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Case Report

Intraoperative Thrombolysis for Pulmonary Embolism during Thymoma Resection

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ABSTRACT

We report a case of pulmonary embolism during resection of a mediastinal mass requiring intraoperative thrombolysis. The diagnosis, although difficult to establish due to simultaneous bleeding and technical difficulties with transthoracic echocardiography, was based on the patient's history and clinical evidence of low cardiac output and was confirmed by clinical improvement post thrombolysis. When awakened in the intensive care unit, the patient was found to be blind and also required a tracheostomy. We present this case, as it requires complex clinical reasoning throughout different stages of its management and it demonstrates that, when facing an imminent disaster, a risky decision not necessarily conforming to current practice but based on individualisation of treatment can be life-saving.

Introduction

Resection of mediastinal masses is regarded as an anaesthetic challenge, as it carries a significant risk of haemodynamic and respiratory decompensation [1]. One of those risks is the development of superior vena cava syndrome (SVCS) [1]. Massive pulmonary embolism (PE) is an unusual intraoperative complication with significant morbidity and mortality and challenging diagnosis and treatment, as the associated clinical signs (hypoxaemia, increased alveolar dead space and haemodynamic instability) and electrocardiographic changes can be attributed to various causes perioperatively [2, 3]. Patients presenting for surgery, often have one or more risk factors for pulmonary embolism including obesity, malignancy, smoking and prolonged immobilization [4]. In addition, surgery itself causes an acute inflammatory response, following tissue trauma, that activates the clotting cascade and increases the risk for pulmonary embolism [4]. Thoracic surgical patients have a high incidence (1.5-2%) of perioperative pulmonary embolism [4]. We report a complex case of a thymoma resection leading to PE requiring intraoperative thrombolysis and to postoperative blindness, possibly in the setting of SVCS.

Case Report

A 48-year-old man (BMI 36,85 kgm^{-2}) was referred for resection of mediastinal mass, possibly a thymoma. Preoperative chemotherapy resulted in size decrease by 20-30% and successful management of associated SVCS. CT and MRI scans and transthoracic echocardiography (TTE) suggested a still large tumor (7.6x6 cm) adjacent to mediastinal structures (pericardium, aortic arch, ascending aorta) and either infiltrating (left subclavian artery), partially obstructing (superior vena cava) or surrounding major vessels (right brachiocephalic vein). Comorbidities included type 2 diabetes mellitus, left ventricular hypertrophy with good systolic function and an ex-smoking status. Liver function tests were abnormal and bilirubin was suggestive of positive Coombs reaction due to haemolytic anaemia. Preoperative assessment did not reveal significant breathing abnormalities or an anticipated difficult airway.

Before induction of anaesthesia a left foot peripheral venous cannula and a left femoral arterial catheter were inserted and external defibrillation pads were placed. Induction was uneventful with midazolam 2 mg, fentanyl 200 mcg, lidocaine 100 mg, propofol 270 mg and rocuronium 100 mg. A No 41 double lumen left-sided Robert Shaw tube was

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inserted. Post induction, a right radial arterial catheter, a left femoral venous 3-lumen catheter, a left femoral venous sheath and a urinary catheter were inserted. Anaesthesia was maintained with desflurane at 1.0 MAC and boluses of fentanyl 50-150 mcg and cisatracurium 4 mg as required. In addition to standard haemodynamic and respiratory monitoring, cardiac output measurement was ensured. In view of possible superior vena cava clamping, neurology was monitored (temperature, cerebral oximetry, blood glucose and pupils check). We aimed for normal haemodynamic, respiratory and metabolic parameters, minimal fluid administration, mild hypothermia for neuroprotection and control of any bleeding tendency.

At a level of 750 ml blood loss the patient required fluid (1,25 L Ringer's Lactate over 4 hours), 1 unit of red blood cells and a low norepinephrine infusion (0.02-0.04 mcg/kg/min). The left brachiocephalic vein was ligated because of possible thrombosis and tumor infiltration without any change in cerebral oxymetry or pupils. One-lung ventilation was attempted twice but failed; the patient desaturated without response to our standard strategies (recruitment of left lung ± CPAP on right lung), but recruitment on two-lungs ventilation was always easy. There was no significant change in airway pressures or $ETCO_2$.

Following further 250 ml blood loss the patient was compromised haemodynamically without response to fluid (2 L Ringer's Lactate) and red blood cells (2 units) administration or to norepinephrine increase up to 0.4 mcg/kg/min. Based on ROTEM testing, fibrinogen 2g was given to enhance coagulation. The persistence of low cardiac output despite aiming at improving preload by filling and haemostasis was suggestive of right ventricular (RV) dysfunction. Dopamine infusion (5 mcg/kg/min) was started. Meanwhile the superior vena cava was torn and clamped. By that time temperature was at 33°C and further neuroprotective strategies were instituted (ice on head, dexamethasone 20 mg, thiopentone 200 mg and magnesium sulphate 2.5 g). As the patient further deteriorated, decision was made to only debulk the tumor, dopamine and norepinephrine were increased up to 6 mcg/kg/min and 0.8 mcg/kg/min respectively and epinephrine infusion of up to 4 mcg/kg/min was added. A decrease of $ETCO_2$ to 25 mmHg with increase of dead space and lactic acidosis of 65.6 mg dl^{-1} supported a working diagnosis of PE.

An intensivist reviewed the patient, and a cardiologist performed an inconclusive transthoracic echocardiogram (TTE). In view of peri-arrest situation (systolic blood pressure 50 mmHg), we decided to thrombolyse intraoperatively. The endotracheal tube was changed into a single-lumen one. Thrombolysis resulted in significant improvement in inotropic support, but massive bleeding occurred in the intensive care unit (ICU). Over the following week SVCS recurred, leading to tracheostomy, and the patient developed respiratory insufficiency, which was attributed to phrenic nerve injury, diagnosed via eosophageal and gastric balloon catheters insertion. When he was awakened, he was bilaterally blind. Initial ophthalmology review and brain CT and MRI did not reveal the cause, but brain ischaemia was identified four months later. A gastrostomy was performed due to dysphagia. The patient was discharged from hospital bilaterally blind and dependent on mechanical ventilation via tracheostomy, after 30 days in ICU and 120 days in respiratory care ward.

Discussion

This case demonstrates the value of clinical reasoning under stressful conditions, when situations requiring opposing treatments co-exist, such as hemorrhage and thromboembolism. We believe that the 250 ml blood loss coincided with the thromboembolic event, but fortunately did not disorientate us from the major problem. If we were dealing only with hypovolaemia, filling and haemostasis should have treated it. The persistence of low cardiac output despite these attempts at improving preload was suggestive of RV dysfunction. Differential diagnosis included mainly RV myocardial infarction and PE. As far as we could check intraoperatively, there were no ST changes in lead II and inotropes did not treat haemodynamic instability. On the contrary, multiple factors favoured thrombosis: tumor, major vessel thrombosis and infiltration, diabetes and prolonged operation. Blood gas analysis and decreased $ETCO_2$ also suggested PE.

Diagnosis of perioperative PE requires a high index of clinical suspicion [2]. General anaesthesia may mask recognizable signs and there are many causes for intraoperative hypoperfusion, hypotension and hypoxaemia [3]. There are reports of intraoperative PE cases, where diagnosis was confirmed by TTE or transoesophageal echocardiography (TOE) or CT angiography [5, 6]. In our case poor windows prevented a proper TTE and a TOE could not be performed. As the patient was peri-arrest, transfer to CT scan was not feasible. To reduce intraoperative PE mortality, changes in $ETCO_2$ are a useful alerting tool [7]. Such decrease was taken into consideration during differential diagnosis and prompted treatment, along with the haemodynamic instability. Multidisciplinary review resulted in joint agreement on immediate thrombolysis, based on strong evidence, despite surgery being a contraindication to thrombolysis. The clinical haemodynamic improvement was supportive of our decision and bleeding was expected. Thrombolysis is regarded as first line treatment, with major bleeding in >50% of thrombolysed patients within 1 week of operation and in 20% of them 1-2 weeks postoperatively [8]. Surgical embolectomy or percutaneous catheter-directed therapy are considered as alternative options to systemic thrombolysis [3, 9, 10]. However, perfusionist unavailability prevented a cardiopulmonary bypass operation and haemodynamic instability did not allow for transfer to angiography.

In the literature there are not many reported cases of suspected intraoperative PE, without echocardiographic or angiographic confirmation, treated solely with thrombolysis. Among intraoperative thrombolysis survivors, our search identified five case reports with PE diagnosis based only on clinical evidence and thrombolysis without imaging confirmation [11-14]. None of these patients underwent thoracic surgery. Perioperative vision loss (POVL) is a rare complication in non-ocular operations, with an estimated incidence 0.056%-1.3% and multifactorial background, including corneal abrasion (CA), central or branch retinal artery occlusion (CRAO/BRAO respectively), ischaemic optic neuropathy (ION) and cortical blindness (CB) [15-17]. CA is mainly due to inadequate intraoperative corneal protection [15]. Our patient's eyes were lubricated and taped without pressure points and upon direct postoperative inspection there was no accidental uncovering or immediate lesions. CRAO and BRAO are caused by decreased retinal perfusion, usually manifest as unilateral visual field loss and are mainly due to prone position and external ocular pressure; increased intraocular

pressure, microemboli, hypotension and vasospasm can also be implicated [15-18]. In our case there was no extraocular pressure or prone positioning, and blindness was bilateral. ION is the most frequent cause of permanent POVL [15]. While many predisposing factors were present in our case (male gender, diabetes, obesity, prolonged operation, hypotension, vasoconstrictors, hemorrhage and transfusion), the role of possible factors in the pathogenesis of ION remains unclear [15, 17, 18]. CB can be bilateral and due to ischaemia or hypoperfusion of the occipital lobes [15].

Although neurology review raised concern regarding bilateral ION, ophthalmology review was inconclusive. Initial post-operative brain scans did not confirm ischaemia, but an MRI scan four months later suggested chronic ischaemia of frontal, parietal and occipital lobes in the context of global cerebral hypoxia. Cerebral hypoxia and ION could be a result of either intraoperative hypotension or SVCS. There are few reports of blindness post SVCS in the literature. In one case blindness was associated with acute intraorbital retrobulbar bleeding possibly in the context of proximal superior vena cava clamping during cardiac surgery [19]. In another case blindness was attributed to SVCS post-mediastinal mass resection [20]. In summary, resection of mediastinal masses can be accompanied by fatal complications, such as massive bleeding or massive pulmonary embolism and debilitating conditions, such as persistent respiratory failure due to phrenic nerve injury or permanent blindness. In these circumstances multidisciplinary teamwork is of paramount importance for the individualization of treatment.

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Conflicts of Interest

None.

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Not Applicable.

Consent

A written patient's consent was obtained.

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