Acute massive pulmonary embolism treated by thromboembolectomy using intermittent deep hypothermic circulatory arrest

Bart P. Van Putte, Nabil Bantal, Repke Snijder, Wim J. Morshuis, Wim-Jan Van Boven*

Department of Cardiothoracic Surgery, Sint Antonius Hospital, Koekoekslaan, Nieuwegein, The Netherlands

Abstract

Acute massive pulmonary embolism is a life threatening medical emergency resulting in a high mortality rate. Usually, urgent thromboembolectomy is performed using double venous cannulation without circulatory arrest. We describe a patient suffering from acute massive pulmonary embolism that was treated by emergency thromboembolectomy. Due to back-bleeding the view into the lobar and segmental pulmonary arteries was severely compromised. In order to achieve complete thromboembolectomy, intermittent deep hypothermic circulatory arrest was performed.

Keywords: Acute massive pulmonary embolism; Thrombo-embolectomy; Deep hypothermic circulatory arrest

1. Introduction

Acute massive pulmonary embolism is a life threatening medical emergency resulting in a high mortality rate of 15% [1]. Usually, urgent thrombo-embolectomy is performed using double venous cannulation without circulatory arrest [2]. In this report we describe the usage of intermittent deep hypothermic circulatory arrest for the treatment of pulmonary embolism.

2. Text

A 35-year-old woman was referred to our hospital with a history of deep venous thrombosis. She received no anticoagulation or platelet inhibition therapy.

On admission the patient complained about coughing, dyspnea and angina pectoris (both, NYHA-IV). Except for her poor clinical condition, physical examination was normal. Blood analysis showed an elevated D-dimer (1.4 ng/ml) and elevated liver enzymes (ASAT 459, ALAT 594, GGT 120, LD 1145). Negative T waves were present on electrocardiography. Echocardiography revealed a dilated right atrium and ventricle and concomitant tricuspid insufficiency. Under suspicion of pulmonary embolism, contrast enhanced CT-scan was performed showing massive thrombosis in the right atrium and the common pulmonary artery, the left and right pulmonary artery (Fig. 1a). Subsequently, an urgent thrombo-embolectomy was planned.

During induction of anaesthesiology, the patient went into haemodynamic collapse and total cardiopulmonary bypass was instituted urgently using double venous cannulation. A longitudinal incision was made in the common pulmonary artery and an organised massive clot was completely removed that occluded the origin of the left pulmonary artery. Two separate clots of 6 cm were dissected from the right pulmonary artery. During induction of deep hypothermic (rectal 16 °C) circulatory arrest for 10, 8 and 18 min, the segmental and subsegmental arteries were inspected on both sides after an incision to the right pulmonary artery without opening the pleural space. Several clots were individually removed on both sides. Finally, the right atrium was opened and inspection of the atrial septum and ventricle did not reveal any defects or clots. Rewarming time was used for reperfusion of an extremely compromised and dilated heart due to the acute embolus.

Postoperatively, the patient was anticoagulated according to a standard protocol and received coumadin therapy and intravenous heparin for three days until an INR ≥2.5. The postoperative course was complicated by pneumonia, treated by antibiotics, and the patient was discharged after 26 days. A control contrast enhanced CT-scan after one year showed a completely open pulmonary circulation on both sides to the peripheral parts of the lungs (Fig. 1b).

3. Discussion

Patients suffering from acute massive pulmonary embolism are in a detrimental clinical situation. The only chance
for survival can be achieved by emergency thrombo-embolectomy. At induction, most patients get into circulatory-collapse due to the impaired filling of the left ventricle necessitating immediate cardio-pulmonary bypass. Generally, thrombo-embolectomy is performed by using extracorporeal circulation using Fogarty balloon catheters, suction and opening the pleural space to allow for massaging of the lung as a means to dislodge the peripheral emboli [3]. This approach is characterised by a compromised view into the left and right lobar and segmental pulmonary arteries due to retrograde bleeding from the bronchial circulation often resulting in incomplete thrombo-embolectomy. Usually, massive thrombus formation occurs in the segmental arteries after an acute thrombogenic central occlusion.

Based on our excellent experience with thrombo-endarterectomy using intermittent deep hypothermic circulatory arrest in patients suffering from chronic pulmonary embolism, we performed the same technique in acute massive pulmonary embolism [4].

An optimal view deep into the segmental pulmonary arteries is achieved allowing extensive thrombo-embolectomy on both sides during a limited period of circulatory arrest.

In conclusion, we propose intermittent deep hypothermic circulatory arrest as a new and more effective approach for the treatment of acute massive pulmonary embolism in cases in which complete embolectomy was felt to be incomplete.

References


eComment: Acute pulmonary embolism and surgical treatment

Author: Theodor Tirilomis, Department for Thoracic, Cardiac, and Vascular Surgery, University Göttingen, Göttingen 37075, Germany
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I read with interest the article by Van Putte et al. [1] in which they describe intermittent application of deep hypothermic circulatory arrest for open pulmonary thrombo-embolectomy in acute massive embolism. Massive pulmonary embolism is a life threatening condition and urgent treatment is indicated immediately after confirmation of diagnosis. Open pulmonary embolectomy is in most cases performed in patients with hemodynamic instability or contraindications for thrombolytic or interventional treatment and results are regarding the acceptable severity of illness. Surgical techniques performed are still controversial.

I agree with the authors that deep hypothermic circulatory arrest is an excellent technique in cases of chronic pulmonary embolism, but I think that deep hypothermic circulatory arrest will not be needed in cases of acute pulmonary embolism. Although longitudinal incision of pulmonary artery is in many cases performed [2, 3], like in the present one, I would suggest semicircular incision of the main pulmonary artery just before pulmonary bifurcation. Through this incision and using rigid suction segmental pulmonary arteries can be viewed well, especially from the left side. Viewing from the right side is often compromised and can be facilitated in some cases with additional direct incision of right pulmonary artery at the level of right pulmonary artery trifurcation after dissection of tissue between ascending aorta and superior cava vein. I believe that use of Fogarty catheters should be avoided, due to risk of perforation into fragile lung tissue resulting in intrapulmonary bleeding. In addition, compression of lungs very often reveals mobilized peripheral clots and should be performed carefully.

Two other points of view are very important; first, bicaval cannulation should be done making careful inspection of right atrium, interatrial septum, and right ventricle possible and safe, avoiding recurrent embolism of clots remaining in right heart, and second, reperfusion of the extremely dilated and compromised right ventricle is essential. The technique described by Van Putte and colleagues uses rewarming time for extensive reperfusion.
Anyway, I believe that application of deep hypothermic circulatory arrest during pulmonary embolectomy should be a good option in cases of recurrent pulmonary embolism with fresh and old clots in pulmonary artery tree.

References

