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Original research article

Role of echocardiography and cardiac biomarkers in prediction of in-hospital mortality and long-term risk of brain infarction in pulmonary embolism patients

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ABSTRACT

Introduction: The aim of prospective study was to evaluate the ability of echocardiography and cardiac biomarkers to predict in-hospital mortality and the risk of brain infarction during a 12-month follow-up period (FUP) with anticoagulation in pulmonary embolism (PE) patients.
Methods: Eighty-eight consecutive acute PE patients (39 men, mean age 63 years) were enrolled; 78 underwent baseline echocardiography and brain magnetic resonance imaging (MRI). After a 12-month FUP, 58 underwent brain MRI. In-hospital mortality and the rates of new ischemic brain lesions (IBL) on MRI with clinical ischemic stroke (IS) events were predicted based on echocardiography (patent foramen ovale presence with right-to-left shunt – PFO/RLS; right/left ventricle diameter ratio – RV/LD; tricuspid annulus plane systolic excursion – TAPSE; tricuspid annulus systolic velocity – S_T; pulmonary artery systolic pressure – PASP) and biomarkers results (amino-terminal fragment of brain natriuretic peptide – NT-proBNP and cardiac troponin T – cTnT).
Results: Our series involved 88 patients, of whom 11 (12.5%) presented high-risk PE, 24 (27.3%) intermediate-high risk PE, 19 (21.6%) intermediate-low risk PE and 34 (38.6%) patients had low risk PE.

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Nine patients (10.2%) died during hospitalization including high-risk PE [6/9 (66.6%)] and intermediate-high-risk PE [3/24 (12.5%)]. cTnT [odds ratio (OR) 4.3; 95% confidence interval 0.59–31.3, $P = 0.014$], NT-proBNP (OR 14.2 [1.5–133.4], $P = 0.02$), RV/LD ≥0.79 (OR 36.6 [4.2–316.4], $P = 0.001$), TAPSE (OR 0.55 [0.34–0.92, $P = 0.022$) and PASP ≥51.5 mmHg (OR 33.3 [3.8–292.6], $P = 0.022$) were predictors of in-hospital mortality.

Seventeen patients (19.3%) experienced IS ($n = 8$) or new IBL ($n = 9$). On multivariate analysis, PFO/RLS (OR 27.1 [3.0–245.3], $P = 0.003$) and S_T ≤14.5 cm/s (OR 34.1 [CI 3.4–344.0], $P = 0.003$) were independent predictors of IS and IBL risk.

Conclusions: High blood troponin T, NT-proBNP, RV dilatation/systolic dysfunction and pulmonary hypertension predicted in-hospital mortality. PFO/RLS presence and S_T were predictors of clinically apparent/silent brain infarction.

Introduction

Pulmonary embolism (PE) is a common cardiovascular disease, affecting 100–200 cases per 100,000 people every year [1]. High-risk PE still has a high mortality rate and it is complicated by cardiac arrest, shock state or persistent arterial hypotension [2,3]. Right ventricular dysfunction/dilatation (RVD) is a determining factor of the severity of PE and may be recognized from computed tomography (CT) angiography of the pulmonary arteries, serum levels of cardiac troponin T/I and natriuretic peptide, but is most accurately evaluated by echocardiography [4–6].

Paradoxical embolism has been observed in patients with acute PE with coexisting patent foramen ovale (PFO), and PFO was reported to be a significant predictor of poor outcome in this group [7]. Clinically silent ischemic brain lesions (IBL) were detected in patients with PE and PFO, especially in patients with significant right ventricular dysfunction leading to right-left interatrial shunt via PFO in the acute phase of PE [8].

Magnetic resonance imaging (MRI) enables the reliable detection of IBL; moreover, the use of diffusion-weighted MRI allows the sensitive detection of acute cerebral ischemia.

The aim of study was to evaluate the ability of echocardiography and cardiac biomarkers to predict in-hospital mortality and the rates of new clinically silent brain ischemic embolism detected on MRI and clinical ischemic stroke (IS) events in patients with present acute PE during a 12-month follow-up period on effective anticoagulation therapy in PE patients.

Subjects and methods

A prospective observational single center study covering all cases of first unprovoked pulmonary embolism, hospitalized in a medical intensive care unit in a tertiary care hospital, in order to assess in-hospital mortality and long-term stroke/ischemic brain lesion on MRI risk during 1-year follow-up on effective oral anticoagulation therapy (OAT) was conducted.

Eighty-eight consecutive acute PE patients without previous anticoagulation therapy were enrolled between 2010 and 2013.

Acute PE was confirmed with clearly positive findings on computed tomography (CT) angiography of the pulmonary arteries. All CT scans were analyzed and interpreted independently by an experienced radiologist blinded to the clinical data.

In all enrolled patients, the type of initial PE treatment was recorded (anticoagulation or thrombolysis) and then all patients underwent anticoagulation therapy for a 12-month follow-up.

At baseline, all patients underwent: (1) contrast transesophageal echocardiography focused on the morphology and function of both ventricles and on the detection of PFO and intra-cardiac shunt; (2) brain magnetic resonance imaging (MRI) focused on detecting ischemic lesions; and (3) laboratory assessment of specific cardiac markers. At follow-up visit, all patients underwent contrast transthoracic echocardiography and control brain MRI (Fig. 1).

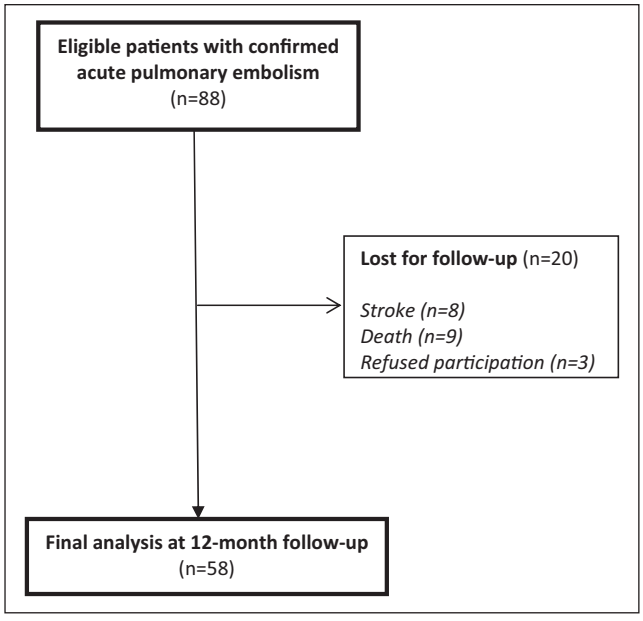

Fig. 1 – Flow chart detailing patient enrollment in the study.

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