

Major pulmonary embolism treated with a rheolytic thrombectomy catheter

P Chiam, V Kwok, BA Johan, C Chan

ABSTRACT

The current treatment of massive pulmonary embolism (PE) has been either thrombolysis or surgical embolectomy. Recently, percutaneous rheolytic thrombectomy has emerged as an alternative treatment in patients with contraindications to thrombolysis. We describe a 45-year-old woman who developed major PE post-operatively, who was treated successfully with the AngioJet system. The principles of percutaneous rheolytic thrombectomy, its effectiveness and potential complications are discussed.

Keywords: percutaneous rheolytic thrombectomy, pulmonary embolism, rheolytic thrombectomy catheter, thrombolysis

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INTRODUCTION

The standard treatment of massive pulmonary embolism (PE) has been either surgical thrombectomy or thrombolysis. In recent years, the rheolytic thrombectomy catheter (AngioJet, Minneapolis, MN, USA) has been used as an alternative to thrombolysis.

We report a case of major PE with contraindications to thrombolysis, that was successfully treated with the AngioJet system. We believe this is the first case of PE to be treated with this device locally.

CASE REPORT

A 45-year-old Indian woman was referred for management of major pulmonary embolism. Three days previously, she underwent an abdominal hysterectomy for multiple uterine fibroids at another hospital. Post-operatively, she was on compressive stockings and subcutaneous fraxiparine. On the third post-operative day, she developed sudden dyspnoea, sweating and giddiness. Clinical examination was unremarkable except for tachycardia (132 beats/min) and pulse oximetry of 92% (on ambient air). Blood pressure was 130/70 mmHg. Her electrocardiogram showed sinus tachycardia, partial right bundle branch block and a S1Q3T3 pattern (Fig.1). PaO₂ was 85 mmHg on 4L/min oxygen and PaCO₂ was 31 mmHg. Urgent spiral computed tomography (CT) of the thorax revealed bilateral lower lobe segmental pulmonary embolism.

Intravenous heparin was commenced and she was transferred to our department for further

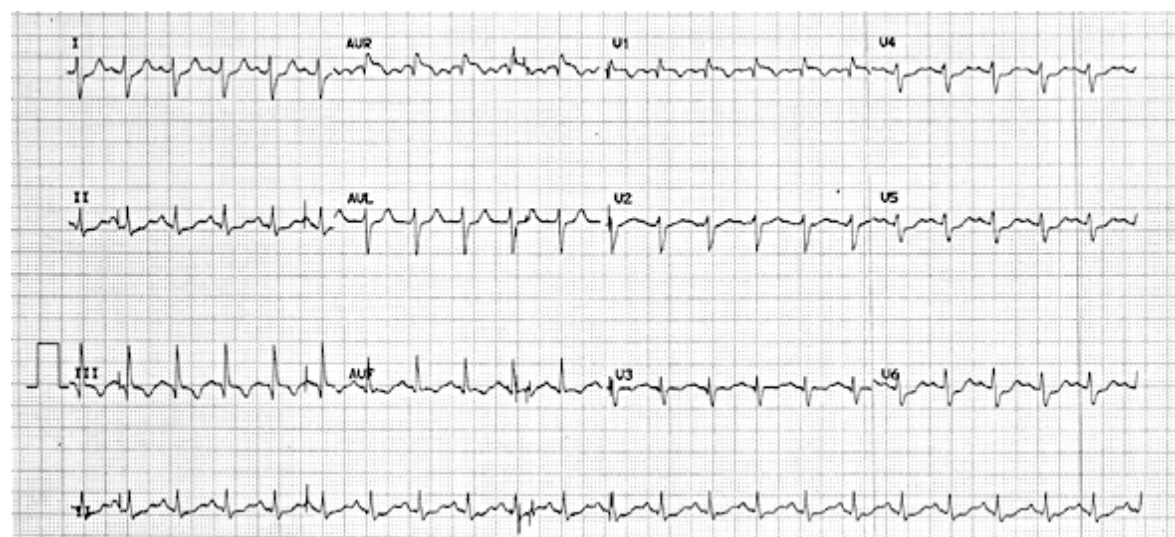


Fig. 1 ECG shows sinus tachycardia, partial RBBB and S1Q3T3 pattern.

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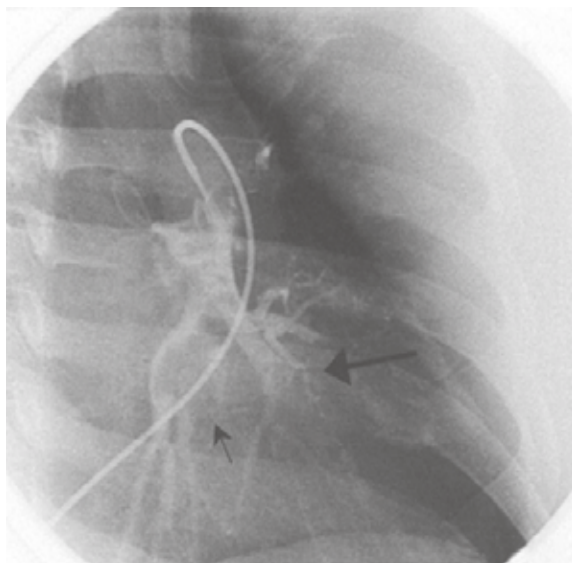


Fig. 2 Pulmonary angiogram shows large filling defects in the left lower lobe pulmonary arteries and occlusion of a segmental artery. Thin arrow shows large thrombus. Thick arrow shows occluded left lower lobe segmental pulmonary artery.

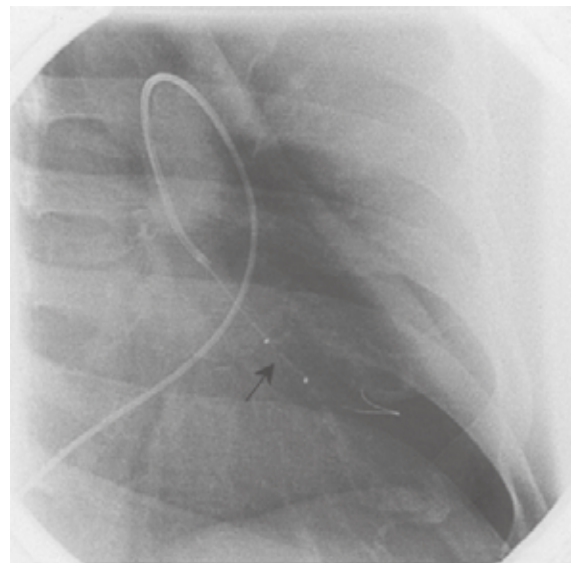


Fig. 3 Thrombectomy with the AngioJet catheter. Arrow indicates AngioJet catheter.



Fig. 4 Pulmonary angiogram shows restoration of circulation to the segmental arteries and reduced clot burden. Thin arrows show restored flow to the left lower lobe segmental pulmonary arteries. Thick arrow shows reduced thrombus load.

management. She underwent a pulmonary angiogram, with a view to percutaneous transvenous rheolytic thrombectomy. Access was via a 6F-size sheath in the right common femoral vein, and a 5F-size sheath was also inserted in the right common femoral artery for blood pressure monitoring. Pulmonary angiography, performed using an angled 6F pigtail catheter positioned in the main pulmonary trunk, revealed large filling defects in the right upper and lower lobe, and in the left lower lobe pulmonary arteries (Fig. 2). Her blood pressure was 109/76mmHg, heart rate was 116/min and her pulmonary artery pressure was 45/26 mmHg (mean 34 mmHg). The pigtail catheter was then exchanged over a 260 cm

0.035-inch Terumo wire for a 6F Judkins Right 4 (JR 4) guiding catheter (Medtronic Inc, Minneapolis, MN, USA), which was positioned in the left pulmonary artery. A 0.014-inch Stabiliser Supersoft angioplasty guidewire was then manoeuvred to the left lower lobe segmental pulmonary artery.

Thrombectomy was performed with a 4F AngioJet XMI™ (Possis Medical Inc, Minneapolis, MN, USA) catheter advanced over the angioplasty wire to the left lower lobe pulmonary artery (Fig.3). The same process was repeated in the right upper and lower lobe pulmonary arteries. After five passes with the AngioJet catheter, aspiration was terminated because significant reduction in thrombus burden was observed angiographically. Furthermore, it is not recommended to aspirate more than 200 ml of blood during the procedure. Post-procedure, repeat selective pulmonary angiogram of the treated lung segments showed marked improvement (Fig. 4). The entire process took 59 minutes. Intravenous heparin was continued, as there was residual thrombus.

Her symptoms improved, with less dyspnoea post-procedure. Her blood pressure and pulmonary artery pressure remained stable. Blood gases improved markedly with PaO₂ 91 mmHg (on ambient air) 12 hours later and PaCO₂ 33 mmHg. Subsequent Duplex ultrasonography of her lower limbs revealed bilateral deep venous thrombosis in both peroneal veins. She had an uneventful recovery and was discharged with oral anticoagulation.

DISCUSSION

The incidence of pulmonary embolism is estimated to be one in 1000 per year⁽¹⁾. All-cause mortality in

patients with PE is estimated to be 9% at three months⁽²⁾. Heparin constitutes the mainstay of treatment by preventing additional thrombus formation, and permitting endogenous fibrinolysis to dissolve some clot. For massive PE with haemodynamic compromise, thrombolysis has been shown to be life-saving⁽³⁾. For major PE with stable systemic pressures and right ventricular (RV) dysfunction or pulmonary hypertension (mean pulmonary artery pressure >20mmHg), the recent Management Strategies and Prognosis in Patients with Pulmonary Embolism (MAPPET) registry suggested that those treated with thrombolysis and anticoagulation had better clinical outcomes than those treated with anticoagulation alone⁽⁴⁾, although this is not universally accepted by all experts⁽⁵⁾.

Contraindications such as recent surgery (as in our patient), haemorrhagic stroke, head trauma, intracranial neoplasm, pregnancy, acute peptic ulcer and active internal bleeding may preclude use of thrombolysis. Traditionally, such patients would be considered for surgical embolectomy. Although first introduced in 1969 by Greenfield et al⁽⁶⁾, it is only in recent years that percutaneous catheter thrombectomy has gained increasing use in the treatment of massive/major PE with contraindications to thrombolysis^(7,8). Various thrombectomy systems are available, such as: aspiration thrombectomy (applying suction through a catheter to remove thrombus), fragmentation thrombectomy (mechanically breaking up thrombus with a catheter) and rheolytic thrombectomy⁽⁹⁾.

The AngioJet is a rheolytic thrombectomy catheter system, used to remove thrombus in coronary arteries, saphenous vein grafts, and peripheral arteries. It was recently first used in PE by Koning et al⁽⁷⁾. The catheter consists of a lumen for high-pressure saline delivery and an effluent lumen for removal of thrombus. Three orifices at the tip allow three retrograde high-pressure saline jets to form toward the opening of the effluent lumen. These jets create a localised pressure region (Bernoulli effect) that attracts thrombus for fragmentation into small particles. The fragmented debris is then pushed out through the evacuation line as a result of the retrograde high-pressure saline jets and then transported into a collection bag. In-vitro studies demonstrated that the AngioJet was effective in disruption of whole-blood or fibrin thrombi up to five days old, although it was successfully used in PE up to 15 days old^(7,10). The AngioJet system also has the advantage of being able to clear a vessel much

larger than the catheter diameter compared to other mechanical devices⁽¹⁰⁾.

Three AngioJet catheter sizes are available: 4F (used mainly for coronary intervention), and larger 5F and 6F catheters (used mainly for peripheral vascular intervention). Only the 4F catheter system is available in our institution. A larger catheter size may have been more effective in removing the thrombus load. Our patient's mean pulmonary artery pressure remained similar pre- and post-thrombectomy. This concurs with the findings of a small series using fragmentation thrombectomy⁽¹¹⁾. Reasons postulated were enhanced right ventricular output and pulmonary vasoconstriction caused by release of neurohumoral factors⁽¹¹⁾. Unlike that study, our patient's blood gases improved markedly. This may be due to the different mechanisms of clot disruption.

Complications of catheter thrombectomy, which are rare in experienced operators, include pulmonary infarction, wound haematoma and infection, myocardial infarction and ventricular perforation⁽¹²⁾. A reperfusion syndrome with haemorrhage and focal pulmonary oedema has been described⁽¹³⁾. Microembolisation of the thrombus may occur. Fortunately, in PE, this does not affect RV relief because the peripheral cross-sectional area of the pulmonary vasculature is larger than the central area. Thus, any dislocation of fragments to the periphery may result in a relative gain of non-obstructed cross-sectional area, and this may be critical in patients threatened by RV failure⁽¹¹⁾. Limitations of the AngioJet system include the cost of the pump-drive set, the risk of fluid overload, and complications from haemolysis and bradyarrhythmias.

In conclusion, in patients with massive or major PE and contraindications to thrombolysis, percutaneous thrombectomy is an increasingly attractive option. This procedure could be performed at the time of the pulmonary angiogram with immediate haemodynamic improvement in some reports. Currently, it is unknown if percutaneous catheter thrombectomy would improve long-term outcomes in patients with haemodynamically stable PE. Further studies would be required to determine if it would be an alternative to thrombolysis in selected patients.

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