How-to-do-it

Retrograde pulmonary embolectomy in massive pulmonary embolism

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Abstract

The purpose of this study was introduction and evaluation of efficacy and safety of retrograde thromboembolectomy in acute massive pulmonary emboli. The method is described in a 56-year-old woman with acute massive pulmonary thromboemboli. Postoperative course was uneventful. The described surgical technique is not a panacea and definitely not the whole answer, but is a big part of the solution and may be accompanied with less adverse effects. Additionally, there is a need of being reviewed further in large experimental studies and measurements before it could be used safely as a new technique.

Keywords: Pulmonary; Embolism; Pulmonary arteries; Embolectomy; Stenosis or obstruction; Retrograde; Mechanical

1. Introduction

Here, we present a surgical technique in which we believe small fragmented thrombi are sufficiently evacuated and are accompanied with fewer traumas to the lung tissue or the pulmonary arteries (PA).

2. Case presentation

A 56-year-old lady had referred to emergency department due to abrupt onset of vague abdominal pain and tenderness, mostly located in her right upper quadrant, 30 min prior to her arrival. On arrival, she had severe pleuritic chest pain, decrease blood pressure, and engorged neck veins. EKG had showed inverted T in III, V1 and V2 leads and Q-wave formation in V1. Chest radiography (CXR) was hazy in both lung fields, mostly in the left side (Fig. 1). Arterial blood gas revealed hypoxia (PaO₂ 42.2 mmHg, pH 7.28, O₂ saturation of 69.4%, Hb 13.2 mg/dl). CK-MP and Troponin-I were negative. The patient was admitted in the intensive care unit and an emergency color Doppler sonography from renal, abdominopelvic, and both lower extremities along with an emergency echocardiography were done. No evidence of thrombophlebitis or stenosis was detected in the color Doppler. However, echocardiography revealed dilated right atrium (RA), large clot in the apex of right ventricle (RV), and an oscillating clot in the main PA with extension to both pulmonary arteries and mostly the right PA. Computerized tomography (CT) scanning from the chest showed dilated main PA and its branches with luminal defect in favor of clot (Fig. 2). Therefore, due to hemodynamic instability the patient was transferred to operating room.

3. Surgical procedure

Shiraz University of Medical Sciences Ethical Committee had approved the procedure. The chest was entered through a median sternotomy. On inspection, the RA and RV were dilated and PA was tense and distended. PA pressure prior to transferring to pump circulation was 60/40 mmHg. The pleura of left lung was opened, and large amount of serous fluid sucked. Cardiopulmonary bypass was initialized. The RA was opened and inspected for evidence of clot. However, no evidence of clot in the right heart was detected. Therefore, main PA was opened (length of 3—4 cm, lower end of the arteriotomy incision started 2 cm distal to the pulmonary valves). Large amount of fresh clot and formed thrombi were removed with forceps and bolus saline flush and suction. Afterwards, the RA septum was opened through an incision made on the area corresponding to fossa ovalis and an atrial septal defect was created. Pulmonary veins orifices in the left atrium were identified and an endotracheal tube size 5.5 mm, with its cuff inflated, was inserted in one of the orifices. The pump oxygenator was connected to the endotracheal tube through an accessory line and oxygenated...
blood was infused from the pump with mean pressure of 15—17 mmHg and duration of 60—80 s for each pulmonary vein. The pulmonary veins became full of blood in a retrograde fashion and the blood and thrombi fragments began to appear in the PA and were washed out. The debris and thrombi fragments which were dislodged in the secondary and tertiary branches of PA were evacuated. Every time we retrogradely perfused a PA branch the other branch was snagged and closed, in order to prevent the risk to dislocate thrombotic material into other branches of the PA or to transfix them in larger branches. The atrial septal defect was closed. The PA pressures reduced immediately after surgery (20 mmHg) and decrease further over the next 48 hrs. The cardiac index showed immediate improvement compared with the preoperative state. She had a smooth postoperation course and her condition showed significant improvement. She was discharged 1 week later. One- and 3-month follow-ups were satisfactory.

4. Discussion

Surgical pulmonary embolectomy is now widely recognized as the definitive treatment for acute massive pulmonary thromboembolic disease [1-4]. The first successful pulmonary embolectomy was performed in 1961 by Cooley et al. [5] and his method has remained the preferred technique until now. The operation involved introduction of a suction tip into the PA, and compressing the lungs repeatedly to remove the peripherally lodged emboli. This technique, however, may cause PA wall injury and sometimes causes massive endobronchial hemorrhage [2]. Forced insertion of the embolectomy catheter into the peripheral PA and balloon over-inflation are frequently the causes of pulmonary artery injury [2]. In the method described, the lung is not compressed and the plugged clots are gently washed out by the blood flow which is pushing retrograde from the distal area, and therefore causing less injury. Kieny et al. [6] also did not compress the lungs; however, a large aspirator was introduced into each arterial branch. Robison et al. [7] avoided the use of embolectomy catheters for fear of injuring the PA. The pressure we utilized for retrograde injected blood into the pulmonary vasculature was 15—17 mmHg, which is an acceptable pressure for the pulmonary vasculature. This was obtained according to normal physiology and anatomy of PA, estimated to be 10—15 mmHg. Therefore, the patient would not develop pulmonary congestion if acutely subjected to a left atrial pressure of 15—17 mmHg. Additionally, we did not need higher pressures since the duration of flow was more important. We achieved our goal of emptying clot fragments from the PA with ever lower pressures. The clots started to evacuate with low pressures of 5—10 mmHg. Then when we observed no more clots we gradually increased the pressure to 15 mmHg, in order to clean any remaining clot fragments. However, most of the clot fragments had been washed-out earlier. This terminal increase in pressure was done since we thought maybe increase in pressure would be helpful. More prospective studies are needed in order to find the best pressure. In the conventional method, small fragments of thrombi which have got dislodged into the peripheral arteries are usually incompletely removed and left to be lysed by medical thrombolytic therapy [5,7]. However, this does not happen in the retrograde method.

In conclusion, although our method should not be over interpreted with regard to only one case, it might indicate the possibility of reduction in complications of previous techniques. It is simple, safe, effective (removing even small fragments of thrombi, dislodged in the peripheral segments), and can be rapidly accomplished. There is a need of being reviewed further in large experimental studies and measurements before it could be used safely as a new technique.

References


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