Pulmonary Embolism

Clinical Practice Points

Background

Acute Venous Thromboembolism (VTE) is the third most common cardiovascular disease after stroke and myocardial infarction[1]. Pulmonary embolism (PE), the most critical manifestation of VTE, requires timely diagnosis and initiation of treatment to prevent morbidity and mortality. Analysis of PE-related Sentinel Events (SE) informed conversations with Victorian clinicians and the development of PE practice points for dissemination to Victorian Health Services.

Methodology

- **Data Source:** SEs related to PEs reported to Safer Care Victoria (SCV) between July 2021 and November 2024 were analysed for recurring care issues.
- **Definition**: A SE is an "unexpected and adverse event that occurs infrequently in a health service entity and results in death or serious injury due to system and process deficiencies" [2].
- **Analysis**: 23 SEs were identified involving PE, with 22 cases involving intermediate-risk PE with progressive to high-risk PE. Care delivery problems identified in ≥2 cases were included for thematic analysis.
- **Participants**: 12 health services and 21 clinicians (respiratory, hematology, emergency medicine, intensive care, interventional radiology, pharmacy) contributed.
- **Context**: PE can be categorised as low, intermediate, intermediate-high and high risk. Intermediate-high and high risk PE involve acute right heart strain and shock and carry a ~9% and ~30% mortality respectively [3,4].
- **Evolving Care**: PE management is shifting toward advanced and nuanced short term PE mortality risk stratification, Pulmonary Embolism Response Teams (PERT), and integration of catheter-directed interventions into PE management algorithms. This reflects national and international trends amid limited guidelines [3,6–10].

Care Delivery Problems

PE related care delivery problems were analysed and themed below, to support the practice points

- Diagnostic error, misdiagnosis and delayed diagnosis
- Significant delays to diagnostic imaging and results
- Significant delays in initiation of therapeutic anticoagulation
- Missed opportunity to detect early deterioration
- Variation in systemic thrombolysis, particularly in cardiac arrest scenarios
- VTE prophylaxis errors

Practice Points

The following practice points have been formulated in response to review of PE-related SEs, clinician consultation and alignment with international guideline recommendations [3,6]

Practice Point 1: Expedited work-up for intermediate-high risk features PE

- Once the decision has been made to embark on a work-up for PE, diagnostic clinicians can screen and monitor for features of intermediate-high and high-risk PE. Table 1 outlines available information to identify those at risk of deterioration.

Table 1: Risk factors for deterioration available prior to diagnosis
Clinical • History of syncope/presyncope • Persistent tachycardia • Transient hypotension • New hypoxia or tachypnoea • Clinician gestalt
Biochemical • Elevated troponin • Elevated lactate • Elevated Brain Natriuretic Peptide (BNP) (if available)
ECG • Evidence of new right heart strain
Imaging • Point of care ultrasound suggestive of Rheumatic Heart Disease (RHD)

Practice Point 2: Early Anticoagulation

- Initiate therapeutic anticoagulation promptly when PE is highly suspected and bleeding risk is low, especially in those with risk factors for deterioration as per Table 1 or when diagnostic imaging will be delayed [3].
- Enoxaparin is first-line; protocols and education should address dosing challenges in obesity [3].

Practice Point 3: Reporting Right Heart Strain on Computed Tomography Pulmonary Angiogram (CTPA)

- Consistent CTPA reporting of evidence of right heart strain, particularly the validated Right Ventricular (RV)/Left Ventricular (LV) ratio (≥1.0), assists treating clinicians to risk stratify and guide monitoring/ reperfusion treatment decisions [3].
- Central PE with RV/LV ≥1.0 should trigger direct communication with the referring clinician [3].

Practice Point 4: Multi-disciplinary Decision-making

- Develop local guidelines that support early senior multi-disciplinary decision making for patients with PE and right heart strain and/or shock (intermediate-high and high risk PE).
- Decision making should include referral and activation pathways, reperfusion plan, plan in case of deterioration, disposition and goals of care. The PERT model is the most advanced version of this [3].
- Specifically, consider agreement of close monitoring environment e.g. Intensive Care or High Dependency Unit for patients with right heart stain; ensure senior clinician oversight at point of admission [3].

Practice Point 5: Systemic Thrombolysis in Cardiac Arrest

- Ensure ready access to systemic thrombolysis protocols, specifically in cardiac arrest: include drug, indications, dosing, timing, and CPR duration [6,15-19]. Guidelines lack specific detail and only some health services have protocols available.

References

1. Shiraev TP, Omari A, Rushworth RL. Trends in pulmonary embolism morbidity and mortality in Australia. Thromb Res. 2013 Jul 1;132(1):19–25.

2. Safer Care Victoria. Victorian sentinel event guide (Version 2) Essential information for health services about managing sentinel events in Victoria [Internet]. Victorian Government; 2024. Available from: https://www.safercare.vic.gov.au

3. Konstantinides SV, Meyer G, Becattini C, Bueno H, Geersing GJ, Harjola VP, et al. 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS). Eur Heart J. 2020 Jan 21;41(4):543–603.

4. Silver MJ, Giri J, Duffy Á, Jaber WA, Khandhar S, Ouriel K, et al. Incidence of Mortality and Complications in High-Risk Pulmonary Embolism: A Systematic Review and Meta-Analysis. J Soc Cardiovasc Angiogr Interv. 2023 Jan;2(1):100548.

5. Iannaccone M, Franchin L, Russo F, Botti G, Castellano D, Montorfano M, et al. Mortality across treatment strategies in intermediate-to-high risk pulmonary embolism in the modern era: A meta-analysis of observational studies and RCTs. Int J Cardiol. 2023 Sep;387:131127.

6. Rivera-Lebron B, McDaniel M, Ahrar K, Alrifai A, Dudzinski DM, Fanola C, et al. Diagnosis, Treatment and Follow Up of Acute Pulmonary Embolism: Consensus Practice from the PERT Consortium. Clin Appl Thromb. 2019 Jan 1;25:1076029619853037.

7. Tran HA, Gibbs H, Merriman E, Curnow JL, Young L, Bennett A, et al. New guidelines from the Thrombosis and Haemostasis Society of Australia and New Zealand for the diagnosis and management of venous thromboembolism. Med J Aust. 2019 Mar;210(5):227–35.

8. British Thoracic Society guidelines for the management of suspected acute pulmonary embolism. Thorax. 2003 Jun 1;58(6):470–83.

9. National Institute for Health and Care Excellence (NICE). Pneumonia (community-acquired): antimicrobial prescribing (NICE guideline NG138) [Internet]. United Kingdom: NICE; 2019 [cited 2025 Jan 30]. Available from: https://www.nice.org.uk/guidance/ng138/resources/pneumonia-communityacquired-antimicrobial-prescribing-pdf-66141726069445

10. Zuin M, Bikdeli B, Ballard-Hernandez J, Barco S, Battinelli EM, Giannakoulas G, et al. International Clinical Practice Guideline Recommendations for Acute Pulmonary Embolism. J Am Coll Cardiol. 2024 Oct;84(16):1561–77.

11. Safer Care Victoria. Victorian Guideline for the Prevention of Venous Thromboembolism in Adult Hospitalised Patients [Internet]. Victorian Government; 2023. Available from: www.safercare.vic.gov.au

12. Aday AW, Beckman JA. Pulmonary Embolism and Unfractionated Heparin: Time to End the Roller Coaster Ride. Acad Emerg Med Off J Soc Acad Emerg Med. 2020 Feb;27(2):176–8.

13. Wright C, Elbadawi A, Chen YL, Patel D, Mazzillo J, Acquisto N, et al. The impact of a pulmonary embolism response team on the efficiency of patient care in the emergency department. J Thromb Thrombolysis. 2019 Aug;48(2):331–5.

14. Roy B, Cho JG, Baker L, Thomas L, Curnow J, Harvey JJ, et al. Pulmonary embolism response teams. A description of the first 36-month Australian experience. Intern Med J. 2024 Aug;54(8):1283–91.

15. Australian and New Zealand Committee on Resucitation (ANZCOR). Adult Advanced Life Support: Guideline 11.10 Resusciation in special circumstances [Internet]. ANZCOR; Available from: www.anzcor.org

16. Sharifi M, Bay C, Skrocki L, Rahimi F, Mehdipour M. Moderate Pulmonary Embolism Treated With Thrombolysis (from the “MOPETT” Trial). Am J Cardiol. 2013 Jan;111(2):273–7.

17. Murguia AR, Mukherjee D, Ojha C, Rajachandran M, Siddiqui TS, Nickel NP. Reduced-Dose Thrombolysis in Acute Pulmonary Embolism A Systematic Review. Angiology. 2024 Mar;75(3):208–18.

18. Sanchez O, Charles-Nelson A, Ageno W, Barco S, Binder H, Chatellier G, et al. Reduced-Dose Intravenous Thrombolysis for Acute Intermediate–High-risk Pulmonary Embolism: Rationale and Design of the Pulmonary Embolism International THrOmbolysis (PEITHO)-3 trial. Thromb Haemost. 2022 May;122(05):857–66.

19. Truhlář A, Deakin CD, Soar J, Khalifa GEA, Alfonzo A, Bierens JJLM, et al. European Resuscitation Council Guidelines for Resuscitation 2015. Resuscitation. 2015 Oct;95:148–201.