Case report

Paradoxic aortic arch embolization with occlusion of the supraaortic arteries

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Abstract

Pulmonary embolization usually occurs when thrombotic material that originates from deep venous thrombosis of the lower extremities is washed out into the pulmonary vasculature via the blood stream. However, in the presence of a patent foramen ovale (PFO), systemic paradoxic embolization may also occur (Am J Surg 176 (1998) 158). Here, we report on the case of a patient with a PFO, who developed paradoxic embolization of the aortic arch following deep venous thrombosis and massive pulmonary embolism.

Keywords: Paradoxic embolization; Pulmonary embolization; Patent foramen ovale

1. Clinical summary

A 60-year-old female patient was admitted to our hospital with a 5-day history of severe dyspnea. In addition, she complained of acute paresthesia and movement disorders in her right arm as well as severe pain in her left shoulder. Physical examination at admission revealed a loss of pulse in both arms. Chest X-ray and routine blood work 3 days prior to admission were within normal ranges. Our patient had a medical history of arterial hypertension, hypercholesterolemia and deep vein thrombosis (DVT) 10 years ago. No signs of recurrent DVT were evident on physical examination. However, due to the patient’s history an ultrasound examination of both legs was performed, which revealed a DVT in her left foreleg. In order to exclude pulmonary embolization computed tomography (CT) scan of the chest was performed, which showed a floating thrombus in the ascending aorta with total occlusion of her right and partial occlusion of her left subclavian artery as well as infiltration of both carotid arteries (Fig. 1A). Thrombus in both pulmonary arteries and massive peripheral pulmonary embolization (PE) also became evident (Fig. 1B). The woman underwent emergency embolectomy of the aortic arch and the pulmonary arteries. Following median sternotomy and pericardiotomy a distended right ventricle was seen. After complete heparinization cardiopulmonary bypass (CPB) was implemented by two-stage cannulation of the right atrium and direct cannulation of the left ventricular apex. This cannulation site was chosen to avoid thrombus dislocation by inserting a cannula via the ascending aorta, the arch, or the femoral artery. Circulatory arrest was allowed at a body temperature of 24 °C. To avoid distension of the left ventricle following ventricular fibrillation at 28 °C, the heart was manually compressed until the arrest temperature had been reached. Incision of the ascending aorta revealed fresh intraaortic thrombotic material infiltrating all supraaortal branches. All obtainable thrombotic material was removed and the aortotomy was closed. No cardioplegia was administered. In a next step the ascending aorta was cannulated for arterial return and CPB was initiated again after a circulatory arrest time of 8 min. Bilateral pulmonary artery embolectomy was then performed through a longitudinal incision in the main pulmonary artery. Right atrial incision and examination of the atrial septum revealed a patent foramen ovale (PFO), which was closed directly without a patch plasty. The patient was weaned from the extracorporeal circulation after a total CPB time of 78 min and was transferred to our intensive care unit for 1 day. On postoperative day 3 a vascular filter device was inserted into the inferior vena cava in order to prevent future embolization from the lower to the upper part of the body. Residual thrombi in the right brachial and distal right subclavian artery caused persistent postoperative pain. Therefore, intravenous administration of prostavasin was initiated on postoperative day 8 for 2 weeks. The patient recovered uneventfully and was discharged from our hospital on postoperative day 22.
2. Discussion

Here we report on the rare case of a massive paradoxic embolization of the aortic arch with partial occlusion of all supraaortic arteries. A PFO is present in about 25–35% of the normal population [1]. In the event of pulmonary embolism with accompanying PFO the sudden increase in right ventricular pressure can cause right to left arterial shunting [2]. This is associated with increased mortality due to systemic thrombembolic complications such as cerebral ischemic stroke, intestinal ischemia or malperfusion of the extremities. After diagnosis of acute pulmonary embolism patients can be treated conservatively by administration of thrombolytic agents or heparinization. Only in severe and life-threatening situations is surgical pulmonary embolectomy indicated [3].

The diagnosis of paradoxic embolism is often difficult since signs of a DVT are absent in most patients. In case of suspected paradoxic embolization transesophageal echocardiography (TEE) is a reliable diagnostic tool to detect a PFO [4]. In our case the combined occurrence of PE and aortic thrombus led to the diagnosis, confirmed by CT scan.

Due to the life-threatening situation with floating thrombotic material in the aortic arch occluding the supraaortal arteries we waived further investigation by TEE.

Institution of CPB in this patient did bear a significant threat of peripheral embolization by thrombus material originating from the ascending aorta or the aortic arch. The apex of the heart was therefore cannulated to prevent altered blood flow in the aortic arch. A retrograde perfusion via the right femoral artery might also have caused a dislocation of the thrombus in the aortic arch.

Closure of the PFO was performed to prevent future paradoxic embolization. The standard approach for PFO closure requires bicaval cannulation for CPB to achieve access to the interatrial septum. In our case we decided to use two-stage cannulation of the right atrium and implementation of short-term circulatory arrest, allowing thrombectomy of the aortic arch, the supraaortic arteries and right and left atrium as well as direct closure of the PFO.

Since a DVT was still present at the time of discharge from hospital, an IVC filter was interventionally implanted on postoperative day 3. Clinical studies have confirmed the efficacy of IVC filters in reducing the rate of recurrent PE [5].

Many centers advocate the closure of a persistent PFO by an interventional catheter technique, even in the absence of symptoms. However, currently no consensus exists about its indication [6].

Our case demonstrates the sufficient treatment of a massive paradoxic embolization of the aortic arch caused by DVT and PE putting our patient at risk of lethal cerebral embolization. By implementing circulatory arrest in deep hypothermia it was possible to manage aortic arch thrombectomy and PFO closure in a sufficient and fast way with the least risk of peripheral systemic embolization due to surgical manipulation. To our knowledge this approach to the surgical management of aortic arch embolectomy, pulmonary embolectomy and PFO closure has not been described previously.

References