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Anesthetic Management of Cavernous Sinus Meningioma with Pre-existing Cranial Nerve Deficits: A Case Report

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ABSTRACT

Cavernous sinus meningioma poses significant neuroanesthetic challenges due to its skull base location, close proximity to critical neurovascular structures, and frequent association with pre-existing cranial nerve dysfunction. Optimal perioperative anesthetic management is essential for preserving cerebral perfusion pressure, maintaining optimal intracranial dynamics, and preventing secondary brain injury during complex skull base surgery. We report the perioperative anesthetic management of a 52-year-old woman with a right cavernous sinus meningioma who presented with a five-month history of progressive headache and multiple cranial nerve deficits, including ptosis, facial hypoesthesia, and deviation of the mouth and tongue, without limb motor weakness. The patient had long-standing poorly controlled hypertension and was classified as American Society of Anesthesiologists physical status III. Preoperative assessment demonstrated stable cardiopulmonary function, anisocoria, and preserved consciousness. Magnetic resonance imaging revealed a right cavernous sinus tumor measuring 2.4 × 1.7 × 1.9 cm. The patient underwent elective craniotomy and tumor removal under general anesthesia with endotracheal intubation. A comprehensive neuroprotective anesthetic strategy was implemented, including head-up positioning, controlled ventilation to maintain normocapnia, strict hemodynamic control to preserve cerebral perfusion pressure, and goal-directed fluid and blood management. The surgical procedure lasted six hours with an estimated blood loss of 1600 mL, managed with crystalloid, colloid, and blood component therapy. Postoperatively, the patient was managed in the intensive care unit with mechanical ventilation, adequate analgesia and sedation, osmotherapy, anticonvulsant prophylaxis, and close neurological monitoring. Despite transient metabolic acidosis, the patient remained hemodynamically stable, with preserved oxygenation and neurological improvement.

Keywords

Cavernous Sinus Meningioma, Neuroanesthesia, Craniotomy, Cerebral Perfusion Pressure, Secondary Brain Injury

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INTRODUCTION

Meningiomas account for approximately 30–35% of all primary intracranial tumours in adults [1]. Although generally benign and slow-growing, their clinical significance is strongly influenced by tumor location rather than histological grade [2]. Cavernous sinus meningiomas constitute a distinct subgroup because of their intimate anatomical relationship with critical neurovascular structures, including cranial nerves III, IV, V1, V2, and VI, and the intracavernous segment of the internal carotid artery [3,4]. As a consequence of this complex anatomy, patients frequently present with cranial nerve dysfunction, such as ptosis, ophthalmoplegia, facial sensory loss, and ocular proptosis, often without limb motor weakness [5]. Surgical resection remains

the primary treatment for symptomatic cavernous sinus meningiomas, despite its technical difficulties and substantial perioperative risks [6].

From an anaesthetic perspective, skull base surgery presents major challenges related to intracranial pressure control, maintenance of cerebral perfusion pressure, prevention of secondary brain injury, and management of significant blood loss. Neuroanesthetic strategies emphasize the meticulous control of ventilation, hemodynamics, fluid balance, and patient positioning to optimize cerebral physiology and improve neurological outcomes. This case report describes the perioperative anesthetic management of a patient with cavernous sinus meningioma and a preexisting cranial nerve deficit.

CASE DESCRIPTION

A 52-year-old woman (body weight 60 kg) presented with a five-month history of progressive headache that worsened in the month before her presentation. Neurological symptoms included difficulty in closing the right eyelid, right facial numbness, mouth and tongue deviation to the right, and mild protrusion of the right eye. The patient had no history of seizures, vomiting, decreased consciousness, or sphincter dysfunction. The patient had a history of poorly controlled hypertension for approximately eight years, with a systolic blood pressure of 180 mmHg. The patient was administered amlodipine (10 mg once daily). No other comorbidities were observed.

Clinical examination revealed a clear airway with Mallampati class I, a respiratory rate of 18 breaths/min, and oxygen saturation of 99% on room air. The blood pressure was 160/100 mmHg, and the heart rate was 58 beats/min. Neurological examination revealed anisocoria (4 mm right, 3 mm left), intact pupillary light reflexes, right-sided ptosis, and cranial nerve deficits without motor weakness in the limbs. Baseline laboratory investigations showed a hemoglobin level of 12.4 g/dL, platelet count of 293,000/µL, INR of 1.02, serum sodium of 134 mmol/L, potassium of 3.1 mmol/L, and serum creatinine of 1.37 mg/dL. Arterial blood gas analysis indicated respiratory alkalosis. Magnetic resonance imaging revealed a right cavernous sinus tumor measuring 2.4 × 1.7 × 1.9 cm, with associated left maxillary sinusitis and left mastoiditis (Figure 1).

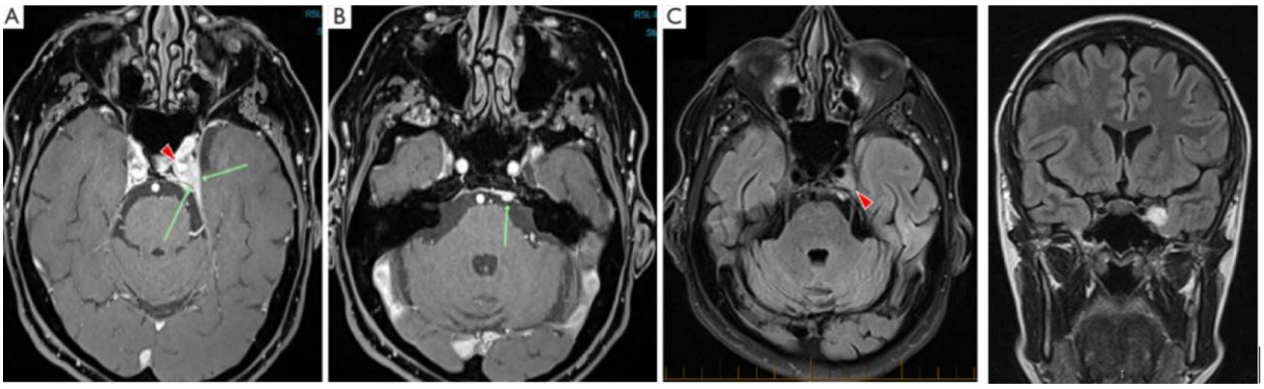

Figure 1. Axial and coronal MRI views demonstrating a right cavernous sinus meningioma (arrow).

Diagnosis and Surgical Plan The patient was diagnosed with a right cavernous sinus meningioma and was scheduled for elective craniotomy and tumor removal. She was classified as ASA III because of her uncontrolled hypertension and pre-existing neurological deficits. Postoperative intensive care unit (ICU) admission and blood product preparation were planned. Anesthetic technique General anesthesia with endotracheal intubation was performed. The patient was placed in the supine position with the head elevated at 30° to facilitate cerebral venous drainage. Premedication and induction included midazolam, fentanyl, dexamethasone, titrated propofol, and rocuronium administration, and tracheal intubation was performed using a cuffed endotracheal tube of size 7. Anesthesia was maintained with sevoflurane (1–1.5%), an oxygen–air mixture, continuous propofol infusion, intermittent fentanyl, and rocuronium (Figure 2).

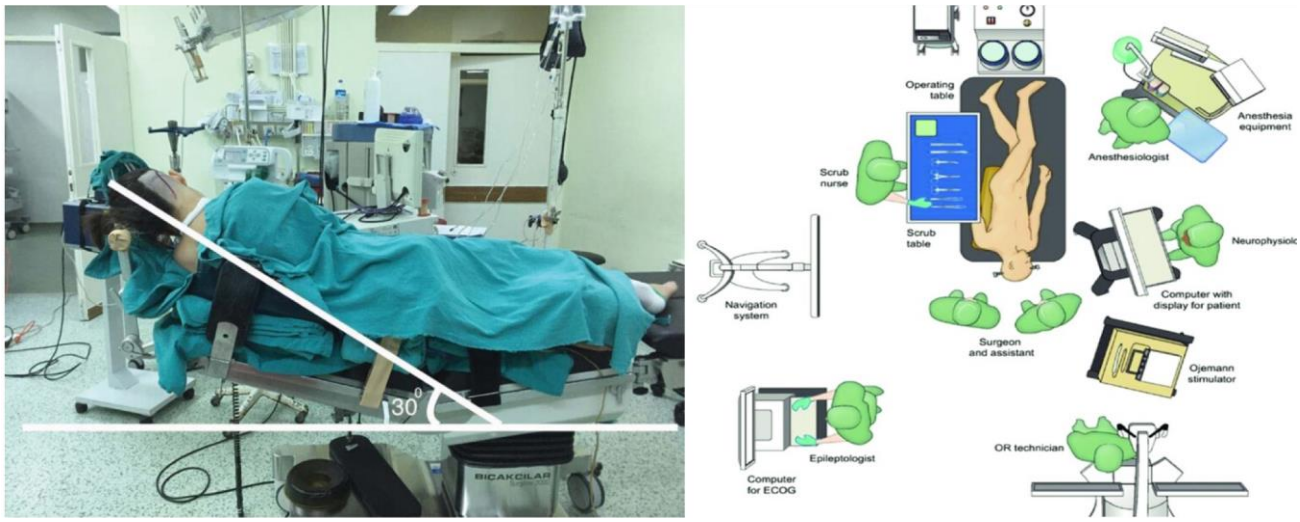

Figure 2. Supine position with 30° head elevation to facilitate cerebral venous drainage during skull-base surgery.

The surgical procedure lasted for six hours. The hemodynamic parameters were maintained within the predefined neuroprotective targets. The estimated blood loss was 1600 mL, which was managed with crystalloids, colloids, and blood component therapy. The urine output remained adequate throughout the procedure. Table 1

Table 1. Intraoperative Neuroanesthetic Targets

Parameter	Target
Mean arterial pressure (MAP)	≥ 70 mmHg
Cerebral perfusion pressure (CPP)	70–90 mmHg
$PaCO_2$	35–40 mmHg
Oxygen saturation	≥ 97%
Urine output	≥ 0.5 mL/kg/h

Postoperative Management The patient was transferred and intubated in the ICU for continued neurocritical care. Management included controlled mechanical ventilation, head-up positioning, adequate analgesia and sedation, osmotherapy with mannitol, anticonvulsant prophylaxis, antibiotic therapy, and tranexamic acid administration. Serial laboratory and arterial blood gas analyses revealed postoperative anemia and transient high-anion-gap metabolic acidosis, which were managed conservatively. Table 2

Table 2. Postoperative ICU Management

Domain	Intervention
Airway	Controlled mechanical ventilation
Brain protection	Head elevation, mannitol
Seizure prophylaxis	Phenytoin
Hemostasis	Tranexamic acid
Monitoring	Serial ABG, labs, neurological assessment

DISCUSSION

Cavernous sinus meningiomas pose significant anesthetic challenges because of their complex skull base anatomy and close proximity to critical neurovascular structures, particularly multiple cranial nerves and the intracavernous segment of the internal carotid artery [3-5]. Patients frequently present with pre-existing cranial nerve deficits, which increase perioperative risk and necessitate meticulous anesthetic planning to avoid further neurological deterioration. From a neuroanesthetic perspective, the primary goals include the preservation of

cerebral perfusion pressure, control of intracranial pressure, and prevention of secondary brain injury related to hypoxia, hypercapnia, hypotension, and anemia [7-9].

Head-up positioning has been shown to improve cerebral venous drainage and reduce intracranial pressure, thereby optimizing cerebral physiology during prolonged skull-base surgery [10]. Controlled ventilation aimed at maintaining normocapnia is essential, as both hypercapnia and hypocapnia may adversely affect cerebral blood flow and intracranial dynamics. Strict hemodynamic control is particularly important in patients with preexisting hypertension to ensure adequate cerebral perfusion while avoiding excessive increases in intracranial pressure [7,8]. In addition, the potential for significant blood loss during cavernous sinus surgery necessitates the early preparation of blood products and goal-directed fluid and transfusion strategies to maintain oxygen delivery and hemodynamic stability [11].

Postoperative management in the intensive care unit plays a critical role in the early detection and treatment of neurological and systemic complications. Close neurological monitoring, appropriate sedation and analgesia, osmotherapy, and seizure prophylaxis contribute to neurological recovery and the prevention of secondary injury [12,13]. Compared with previously reported cases, this report highlights that comprehensive neuroanesthetic control combined with early ICU-based neurocritical care can be safely implemented even in patients presenting with significant pre-existing cranial nerve deficits [14]. This emphasizes the importance of individualized anesthetic strategies and multidisciplinary collaboration to optimize outcomes in complex cavernous sinus meningioma surgery [15].

CONCLUSION

Successful anesthetic management of cavernous sinus meningioma requires comprehensive preoperative assessment, meticulous intraoperative neuroprotective strategies, and vigilant postoperative care to prevent complications from occurring. The maintenance of optimal cerebral perfusion, strict control of ventilation and hemodynamics, and adequate fluid and blood management are essential for preventing secondary brain injuries. A coordinated multidisciplinary approach involving anesthesiology, neurosurgery, and intensive care teams is pivotal for optimizing neurological and overall patient outcomes.

DECLARATIONS

Ethical approval was not required for this case report, in accordance with institutional policies and national regulations. Written informed consent was obtained from the patient for publication of this case report and accompanying clinical information.

CONSENT FOR PUBLICATION

The Authors agree to be published in the Journal of Society Medicine.

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COMPETING INTERESTS

The authors declare no conflicts of interest in this case report.

AUTHORS' CONTRIBUTIONS

All authors have made substantial contributions to the case report. SR and BL were responsible for patient management, data collection, and initial drafting of the manuscript. All authors reviewed and approved the final version of the manuscript, ensuring its accuracy and integrity, and are accountable for all aspects of the work.

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