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(CASE REPORT)

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Thorough perioperative and anesthetic considerations for cerebellar syndrome induced by posterior fossa tumors

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Abstract

Posterior fossa tumors are relatively rare pathologies, predominantly observed in pediatric populations. Nevertheless, there have been documented cases in adults, where these tumors are often associated with a higher prevalence of vascular lesions compared to those found in children. Given the inherent high mortality risk associated with this condition, meticulous anesthetic management is paramount. A comprehensive evaluation of patient-specific factors, including existing comorbidities, hemodynamic stability, and neurological status, is essential. Moreover, perioperative considerations such as patient positioning, the choice of anesthetic technique, and the duration of the surgical procedure must be carefully planned to optimize outcomes. This article presents a case review of a young adult patient with no significant medical history who was diagnosed with a posterior fossa tumor. The discussion encompasses the anatomical considerations of this pathology, critical preoperative assessments, anesthetic strategies tailored to this surgical context, and an analysis of the patient's postoperative course.

Keywords: Posterior Fossa Tumors; Cerebellar Syndrome; Perioperative Management; Anesthetic Techniques; Neurophysiological Monitoring; Surgical Positioning

1. Introduction

The posterior fossa represents the suboccipital compartment of the cranial vault, delineated superiorly by the tentorium cerebelli and inferiorly by the foramen magnum. Its lateral boundaries are defined by the petrous and mastoid portions of the temporal bone, encompassing critical neural structures such as the cerebellum, pons, and medulla oblongata. This compartment also houses the foramen magnum within the occipital bone, a crucial passageway containing the brainstem, cerebellum, and lower cranial nerves. Notably, the pons and medulla oblongata in this region harbor the principal nuclei of cranial nerves V, VII, VIII, IX, X, XI, and XII, as well as their respective exits from the brainstem (6)(10).

The brainstem, located within the posterior fossa, contains vital respiratory centers situated in the floor of the fourth ventricle, which autonomously regulate respiratory rhythms. Central chemoreceptors, located on the ventral surface of the medulla, are responsible for detecting alterations in the chemical composition of the blood, subsequently modulating ventilation. The venous drainage of the posterior fossa is mediated through the sigmoid, transverse, and occipital sinuses. Given the narrow pathways through which cerebrospinal fluid (CSF) circulates in this region, any obstruction can precipitate hydrocephalus, leading to a marked increase in intracranial pressure (ICP) (6).

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This paper presents a case report of a patient with a posterior fossa tumor, underscoring the importance of understanding the regions likely to be affected by the neoplasm. The clinical implications will depend on the tumor's precise location and extent, as well as the regulatory centers and structures at risk during intraoperative complications.

Epidemiological data specific to posterior fossa tumors remain sparse; however, general statistics on central nervous system (CNS) neoplasms from 2007 to 2011 report an annual incidence rate of 3.4 per 100,000 men and 2.5 per 100,000 women, with corresponding mortality rates of 2.5 per 100,000 men and 1.9 per 100,000 women. The posterior fossa is a common site for both benign and malignant tumors (13), with approximately 75% of these tumors classified as neuroepithelial. Astrocytoma emerges as the predominant histological type, accounting for 67% in men and 72% in women (1). While posterior fossa tumors are most prevalent in children aged 5 to 10 years, only 20% of cases occur in adults. Despite being less common in adults, the incidence of vascular lesions is notably higher in this population (6). In adults, 80-85% of primary intracranial tumors arise in the supratentorial region, with 15-20% occurring in the infratentorial region (4). Additionally, the posterior fossa is frequently implicated in metastatic tumors (13), with cerebellar metastasis (intra-axial) and vestibular schwannoma (extra-axial) being the most common presentations (10).

The clinical presentation of posterior fossa tumors typically includes severe headaches, vomiting, and hydrocephalus, symptoms attributable to the focal compression of the cerebellum or brainstem. Brainstem compression can result in ocular paralysis, diplopia, and hemiparesis, often involving cranial nerves III, IV, and VI. Compression at the level of the cerebellum manifests as ataxia, nystagmus, and dysmetria (12).

2. Case Report

A 40-year-old male patient with no significant medical history, a former smoker with a 25-year history, and a functional capacity greater than 4 METS, presented to the clinic with symptoms persisting over the past three months. These symptoms included a 30 kg weight loss, asthenia, sharp bilateral occipitoparietal headaches, adynamia, gait disturbances, nausea, recurrent episodes of urinary retention, and right hemifacial paresthesia. Upon physical examination, the patient exhibited normal vital signs, central facial paralysis, lateropulsion, and ataxia.

A non-contrast cranial CT scan revealed a hyperdense, heterogeneous mass measuring 49x49 mm at the right pontocerebellar angle. This mass was compressing the fourth ventricle and causing dilatation of the ventricular system, without evidence of transependymal edema or hemorrhagic lesions in the cerebral parenchyma. The midline structures were preserved (Figure 1).

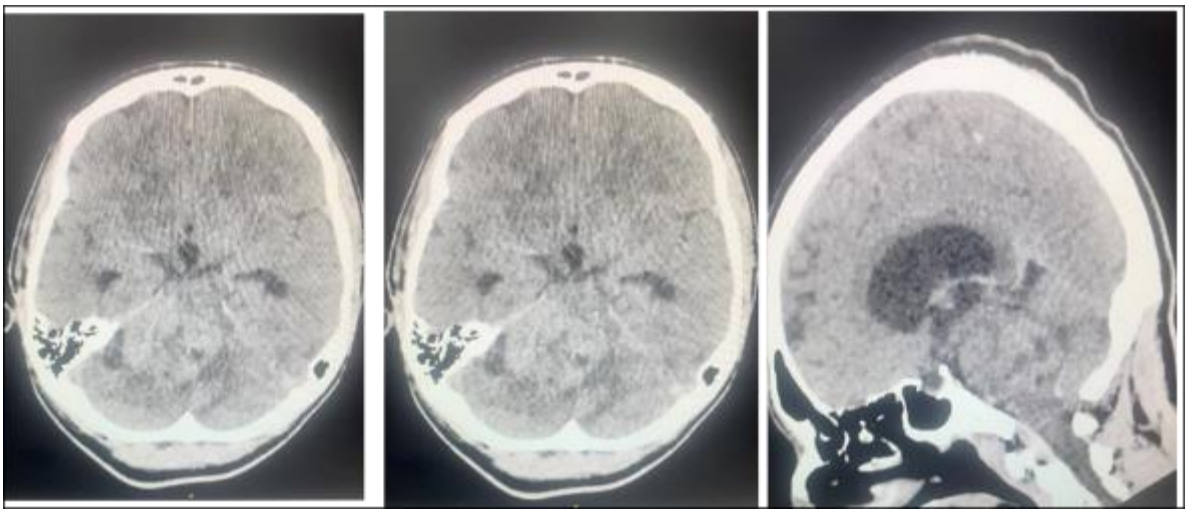

Figure 1 Non-contrast cranial CT

The patient was referred to a tertiary care hospital, where further examination revealed symmetric, reactive pupils measuring 3 mm, with preserved eye movements in all directions. Horizontal nystagmus was observed during lateral and medial eye movements. Neurological examination demonstrated right-sided central facial paralysis, a midline tongue and uvula, symmetric elevation of the palate, and normal strength in the sternocleidomastoid muscles and shoulder elevation (5/5). Muscle strength was intact (5/5) across all 20 clinical myotomes, with brisk reflexes (++/++++) in all four extremities. No sensory deficits, signs of meningeal irritation, or indications of intracranial

hypertension were noted. The patient's Glasgow Coma Scale (GCS) score was 15/15. Based on these findings, a diagnosis of cerebellar syndrome secondary to a tumor in the right pontocerebellar angle, with a high risk of developing intracranial hypertension, was made. A brain MRI was performed, revealing a mass in the posterior fossa (Figure 2), and surgical intervention by neurosurgery was recommended.

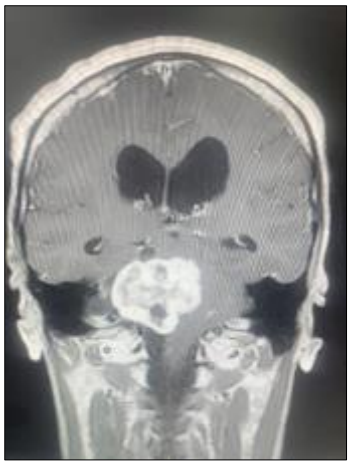

Figure 2 Brain MRI

The patient was evaluated by the anesthesiology team, who classified him as an ASA III patient and scheduled the procedure as high-risk. Hemodynamic monitoring was initiated, followed by intravenous anesthetic induction using propofol, with sedation maintained by remifentanil and muscle relaxation achieved with rocuronium. Flexible direct laryngoscopy revealed a Cormack-Lehane grade I view. The patient was positioned in a three-quarters left lateral "park bench" position, and intraoperative monitoring included a right radial arterial line and neurophysiological monitoring. A volumetric resection of the tumor located in the right pontocerebellar angle was performed, guided by neuronavigation. The procedure was completed successfully, and the patient was transferred to the ICU, where he remained intubated for postoperative management, receiving norepinephrine, dexmedetomidine, and remifentanil. After five days, the patient was successfully extubated.

3. Discussion

The pathologies necessitating neurosurgical intervention in the posterior fossa are severe and can critically impact patient outcomes (2). Tumors in this region often lead to neurological deterioration through compression of the brainstem, which can result in hydrocephalus, cerebral edema, bulbar dysfunction, and respiratory complications that may require mechanical ventilation.

The inherent risks of mortality and neurological sequelae during surgery underscore the importance of a thorough understanding of the surgical approach and objectives. This includes careful consideration of the patient's characteristics, underlying conditions, medication history, allergies, hemodynamic and neurological status—encompassing consciousness levels using the Glasgow Coma Scale, lower cranial nerve functions, motor and sensory capabilities, language assessment, and cerebellar functions. Preoperative analysis through laboratory tests and neuroimaging is essential to evaluate tumor location, size, relation to adjacent structures, degree of edema, and presence of hydrocephalus. This comprehensive assessment helps optimize conditions and mitigate surgical risks and postoperative mortality. Effective preoperative planning and airway management strategies are crucial for achieving favorable surgical outcomes (6).

Hemodynamic monitoring is critical to managing risks and complications, as surgical manipulation of the brainstem can cause significant changes in blood pressure and heart rate. Monitoring and airway management are integral to minimizing these risks (2). Neurophysiological monitoring is recommended in neurosurgical procedures when the tumor is near cranial nerves or if there is a risk of postoperative ischemia. Techniques such as bispectral index monitoring, entropy analysis, neuromuscular monitoring, electroencephalography, evoked potentials, and continuous cranial nerve monitoring are employed (2) to ensure cerebral protection during prolonged surgeries and to reduce the risk of ischemia. Electromyography (EMG) monitoring, in particular, helps mitigate the risk of facial nerve injury in pontocerebellar tumors (12).

The intraoperative positioning of the patient is a critical consideration, as these procedures are often lengthy. An optimal position should balance physiological benefits for the patient with operational efficiency for the surgical team. The position should facilitate the best possible access for the anesthesiologist and surgeon, minimizing manipulation of nervous and vascular structures to reduce the risk of complications (5).

Three primary positions for posterior fossa surgery are identified: lateral decubitus, prone decubitus, and seated. A more recent alternative, the lateral oblique or "park bench" position, has shown favorable results in terms of anatomical exposure and comfort for both patient and surgeon (5). In the reported case, the park bench position was selected, providing optimal conditions for the procedure.

The semi-sitting position is associated with a higher risk of air embolism. Both prone and semi-sitting positions can induce significant physiological changes in respiratory and hemodynamic parameters, which must be carefully managed to avoid complications (2). Postural changes can affect hemodynamics, so any positional adjustments should be made gradually, with close monitoring for tolerance (2). Although the semi-sitting position has a higher incidence of air embolism, morbidity rates are not statistically higher, making the choice of position dependent on surgical team preference (11).

Head fixation using a Mayfield craniostat can induce tachycardia and hypertension, with associated pain potentially increasing intracranial pressure (ICP). Adjustments to the craniostat should be made after controlling sympathetic responses, and local anesthesia on the scalp can help mitigate postoperative pain, often in combination with dexmedetomidine (2)(3).

Infratentorial posterior fossa tumors are not typically associated with difficult intubation. Patient factors such as obesity, diabetes, and anatomical or vascular abnormalities may contribute to intubation challenges. In cases of difficult airway management, awake intubation is preferred (2). In the reported clinical case, intubation was performed under general anesthesia, using total intravenous anesthesia (TIVA).

Remifentanil is preferred over propofol for sedation in neurointerventions due to its superior patient stability and minimal sympathetic response. IV lidocaine can reduce laryngeal response during intubation and extubation. Neuromuscular relaxants (NMR) aid in preventing patient movement, ensuring brain relaxation, and decreasing airway pressure during mechanical ventilation. Thiopental offers significant neuroprotective benefits by reducing neuronal oxygen consumption (CMRO2), while propofol, though effective, can lower mean arterial pressure (MAP) and cerebral perfusion pressure (CPP). Fentanyl, at doses of 5-10 mcg/kg, helps attenuate cardiovascular responses and reduce CMRO2. Remifentanil, administered as a continuous infusion, has demonstrated excellent results when used with an inhaled agent for induction. Non-depolarizing neuromuscular relaxants, such as vercuronium at doses of 1.0-1.2 mg/kg, are recommended to manage hemodynamic responses during laryngoscopy (12).

To optimize anesthesia and reduce the reliance on inhaled agents, it is advisable to use opioids such as fentanyl, administered at doses of 5-10 mcg/kg, or remifentanil, administered at 0.1-0.5 mcg/kg/min. Additionally, alpha-2 agonists like dexmedetomidine are utilized to decrease cerebral blood flow (CBF) and cerebral metabolic rate of oxygen (CMRO2), thereby achieving a balanced neuronal metabolic state.

The use of neuromuscular blockers (BNM) should be avoided in patients undergoing electromyographic monitoring of motor nerves. If rocuronium is employed and such monitoring is necessary, sugammadex should be used to facilitate the recovery from neuromuscular blockade (12).

No single anesthetic technique is definitive for this procedure. Both inhalation and intravenous techniques are viable, with the choice depending on patient-specific factors. Intravenous anesthesia is often preferred for patients in a semi-comatose state, as it does not elevate ICP and aids in brain relaxation. Among inhaled anesthetics, isoflurane is commonly used in neuroanesthesia due to its minimal impact on ICP and CBF and its significant reduction of CMRO2 (12). Nitrous oxide should be avoided in re-interventions within 6-8 weeks post-craniotomy and should be discontinued in cases of intracranial hypertension or air embolism (2).

Inhaled anesthetics can affect the amplitude and latency of auditory and somatosensory evoked potentials. A total intravenous technique or a balanced approach with minimal inhaled agent concentrations (<1 MAC) is recommended to mitigate these effects (12).

Post-procedure, the decision to continue mechanical ventilation is influenced by preoperative evaluations and procedural factors. Upon extubation, managing sympathetic discharge is crucial to prevent complications such as edema and infra-tentorial bleeding.

4. Conclusion

The management of posterior fossa tumors requires a nuanced approach due to the complexity of the region and the potential for severe complications. This case highlights the critical role of meticulous preoperative evaluation, including patient-specific factors and detailed neuroimaging, in guiding anesthetic and surgical decisions. Optimal patient positioning, careful selection of anesthetic techniques, and vigilant intraoperative monitoring are essential to minimize risks and ensure favorable outcomes. The use of advanced monitoring tools and tailored anesthetic strategies, such as the administration of opioids and alpha-2 agonists, can significantly enhance patient stability and safety during these high-risk procedures. As demonstrated in the presented case, a comprehensive and individualized approach not only improves surgical efficacy but also contributes to better postoperative recovery and reduced risk of complications.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Gómez Vega JC, Ocampo Navia MI, Feo Lee O. Epidemiology and general characterization of primary brain tumors in adults. Universitas Medi. 2019;60:1–14.

[2] Iturri Clavero F, Honorato C, Ingelmo I, Fàbregas Julià N, Rama-Maceiras P, Valero R, Buisán Garrido F, Vázquez Alonso E, Verger Bennasar AM, Badenes Quiles R, Valencia Sola L, Hernández Palazón J. Preoperative considerations and intraoperative neuroanesthetic management. Rev Esp Anestesiol. 2012;59:3–21.

[3] Ingelmo I, Iturri Clavero F, Fàbregas Julià N, Honorato Cía C, Rama-Maceiras P, Valero Castell R, Buisan Garrido F, Vázquez Alonso E, Verger Bennasar AM, Badenes Quiles R, Valencia Sola L, Hernández Palazón J. Considerations and neuroanesthetic management in the postoperative period. Rev Esp Anestesiol Reanim. 2012:25–37.

[4] Velasquez AF. Posterior fossa tumors in adults at the Escuela Hospital from June 1998 to September 2000. Rev Med Post UNAH. 2001;6:1–6.

[5] Pérez Santos GM. Manual of postoperative care for neurosurgical patients. Ergón S.A.; 2013.

[6] De La Serna-Soto M, Osorio-Santiago LP, Manrique-Carmona HJ. Posterior fossa surgery and failed extubation. Anestesia en México. 2017;29(2):3–8.

[7] Lopez-Castruita VM. Perioperative management of microvascular decompression surgery. Rev Mex Anestesiol. 2016;39:137–41.

[8] López-Castruita VM, Manrique-Carmona LP, Revuelta-Gutierrez R. Topical lidocaine to prevent trigeminal cardiac reflex during microvascular decompression surgery. Anestesia en México. 2017;29(1).

[9] Shih RY, JGS. Posterior fossa tumors in adult patients. Neuroimaging Clin N Am. 2016;26(4):493–510.

[10] Grupo de Neurooncología de la Sociedad Española de Neurocirugía. Posterior fossa tumors. Publicaciones Permanyer; 2008.

[11] Del Rio-Contreras G, Diaz-Saavedra F, B-GF. Anesthesia for neurosurgery in the seated position: Experience in a Colombian neurological center. Rev Cienc Biomed. 2016;7(1):41–46.

[12] Echeverría M. Anesthesia for posterior fossa surgery. In: Niño M, Ferrer L, editors. Neuroanesthesia: perioperative approach in neurological patients. Distribuna Editorial Médica; Bogotá, Colombia. 2005. p. 173–93.

[13] Ferson D, DeMonte F. Anesthetic management of patients undergoing surgery for brain tumors. Anesth Clin N Am. 1998;18:122–3.