CASE REPORT

Intraoperative management of venous air embolism in cervical spine surgeries

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Abstract

Venous Air Embolism (VAE) is a well described phenomenon which can have potentially life threatening consequences. Its early detection and appropriate management is of utmost importance for the survival of the patient. Even though it is common in neurosurgery with sitting position, it can occur in other procedures with other positions as well. Here we present a report of an unusual case of 43 year female patient posted for cervical spine surgery in supine position who developed intraoperative VAE.

Keywords: Venous Air Embolism, Supine Position, Cervical Spine Surgery

Introduction

Intraoperative Venous Air Embolism (VAE) was reported as early as 19th century, in both adult and pediatric practice. Well over 4,000 articles have been published during past 30 years alone, providing ample resonance to the ubiquity and seriousness of the vascular event [1]. With the development of recent technologies, detection and hence incidence of VAE is increased. Appropriate knowledge and skill development avoids further complications and hence improves chances of survival.

Case report

A 43 year old female, presented to neurosurgery department with complaints of neck pain radiating to left upper limb since 2 months. She was an operated case of C6-C7 hemidiscectomy 6 years back. After thorough evaluation she was diagnosed to have C5-6 disc prolapse with inferior migration with left nerve root compression. She was posted for C5-C6 discectomy with partial C6 corpectomy and fixation using expandable cage and screws via anterior cervical approach. Preoperatively patient was American Society of Anaesthesiologists (ASA-I) except power in left upper limb was 4/5. After applying monitors, general anesthesia was administered and it was maintained with oxygen, nitrous oxide and isoflurane with intermittent boluses of rocuronium. Patient was given supine position with head extended and slightly rotated to left side. Intraoperatively, surgeon incidentally noticed air column movement under microscope in right Internal Jugular Vein (IJV) and communicated to us. To and fro movement of air bubbles was seen on the screen. Immediately, surgical field was flushed with saline, 100% of Oxygen (O_2) was given, Nitrous Oxide (N_2O) discontinued, Durant position initiated and IV fluids given. We requested surgeon to aspirate air bubbles under microscopic vision. 1- 1.5 ml of air was aspirated. There was no change in End Tidal Carbon Dioxide

($ETCO_2$), Oxygen Saturation (SpO_2), pulse and Blood Pressure (BP) before, during and after removal of air bubbles. Contralateral IJV, heart chambers were also examined by ultrasound and echo probe for air bubbles and it was negative for the same. Surgery was completed and patient was gradually weaned in the Post Anaesthesia Care Unit (PACU). In post operative period, patient complained of blurring of vision and episodes of diplopia. Magnetic resonance imaging of brain was done which was within normal limits. Diplopia resolved over period of ten days but slight blurring of vision persisted and she was discharged on 14th post operative day.

Discussion:

The rate of occurrence of VAE varies according to the procedure, intraoperative position and detection method used. VAE principally is a hazard of posterior fossa surgeries and upper cervical spine surgeries performed in sitting position [2]. The common sources of VAE in supine position are Central Venous Catheterization (CVC), head and neck surgeries, trauma, lung biopsy, radiologic procedures, child birth and hip replacement surgery [3]. CVC performed using landmark technique is associated with complications like arterial puncture, pneumothorax, air embolism and cardiac arrhythmias. Use of ultrasound (US) is currently indicated to reduce complications during CVC [4]. In our case probable causes of VAE could be air injected from peripheral venous access or air absorbed from atmosphere by the veins which were open at the surgical site. Air bubbles could have been absorbed into the systemic circulation and transported to lungs and then entered IJV.

Physiological consequences of VAE depend on volume and rate of air entry and type of gas (room air, CO_2 or N_2O) and the position of the patient when the embolism occurs [5]. Physiologic effects of venous air embolism mimics pulmonary embolism as – (1) elevated pulmonary artery and right ventricular pressures; (2) increased ventilation/perfusion mismatch; (3) intrapulmonary shunting; and (4) increased alveolar dead space. Air accumulation in left ventricle impedes diastolic filling and during systole air is pumped into

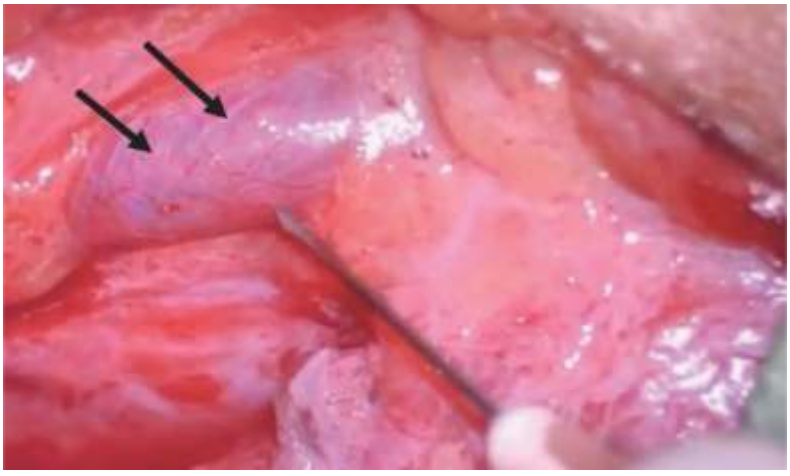

Figure 1: Intraoperative finding of air bubble column in right internal jugular vein

coronary circulation, disrupting coronary perfusion [5]. Right Ventricle (RV) hypokinesis on echocardiography, RV enlargement on chest CT, and troponin elevation predict increased mortality from Pulmonary Embolism (PE) [6]. Small volumes are usually well tolerated by most patients. When air entrained is >3-5 ml/kg body weight or around 300 ml or >100 ml/sec, critical air embolism occurs and patient can have serious consequences [5]. In our case around 1-1.5cc of air was aspirated from right IJV which was too small to develop serious effects.

VAE is primarily diagnosed by clinical signs like sudden drop in $ETCO_2$, fall in SpO_2, hypotension, very rarely by direct detection of air bubbles in the veins by the surgeon. Transesophageal Echocardiography (TEE) is more sensitive and definitive method for detecting intracardiac air [5]. Mill wheel murmur can be heard as a late manifestation of VAE [5]. In our case, vitals were maintained probably because the amount of air column was too small and the air column was moving to and fro and did not embolize to the right side of the heart.

Successful management of VAE lies in early detection and prompt treatment. Surgeon should be informed immediately when VAE occurs [3]. Flood the surgical field with saline, give 100% O_2, lower the head with left lateral decubitus position (Durant position), apply jugular venous pressure, aspirate air from right heart through central venous cannula. Vasopressors and inotropic support should be started if necessary to maintain BP [7]. In our case patient was successfully managed using appropriate steps.

Best preventive measure of VAE is neurosurgeon's meticulous control of bleeding and the tolerance of lower head position, raising venous fluid column by adequate hydration, decreasing venous compliance by use of pneumatic calf compression devices and avoidance of venodilators like nitroglycerin [7]. Study conducted by Mirski *et al*. advised the use of hyperbaric oxygen and perfluorocarbons in VAE management [1]. There is a case report of VAE in a patient undergoing cervical spine surgery in prone position which could be because of anatomical variations in venous plexus at atlanto-occipital joint [8]. VAE can manifest in different forms clinically, so educating practitioners regarding VAE manifestations can help in early diagnosis, and better management. It may also avoid doctors panicking in such situations.

Conclusion

VAE in supine position necessitates utmost caution for cause and diagnosis. Timely diagnosis and management is the key to successful management of VAE. For this adequate training of anesthesiologist must be done.

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