



Figure 1 Pulmonary embolism (PE) protocol. COPD, chronic obstructive pulmonary disease; HR, heart rate; PESI, pulmonary embolism severity index; RR, respiratory rate; SaO₂, saturation of oxygen; SBP, systolic blood pressure; T, temperature.

In an attempt to identify patients who can be appropriately managed in a semi-outpatient (after day 2) ambulatory manner and, at the other extreme, patients for active thrombolysis, we have used the enclosed protocol (figure 1) where individual components are based on published evidence but not necessarily guidelines. More specifically it incorporates the pulmonary embolism severity index (PESI)⁵ in the two-test approach and gives more confidence, particularly when thrombolysis becomes an option in those with high severity (class IV and V) scores. Using the initial troponin, as a sensitive but not specific triage tool addressing right heart strain, reduces the overuse of ECHO and adds to the value of the pathway as there will still be patients who can be discharged diagnosed with a small PTE and low PESI score (class I and II) and therefore low risk of mortality. The future may see further validated use of highly sensitive cardiac troponin (hsTnT) and CT assessment of the right heart, but it is likely that a two-test approach will be maintained in risk stratification.

N Ahmad,¹ K Srinivasan,² H Moudgil²

¹University Hospitals of North Staffordshire NHS Trust, Stoke on Trent, Staffordshire, UK; ²The Shrewsbury and Telford Hospitals NHS Trust, Apley Castle, Telford, UK

Correspondence to Dr N Ahmad, University Hospitals of North Staffordshire NHS Trust, Newcastle Road, Stoke on Trent, Staffordshire ST4 6QG, UK; navvydoc@gmail.com

Competing interests None.

Provenance and peer review Not commissioned; not externally peer reviewed.

Accepted 22 January 2011
Published Online First 23 February 2011

Thorax 2011;**66**:1098–1099.
doi:10.1136/thx.2011.159699

REFERENCES

1. Jiménez D, Aujesky D, Moores L, *et al.* Combinations of prognostic tools for identification of high-risk normotensive patients with acute symptomatic pulmonary embolism. *Thorax* 2011;**66**:75–81.
2. Vitarelli A. Echocardiography, troponins and lower extremity ultrasound: the 'Three Musketeers' lead the prognosis of acute pulmonary embolism. *Thorax* 2011;**66**:2–4.
3. British Thoracic Society Standards of Care Committee Pulmonary Embolism Guideline Development Group. British Thoracic Society guidelines for the management of suspected acute pulmonary embolism. *Thorax* 2003;**58**:470–83.
4. Konstantinides S, Geibel A, Heusel G, *et al.* Heparin plus alteplase compared with heparin alone in patients with submassive pulmonary embolism. *N Engl J Med* 2002;**347**:1143–50.
5. Aujesky D, Obrosky DS, Stone RA, *et al.* Derivation and validation of a prognostic model for pulmonary embolism. *Am J Respir Crit Care Med* 2005;**172**:1041–6.

Authors' response

We thank Dr Ahmad and colleagues for their thoughtful comments.¹ Haemodynamic instability has significant prognostic impli-

cations for patients diagnosed as having acute pulmonary embolism (PE), and guidelines generally recommend consideration of treatment with thrombolytic agents.^{2–3} At the other end of the spectrum, different studies suggest that risk stratification models (particularly the Pulmonary Embolism Severity Index (PESI) and the simplified PESI) may accurately identify patients at low risk of death within the first 3 months after the diagnosis of PE.^{4–5} One study found that the addition of troponin testing to the PESI did not increase the prognostic value of the PESI for the identification of low-risk patients who might benefit from a shortened hospital stay or outpatient therapy.⁶ Although recent data suggest that the use of a highly sensitive troponin T (hsTnT) assay may improve the risk stratification of PE,⁷ future studies should address the usefulness of hsTnT and risk stratification models, alone or in combination, for identifying low-risk patients who can be discharged early from the hospital and treated as outpatients. Our recent study adds to the body of evidence that a combination of cardiac biomarkers, echocardiographic findings and lower limb ultrasound testing are useful for fine-tuning risk stratification in the subgroup of intermediate-risk patients with acute symptomatic PE.⁸

David Jiménez, on behalf of all coauthors

Respiratory Department, Ramón y Cajal Hospital, IRYCIS, Madrid, Spain

Correspondence to David Jiménez, Ramón y Cajal Hospital, Colmenar Road, Madrid 28034, Spain; djc_69_98@yahoo.com

Competing interests None.

Provenance and peer review Not commissioned; not externally peer reviewed.

Accepted 2 February 2011
Published Online First 23 February 2011

Thorax 2011;**66**:1099–1100.
doi:10.1136/thx.2011.160812

REFERENCES

1. Ahmad N, Srinivasan K, Moudgil H. Risk stratification in pulmonary embolism: an algorithmic tool approach. *Thorax* 2011;**66**:1098–9.
2. Torbicki A, Perrier A, Konstantinides SV, *et al.* ESC Committee for Practice Guidelines (CPG). Guidelines on the diagnosis and management of acute pulmonary embolism: The Task Force for the Diagnosis and Management of Acute Pulmonary Embolism of the European Society of Cardiology (ESC). *Eur Heart J* 2008;**29**:2276–315.
3. Kearon C, Kahn SR, Agnelli G, *et al.* American College of Chest Physicians. Antithrombotic therapy for venous thromboembolic disease: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). *Chest* 2008;**133**(Suppl 6):454S–545S.
4. Aujesky D, Obrosky DS, Stone RA, *et al.* Derivation and validation of a prognostic model for pulmonary embolism. *Am J Respir Crit Care Med* 2005;**172**:1041–6.
5. Jiménez D, Aujesky D, Moores L, *et al.* RIETE Investigators. Simplification of the pulmonary embolism severity index for prognosticating patients with acute

symptomatic pulmonary embolism. *Arch Intern Med* 2010;**170**:1383–9.

6. **Moore L**, Aujesky D, Jiménez D, *et al*. Pulmonary embolism severity index and troponin testing for the selection of low-risk patients with acute symptomatic pulmonary embolism. *J Thromb Haemost* 2010;**8**:517–22.
7. **Lankeit M**, Friesen D, Aschoff J, *et al*. Highly sensitive troponin T assay in normotensive patients with acute pulmonary embolism. *Eur Heart J* 2010;**31**:1836–44.
8. **Jiménez D**, Aujesky D, Moore L, *et al*. Combinations of prognostic tools for identification of high-risk normotensive patients with acute symptomatic pulmonary embolism. *Thorax* 2011;**66**:75–81.

Authors' response

I appreciate the interest of Dr Ahmad *et al*¹ in the article by Jiménez *et al*² and the accompanying editorial³ in which it has been pointed out that the use of echocardiography, laboratory findings and venous ultrasonography should be encouraged in patients with suspected high-risk pulmonary embolism (PE), and management decisions should be taken on all collected data on a case-by-case basis. Due to the high hospital mortality in patients with PE, it is important to select those at the highest risk, who cannot be treated in an outpatient setting and require close monitoring or even more aggressive therapy.^{4 5}

Dr Ahmad *et al* suggest using their protocol, where individual components are based on published evidence, in order to attempt to identify patients who can be appropriately managed in a semi-outpatient ambulatory manner and, at the other extreme, patients for active thrombolysis. I agree that the use of initial troponin as a sensitive but not specific triage tool addressing right heart strain would add to the value of prognostic assessment of

PE. I also agree that a further validated use of highly sensitive cardiac troponin (hsTnT) would be desirable in the future. Of course a right ventricle (RV)-sensitive troponin would be preferable.

However, I would like to clarify the term 'overuse' of echo. 'Reduce the overuse' does not mean 'no use' but a 'better use' of echocardiography. Although the assessment of RV function can be challenging even with good acoustic echo windows as well as other alternative techniques such as CT scan, RV dysfunction and dilatation have been reported as robust prognostic factors in acute PE with normal or abnormal troponins. The particular approach (echo or CT) may depend on the available hospital resources. Moreover, while CT provides information on RV dilatation only, echocardiography gives some information on contractility also. To date, we don't have a uniformly accepted definition of the criteria for echocardiographically detected RV dysfunction to give a conclusive answer on the prognostic significance of decreased RV performance in haemodynamically stable patients with PE. Nonetheless, available echocardiographic parameters of RV dysfunction can be carefully assessed and interpreted to judge a possible RV involvement. Furthermore, with recent advances in Doppler and tissue Doppler echocardiography, new methods for measuring regional and global RV function or contractility have been suggested⁶ and may enter the clinical routine in the future.

We realise that a combination of imaging modalities with cardiac biomarkers may optimise risk stratification by a two-test or three-test approach. More sophisticated biochemical assays of troponin hopefully will come, but in pulmonary heart disease we

certainly cannot neglect a detailed and reliable morphofunctional RV assessment.

Antonio Vitarelli

Cardio-Respiratory Department, Sapienza University, Rome, Italy

Correspondence to Professor Antonio Vitarelli, Sapienza University, via Lima 35, Rome, 00198, Italy; vitar@tiscali.it

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; not externally peer reviewed.

Accepted 2 February 2011

Published Online First 23 February 2011

Thorax 2011;**66**:1100.

doi:10.1136/thx.2011.160770

REFERENCES

1. **Ahmad N**, Srinivasan K, Moudgil H. Risk stratification in pulmonary embolism: an algorithmic tool approach. *Thorax* 2011;**66**:1098–9.
2. **Jiménez D**, Aujesky D, Moore L, *et al*. Combinations of prognostic tools for identification of high-risk normotensive patients with acute symptomatic pulmonary embolism. *Thorax* 2011;**66**:75–81.
3. **Vitarelli A**. Echocardiography, troponins and lower extremity ultrasound: the 'Three Musketeers' lead the prognosis of acute pulmonary embolism. *Thorax* 2011;**66**:2–4.
4. **Lega JC**, Lacasse Y, Lakhal L, *et al*. Natriuretic peptides and troponins in pulmonary embolism: a meta-analysis. *Thorax* 2009;**64**:869–75.
5. **Stein PD**, Matta F, Janjua M, *et al*. Outcome in stable patients with acute pulmonary embolism who had right ventricular enlargement and/or elevated levels of troponin I. *Am J Cardiol* 2010;**106**:558–63.
6. **Vitarelli A**, Terzano C. Do we have two hearts? New insights in right ventricular function supported by myocardial imaging echocardiography. *Heart Fail Rev* 2010;**15**:39–61.