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Anesthetic Considerations in a Patient with Large Cavernous Carotid Aneurysm

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Abstract

Cavernous carotid aneurysms (CCA) are a rare form of intracranial aneurysms. Patients undergoing clipping of a large unruptured CCA pose multiple anesthetic concerns including intraoperative trigeminocardiac reflex (TCR). The anesthetist's role is paramount, specifically, preprocedure anesthetic preparation, close vital monitoring, familiarity with surgical steps, provision of a relaxed brain, and meticulous control of hemodynamics. Closed-loop communication with the surgeons throughout the surgical procedure is paramount. When TCR occurs, unnecessary use of anticholinergics should be discouraged as the hemodynamic perturbations resolve with cessation of the surgical stimulus.

Keywords
- cavernous
- aneurysm
- trigeminocardiac reflex
- anesthesia

Introduction

Cavernous carotid aneurysms are uncommon, representing 2 to 9% of all intracranial aneurysms.[1] The atypical presentation along with the complex surgical approach poses unique anesthetic concerns. Understanding the pathophysiology, awareness of the surgical technique, vigilant intraoperative monitoring, and optimal postoperative care entail a favorable outcome. We hereby describe the anesthetic concerns of clipping an aneurysm located in the cavernous segment of the internal carotid artery (ICA) in which multiple episodes of trigeminocardiac reflex (TCR) were observed. Written informed consent was taken from the patient's relative for this case report.

Case Report

A 36-year-old laborer with no known comorbidities presented with headache associated with double vision for 1 month, ptosis of the right eye for 20 days, and new onset vomiting for 1 day. On examination, he was drowsy with a full Glasgow Coma Scale (GCS) score and had stable vitals. The left pupil was reactive, while the right was nonreactive to light. Cranial nerve examination demonstrated right third, fourth, and sixth nerve palsies. The remaining cranial nerves, motor strength, sensation, and gait were tested and found to be normal. Examination of the back revealed a kyphoscoliotic deformity with curvature toward the left with no asymmetry of the shoulders or iliac crest.

Nonenhanced computed tomography (CT) head showed a right parasellar heterogeneous mass. Magnetic resonance imaging brain was suggestive of a lesion in the right cavernous sinus close to the cavernous ICA. CT angiography revealed a 16.6*17.3*14.4 mm unruptured lobulated saccular aneurysm arising from the right distal cavernous ICA along the dorsal surface that was directed posterosuperiorly and narrowing of right cavernous ICA (►**Fig. 1**). Digital subtraction angiography (DSA) with balloon test occlusion of right ICA suggested a delayed transit time across the right posterior communicating artery.

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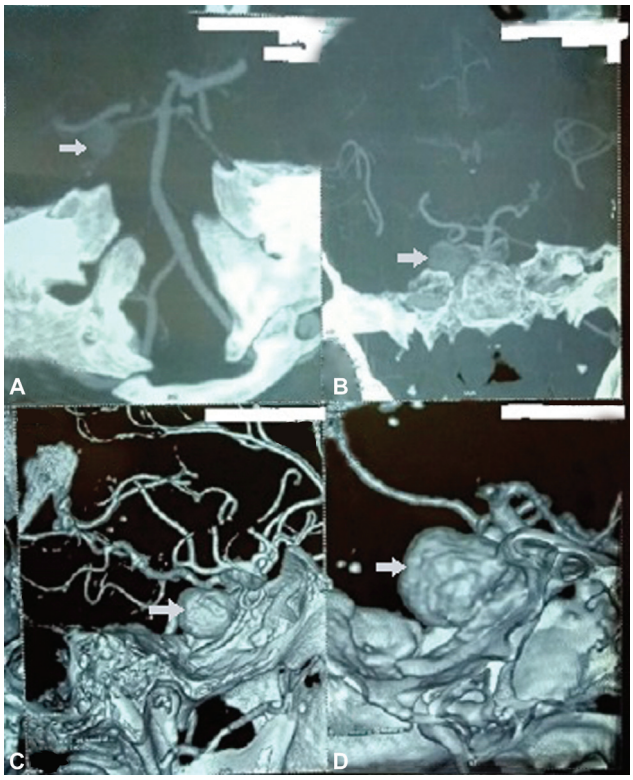

Fig. 1 All images showing computed tomographic angiography of the patient with a 16.6*17.3*14.4 mm unruptured lobulated saccular aneurysm (arrows) arising from right distal cavernous internal carotid artery along the dorsal surface causing mass effect. (**A**) Maximum intensity projection image coronal cut. (**B**) Maximum intensity projection image axial cut. (**C**) Volume-rendered image. (**D**) Volume-rendered image zoomed in.

Baseline investigations were unremarkable except for a chest X-ray that confirmed the kyphoscoliotic deformity. Preoperative arterial blood gas analysis on room air and bedside echocardiography were normal. Given the mass effect from the intracranial lesion, we proceeded with emergency craniotomy and clipping of the aneurysm under general anesthesia after obtaining high-risk consent.

In the operation theater, standard American Society of Anesthesiologists monitors (pulse oximeter, noninvasive blood pressure cuff, electrocardiogram) were attached. Before induction, the right radial artery was cannulated under local anesthesia. Baseline vitals were stable. The patient was induced with an injection of fentanyl and titrated doses of injection propofol. Injection atracurium was administered to facilitate intubation, and esmolol was given to prevent a laryngoscopy response. Under ultrasound guidance, the left subclavian vein was cannulated. The patient was maintained on propofol and fentanyl infusion with oxygen: air 1:1. Repeated blood gas analyses during the procedure were unremarkable with normal partial pressures of oxygen, carbon dioxide, and partial pressure of oxygen to fraction of inspired oxygen ratios.

Intraoperatively, the patient had multiple episodes of TCR (heart rate around 35–40 per minute with stable blood pressure) when the surgeon was dissecting around the nerves in the cavernous sinus. Even the slightest manipulation in the cavernous sinus triggered this reflex. Surgeons were informed repeatedly and with cessation of the stimulus, hemodynamics would normalize. After multiple pauses, the aneurysm was eventually clipped without any untoward events. The total temporary clipping time was approximately 45 minutes. The patient was shifted unreversed on mechanical ventilation to the neurosurgical intensive care unit. The patient developed left-sided weakness on the second postoperative day (POD). Nonenhanced CT head revealed a right ICA infarct with mass effect. He underwent an urgent right-sided decompressive craniectomy. He demonstrated improvement in GCS score (E4VTM6) with left hemiparesis at discharge (POD8).

Discussion

ICA has seven anatomically distinct segments, C1 to C7. The cavernous segment (C4) lies medially in the cavernous sinus with cranial nerves III, IV, and V (branched V1 and V2) lying adjacent to it. The majority of cavernous sinus aneurysms is asymptomatic, while a few can attain large size to cause mass effects.[2] Patients usually present with double vision, pain, ptosis, and ophthalmoparesis. Extradural location and the likelihood of rupture into the subarachnoid space, cavernous sinus, or surrounding sphenoid sinus make these aneurysms unique.

The management options include microneurosurgical clipping and endovascular techniques. Endovascular techniques are considered relatively safe and include coil embolization, flow diverters, and the use of liquid embolic agents.[3] Apart from concerns unique to DSA suites like remote location, lack of skilled assistance, and radiation exposure, these are expensive and do not cause an immediate reduction in mass effect. Direct microsurgical clipping to exclude the lesion while maintaining patency of the parent artery was planned in this case. However, the critical location of the aneurysm necessitated lengthy temporary occlusions and multiple complex clippings that would have led to distal ischemia in this case.

The relative rarity of these aneurysms and the complex microsurgical techniques necessitates a thorough understanding of the nuances of anesthesia management. The surgical approach to an aneurysm and the patient's position should be discussed with the surgeon beforehand. In this case, right frontotemporal–orbitozygomatic craniotomy was made and a subtemporal, intradural, transcavernous approach was used with prior proximal control of the ICA in the cervical segment. This necessitates the endotracheal tube fixation and central line placement on the opposite side of the neck control.

The onus lies on the neuroanesthetists to provide a relaxed brain to the surgeon, control the transmural pressure gradient of the aneurysm, avoid a significant increase in intracranial pressure and significant hemodynamic fluctuations and preservation of adequate cerebral perfusion pressure along with a plan for rapid awakening. In an unruptured aneurysm, it becomes more important to avoid any undue sympathetic responses as in laryngoscopy, tracheal

intubation, patient positioning, placement of the pin headholder, and raising of the bone flap.

We kept the patient on propofol infusion as it leads to dose-dependent cerebral vasoconstriction, and fall in cerebral blood flow and cerebral metabolic rate of oxygen, hence offering neuroprotection. In case of brain bulge, various measures include head end elevation, switching off nitrous oxide/inhalational agent (if in use), and hyperventilation to the partial pressure of arterial carbon dioxide of around 35 mm Hg, ensuring adequate diuresis following decongestant, checking airway pressures, and supplementing anesthesia with boluses of muscle relaxant and propofol. Intraoperative aneurysm rupture runs the risk of colossal blood loss and prompts us to be ready with adequate blood products.

Manipulation of the fifth cranial nerve can cause TCR that is quite predictable in this case. However, TCR has also been reported in patients undergoing aneurysmal clipping even when aneurysm is not in the cavernous portion. A light mechanical stimulus to the dura mater induced severe bradycardia in a 77-year-old woman undergoing clipping for an unruptured left middle cerebral artery aneurysm that resolved with topical anesthesia of the dura surface.[4] TCR refers to the sudden onset of parasympathetic dysrhythmia or sympathetic hypotension under general anesthesia. It is defined as a fall in heart rate and mean arterial blood pressure of more than 20% as compared with baseline. The mainstay of management remains vigilant monitoring and frequent notifications to the surgeon. Cessation of stimulus characteristically resolves the hemodynamic instability. As a novice, we tend to immediately reach out to anticholinergics, which is seldom required and has its own set of side effects. Pharmacological masking of TCR that is a protective brain reflex is not needed till the hemodynamic instability is reversible.[5] In this case, the patient was drowsy preoperatively and had undergone a major procedure involving multiple lengthy complex clippings with multiple episodes of TCR. Hence, patient was not extubated on table and shifted for postoperative elective ventilation.

Scoliosis poses additional concerns with restrictive ventilatory defects, reduced lung volumes, and hypoxemia leading to raised right heart pressures. Detailed history and physical examination should exclude the association with various syndromes and neuromuscular disorders.[6] Scoliosis in this patient was noticed just before the surgery but did not affect the course of management.

The decision regarding extubation or continued mechanical ventilation has to be done considering the patient and surgery-related factors in coordination with the surgical team.

Conclusion

It becomes indispensable to understand the nuances of anesthesia management given the relative rarity of these aneurysms and the complex microsurgical techniques associated with their clipping. Close observation of the vitals, ventilatory parameters, and surgical field along with maintenance of normothermia, normocapnia, normotension, and adequate analgesia is paramount. A vigilant neuroanesthesiologist should keep in mind the characteristic management feature of TCR, that is, resolution with the stopping of stimulus.

Conflict of Interest
None declared.

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