CASE REPORT

Pulmonary thromboembolism treatment by percutaneous clot aspiration – case report

Tratamento de tromboembolismo pulmonar por aspiração percutânea do trombo – relato de caso

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Abstract

Massive pulmonary thromboembolism is an important cause of mortality. Its main cause of death is the failure of the right ventricle due to the high resistance to its outflow, and the patient survival, in these cases, depends on prompt recanalization of the pulmonary arteries. Anticoagulation, use of thrombolytics and pulmonary embolectomy represent established therapeutic options to different clinical scenarios of pulmonary thromboembolism. Nowadays, Interventional Radiology represents an alternative to treat patients with massive pulmonary thromboembolism and contra indications to thrombolytics, and is a less invasive option compared to embolectomy. The authors reported a case of a patient with massive pulmonary thromboembolismand contra-indication to thrombolysis, who was submitted to percutaneous clot aspiration of the pulmonary arteries, and discussed the main mechanisms of endovascular techniques of pulmonary thromboembolism treatment.

Keywords: Pulmonary embolism, therapeutics, suction, thrombosis, vascular patency.

Resumo

O tromboembolismo pulmonar (TEP) maciço é uma importante causa de mortalidade. A principal causa de óbito é a disfunção do ventrículo direito, provocada pela alta resistência ao seu fluxo de ejeção, e a sobrevida do paciente, nessas situações, depende da pronta desobstrução das artérias pulmonares. A anticoagulação, o uso de trombolíticos e a embolectomia pulmonar representam opções terapêuticas consolidadas para diferentes cenários clínicos de TEP. A Radiologia Intervencionista representa hoje uma alternativa terapêutica para pacientes com TEP maciço e contraindicação ao uso de trombolíticos, sendo uma escolha menos invasiva do que a embolectomia. Os autores relataram um caso de paciente com TEP maciço e contraindicação à trombólise, a qual foi submetida a aspiração percutânea dos trombos das artérias pulmonares, e discutiram os principais mecanismos de técnicas endovasculares para tratamento de TEP.

Palavras-chave: Embolia pulmonar, terapêutica, sucção, trombose, desobstrução vascular.

Introduction

Pulmonary embolism (PE) is the blockage of pulmonary arteries or their branches by a thrombus that often originates in the deep venous system, breaks free, and, by crossing the right cavities of the heart, reaches the pulmonary circulation[1,2].

Acute PE is associated with high morbidity and mortality rates, especially during hospitalization[3]. Some records indicate that the hospital mortality rate for patients with massive PE is above 30%[1]. The main mechanism that causes deaths is right ventricular dysfunction, and patients' survival depends on rapid recanalization of pulmonary arteries and on reduction of right ventricular ejection fraction resistance[4]. Patients with massive pulmonary embolism (PE), hemodynamic instability and right ventricular dysfunction present a poor prognosis, therefore thrombolytic therapy is indicated[2].

When these agents can not be used, surgical thrombectomy is an alternative technique[5]. Percutaneous procedures are additional therapeutic options for patients who present contraindication to thrombolysis, besides being an alternative to surgery[1,5].

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Case report

A 51-year-old female patient with arterial hypertension underwent craniotomy with exeresis of an arachnoid cyst of the posterior fossa.

On the 13rd postoperative day (PO), she presented with dyspnea. Upon physical examination, she was tachypneic and presented crepitant rales at bilateral pulmonary auscultation.

She was admitted to the Intensive Care Unit (ICU) and received noninvasive ventilatory support with oxygen mask; however, the pulse oximetry indicated desaturation when support was removed. The patient had arterial hypotension, but vasoactive drugs were not necessary. Chest radiography revealed diffuse pulmonary edema.

On the same day, transthoracic echocardiogram demonstrated "… heart rate at 120 bpm, moderate dilatation of the right heart chambers, moderate impairment of the right ventricular function, systolic pressure of the pulmonary artery estimated in 60 mmHg", and the conclusion was "pulmonary hypertension; moderate impairment of the right ventricular systolic function; moderate tricuspid regurgitation".

Helical CT scan of the chest with contrast (Figures 1 and 2) showed "… restrictive filling determined by intraluminal thrombi distally involving the right pulmonary artery, thus determining apparent blockage of the artery and its main branches…. restrictive filling determined by intraluminal thrombi involving the left pulmonary artery bifurcation, thus promoting apparent blockage of its main branches…"

Between the 13rd and the 14th postoperative days, there were no significant clinical changes. Color flow Doppler ultrasonography showed great saphenous vein thrombophlebitis and popliteal vein thrombosis, both on the left. On the 15th PO day, the ICU medical team contacted the service of Interventional Radiology.

The patient was referred to the hemodynamics room, where pulmonary arteriography was performed by percutaneous puncture of the right common femoral vein (Seldinger's Technique), as well as a selective catheterization of the pulmonary artery trunk, right and left pulmonary arteries by a 5F pigtail catheter, which revealed patent pulmonary artery trunk with slightly increased caliber, occlusive thrombi in both pulmonary arteries, and reduction of pulmonary parenchymal perfusion (Figure 3 and 4).

Through a hydrophilic guide wire, the diagnostic catheter and the introducer sheath (5F) were removed, a 10F sheath was placed and an Aspirex® catheter (Straub Medical) was inserted through it (Figure 5). Mechanical thrombectomy and aspiration of thrombus' fragments of the pulmonary arteries were performed.

Pulmonary arteriography revealed reduction in the number of occlusive thrombi on the pulmonary arteries, and improvement of bilateral pulmonary perfusion (Figures 6 and 7). A vena cava filter was placed on the infrarenal portion of the inferior vena cava.

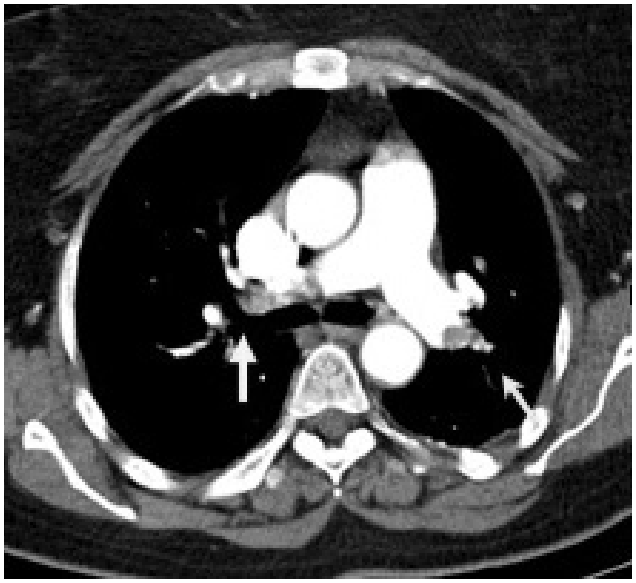

Figure 1 – Chest CT scan. The arrows point to the thrombi on the pulmonary arteries.

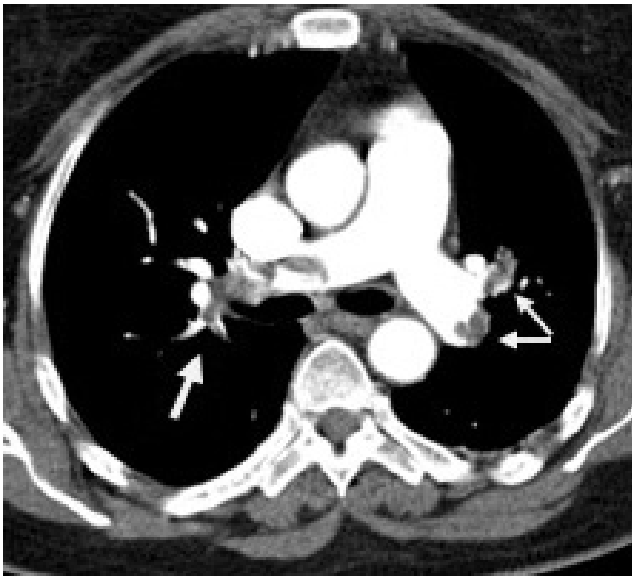

Figure 2 - Chest CT scan. The arrows point to the thrombi on the pulmonary arteries.

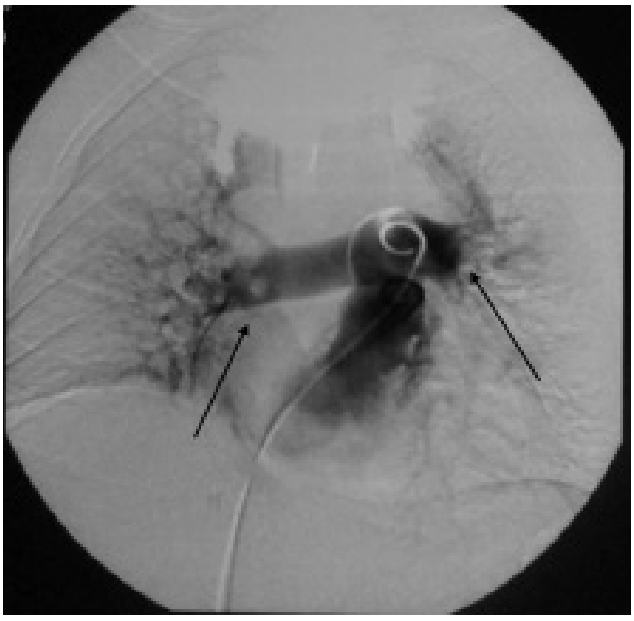

Figure 3 – Pulmonary arteriography. The arrows indicate images of subtraction on the pulmonary arteries.

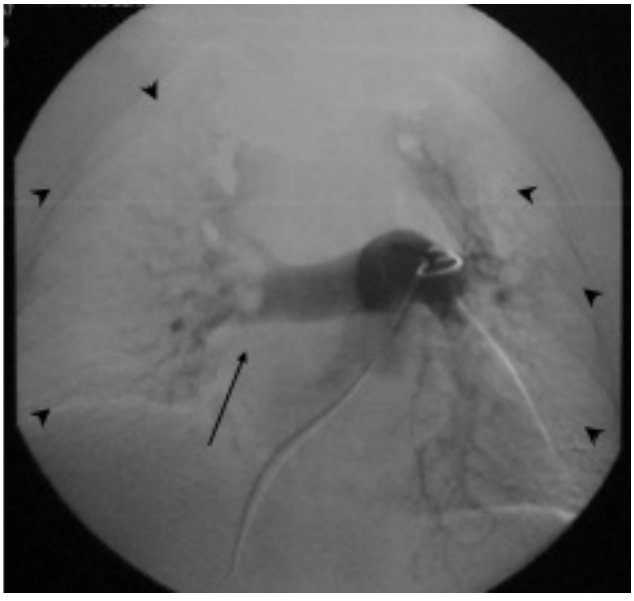

Figure 4 - Pulmonary arteriography. The arrow indicates a thrombus on the right pulmonary artery; the arrowhead indicates hypoperfusion on the peripheral portion of the pulmonary parenchyma.

Dyspnea and oxygen saturation improved and the patient was sent back to the ICU. On the day after, the follow-up echocardiogram showed "… regular sinus rhythm, heart rate of 90 bpm, moderate increase in the right chambers, moderate right ventricular systolic dysfunction, systolic pressure of 37 mmHg in pulmonary artery…", with diagnosis of "moderate pulmonary hypertension". The patient had a good recovery without intercurrences.

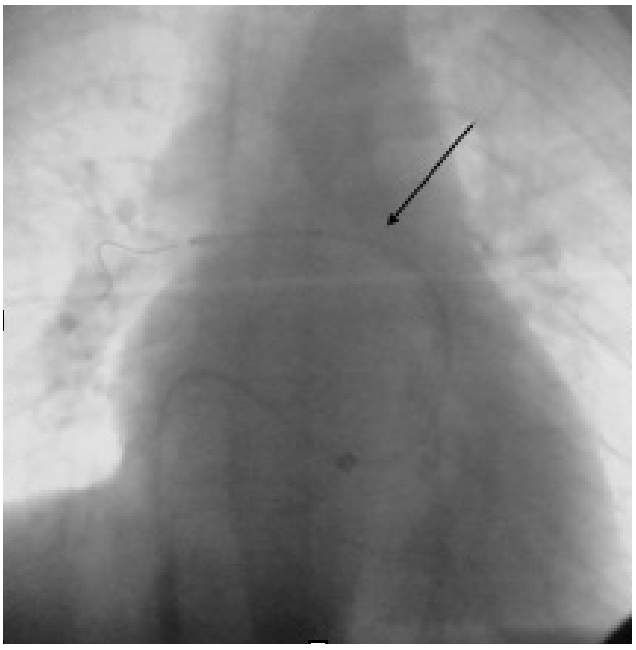

Figure 5 – Aspirex device placed on the right pulmonary artery.

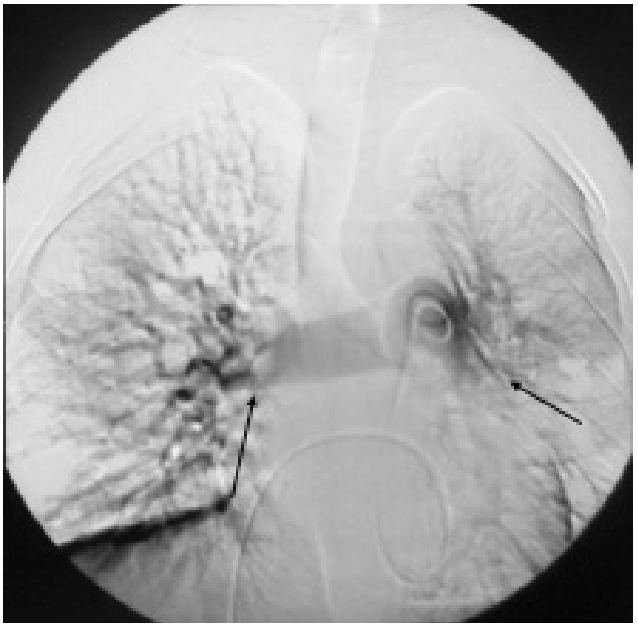

Figure 6 – A decrease in the number of thrombi in the pulmonary arteries is observed.

Discussion

The PE is an important cause of morbidity and mortality in the general population, with an estimated incidence of 0.5 per 1,000 people[1,6].

According to the extension and duration of the blockage, it may be categorized as acute, subacute and chronic. The acute form may be classified as massive or

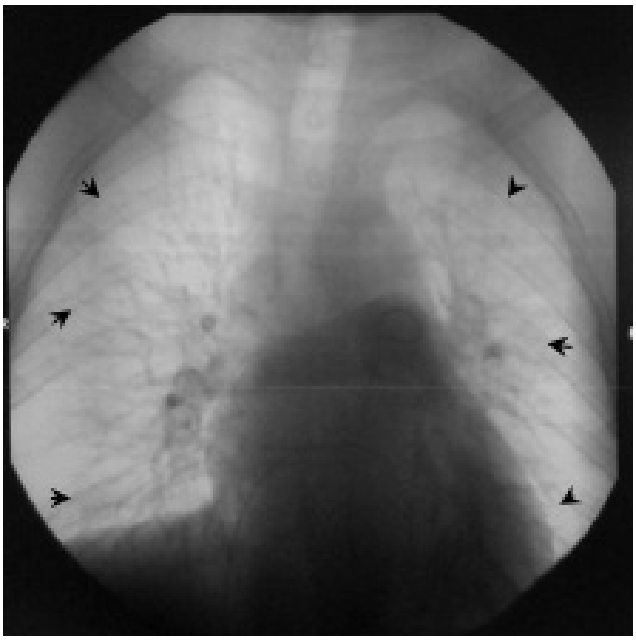

Figure 7 - Pulmonary arteriography. It is possible to observe improvement of peripheral pulmonary perfusion

moderate when it causes, respectively, an obstruction of more or less than 50% of the pulmonary arterial bed[7]. The subacute form is characterized by multiple small and medium emboli that occur within weeks. When the obstructive process is not resolved and the embolus becomes attached to the vein wall, the embolism is categorized as chronic[7].

Nearly 11% of the PE untreated patients have a fatal outcome in the first hour after the disease onset[7]. Until the third month, 15% of the patients die[1,6] and 4% of the acute cases develop secondary pulmonary hypertension[8]. With regard to PE with cardiogenic shock, the mortality rate reaches 70% in some studies[1]. The prevention of this disease must be done, but, after its establishment, it should be promptly diagnosed and treated.

The initial therapeutic approach aims at clinical and hemodynamic stability[2]. In massive PE, the purposes are: to promote rapid thrombolysis, to improve the performance of the right ventricle, to avoid recurrences and to decrease the risk of developing chronic pulmonary hypertension[1]. The endovenous administration of unfractioned heparin is the most common approach, also demonstrably effective and indicated for all forms of PE[2,9].

The death of massive PE patients is caused by cardiogenic shock as a consequence of pulmonary arterial blockage[4,10]. The survival rate depends on the rapid recanalization of the pulmonary arteries and on the reduction of resistance to the right ventricle ejection fraction[4].

Patients with hemodynamic instability and right ventricular dysfuntion[6], characterizing massive PTE have the worst prognosis, so thrombolytic drugs are indicated[2]. These drugs may be administered via the endovenous approach or through a catheter placed on the pulmonary artery[11]. Its use promotes a faster thrombolysis and reduction of the pulmonary hypertension in comparison to the isolated use of heparin. However, hemorrhagic complications are more frequent[9]. Among its absolute contraindications, we can mention recent intracranial surgery[11].

Pulmonary embolectomy was first used by Trendelenburg in 1908, albeit without success. Currently, this procedure is performed through median sternotomy aided by extracorporeal circulation[11], being indicated for massive PE with contraindications for thrombolytic therapy or for patients who do not respond to thrombolysis and remain unstable. The mortality rate disclosed by some case series varies from 10.3 to 56.4%[2,11].

Percutaneous treatments may be used when thrombolytic drugs are prescribed[5], being considered alternatives for surgical treatment[1,3] especially in cases of high surgical risk[9,10]. Percutaneous catheter interventions aim to reduce pulmonary vascular resistance, thus reducing resistance to the right ventricular ejection fraction and improving the cardiac debt[5].

Some techniques do not require specific devices and use diagnostic catheters such as the conventional "pigtail", or little modified, aiming at mechanical fragmentation of the thrombus, which may or may not be associated with local infusion of thrombolytic drugs[1,4,5,10,11].

The first percutaneous system created over 30 years ago specifically for the treatment of massive pulmonary embolism is the Greenfield Embolectomy Device (Boston Scientific®). Since then, many options have become available, such as: Hydrolyser Catheter (Cordis®), Angiojet Rheolytic Thrombectomy System (Possis®), Oasis Catheter (Boston Scientific®), Amplatz Thrombectomy Device (Microvena®), Impeller Basket Device and Rotable Pigtail Catheter (Cook®), Kensey device (Dow Corning), Straub Rotarex System® and Aspirex® (Straub Medical), which was employed in this case, among others[3,9,11].

Endovascular therapy function through many techniques or combinations of techniques, e.g., aspiration of the thrombus through sheaths or guiding catheters, fragmentation of the thrombus by means of catheters, angioplasty balloons, guide wires, maceration by high-speed rotational catheters, fragmentation and aspiration

through hydrodynamic catheters, and pulmonary artery stenting[5,9,11]. Whatever method is used, the endovascular techniques aim at unblocking the pulmonary artery trunks by aspiration or fragmentation and dispersion of the thrombi to peripheral arteries[2,9,10,11]. The fragmentation of a central thrombus and the displacement of its fragments to the peripheral portion result in increased area of unblocked transverse section in the pulmonary arterial tree, because arteries measuring 1 mm in diameter have twice the area of the transverse section in comparison to those of the trunk arteries[1,4,11]. In patients with severe right ventricular dysfunction, it may result in hemodynamic improvement. Besides that, the increase of total thrombus surface promoted by the percutaneous fragmentation accelerates the pharmacological or spontaneous lysis[1,4,10,11].

The Aspirex device (Straub Medical®) is a rotational catheter that exerts a negative pressure through an aspiration system in "L", macerating the thrombus and removing it by aspiration. The device is connected to an engine that generates a 40,000 rpm frequency. The catheter is, then, introduced on a 0.018 guide wire and advanced to the proximal portion of the pulmonary artery occlusion or wherever a major number of thrombi is found; then, it is operated[3].

The indications currently accepted as to the use of percutaneous techniques include arterial hypotension (systolic <90 mmHg or a drop <40 mmHg), cardiogenic shock, cardiopulmonary resuscitation, right ventricular dysfunction, precapillary pulmonary hypertension, alveolar-arterial oxygen gradient >50 mmHg and clinically significant pulmonary embolism with contraindication for thrombolytic therapy[3].

The angiographic results of the interventional procedures are not important: the procedure must be concluded after obtaining improvement of hemodynamic parameters regardless of the presence of residual thrombi revealed by the control arteriography[5].

Two published meta-analyses point out success rates of 71% with the use of various percutaneous techniques for treating PE, increasing to 90% when associated with catheter-guided thrombolysis[3].

Among the reported complications, one can mention right ventricle perforation, tricuspid failure, significant bleeding in the vascular access and mechanical hemolysis. The mortality rate varies from 0 to 25%[3].

Final comments

The bibliographical references state that the percutaneous interventions represent the only alternative therapy to the detriment of surgical embolectomy in massive PE patients with contraindications to thrombolytic therapy.

There are data in literature that assure the efficacy and safety of these devices. However, this promising therapeutic modality requires further studies to have its place established in the algorithms for PE treatment. Because of the significant potential for complications, its use should be restricted to patients with massive PE.

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