Awake Craniotomy for Cerebral Abscess with Pulmonary Arteriovenous Malformation

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Abstract

A cerebral abscess can be a life-threatening complication of pulmonary arteriovenous malformations (PAVM), thus posing significant morbidity if left untreated. We report a case of an incidental finding of a PAVM in a patient diagnosed with cerebral abscess. A 22-year-old male presented to the emergency department with acute onset right-sided weakness in both upper and lower limbs for 1 week. Magnetic resonance imaging showed a ring-enhancing lesion within the left parasagittal frontoparietal region s/o intracerebral abscess. High-resolution computed tomography was done as a protocol in patients posted for surgery due to coronavirus disease 2019 and coincidentally, it showed a single well-defined parenchymal nodule, 4×3.4 cm in the lateral basal segment of the left lower lobe. The knowledge of the pathophysiology of PAVM and expected complications during general anesthesia (GA) and positive pressure mechanical ventilation is essential. In such conditions, awake craniotomy under conscious sedation and scalp block may be considered as an alternative to GA.

Keywords

- awake craniotomy
- pulmonary arteriovenous malformation
- dexmedetomidine
- conscious sedation
- cerebral abscess

Introduction

Cerebral abscesses are common in patients with cyanotic heart disease and pulmonary arteriovenous malformations (PAVM) due to the intracardiac right to left shunting of blood that is not filtered through pulmonary circulation. The incidence of cerebral abscess in patients with PAVM is around 1 to 5% based on the limited epidemiological data available.[1] In this case report, we are going to highlight the complications of general anesthesia (GA) in a patient with PAVM and its alternative for the anesthesia management of cerebral abscess.

Case Report

A 22-year-old male patient (weight: 50 kg, height: 170 cm) presented to the emergency department with frontal headache and acute onset of right-sided weakness in both upper and lower limbs for the last 1 week. Gadolinium-enhanced magnetic resonance imaging supported the differential diagnosis of a $3.5 \times 4.0 \times 3.3$ cm well-defined, thick-walled, ring-enhancing lesion within the left parasagittal frontoparietal region suggestive of acute intracerebral abscess with perifocal vasogenic edema (►**Fig. 1**). The preanesthetic assessment revealed grade III clubbing. Blood investigations were done that showed polycythemia with hemoglobin of 17.6 gm/dL and packed cell volume of 56.3%. On examination, Glasgow Coma Scale was 15/15. Muscle power of right upper limb was 3/5 and lower limb was 4/5. According to the department protocol, high-resolution computed tomography (HRCT) is done in all patients posted for surgery to rule out coronavirus disease 2019. Coincidentally, HRCT showed single well-defined PAVM, 4×3.4 cm in the lateral basal segment of left lower lobe (►**Fig. 2**). Arterial blood gas in supine position on room air revealed a partial pressure of oxygen of 55 mm Hg, oxygen saturation (SpO2) of 87%, and normal partial pressure of carbon dioxide. The PAVM was asymptomatic here and there had been no suggestion of a previous systemic abscess to raise concern. Two-dimensional

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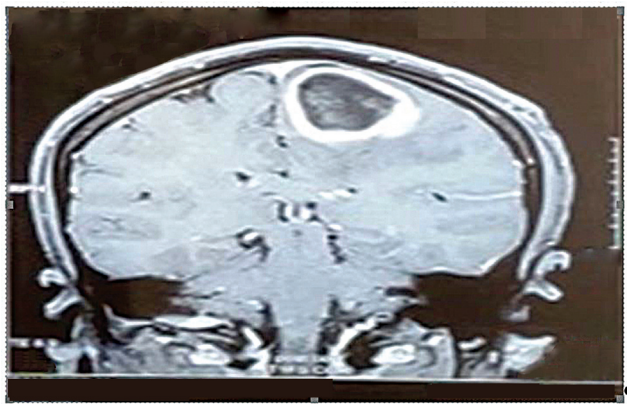

Fig. 1 Gadolinium-enhanced T1-weighted magnetic resonance imaging of coronal section-well-defined, thick walled, 3.5 × 4.0 × 3.4 cm ring-enhancing lesion within the left parasagittal frontoparietal region with perifocal vasogenic edema.

echo was done to rule out congenital heart disease. After discussing with the neurosurgical team, we decided to perform the procedure as an awake craniotomy (AC) under conscious sedation (CS), considering the risks with GA. Our second plan of anesthesia was GA if the patient was noncooperative or the patient desaturated intraoperatively.

Patient was kept nil by mouth for 8 hours and was counselled for AC. Written informed consent was obtained from the patient. On arrival in the operation theater, routine anesthesia monitors were attached. Care was taken to keep the intravenous (IV) line free of air bubbles. Supplemental oxygen at 20 L/min was administered via high flow nasal cannula to the spontaneously breathing patient. Saturation improved to 97%. Expiratory carbon dioxide and respiratory rate were measured. Adequate hydration, antibiotic prophylaxis, and Levetiracetam 1 gm as anticonvulsant were given during preparation for surgery. The patient was given antiemetic ondansetron 4mg and pantoprazole 40 mg IV

Fig. 2 High-resolution computed tomography of single well-defined parenchymal nodule, 4 × 3.4 cm in the lateral basal segment of left lower lobe. Single dilated (11 mm) branch of left lower lobe pulmonary artery was supplying the nodule and single dilated vein (12 mm) was noted draining the nodule into the left lower lobe pulmonary vein s/o simple type pulmonary arteriovenous malformations.

30 minutes before the start of the surgery. An arterial line was secured in the right radial artery under local anesthesia for invasive blood pressure monitoring. Fentanyl 50 µg and midazolam 1 mg were administered before the scalp block. Levobupivacaine 0.25% 20cc was given as scalp block for pain relief. CS with dexmedetomidine was initiated with a loading dose of 1 µg/kg over 10 minutes followed by an infusion rate of 0.2 to 0.7µg/kg/h depending on the level of sedation required. Sedation was monitored and titrated according to the bispectral index (BIS) monitor and Ramsay sedation scale (RSS). The RSS was maintained from 2 to 4 and the BIS value was kept between 75 and 80 to maintain CS.[2]

Depth of sedation was increased during the application of the Mayfield Pins, skin incision, and removal of the bone flap. Dura mater was additionally sprayed with lignocaine. Craniotomy with drainage of encapsulated abscess cavity was performed by neurosurgeon. The surgery lasted for about 2 hours and throughout the procedure, there was no episode of hypoxia. Adequate hydration was monitored by maintaining pulse pressure variation below 12% and by a urine output of 1 to 2 mL/kg/h. The hemodynamics remained stable with heart rate (HR) 86 to 96/min, blood pressure 100 to 120 mmHg systolic, SpO2 ranging between 95 and 97%, and end-tidal carbon dioxide between 30 and 33 mm Hg. The patient's right hemiparesis improved immediately following craniotomy and abscess decompression.

Discussion

PAVM are abnormal connections between the pulmonary artery and pulmonary vein bypassing the capillary bed. Untreated PAVM has been associated with right-to-left shunt causing hypoxemia and paradoxical embolism and is often overlooked as a potential etiology of a cerebral abscess and stroke. However, the presence of features such as clubbing, polycythemia and low SpO2 should raise the suspicion for its presence, especially if a congenital heart disease has been ruled out. If the right to left shunt is greater than 20% of the cardiac output, the patient can then develop clubbing and polycythemia. Seventy percent of PAVM are usually associated with hereditary hemorrhagic telangiectasia. Other acquired causes of PAVM are tuberculosis, hepato-pulmonary disease, and metastatic lung disease.[3]

PAVM poses quite a challenge to the anesthesiologist. The evidence from the literature regarding the use of AC in patients with PAVM is scarce. Adequate hydration is needed to maintain the fluidity of blood and prevent sludging if polycythemia is present.[4] Antibiotic prophylaxis is essential as paradoxical shunting of emboli leads to unfiltered blood returning to the heart causing septic embolism especially brain abscesses.[5] GA in PAVM inhibits hypoxic pulmonary vasoconstriction and worsening of shunting by inhalational anesthetics and positive pressure ventilation intraoperatively.[4] It also causes rise in airway pressures and may cause rupture of PAVM. Patients with PAVM have a decreased systemic vascular resistance (SVR) and anesthesia induces a further drop in SVR. Hence, we used AC

under CS and scalp block with spontaneous ventilation avoiding the risks of GA.

AC is used not only for tumor excision located close to eloquent areas of the brain, but also for other procedures like drainage of cerebral abscess, brain biopsy, and evacuation of subdural hematomas.[6] In our case, AC gave the added advantage of real-time neuromonitoring of the motor and sensory area of the brain. Short-acting IV anesthetic agents such as propofol, dexmedetomidine, and fentanyl are used for providing sedation and analgesia during AC.[7]

In our case, intraoperative dexmedetomidine infusion was given to maintain CS, spontaneous respiration intraoperatively, and to prevent increase in blood pressure. Studies in healthy adults have shown dexmedetomidine to elicit decreases in HR and mean arterial pressure, coincident with decreases in cardiac index and stroke index, and an increase in systemic vascular resistance index.[8]

Adequate preoperative psychological preparation of the patient is the key element for successful AC.[9] Adequate analgesia is required for an AC and cannot rely on sedation alone, especially when sedation is at a minimal level during neurocognitive testing and intraoperative mapping. A scalp block provides surgical analgesia, hemodynamic stability, and decreases the stress response to painful stimuli.[9]

Conclusion

Basic knowledge of pathophysiology of PAVM along with expected complications during GA and positive pressure mechanical ventilation is essential for anesthetic management of such cases. Hence, AC is an alternative to GA in such neurosurgical cases.

Conflict of Interest
None declared.

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