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Case Report

Right-sided Decortication in a Patient with Left Pulmonary Artery Embolism – a Case Report

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ABSTRACT

This case is an anesthesia challenge and management of one-lung ventilation in a patient with pulmonary embolism of the ventilated lung. A 50 years old male with a history of pulmonary thromboembolism of segmental and subsegmental branches of the left pulmonary artery was posted for right decortication. He developed hypoxia ($sp0_2$~82-85%) and $PaCO_2$-$EtCO_2$ difference of ~30 mm Hg on initiation of one lung ventilation indicating significant shunting of blood and V/Q mismatch. We want to emphasize the importance of intraoperative arterial blood analysis to look for ($PaCO_2$ –$EtCO_2$) difference and periodic reinflation of the collapsed lung for management of patients in whom the blood supply to the dependent is compromised. The presence of pulmonary vascular compromise on the dependent side offers a great number of challenges during the management of one-lung ventilation

Keywords: Anesthesia; Decortications; One lung ventilation; Pulmonary embolism; VATS; Thoracic surgery; V/Q mismatch

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INTRODUCTION

One-lung ventilation causes an increase in shunt fraction and V/Q mismatch causing impairment of oxygenation. During one-lung ventilation, the incidence of hypoxemia is reported to be 4%.[1] The common causes of hypoxemia during one-lung ventilation are dislodgment of the double lumen tube, inadequate ventilation leading to atelectasis in the ventilated lung, and occlusion of major bronchi of the ventilated lung with secretions or blood .[2]We present a rare cause of hypoxemia and hypercarbia during one-lung ventilation caused by pulmonary embolism to the ventilated lung.

CASE REPORT

We present a case of a 50-years-old male with a history of road traffic accidents. The written informed consent for publication was obtained from the patient. The patient had suffered a burst fracture of D2-D3 vertebrae causing paraplegia, and right-sided hemothorax for which an intercostal drain was inserted. During the course of his hospital stay, the patient developed dyspnea around seven days after the trauma. A CT pulmonary angiogram was done in suspicion of pulmonary embolism which showed

pulmonary thromboembolism of segmental and subsegmental branches of the left pulmonary artery along with the collapse of the right middle and lower lobe. An intercostal drain was repositioned and low molecular weight heparin was started.

This patient came to us for a video-assisted thoracotomy for decortication of the right lung. On arrival to the operation theatre, the following were the vitals- heart rate 90/min, blood pressure 115/72mm Hg, SpO_2 of 98 % on Oxygen by Face mask @ 5L/ min. After intravenous induction with fentanyl, propofol, and rocuronium, a left-sided double-lumen tube was inserted and position confirmed with a fiberoptic bronchoscope. The patient was then positioned in the left lateral position. The SPO_2 ranged from 97-99%on FiO_2 of 0.6with $EtCO_2$of 38, before lung separation.

Just after initiation of one-lung ventilation, the SpO_2 gradually dropped to 80- 82% which failed to improve even on FiO_2 of 1. The position of the double lumen tube was rechecked and PEEP to the dependent lung was increased from 5 cmH_2O to 8 cm H_2O, which improved SpO_2 to 84-86%. The surgery was continued, and adhesions and collected blood clots were removed. Intraoperatively, the patient developed hypotension (MBP 55-58 mmHg) for which noradrenaline infusion was started and titrated to maintain an MBP of 65-75 mmHg.At this time, ABG showed a pH- 7.1, PO_2-52.9mmhg, $PaCO_2$-72mmhg, HCO_3– 22.6mmol/l, and normal lactates. There was a marked difference in the $PaCO_2$ (72 mmHg) and $EtCO_2$ (42 mmHg) levels, which was discussed with the surgeon, and the two-lung ventilation was resumed for a brief period. The saturation improved to 100 % on resuming two lung ventilation and the $PaCO_2$ normalized. The surgery was resumed and completed with intermittent two-lung ventilation to correct the respiratory acidosis and oxygen saturation. The surgery lasted for 3 hours and 1.5 L of clotted blood was removed. The double lumen tube was replaced with a single lumen endotracheal tube and the patient was shifted to ICU for elective ventilation. The patient was extubated on a post-operative day 1 in the ICU and the next day shifted to a ward with stable vitals.

DISCUSSION

During one-lung ventilation, the anesthesiologists have the unique challenge to facilitate atelectasis in the non-ventilated lung for improving surgical access and to prevent atelectasis in the ventilated lung, and improve perfusion to the ventilated lung.

During one-lung ventilation, the nondependent lung is bypassed from ventilation with all ventilation reaching only the dependent lung. In this scenario, the perfusion to the dependent lung is the main determinant of oxygen and carbon dioxide (CO_2) elimination. The blood flow through the non-dependent operative lung acts as a right-to-left shunt. The blood flow to the dependent lung is increased by the various machines which include passive mechanisms like surgical manipulation, the effect of gravity, the amount of pre-existing lung disease, and active mechanisms like hypoxic pulmonary vasoconstriction (HPV). HPV decreases the blood flow to the non-ventilated lung by 50%. As the left lung is 10% smaller than the right lung, there is less shunt when the left lung is collapsed.[3] At a given inspired oxygen concentration and hemodynamics, one lung ventilation results in a larger alveolar-arterial oxygen tension difference $P(A\text{-}a)O_2$, and lower arterial oxygen partial pressure (PaO_2) than during two-lung ventilation.[4]

Pulmonary embolism causes a mismatch of ventilation and perfusion causing hypoxia and impaired CO_2 elimination. Shunting occurs when the venous blood enters the systemic arterial system without passing through ventilated units of the lung. The persistent arterial hypoxemia accompanying acute PE even after supplemental oxygen, suggests the existence of a right to left shunting of venous blood. Efficient elimination of CO_2 is impaired due to increases in physiological dead space because of incomplete obstruction of a pulmonary artery.[5]

In this case, the goal to increase the perfusion to the dependent lung was met with the challenge of segmental and sub-segmental pulmonary artery thrombosis in the dependent lung. It precluded us from increasing the perfusion to the dependent lung causing a significant V/Q mismatch. Also as mentioned earlier as the left lung is smaller, its perfusion is less as compared to the right lung. Therefore, on initiation of one-lung ventilation, there was a significant fall in oxygen saturation to 85 % even on FiO_2 of 1 indicating the presence of a shunt. Though the $EtCO_2$ was in the normal range, there was a significant difference in $PaCO_2$ – $EtCO_2$ causing respiratory acidosis because of increased V/Q mismatch. Lower oxygen saturation of 85-90% was accepted and intermittent re-expansion of the nondependent lung was undertaken during the whole procedure. The lactate levels were monitored for tissue hypoxia and remained within normal levels. The minimum SpO_2 below which hypoxemia appears is not known and the tolerable limits of hypoxemia during one-lung ventilation have not been studied.SpO2 values between 90 and 75% have been suggested to be safe based on observations in healthy individuals.[6] Guidelines for the adult respiratory failure of the Extracorporeal Life Support Organization accept hypoxemia with a SaO_2 of 80% if cardiac output and hemoglobin concentration are adequate.[7] Although $EtCO_2$ has been widely used to monitor ventilation status, its accuracy during one-lung ventilation is less as compared to two-lung ventilation, and studies have suggested maintenance of normocarbia during one-lung ventilation. It can become a highly unreliable indicator in a patient with pulmonary embolism undergoing one-lung ventilation owing to an increased difference in $PaCO_2$ –$EtCO_2$ and significant respiratory acidosis.[8]

To conclude, we want to emphasize the importance of intraoperative arterial blood analysis to look for ($PaCO_2$ – $EtCO_2$) difference and periodic reinflation of the collapsed lung for management of patients in whom the blood supply to the dependent is compromised. The presence of pulmonary vascular compromise on the dependent side offers a great number of challenges during the management of one-lung ventilation.

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