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ORIGINAL ARTICLE

Percutaneous Aspiration Thrombectomy in Treatment of Massive Pulmonary Embolism

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Background Pulmonary embolism (PE) associated with haemodynamic instability has exceedingly high mortality. We describe our experience using percutaneous mechanical thrombectomy (PMT) in patients with massive PE and right ventricle dysfunction.

Methods Sixteen patients (11 males and five females; mean age, 55.7 ± 8.3 years) with massive PE were treated with PMT. A percutaneous Aspiration Device (8 French Aspirex® aspiration thrombectomy catheter, Straub Medical, Switzerland) was used in all patients. Clinical outcomes, right ventricle and pulmonary artery pressures (PAP), thrombus clearance and complications were evaluated.

Results Treatment of 16 patients resulted in complete thrombus clearance (≥90%), in 87.5% of the patients and near-complete (50%–90%) clearance in 6.3%. Measurements before and after treatment showed a decrease in PAP (73 ± 11 mm Hg to 34 ± 8 mm Hg, P < .001). The RV/LV ratio decreased from 1.32 ± 0.15 to 0.84 ± 0.13 at follow-up (P < .001). One patient died from refractory shock. No cardiovascular deaths or recurrent PE were documented during clinical follow-up but one patient demonstrated evidence of mild cor pulmonale.

Conclusions This study demonstrates safety and effectiveness of percutaneous mechanical aspiration thrombectomy in patients with massive PE with a large thrombus burden.

Keywords Aspiration thrombectomy • Catheter-directed therapy • Pulmonary artery pressure • Pulmonary embolism • Right ventricle disfunction.

Introduction

Pulmonary embolism (PE) is the third most common cardiovascular disorder after myocardial infarction and stroke and is considered the leading cause of preventable death in hospitalised patients [1,2]. The mortality rate in the first three months following the diagnosis of PE has been shown to range from 15% to 18% [3].

Massive pulmonary embolism (PE) is heralded by sudden onset of dyspnoea, chest discomfort, or syncope, causing clinical deterioration toward cardiovascular collapse. As the clinical course worsens, systemic arterial hypotension, respiratory failure, and impaired organ perfusion ensue [4]. Right ventricular dysfunction (RVD) and the presence of haemodynamic instability are powerful predictors of the poor prognosis of patients with acute PE [5]. A definitive treatment of RVD secondary to acute PE has not been defined, and the therapeutic controversy about using thrombolytics in patients with RVD but without systemic hypotension still continues [5,6]. Treatment should be more aggressive for this group of patients, with the basic objective of reestablishing patency of the pulmonary circulation and

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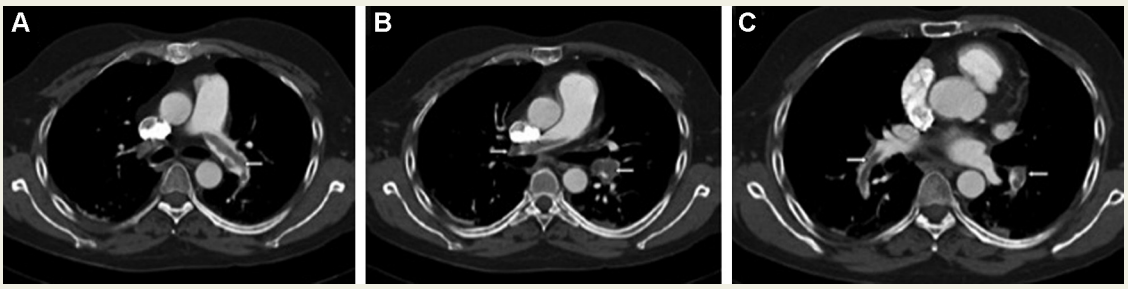

Figure 1 A, B, C; Computed tomography showed extensive filling defects within the main trunk, right and left main branches, secondary and tertiary branches of the pulmonary arteries representing massive pulmonary embolism (arrows).

preventing further deterioration of right ventricular function and progression to cardiogenic shock [4].

In patients who present with compromised haemodynamics or cardiac function, a variety of treatment options have been utilised to treat acute PE, including surgical embolectomy, intravenous fibrinolysis, catheter directed thrombolysis, and trans catheter mechanical clot fragmentation with or without thrombectomy [7,8].

In recent years, interest has risen in a variety of endovascular strategies based on catheter-based technologies for thrombus removal in patients with massive PE. The goal of the catheter directed procedure is to reduce pulmonary vascular resistance and right ventricular afterload and to increase cardiac output and systemic arterial pressure. PMT has been developed over the past years as a reliable alternative method to treat patients with acute PE and RVD [9].

The primary objective of this study was to evaluate the clinical efficacy of PMT in patients with massive PE. Our secondary objective was to objectively measure the difference in clot burden as assessed by the Miller Score [10]. Following CT-angiography, before and after intervention, as well as to compare the difference in preprocedure and 24-48 hours post-procedure right ventricle and PAP.

Materials and Methods

Study Population

Consecutive patients with PE, initially diagnosed by either computer tomography, or echocardiography, and transferred from emergency and medical divisions to our catheterisation laboratory for pulmonary angiography from April 2012 to February 2014, were retrospectively evaluated. Twenty-nine patients were referred to the cardiac catheterisation laboratory with a diagnosis of PE, of whom 16 patients met the criteria for massive PE based on the angiographic evidence of a thrombus image in a main pulmonary branch or in two or more lobar branches, and one or more criteria of RVD, the subject of this report.

The criteria applied for the diagnosis of RVD were a diastolic diameter of the right ventricle >30 mm, a right ventricular diastolic diameter/left ventricular diastolic diameter ratio > 1, paradoxical septal movement, hypokinesia of the right ventricular free wall, loss of inspiratory collapse of the inferior vena cava (IVC), and tricuspid regurgitation at a velocity > 2.5 m/s in the absence of inspiratory collapse of the IVC or > 2.8 m/s. [5]. A compromise of the central pulmonary arteries or of two or more lobar arteries by multi-detector contrast-enhanced computed tomography (CT) and confirmed by pulmonary angiography during the procedure was defined as massive PE [11,12] (Fig. 1). The clinical definition of massive PE was established in the presence of cardiogenic shock or hypotension, the latter defined as systemic systolic blood pressure (sSBP) < 90 mm Hg, or a pressure drop > 40 mm Hg for > 15 min not caused by arrhythmia, hypovolaemia, or sepsis.

At our centre, PMT was used in patients with massive PE with Miller scores indicative of severe pulmonary vascular bed involvement. PMT was performed in patients with contraindications to or failure of fibrinolysis or with comorbidities resulting in a potentially higher risk of bleeding in case of fibrinolytic administration. Informed consent for participation in the study was obtained according to the guidelines of our institutional review board and the local ethics committee, which approved the study.

Patient medical records were reviewed and evaluated for relevant clinical information including: demographics, risk factors for thromboembolism, comorbidities, symptomatic improvement or resolution after treatment, RV pressure and PAP, thrombus clearance, hospital length of stay, survival to discharge and complications.

Treatment Procedure

Common femoral venous access was established by placement of a vascular sheath (8F, 10 cm;Terumo Medical Corporation, Elkton, Maryland). The main pulmonary artery was catheterised using a 6-F angled pigtail diagnostic catheter (Cordis Corporation, Miami Lakes, Florida). In all cases, we utilised a 65-cm-long introducer (8F) that was placed selectively in either of the two main pulmonary arteries for selective angiography, and as a conduit to manipulate the pigtail catheter. Intraluminal PAP was measured by direct catheter transduction after a satisfactory pulmonary artery waveform was observed. Digital subtraction angiography was performed in two bilateral anterior oblique