/ACC PE Category E1, it is reasonable to choose MT plus anticoagulation over anticoagulation alone to prevent further clinical decompensation and acute mortality. <sup>1-3</sup>                                                                                                                                                                                       |
| <b>2b</b>            | <b>B-NR</b> | 2. In patients with acute PE in AHA/ACC PE Categories D1-2 in whom advanced therapy is being considered, MT plus anticoagulation may be considered over anticoagulation alone to prevent further clinical deterioration. <sup>4-6</sup>                                                                                                                                                                    |
| <b>2b</b>            | <b>C-LD</b> | 3. In patients with acute PE in AHA/ACC PE Categories C2-3, the benefit of MT plus anticoagulation compared with anticoagulation alone is unclear in preventing short-term fatal/nonfatal clinical deterioration and improving long-term survival and functional capacity. <sup>7</sup>                                                                                                                    |
| <b>2b</b>            | <b>B-NR</b> | 4. In patients with acute PE in AHA/ACC PE Categories D1-E1 in whom advanced therapy is being considered, the efficacy of MT to reduce short-term fatal/nonfatal clinical deterioration and improve long-term survival, functional capacity, and quality of life over systemic thrombolysis is unclear, but MT may be considered over systemic thrombolysis to reduce major bleeding risks. <sup>3,6</sup> |
| <b>3: No Benefit</b> | <b>C-EO</b> | 5. In patients with acute PE in AHA/ACC PE Categories A-C1, MT is not recommended over anticoagulation alone for improving clinical outcomes or symptoms.                                                                                                                                                                                                                                                  |

### Surgical Embolectomy

|                      |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2a</b>            | <b>B-NR</b> | 1. In patients with acute PE in AHA/ACC PE Category E1, surgical embolectomy compared with anticoagulation alone is reasonable to prevent further clinical decompensation and acute mortality. <sup>1-5</sup>                                                                                                                                                                                                                                                                |
| <b>2b</b>            | <b>C-LD</b> | 2. In patients with acute PE in AHA/ACC PE Categories D1-2 in whom advanced treatment is being considered, surgical embolectomy plus anticoagulation may be considered over anticoagulation alone to prevent further clinical deterioration. <sup>1-5</sup>                                                                                                                                                                                                                  |
| <b>2b</b>            | <b>B-NR</b> | 3. In patients with acute PE in AHA/ACC PE Categories D1-E1 who are surgical candidates and in whom advanced therapy is being considered, the benefits of surgical embolectomy to reduce short-term fatal/nonfatal clinical deterioration and improve long-term survival, functional capacity, and quality of life over systemic thrombolysis is unclear, but surgical embolectomy may be considered over systemic thrombolysis to reduce the risk of ICH. <sup>4-8,12</sup> |
| <b>3: No Benefit</b> | <b>C-EO</b> | 4. In patients with acute PE in AHA/ACC PE Categories A-C3, surgical embolectomy is not recommended over anticoagulation alone for improving clinical outcomes or symptoms.                                                                                                                                                                                                                                                                                                  |
| <b>3: No Benefit</b> | <b>B-NR</b> | 5. In patients with acute PE in AHA/ACC PE Category E2 not on mechanical circulatory support, surgical embolectomy is not recommended over other advanced therapies for preventing short-term mortality. <sup>9</sup>                                                                                                                                                                                                                                                        |

**Table 21. AHA/ACC 2026 GL on PE.**  
**Anticoagulation Therapy by Recurrence Risk**

|           |             |                                                                                                                                                                                                                                                                                                                                                                         |
|-----------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | <b>A</b>    | 1. In patients with a first acute PE and no major reversible risk factor, continuing anticoagulation beyond the initial treatment phase (3-6 months) into the extended treatment phase* is beneficial to prevent recurrent VTE. <sup>1-4</sup>                                                                                                                          |
| <b>1</b>  | <b>B-NR</b> | 2. In patients with a first acute PE due to a major reversible risk factor, stopping anticoagulation at the end of the initial treatment phase (3-6 months) is recommended over continuing anticoagulation into the extended treatment phase in order to optimize the net clinical benefit of recurrent VTE versus bleeding. <sup>5</sup>                               |
| <b>1</b>  | <b>C-LD</b> | 3. In patients with a first PE due to a persistent risk factor, continuing anticoagulation at the initial treatment phase (3-6 months) into the extended treatment phase is reasonable in order to prevent recurrent VTE. <sup>6</sup>                                                                                                                                  |
| <b>1</b>  | <b>A</b>    | 4. For patients with a PE who are offered anti-coagulation beyond the initial treatment phase (3-6 months) into the extended treatment phase, treatment with a DOAC, unless contraindicated, is recommended over a VKA to reduce the risk of bleeding. <sup>7-9</sup>                                                                                                   |
| <b>1</b>  | <b>A</b>    | 5. For patients with a PE and with cancer who are offered anticoagulation beyond the initial treatment phase (3-6 months) into the extended treatment phase, either a DOAC or LMWH is recommended over VKA to reduce the risk of recurrent VTE. <sup>10-15</sup>                                                                                                        |
| <b>1</b>  | <b>B-R</b>  | 6. For patients with a PE and without cancer offered anticoagulation beyond the initial treatment phase (3-6 months) into the extended treatment phase, but have a contraindication to DOAC, VKA is recommended over aspirin or no therapy to reduce the risk of recurrent VTE. <sup>16-18</sup>                                                                        |
| <b>1</b>  | <b>A</b>    | 7. For patients with a PE who are offered anticoagulation beyond the initial treatment phase (3-6 months) into the extended treatment phase, treatment with half-dose apixaban or rivaroxaban is recommended to reduce the risk of bleeding. <sup>8,9,19,20</sup>                                                                                                       |
| <b>2a</b> | <b>B-NR</b> | 8. In patients with a first acute PE due to a minor reversible risk factor, shared decision-making about stopping anticoagulation at the end of the initial treatment phase (3-6 months) versus continuing anticoagulation into the extended treatment phase is reasonable in order to optimize the net clinical benefit of recurrent VTE versus bleeding. <sup>3</sup> |
| <b>2a</b> | <b>B-R</b>  | 9. For patients who would be offered anticoagulation beyond the initial treatment phase (3-6 months) into the extended treatment phase, but have a contraindication to or refuse anticoagulation, it is reasonable to choose low-dose aspirin over no therapy to reduce the risk of recurrent VTE. <sup>21,22</sup>                                                     |

\*Anticoagulation beyond the initial 3 to 6 months without an anticipated stop date.

## Recurrent Pulmonary Embolism

|    |      |                                                                                                                                                                                                                                                     |
|----|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | C-EO | 1. In patients with a history of PE and who present with new symptoms and signs suggestive of recurrent or breakthrough PE, radiographic imaging with a CTPA or V/Q scan is recommended to objectively confirm or exclude the diagnosis.            |
| 1  | C-LD | 2. In patients with a history of PE who have a documented recurrent PE despite being treated with an anticoagulant, an evaluation is recommended to detect clinical and pharmacological factors that may contribute to recurrent PE. <sup>1-3</sup> |
| 2a | C-EO | 3. In patients with recurrent PE who are adherent with prescribed therapeutic-intensity anticoagulation, changing therapy to an alternative drug class rather than continuing therapy with the same drug class is reasonable.                       |
| 2a | C-EO | 4. In patients who have documented recurrent acute PE while adherent to anticoagulation with a reduced-dose DOAC, it is reasonable to anticoagulate with a full-dose DOAC within the same class.                                                    |
| 2a | B-NR | 5. In patients with cancer and a recurrent PE despite being therapeutically anticoagulated with LMWH, dose escalation of LMWH by 20% to 25% is reasonable to prevent future recurrent PE. <sup>4</sup>                                              |

**Table 22. ESC 2019 GL on PE Categorization of risk factors for venous thromboembolism based on the risk of recurrence over the long-term**

| Estimated risk for long-term recurrence <sup>a</sup> | Risk factor category for Index PE <sup>b</sup>                                                                                                       | Examples <sup>b</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low (<3% per year)                                   | Major transient or reversible factors associated with >10-fold increased risk for the index VTE event (compared to patients without the risk factor) | <ul style="list-style-type: none"> <li>• Surgery with general anaesthesia for &gt;30 min</li> <li>• Confined to bed in hospital (only "bathroom privileges") for ≥3 days due to an acute illness, or acute exacerbation of a chronic illness</li> <li>• Trauma with fractures</li> </ul>                                                                                                                                                                  |
| Intermediate (3–8% per year)                         | Transient or reversible factors associated with ≤10-fold increased risk for first (index) VTE                                                        | <ul style="list-style-type: none"> <li>• Minor surgery (general anaesthesia for &lt;30 min)</li> <li>• Admission to hospital for &lt;3 days with an acute illness</li> <li>• Oestrogen therapy/contraception</li> <li>• Pregnancy or puerperium</li> <li>• Confined to bed out of hospital for ≥3 days with an acute illness</li> <li>• Leg injury (without fracture) associated with reduced mobility for ≥3 days</li> <li>• Long-haul flight</li> </ul> |
|                                                      | Non-malignant persistent risk factors                                                                                                                | <ul style="list-style-type: none"> <li>• Inflammatory bowel disease</li> <li>• Active autoimmune disease</li> </ul>                                                                                                                                                                                                                                                                                                                                       |
|                                                      | No identifiable risk factor                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| High (>8% per year)                                  |                                                                                                                                                      | <ul style="list-style-type: none"> <li>• Active cancer</li> <li>• One or more previous episodes of VTE in the absence of a major transient or reversible factor</li> <li>• Antiphospholipid antibody syndrome</li> </ul>                                                                                                                                                                                                                                  |

<sup>a</sup> If anticoagulation is discontinued after the first 3 months

<sup>b</sup> The categorization of risk factors for the index VTE event is in line with that proposed by the International Society on Thrombosis and Haemostasis. The present Guidelines avoid terms such as 'provoked', 'unprovoked', or 'idiopathic' VTE.

PE = pulmonary embolism; VTE = venous thromboembolism

**Table 23. ESC 2019 GL on PE Recommendations for the regimen and duration of anticoagulation after pulmonary embolism in patients without cancer**

Therapeutic anticoagulation for  $\geq 3$  months for all patients with PE. I A

**Patients in whom discontinuation of anticoagulation after 3 months is recommended**

For patients with first PE/VTE secondary to a major transient/reversible risk factor I B

**Patients in whom extension of anticoagulation beyond 3 months is recommended**

Oral anticoagulant treatment of indefinite duration for patients I B  
presenting with recurrent VTE (that is, with at least one previous episode  
of PE or DVT) not related to a major transient or reversible risk factor.

Oral anticoagulant treatment with a VKA for an indefinite period for patients I B  
with antiphospholipid antibody syndrome.

**Patients in whom extension of anticoagulation beyond 3 months should be considered<sup>a,b</sup>**

Extended oral anticoagulation of indefinite duration for patients with a first episode I Ia A  
of PE and no identifiable risk factor.

Extended oral anticoagulation of indefinite duration for patients with a first episode I Ia C  
of PE associated with a persistent risk factor other than antiphospholipid antibody  
syndrome.

Extended oral anticoagulation of indefinite duration for patients with a first episode I Ia C  
of PE associated with a minor transient or reversible risk factor.

**NOAC dose in extended anticoagulation<sup>c</sup>**

If extended oral anticoagulation is decided after PE in a patient without cancer, I Ia A  
a reduced dose of the NOACs apixaban (2.5 mg b.i.d.) or rivaroxaban (10 mg o.d.)  
after 6 months of therapeutic anticoagulation.

**Extended treatment with alternative antithrombotic agents**

In patients who refuse to take or are unable to tolerate any form of oral anticoagulants, I Ib B  
aspirin or sulodexide for extended VTE prophylaxis.

**Follow-up of the patient under anticoagulation**

In patients who receive extended anticoagulation, reassess drug tolerance and adherence, I C  
hepatic and renal<sup>d</sup> function, and bleeding risk be reassessed at regular intervals.

b.i.d. = bis in die (twice a day); DVT = deep vein thrombosis; NOAC(s) = non-vitamin K antagonist oral  
anticoagulant(s); o.d. = omni die (once a day); PE = pulmonary embolism; VKA = vitamin K antagonist; VTE =  
venous thromboembolism.

a The patient's bleeding risk should be assessed (see Supplementary Data for prediction models) to  
identify and treat modifiable bleeding risk factors, and it may influence  
decision-making on the duration and regimen/dose of anticoagulant treatment.

b Refer to Supplementary Data for therapeutic decisions in specific clinical situations.

c If dabigatran or edoxaban is chosen for extended anticoagulation after PE, the dose should remain  
unchanged, as reduced-dose regimens were not investigated in dedicated  
extension trials.

d Especially for patients receiving NOACs.

**Table 24. ESC 2019 GL on PE Recommendations for the regimen and the duration of anticoagulation after pulmonary embolism in patients with active cancer**

For patients with PE and cancer, weight-adjusted subcutaneous LMWH over VKAs for the first 6 months. IIa A

Edoxaban as an alternative to weight-adjusted subcutaneous LMWH in patients without gastrointestinal cancer. IIa B

Rivaroxaban as an alternative to weight-adjusted subcutaneous LMWH in patients without gastrointestinal cancer. IIa C

For patients with PE and cancer, extended anticoagulation (beyond the first 6 months)<sup>a</sup> for an indefinite period or until the cancer is cured. IIa B

In patients with cancer, management of incidental PE in the same manner as symptomatic PE, if it involves segmental or more proximal branches, multiple subsegmental vessels, or a single subsegmental vessel in association with proven DVT. IIa B

DVT = deep vein thrombosis; LMWH = low-molecular weight heparin; PE = pulmonary embolism; VKAs = vitamin K antagonists.

<sup>a</sup> Refer to Supplementary Data for further guidance on therapeutic decisions after the first 6 months.

**Table 25. AHA/ACC 2026 GL on PE. Follow-Up Care for Acute PE**

| <b>Cancer Screening and Thrombophilia Testing in the Absence of PE Risk Factors</b> |             |                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>                                                                            | <b>A</b>    | 8. In patients with acute PE without associated identifiable risk factors, a thorough history, physical examination, and age-appropriate cancer screening should be obtained to diagnose undetected cancer. <sup>17-20</sup>                                                                                                                                       |
| <b>2b</b>                                                                           | <b>C-LD</b> | 9. In patients without a major reversible risk factor <sup>21</sup> for acute PE who have a family history of thrombosis or are <55 years of age, it might be reasonable to perform testing for genetic and acquired thrombophilia if the thrombophilia tests results are anticipated to change management or better inform family risk discussions. <sup>22</sup> |
| <b>3: No Benefit</b>                                                                | <b>A</b>    | 10. In patients with acute PE, routine imaging with CT or positron emission tomography-CT is not recommended to diagnose undetected cancer. <sup>17,18</sup>                                                                                                                                                                                                       |

**Table 26. ESC 2019 GL on PE. Recommendations for pulmonary embolism in pregnancy****Diagnosis**

|                                                                                                                                                                               |       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Formal diagnostic assessment with validated methods if PE is suspected during pregnancy or in the post-partum period.                                                         | I B   |
| D-dimer measurement and clinical prediction rules to rule out PE during pregnancy or the post-partum period.                                                                  | IIa B |
| In a pregnant patient with suspected PE (particularly if she has symptoms of DVT), Venous CUS to avoid unnecessary irradiation.                                               | IIa B |
| Perfusion scintigraphy or CTPA (with a low-radiation dose protocol) To rule out suspected PE in pregnant women; CTPA as the first-line option if the chest X-ray is abnormal. | IIa C |

**Treatment**

|                                                                                                                                            |       |
|--------------------------------------------------------------------------------------------------------------------------------------------|-------|
| A therapeutic, fixed dose of LMWH based on early pregnancy body weight in the majority of pregnant women without haemodynamic instability. | I B   |
| Thrombolysis or surgical embolectomy for pregnant women with high-risk PE                                                                  | IIa C |
| Insertion of a spinal or epidural needle is not recommended, unless $\geq 24$ h have passed since the last therapeutic dose of LMWH.       | III C |
| Administration of LMWH is not recommended within 4 h of removal of an epidural catheter.                                                   | III C |
| NOACs are not recommended during pregnancy or lactation.                                                                                   | III C |

**Amniotic fluid embolism**

|                                                                                                                                                                                                                                          |       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Consider amniotic fluid embolism in a pregnant or post-partum woman with otherwise unexplained cardiac arrest, sustained hypotension, or respiratory deterioration, especially if accompanied by disseminated intravascular coagulation. | IIa C |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|

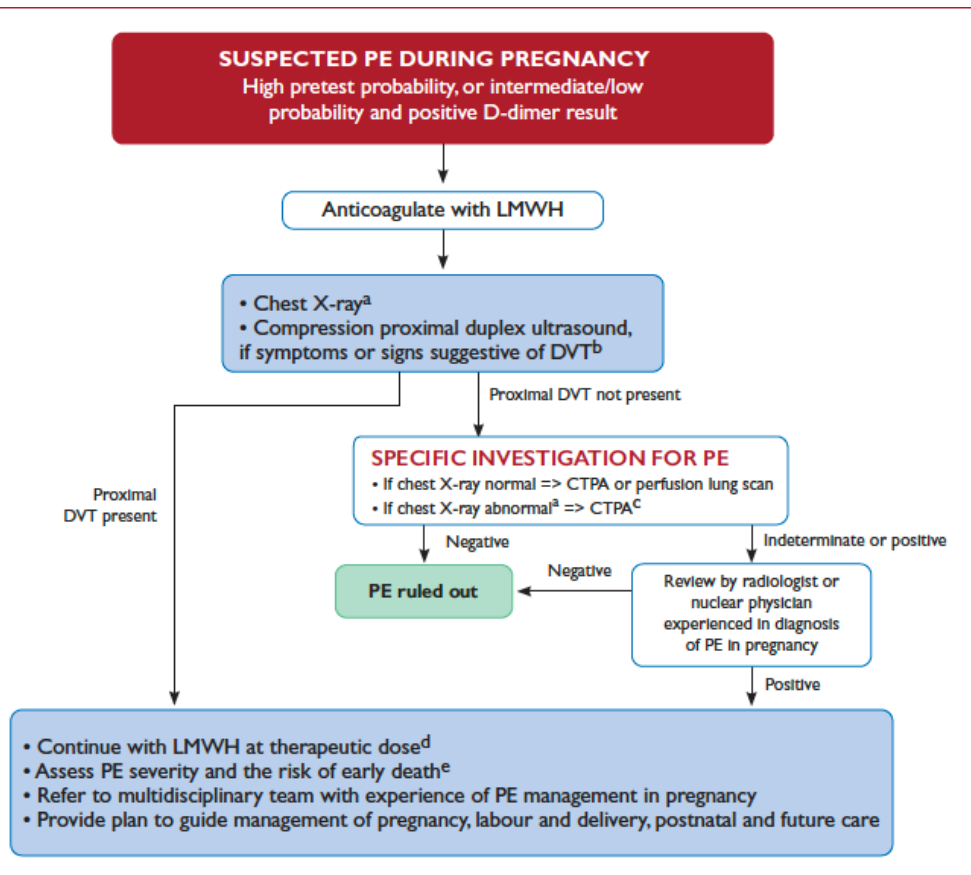
CTPA = computed tomography pulmonary angiography; CUS = compression ultrasonography; DVT = deep vein thrombosis; LMWH = low-molecular weight heparin; NOACs = non-vitamin K antagonist oral anticoagulants; PE = pulmonary embolism.

**Table 27. ESC 2019 GL on PE Estimated amounts of radiation absorbed in procedures used to diagnose pulmonary embolism**

| Test                                                     | Estimated foetal radiation exposure (mGy) <sup>a</sup> | Estimated maternal radiation exposure to breast tissue (mGy) <sup>a</sup> |
|----------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------|
| Chest X-ray                                              | <0.01                                                  | <0.1                                                                      |
| Perfusion lung scan with technetium-99m-labelled albumin |                                                        |                                                                           |
| Low dose: ~40 MBq                                        | 0.02–0.20                                              | 0.16–0.5                                                                  |
| High dose: ~200 MBq                                      | 0.20–0.60                                              | 1.2                                                                       |
| Ventilation lung scan                                    | 0.10–0.30                                              | <0.01                                                                     |
| CTPA                                                     | 0.05–0.5                                               | 3–10                                                                      |

CTPA = computed tomography pulmonary angiography; mGy = milligray; MBq = megabecquerel; PE = pulmonary embolism.

<sup>a</sup> In this section, absorbed radiation dose is expressed in mGy to reflect the radiation exposure to single organs, or the foetus, as a result of various diagnostic techniques. Compare with Table 2, in which effective radiation dose is expressed in millisieverts to reflect the effective doses of all organs that have been exposed.



**Figure 10. ESC 2019 GL on PE.** Diagnostic workup and management of suspected pulmonary embolism during pregnancy, and up to 6 weeks post-partum.

CTPA= computed tomography pulmonary angiography; CUS= compression ultrasonography; DVT= deep vein thrombosis; LMWH= low-molecular-weight heparin; PE = pulmonary embolism.

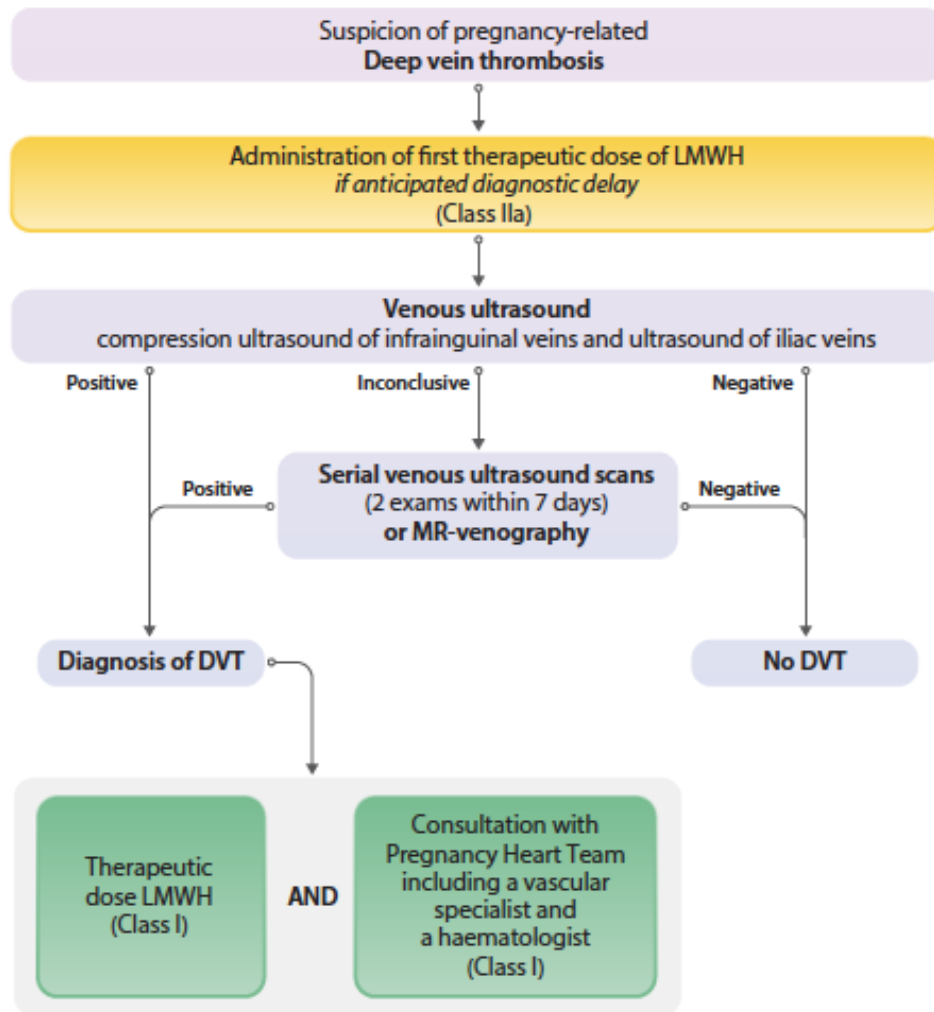
a If chest X-ray abnormal, consider also alternative cause of chest symptoms.

b DVT in pelvic veins may not be ruled out by CUS. If the entire leg is swollen, or there is buttock pain or other symptoms suggestive of pelvic thrombosis, consider magnetic resonance venography to rule out DVT.

c CTPA technique must ensure very low foetal radiation exposure

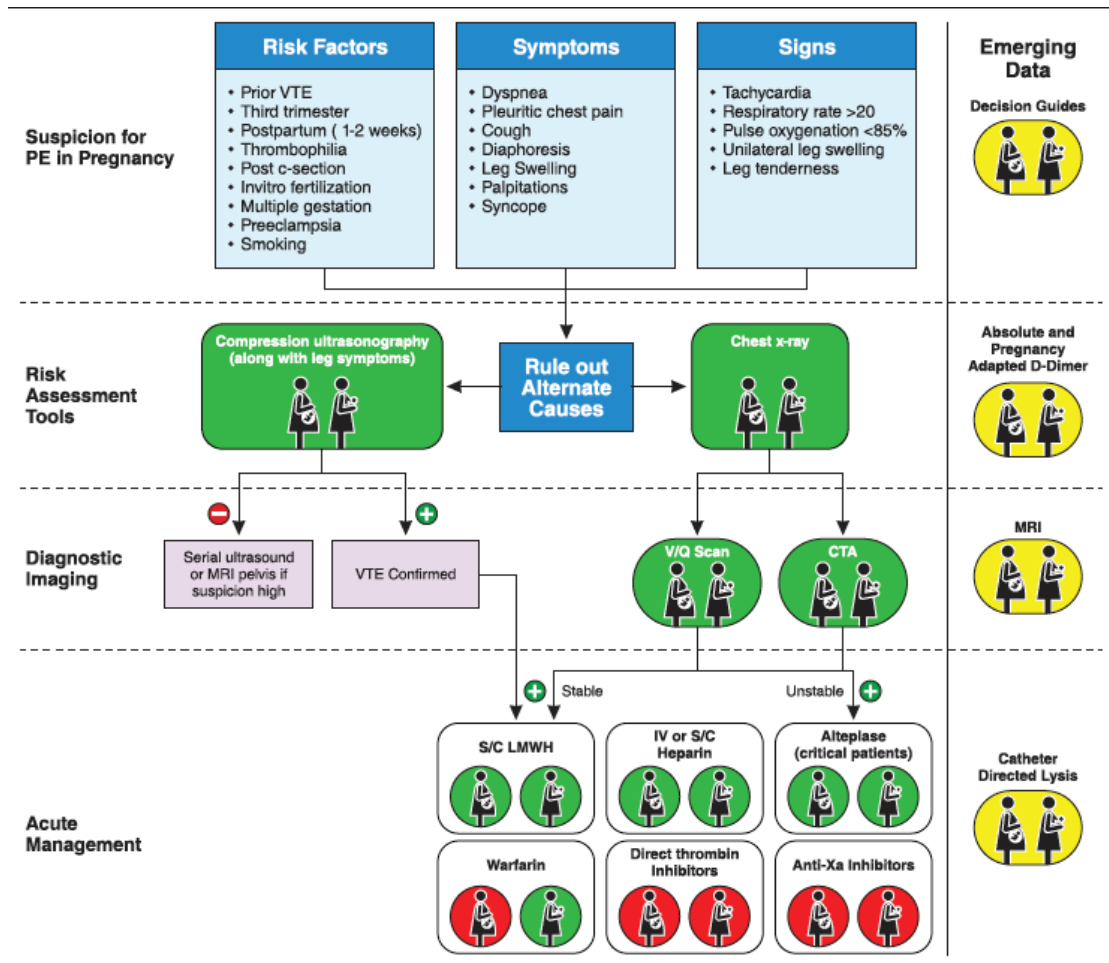
d Perform full blood count (to measure haemoglobin and platelet count) and calculate creatinine clearance before administration. Assess bleeding risk and ensure absence of contra-indications.

e See relevant Table.



**Figure 11. ESC 2025 GL on Pregnancy.** Algorithm for the diagnosis and treatment of pulmonary embolism in pregnancy in stable (A) and unstable women (B).

CTPA, computed tomography pulmonary angiography; DVT, deep vein thrombosis; LMWH, low-molecular-weight heparin; PE, pulmonary embolism; RV, right ventricle; TTE, transthoracic echocardiogram; UFH, unfractionated heparin.



**Figure 12.** Proposed algorithm for the diagnosis of pulmonary embolism (PE) during pregnancy.

Guidelines for diagnosing PE during pregnancy are limited and based on low-level evidence derived primarily from data from small observational trials. Acquired or inherited thrombophilia include lupus anticoagulant, shortened activated partial thromboplastin time, factor V Leiden, prothrombin variations, familial proteins C and S, and antithrombin deficiency. Other population-based risk factors include age; presence of autoimmune conditions, sickle cell disease, or obesity; history of cancer; or bed rest for >72 hours. Absolute cutoff for D-dimer is typically <500 µg for most commercial assays, and the adjusted cutoff may be <500 or <1000 µg or dependent on gestation. Given the high risk of hemorrhage with systemic thrombolytics, particularly in the postpartum period, catheter-based thrombolysis may be considered as an alternative. In stable patients, low-molecular-weight heparin (LMWH) is preferred over unfractionated heparin given the longer half-life, similar efficacy and safety, and lower risk of thrombocytopenia and osteoporosis.

CTA indicates computed tomographic angiography; IV, intravenous; MRI, magnetic resonance imaging; S/C, subcutaneous; V/Q, ventilation/perfusion; and VTE, venous thromboembolism

Mehta LS, et al. Cardiovascular Considerations in Caring for Pregnant Patients: A Scientific Statement From the American Heart Association. *Circulation*. 2020;141:e884-e903.

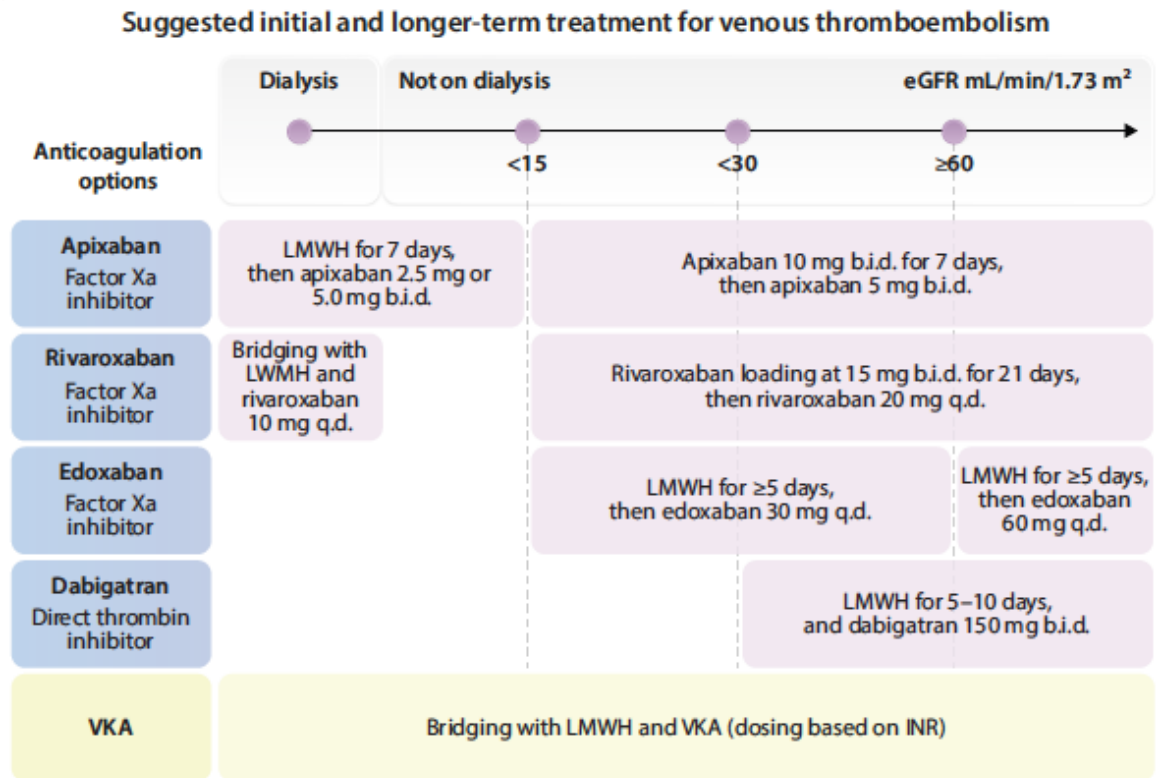
Table 28. AHA/ACC 2026 GL on PE. Follow-Up Care for Acute PE

| Contraception, Pregnancy, and Hormonal Therapy |      |                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                              | C-E0 | 11. Patients of childbearing potential with acute PE should be counseled about contraception and anticoagulation options in the event that they become pregnant.                                                                                                                                                                                                                                                           |
| 2a                                             | C-E0 | 12. In patients who have experienced a PE and become pregnant, management by a team specializing in thrombotic complications can be useful to minimize pregnancy-related complications.                                                                                                                                                                                                                                    |
| 2a                                             | C-LD | 13. For patients using anticoagulant therapy for the treatment or prevention of PE who have experienced or are at risk of abnormal uterine bleeding, it is reasonable to discuss medical management (eg, hormonal therapies), alternate anticoagulant strategies, and gynecologic interventional strategies to mitigate abnormal uterine bleeding risk rather than considering anticoagulation cessation. <sup>29-37</sup> |
| 2b                                             | C-LD | 14. In patients with acute PE who require or are being considered for estrogen-containing hormone therapy, continuation or initiation of hormonal therapy might be considered if there is a favorable risk-benefit ratio and the patient remains on anticoagulation. <sup>28</sup>                                                                                                                                         |

Table 29. ESC 2026 GL on CKD. Recommendations for the treatment of venous thromboembolism in patients with chronic kidney disease

|                                                                                                                                                                                                                                                                                                                                |     |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|
| Anticoagulant treatment with DOACs (oral factor Xa or direct thrombin inhibitors) is recommended over treatment with LMWH and a VKA in patients with CKD with an eGFR $\geq 30$ mL/min/1.73 m <sup>2</sup> for the treatment of VTE and prevention of recurrent VTE. <sup>600-604,613</sup>                                    | I   | B2 |
| Anticoagulant treatment with oral factor Xa inhibitors may be considered instead of conventional treatment with LMWH and a VKA in patients with CKD and an eGFR 15–29 mL/min/1.73 m <sup>2</sup> if the decision is made to anticoagulate for the treatment of VTE and prevention of recurrent VTE. <sup>603,604,607,608</sup> | IIb | C  |
| Anticoagulant treatment with either a VKA or low-dose apixaban (2.5 mg b.i.d.) may be considered in patients with CKD and an eGFR $< 15$ mL/min/1.73 m <sup>2</sup> who are not receiving dialysis if the decision is made to anticoagulate for the treatment of VTE and prevention of recurrent VTE.                          | IIb | C  |
| Anticoagulant treatment with oral factor Xa inhibitors may be considered instead of conventional treatment with LMWH and a VKA in patients with CKD on dialysis if the decision is made to anticoagulate for the treatment of VTE and prevention of recurrent VTE. <sup>603,604,607,608</sup>                                  | IIb | C  |

CKD, chronic kidney disease; DOAC, direct oral anticoagulants; eGFR, estimated glomerular filtration rate; KRT, kidney replacement therapy; LMWH, low molecular-weight heparin; VKA, vitamin K antagonist; VTE, venous thromboembolism.



**Figure 13. ESC 2026 GL on CKD. Suggested initial and longer-term treatment for venous thromboembolism.**

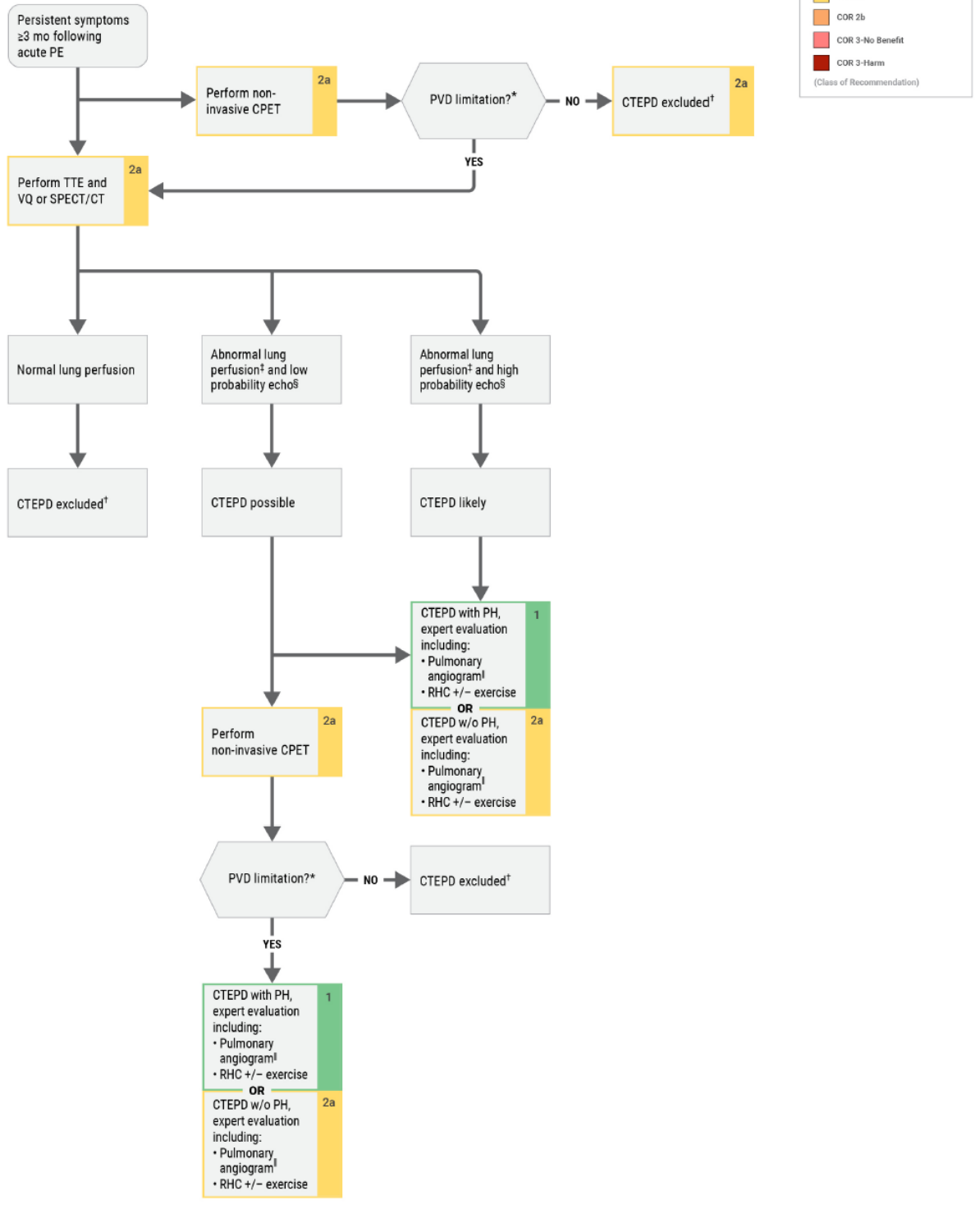
b.i.d., twice daily; BSA, body surface area; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; INR, international normalized ratio; KRT, kidney replacement therapy; LMWH, low molecular weight heparin; q.d., once a day; VKA, vitamin K antagonist. Treatment options shown to be considered when the decision has been made to anticoagulate. Doses at eGFR <30, and particularly <15 mL/min/1.73 m<sup>2</sup>, are suggested due to limited information. Always consult product summaries and local prescribing advice/experts in severe CKD and kidney failure. Apixaban 5 mg b.i.d. may also be used in patients with eGFR <15 who are on dialysis to treat venous thromboembolism when weight >60 kg and age ≤80 years. eGFR is indexed to 1.73 m<sup>2</sup> of BSA, which results in important limitations when used for drug dosing in patients with high or low BSA. A simple approach is to de-index routine eGFR value from estimated BSA (e.g. when estimated BSA is 2.31 m<sup>2</sup> then multiplying eGFR by a factor of 2.31/1.73). For LMWH dose reduction and anti-Xa–guided titration is necessary when eGFR <30 mL/min/1.73 m<sup>2</sup>; if anti-Xa monitoring is not available or bleeding risk is high, unfractionated heparin is an option

**Table 30. AHA/ACC 2026 GL on PE. Persistently Symptomatic Patients After Acute PE**

| Evaluation           |             |                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>             | <b>B-NR</b> | 1. In patients with ongoing dyspnea and/or functional impairment after $\geq 3$ months of therapeutic anticoagulation after an acute PE, a diagnostic evaluation is recommended to assess for CTEPD. <sup>1-3</sup>                                                                                                                                    |
| <b>2a</b>            | <b>B-NR</b> | 2. For patients undergoing a diagnostic evaluation for CTEPD, it is reasonable to obtain both a transthoracic echocardiogram (TTE)* and a lung perfusion scan (planar V/Q, or V/Q single-photon emission CT [SPECT], SPECT/CT) over an echocardiogram alone to exclude CTEPD or determine if additional diagnostic testing is needed. <sup>1,4,5</sup> |
| <b>2a</b>            | <b>B-NR</b> | 3. For patients undergoing a diagnostic evaluation for CTEPD, cardiopulmonary exercise testing (CPET) is reasonable to exclude CTEPD. <sup>4,6-10</sup>                                                                                                                                                                                                |
| <b>3: No benefit</b> | <b>B-NR</b> | 4. In patients with a history of acute PE, who have resolution of symptoms and low suspicion for CTEPD, a follow-up CTPA or lung perfusion scan (planar V/Q, V/Q SPECT, SPECT/CT) is not beneficial to assess for the degree of thrombosis resolution. <sup>11,12</sup>                                                                                |
| Management           |             |                                                                                                                                                                                                                                                                                                                                                        |
| <b>1</b>             | <b>B-NR</b> | 5. Patients being evaluated for CTEPD should continue anticoagulation until the evaluation is completed to prevent recurrent VTE and/or CTEPD progression unless contraindicated due to high bleeding risk. <sup>13</sup>                                                                                                                              |
| <b>1</b>             | <b>B-R</b>  | 6. For patients in whom CTEPD has been excluded but who have ongoing dyspnea and/or functional impairment despite $\geq 3$ months of therapeutic anticoagulation after an acute PE, a pulmonary rehabilitation program is reasonable to improve symptoms and exercise tolerance. <sup>14-16</sup>                                                      |
| <b>1</b>             | <b>C-LD</b> | 7. For patients with a diagnosis of CTEPD with PH, referral to a center with expertise in managing CTEPD is recommended to optimize evaluation and management. <sup>17-19</sup>                                                                                                                                                                        |
| <b>2a</b>            | <b>C-LD</b> | 8. For select patients with a diagnosis of CTEPD without PH, referral to a center with expertise can be beneficial in managing CTEPD. <sup>17-19</sup>                                                                                                                                                                                                 |

\*In a patient with normal echocardiogram at the time of acute PE, a repeated echocardiogram at 3 to 6 months is low yield and may be omitted.

## Evaluating Ongoing Symptoms Following Acute PE



**Figure 14. AHA/ACC 2026 GL on PE.** Evaluating Ongoing Symptoms Following Acute PE.

\*PVD limitation defined by circulatory impairment with abnormalities in stroke volume (oxygen pulse) and VD/VT and/or VE/VCO<sub>2</sub>.

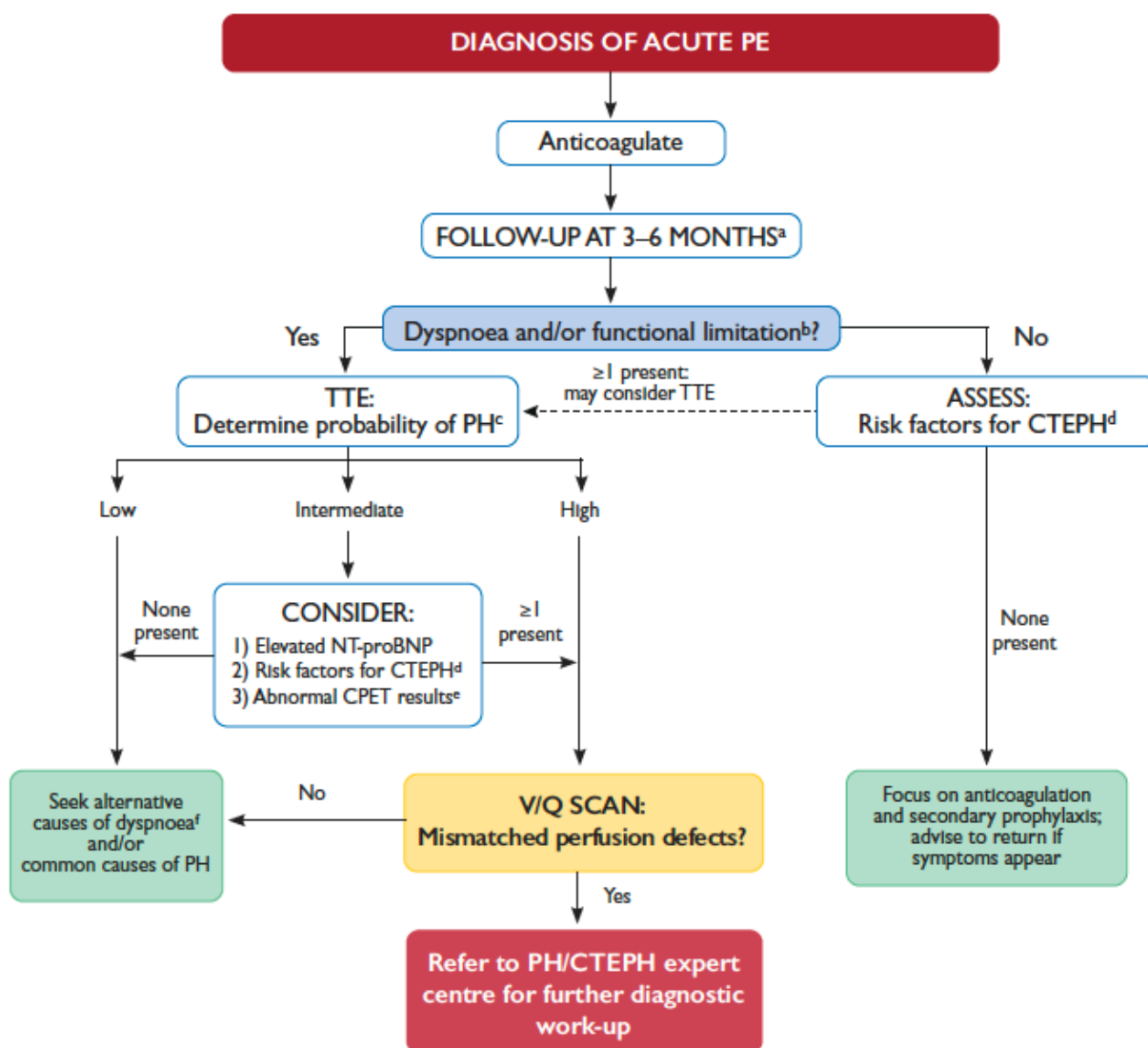
†While CTEPD is excluded, evaluation for other etiologies of symptoms is warranted.

‡Positive V/Q or SPECT/CT scan refers to any mismatched perfusion defects.

§Low-probability echocardiogram is defined as a TRV  $\leq 2.8$  m/s and absence of echocardiographic PH signs. Higher probability echocardiogram is defined as a TRV  $\geq 2.8$  m/s and presence of echocardiographic PH signs. High-risk echocardiogram refers to intermediate- or high-probability echocardiography criteria per 2022 European Respiratory Society guidelines, while low-risk echocardiogram refers to low-probability echocardiography criteria.

||Pulmonary angiography may be CT or invasive pulmonary angiogram depending on clinician choice as evaluation will differ based on center experience.

CPET indicates cardiopulmonary exercise testing; CT, computed tomography; CTEPD, chronic thromboembolic pulmonary disease; PH, pulmonary hypertension; PVD, pulmonary vascular disease; RPVO, residual pulmonary vascular obstruction; RHC, right heart catheterization; SPECT, single-photon emission computed tomography; TRV, tricuspid regurgitation velocity; TTE, transthoracic echocardiography; VE/VCO<sub>2</sub>, ventilatory inefficiency; and V/Q, ventilation-perfusion.



**Figure 15. ESC 2019 GL on PE.** Follow-up strategy and diagnostic workup for long-term sequelae of pulmonary embolism.

CPET= cardiopulmonary exercise testing; CTEPH= chronic thromboembolic pulmonary hypertension; NT-proBNP=N-terminal pro B-type natriuretic peptide; PE= pulmonary embolism; PH= pulmonary hypertension; TTE= transthoracic echocardiography/echocardiogram; V/Q= ventilation/perfusion (lung scintigraphy).

a Assess the persistence (or new onset) and severity of dyspnoea or functional limitation, and also check for possible signs of VTE recurrence, cancer, or bleeding complications of anticoagulation.

b The Medical Research Council scale can be used to standardize the evaluation of dyspnoea; alternatively, the World Health Organization functional class can be determined (Supplementary Data)

c As defined by the ESC/ERS guidelines on the diagnosis and treatment of Pulmonary Hypertension (Supplementary Data)

d Risk factors and predisposing conditions for CTEPH are listed in Table.

e Cardiopulmonary exercise testing, if appropriate expertise and resources are available on site; abnormal results include, among others, reduced maximal aerobic capacity (peak oxygen consumption), reduced ventilatory equivalent for carbon dioxide, and reduced end-tidal carbon dioxide pressure.

f Consider CPET in the diagnostic work-up.

**Table 31. ESC 2019 GL on PE. Risk factors and predisposing conditions for chronic thromboembolic pulmonary hypertension**

| Findings related to the acute PE event (obtained at PE diagnosis)                    | Concomitant chronic diseases and conditions predisposing to CTEPH (documented at PE diagnosis or at 3–6 month follow-up) |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Previous episodes of PE or DVT                                                       | Ventriculo-atrial shunts                                                                                                 |
| Large pulmonary arterial thrombi on CTPA                                             | Infected chronic i.v. lines or pacemakers                                                                                |
| Echocardiographic signs of PH/RV dysfunction <sup>a</sup>                            | History of splenectomy                                                                                                   |
| CTPA findings suggestive of pre-existing chronic thromboembolic disease <sup>b</sup> | Thrombophilic disorders, particularly antiphospholipid antibody syndrome and high coagulation factor VIII levels         |
|                                                                                      | Non-O blood group                                                                                                        |
|                                                                                      | Hypothyroidism treated with thyroid hormones                                                                             |
|                                                                                      | History of cancer                                                                                                        |
|                                                                                      | Myeloproliferative disorders                                                                                             |
|                                                                                      | Inflammatory bowel disease                                                                                               |
|                                                                                      | Chronic osteomyelitis                                                                                                    |

CTEPH = Chronic thromboembolic pulmonary hypertension; CTPA = computed tomographic pulmonary angiography; DVT = deep vein thrombosis; i.v. = intravenous; LV = left ventricular; PE = pulmonary embolism; PH = pulmonary hypertension; RV = right ventricular.

a Echocardiographic criteria of RV dysfunction are graphically presented in Figure and their prognostic value summarized in Supplementary Data. On CTPA (four-chamber views of the heart), RV dysfunction is defined as RV/LV diameter ratio >1.0.

b Direct and indirect vascular signs, as well as lung parenchymal findings, are summarized in Supplementary Data.

**Table 32. AHA/ACC 2026 GL on PE. Echocardiographic Signs Suggestive of Pulmonary Hypertension**

| Echocardiographic Signs Suggestive of Pulmonary Hypertension*                    |                                                           |                                                                                                            |
|----------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| A: Ventricles                                                                    | B: Pulmonary Artery                                       | C: Inferior Vena Cava and RA                                                                               |
| RV/LV basal diameter/area ratio >1.0                                             | RVOT AT <105 ms and/or mid-systolic notching              | IVC diameter >21 mm with decreased inspiratory collapse (<50% with a sniff or <20% with quiet inspiration) |
| Flattening of the intraventricular septum (LVEI >1.1 in systole and/or diastole) | Early diastolic pulmonary regurgitation velocity >2.2 m/s | RA area (end-systole) >18 cm <sup>2</sup>                                                                  |
| TAPSE/sPAP ratio <0.55 mm/mm Hg                                                  | PA diameter >AR diameter<br>PA diameter >25 mm            |                                                                                                            |

\*Signs from at least 2 categories (A/B/C) must be present to alter the level of echocardiographic probability of PH.

AR indicates aortic root; IVC, inferior vena cava; LV, left ventricle; LVEI, left ventricle eccentricity index; m, meters; PA, pulmonary artery; PH, pulmonary hypertension; RA, right atrium; RV, right ventricle; RVOT AT, right ventricular outflow tract acceleration time; sPAP, systolic pulmonary arterial pressure; TAPSE, tricuspid annular plane systolic excursion; TRV, tricuspid regurgitation velocity, and s, second.

**Table 33. ESC 2019 GL on PE. Recommendations for follow-up after acute pulmonary embolism**

|                                                                                                                                                                                                                                                                          |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Routine clinical evaluation <sup>a</sup> of patients 3-6 months after the acute PE episode                                                                                                                                                                               | I B   |
| An integrated model of patient care after PE (involving hospital specialists, Appropriately qualified nurses, and primary care physicians) to ensure optimal transition from hospital to community care.                                                                 | I C   |
| In symptomatic patients with mismatched perfusion defects persisting on V/Q scan <sup>b</sup> beyond 3 months after acute PE, referral to a PH/ CTEPH expert centre, after taking into account the results of echocardiography, natriuretic peptide levels, and/or CPET. | I C   |
| Further diagnostic evaluation should be considered in patients with persistent or new-onset dyspnoea/exercise limitation after PE.                                                                                                                                       | IIa C |
| Further diagnostic evaluation in asymptomatic patients with risk factors for CTEPH.                                                                                                                                                                                      | IIb C |

CPET = cardiopulmonary exercise testing; CT = computed tomography; CTEPH = Chronic thromboembolic pulmonary hypertension; PE = pulmonary embolism; PH = pulmonary hypertension; V/Q = ventilation/perfusion (lung scintigraphy).

a For symptoms suggesting recurrence, bleeding, malignancy, or persistent or new-onset exercise limitation, and to decide on extension of anticoagulant treatment.

b Alternatively, dual-energy CT may be used, if appropriate expertise and resources are available on-site.

Table 34. AHA/ACC 2026 GL on PE. Follow-UP Care for Acute PE

|    |      |                                                                                                                                                                                                                                                                                                                          |
|----|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | C-LD | 1. In patients with acute PE, it is beneficial to have clinical follow-up within the first week of discharge to provide patient education, address barriers to anticoagulation therapy, ensure adherence to prescribed medications, and detect bleeding complications. <sup>1-3</sup>                                    |
| 1  | C-EO | 2. Patients with acute PE should have a clinical visit at or before 3 months after diagnosis to discuss duration of anticoagulation, review the need for further testing, and assess for persistent PE-related symptoms.                                                                                                 |
| 1  | C-LD | 3. Patients who have had acute PE should be asked about PE-related symptoms and functional limitations at every visit for at least 1 year to screen for CTEPD or other causes of dyspnea and functional limitation. <sup>4,5-8</sup>                                                                                     |
| 1  | B-NR | 4. In patients with a history of acute PE who remain on anticoagulation into the extended phase (beyond 3-6 months from diagnosis), periodic reassessment of the risk and benefits of continued anticoagulation is recommended to ensure the safety and efficacy of continuing anticoagulation. <sup>9,10</sup>          |
| 2a | B-NR | 5. In patients with acute PE, the use of general or disease-specific questionnaires is reasonable to screen for anxiety and depression at follow-up visits. <sup>11-14</sup>                                                                                                                                             |
| 2a | B-NR | 6. In select complex patients* with acute PE, it is reasonable to have follow-up care occur in a specialized PE clinic†, if available, to optimize care. <sup>15</sup>                                                                                                                                                   |
| 2b | B-NR | 7. In patients who remain symptomatic 3 to 6 months after acute PE, it may be reasonable to obtain a performance test (six-minute walk test, incremental shuttle walk test, endurance shuttle walk test) to quantify physical limitations and identify which patients require more extensive evaluation. <sup>5,16</sup> |

### Patient Activity and Travel

|           |             |                                                                                                                                                                                                                                                                                                               |
|-----------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2a</b> | <b>A</b>    | 1. In patients recovering from acute PE, it is reasonable to encourage early ambulation rather than bed rest in order to reduce the risk of complications. <sup>1</sup>                                                                                                                                       |
| <b>2a</b> | <b>B-R</b>  | 2. In patients with a history of acute PE, use of compression stockings during long-haul ( $\geq 5$ h) travel can be useful to lower the risk of DVT. <sup>2,3</sup>                                                                                                                                          |
| <b>2b</b> | <b>C-EO</b> | 3. In patients with a history of acute PE related to travel or immobility who are not currently receiving anticoagulation therapy, it may be reasonable to use a one-time prophylactic dose of an oral anticoagulant or a parenteral LMWH on the day of long-haul travel to reduce the risk of recurrent VTE. |
| <b>2b</b> | <b>C-LD</b> | 4. For patients recovering from acute PE in AHA/ACC PE Categories C2-E, it may be reasonable to restrict long-haul travel for 4 weeks after initiation of treatment or when symptoms have resolved to reduce risk of adverse events. <sup>1</sup>                                                             |

### Indications for Referral to a Specialized Clinic for Management

| Indication                         | Description                                                                                                                                                                                           |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Complex anticoagulation management | Patients requiring frequent adjustments or monitoring of anticoagulation therapy, including labile INRs, or fluctuating renal function, anticoagulation failure, allergies, high-risk/active bleeding |
| VTE history or recurrent PE        | Patients with a history of recurrent VTE or those with an elevated risk of recurrence                                                                                                                 |
| Unresolved symptoms                | Patients with ongoing symptoms such as dyspnea or exercise intolerance, potentially indicating CTEPD, may require specialty care                                                                      |
| Pregnancy-related PE               | Pregnant or postpartum patients with PE may require specialized management due to the associated complexities of anticoagulation during pregnancy and the postpartum period                           |
| Complicated clinical presentation  | Patients with a PE in the setting of complex medical conditions (cancer, severe chronic illnesses), which may complicate standard treatment                                                           |
| Expert second opinion              | Patients or referring physicians seeking a second opinion on management of complex patient care                                                                                                       |

CTEPD indicates chronic thromboembolic pulmonary disease; INR, international normalized ratio; PE, pulmonary embolism; and VTE, venous thromboembolism.