Percutaneous mechanical thrombectomy in recurrent massive pulmonary embolism

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Abstract - Pulmonary embolism (PE) is a potentially fatal disease. The clinical picture of massive PE is dramatic and requires urgent treatment. The current standard for massive PE is thrombolytic therapy. In the presence of contraindications to this therapy or its failure to be effective, the remaining therapeutic options are few. Surgical embolectomy is limited to experienced centres. We describe a 44-year-old female with recurrent massive PE treated with percutaneous mechanical thrombectomy. The procedure and therapeutic implications are discussed here.

Keywords - Embolectomy, massive pulmonary embolism, percutaneous mechanical thrombectomy

Introduction

Pulmonary embolism (PE) is a common and often fatal disease. Massive PE is defined as PE combined with hypotension (systolic blood pressure below 90 mm Hg) indicating right ventricular overload [1]. In cases of massive PE with persistent hypotension, thrombolytic therapy should be considered [2]. For recurrent PE or when contraindications to thrombolytic agents are present, alternative treatment strategies should be considered. We describe a patient who was successfully treated with percutaneous mechanical thrombectomy for recurrent massive pulmonary embolism.

Case report

A 44-year old female was admitted to the intensive care unit of our hospital with suspected massive pulmonary embolism and treated with recombinant tissue type plasminogen activator (r-tPA). Her relevant medical history included Crohn’s disease and deep vein thrombosis of the left lower extremity 3 years prior to admission. On admission she presented with severe dyspnoea and persistent haemodynamic instability that required mechanical ventilation and vasopressor support.

Echocardiography showed massive dilatation of the right ventricle and severe tricuspid regurgitation compatible with pulmonary embolism. Because the patient already had severe cardiogenic shock and respiratory insufficiency, we did not perform additional diagnostics to confirm the diagnosis. Thrombolytic therapy (10 mg bolus and 90 mg r-tPA/ two hours) resulted in an initial clear improvement of her clinical condition.

Three days later, despite intravenous unfractionated heparin (iv UFH), her condition deteriorated with recurrent haemodynamic and respiratory instability. Physical examination showed a sedated 44-year-old female on mechanical ventilation and in shock. The patient’s blood pressure was 80/50 mmHg and she had a sinus tachycardia (145 bpm). Her central venous pressure was elevated. On auscultation a widely split second heart sound indicating right ventricular overload was heard. Pulmonary auscultation was normal. The patient was mechanically ventilated with Biphasic Intermittent Positive airway pressure (BIPAP; Draeger XL) mode (PEEP 10 cm H2O, inspiratory pressure 35 cm H2O, respiratory rate 30/min, inspiratory oxygen fraction 75%) with a peripheral oxygen saturation of 94%. Clinically there were no signs of acute tension pneumothorax. Blood gas analysis showed a combined respiratory and metabolic acidosis (pH 7.24, PaCO2 46 mm Hg, PaO2 79 mm Hg, HCO3- 19 mmol/l, BE –8 mmol/l, Saturation 97%).

Chest X-ray showed a normal cardiac range but prominent hili; there were no pulmonary abnormalities and no signs of pneumothorax. The electrocardiogram showed a sinus tachycardia of 130 bpm, axis 90 degrees, normal conduction, S wave in lead I and Q wave in lead III with T wave inversion without ST segment deviations.

Contrast-enhanced 64-multidetector computed tomography (MDCT) showed an embolus in the right pulmonary artery ranging from the second to the fourth category as well as segmental filling defects of the left pulmonary artery in the fourth category compatible with massive PE (figure 1).

We decided to perform percutaneous thrombectomy using a thrombectomy device (Aspirex Straub Medical 6 French). After cannulation of the right femoral vein, an 8 F introduction sheath was positioned in the main right pulmonary artery. Arteriography of the left and right pulmonary artery confirmed findings at MDCT, showing extensive PE. An embolectomy catheter was introduced and repetitively manoeuvred into the thrombi of the right pulmonary artery and side branches. This catheter is an over-the-wire catheter system with a rotational coil within the catheter body. The catheter is connected to a motor via an electromagnetic clutch. This rotational coil (40,000- 60,000 rpm) creates a ne-
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gative pressure through an L-shaped aspiration port at the catheter tip so that it macerates and removes aspirated thrombus (figure 2). After thrombectomy, there was a substantial decrease of thrombus in all treated arteries; estimated blood loss was approximately 150 cc and there were no signs of complications due to thrombectomy. Intra-arterial pharmacologic thrombolysis was not performed.

During the procedure, the patient’s haemodynamics, measured by mean arterial pressure and stroke volume, improved. Within hours ventilator settings could be reduced substantially. Weaning off the ventilator was complicated by a ventilator-associated pneumonia. Two weeks later the patient was extubated and five weeks later she was discharged from hospital on permanent oral anticoagulation. She is currently doing well.

Discussion
PE is a potentially fatal disease with a prevalence in the USA of 150,000 patients annually [3]. Depending on the degree of haemodynamic compromise, the mortality of massive PE ranges between 15% and 52% [1,3]. Approximately 4.5% of patients with PE present with haemodynamic instability indicating right ventricular overload due to massive PE [3,4]. The clinical picture ranges from arterial hypotension and right ventricular failure to cardiogenic shock and cardiopulmonary resuscitation on admission [4]. The use of thrombolytic therapy in PE resulting in right ventricular dilatation and/or hypokinesia without systemic hypotension has shown benefit but remains controversial [1,2]. In cases of massive PE and persistent haemodynamic instability, thrombolytic therapy should be considered [5].

Approximately 8% to 12% of patients will not respond to thrombolysis [1,6]. In addition, approximately one third of patients with massive PE cannot receive systemic fibrinolysis because of absolute contraindications [4]. In case of failure of or contraindications to thrombolytic agents, surgical embolectomy is a well-known option [6]. Rescue surgical embolectomy led to a better clinical response compared to repeated thrombolytic therapy in patients with massive PE who were initially treated with thrombolytic therapy [6]. Surgical embolectomy, however, can only be performed in specialized centres. Percutaneous fragmentation of the thrombus, combined with thrombolysis, has been reported to be a successful and safe alternative [7]. Percutaneous mechanical thrombectomy may be another promising procedure with relatively few complications and a high success rate of more than 85% [8-10].

The Food and Drug Administration (FDA) has assigned the Humanitarian Use Device status for the Aspirex PE catheter device for the treatment of patients with massive PE when thrombolytic therapy is contraindicated. Possible complications of catheter thrombectomy are distal macro- and micro emboli, pulmonary haemorrhage, cardiac perforation, dissection of pulmonary arteries and mechanical haemolysis and substantial blood loss [10,11]. Nevertheless, it was recently shown that percutaneous mechanical thrombectomy could be accomplished without procedure-related complications. Percutaneous mechanical thrombectomy resulted in equivalent, if not lower mortality compared to thrombolytic therapy and surgical embolectomy for the treatment of massive PE [12].

Faced with recurrent massive PE, we refrained from repeated thrombolytic therapy and our patient fulfilled the criteria for catheter thrombectomy. These criteria were haemodynamic instability, defined as systolic blood pressure < 90 mmHg, two subtotal or

Figure 1. Computed Tomography shows an embolus in the right pulmonary artery exceeding from the second to the fourth category.

Figure 2. Aspirex PE thrombectomy catheter showing the aspiration port and rotational coil (Straub medical Services)
total filling defects in the left and/or right main pulmonary artery and failure of previous thrombolytic therapy. Moreover, catheter-based embolectomy is most successful when applied to "fresh" thrombi within the first 5 days of symptoms as in our case [13,14].

In our hospital, surgical pulmonary embolectomy is not performed and transporting the patient to a referral centre was not an option. We decided to end the thrombectomy procedure once the haemodynamic parameters had improved substantially.

In hindsight, one could argue that the initial thrombolytic therapy was presumptive and the decision of not performing additional imaging (e.g. MDCT) within 48 hours after admission is also questionable. Nevertheless, our decision was strengthened by the medical history and the initial response of the patient although this was only firmly established after the second episode of PE.

Conclusion

Treatment of recurrent massive PE by percutaneous mechanical thrombectomy may be a promising and relatively safe alternative to surgical removal of embolus in case of failure of or contraindications to primarily thrombolytic therapy.

References