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Case Report

Telovelomedullary Approach: A Therapeutic Option in the Management of Fourth Ventricle Tumors

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Abstract

Introduction. Tumors of the fourth ventricle are hard to reach. The cavity lies deep in the posterior fossa, in direct contact with the brainstem, and the classic transvermian route requires splitting the cerebellar vermis, with a real risk of cerebellar mutism and other cerebellar deficits. The telovelomedullary approach opens a natural corridor to the ventricle without dividing the vermis. *Objective.* To describe our surgical experience and the technical considerations of the telovelomedullary approach for fourth ventricle tumors, focusing on extent of resection and clinical outcome. *Methods.* We conducted a retrospective, observational, descriptive case series of three patients operated on through this approach at the Institute of Neurology and Neurosurgery in Havana, Cuba, between February 2018 and November 2024. We collected clinical data, neuroimaging findings, key surgical steps, histopathological diagnosis, extent of resection, complications, and postoperative course. *Results.* The three patients were women aged 48, 42, and 24 years. Complete resection was achieved in all of them. Histology showed a hemangioblastoma (grade I), a choroid plexus papilloma (grade I), and an ependymoma (grade II) according to the World Health Organization classification. There were no major complications, all patients were discharged within 6 to 7 days, and all remain in outpatient follow-up. *Conclusions.* In this small series, the telovelomedullary approach allowed complete tumor resection with low morbidity and a favorable early recovery, while sparing the cerebellar vermis. It may be a reproducible option for surgical teams working with limited resources, although larger series with longer follow-up are needed to confirm these results.

Keywords

Fourth Ventricle, Neoplasms, Posterior Cranial Fossa, Telovelomedullary Approach

1. Introduction

Surgery on fourth ventricle tumors is demanding, and the reasons are anatomical. The ventricle is a deep, narrow cavity at the midline of the posterior fossa, with the brainstem in front and the cerebellum behind. Above, it continues into the

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third ventricle through the aqueduct of Sylvius; laterally, it opens toward the cerebellopontine cisterns through the foramina of Luschka; and below, it communicates with the cisterna magna through the foramen of Magendie [1, 2].

For decades the transvermian approach, described by Walter Dandy in the 1920s, was the preferred route to this region. That changed in 2000, when Mussi and Rhoton introduced the telovelar approach after a detailed anatomical study of the fourth ventricle. Instead of splitting the vermis, the telovelar route opens the tela choroidea and the inferior medullary velum, creating a natural corridor into the ventricle. It offers direct visualization of the floor, the lateral walls, and the aqueduct of Sylvius without resecting cerebellar tissue, and it has been associated with fewer neurological sequelae (cerebellar mutism among them), lower postoperative morbidity, and faster recovery [3, 4].

Today many groups regard the telovelar route as the technique of choice for most fourth ventricle tumors. Because each lesion demands a careful, individualized surgical strategy, we report our experience with three patients treated through the telovelomedullary approach, describing the technical considerations, the extent of resection, and the clinical outcome.

2. Methods

2.1. Study Design

This is a retrospective, observational, descriptive case series of three patients with fourth ventricle tumors who underwent surgery through the telovelomedullary approach at the Institute of Neurology and Neurosurgery "Dr. Jose Rafael Estrada Gonzalez" in Havana, Cuba, between February 2018 and November 2024.

2.2. Preoperative Evaluation

Every patient had a complete neurological examination and a magnetic resonance imaging (MRI) study of the brain, with and without contrast, including T1, T2, and fluid-attenuated inversion recovery (FLAIR) sequences. Four neurosurgeons and two neuroradiologists reviewed the images to confirm the location and extent of each tumor and its relationship with the surrounding neurovascular structures. Standard anesthetic assessment and surgical preparation were completed in all cases.

2.3. Surgical Technique

2.3.1. Positioning

Patients were placed prone with slight cervical flexion, and the head was fixed in a Mayfield clamp. After standard asepsis and antisepsis, the bony and vascular landmarks were outlined.

2.3.2. Bone Exposure

We performed a midline suboccipital craniotomy, extended caudally according to the anatomy of each patient. In selected cases we added a C1 laminectomy to widen the surgical corridor.

2.3.3. Dural Opening

The dura was opened in an inverted-U fashion with its base caudal, and it was suspended to improve exposure. Under the operating microscope, the cerebellar hemispheres and tonsils were gently retracted, taking care to preserve the superficial veins and to avoid excessive traction.

2.3.4. Access to the Fourth Ventricle

The extended durotomy gave a wide view of the floor of the fourth ventricle, from the calamus scriptorius to the aqueduct of Sylvius, and both foramina of Luschka could be identified. When the tonsils were prominent, we retracted or partially resected them to optimize the operative field, centering the exposure on the medial quarter of the operative space.

2.3.5. Tumor Resection

Each lesion was removed according to its characteristics, using ultrasonic aspiration, microdissectors, and resection forceps. We respected the neuroanatomical planes and avoided direct manipulation of the ventricular floor.

2.3.6. Closure

After resection, the dura was repositioned and closed in a watertight fashion to prevent cerebrospinal fluid fistula. In most cases, the bone flap was replaced and secured with miniplates or sutures, which helps to prevent cerebellar sag syndrome. The occipital muscles were approximated without tension, and the fascia was closed watertight to favor postoperative recovery.

2.4. Postoperative Evaluation

Serial neurological examinations were performed, and brain MRI was repeated 48 to 72 hours after surgery to assess the extent of resection and to rule out complications.

2.5. Ethical Considerations

The study was approved by the ethics committees of the Cuban Institute of Neurology and Neurosurgery (Havana, Cuba) and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from each patient for the publication of their clinical data and images. 2026-17

3. Results

The series includes three women aged 48, 42, and 24 years. Complete resection was achieved in all of them. Histopathology showed a hemangioblastoma (World Health Organization

[WHO] grade I), a choroid plexus papilloma (WHO grade I), and an ependymoma (WHO grade II). The clinical details of each case follow.

3.1. Case 1

A 48-year-old left-handed woman with a fair skin phototype had a history of hypothyroidism secondary to simple nodular goiter, treated with levothyroxine sodium 0.1 mg/day for five years. She came to us with a left hemicranial headache of neuropathic character, which she described as a cramping pain radiating to the occipital region. Over time she developed dysphagia for both solids and liquids and a progressive weakness of the left side of the body.

On neurological examination she had a left hemiparesis with crural predominance. Muscle strength was 5/5 in both right limbs and 4/5 in both left limbs. She had hyperreflexia of the left patellar reflex and paralysis of the left soft palate, with deviation of the uvula to the right. Her Glasgow Coma Scale score was 15 (eyes opening spontaneously, oriented, and obeying verbal commands).

Laboratory tests showed leukocytosis (15.9 $\times 10^9$/L) with neutrophilia (70.6%), hemoglobin of 123 g/L, platelets of 233 $\times 10^9$/L, and blood glucose of 7.74 mmol/L. Renal function was preserved, and liver and lipid profiles were within normal limits.

Craniospinal MRI (T2) revealed a cystic lesion with a mixed-intensity mural nodule in the bulbomedullary region (Figure 1A-C). Contrast-enhanced MRI showed a complex space-occupying lesion made up of an intra-axial cystic component and a solid, exophytic nodule in the medulla oblongata, with signs of recent hemorrhage, vascular calcifications, and intense postcontrast enhancement (Figure 1D, E). The lesion measured 3.15 cm at its largest diameter, with ascending medullary edema up to C4. There was no hydrocephalus.

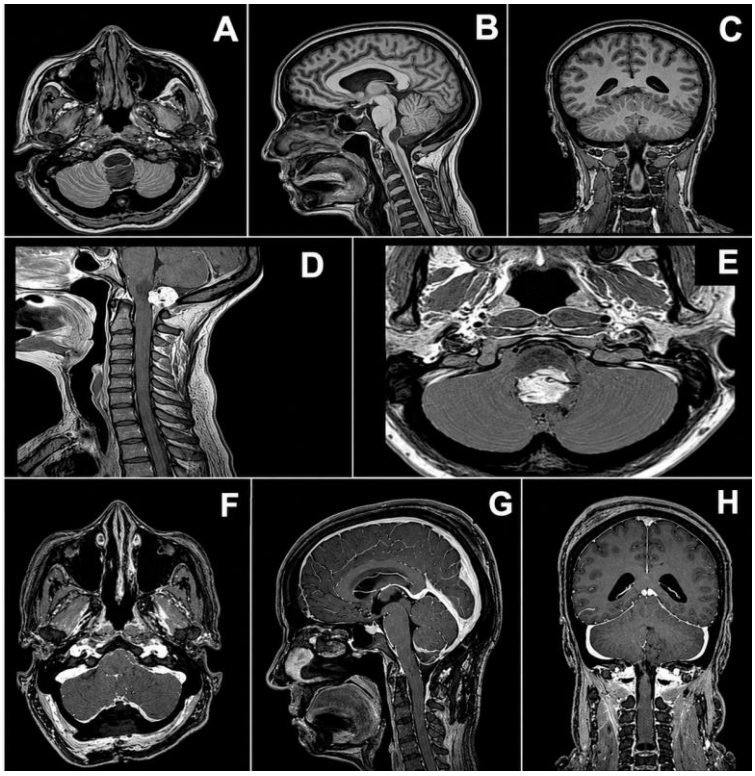


Figure 1. *Case 1: preoperative and postoperative magnetic resonance imaging (MRI). Preoperative non-contrast MRI: axial (A), sagittal (B), and coronal (C) views. Preoperative contrast-enhanced MRI: sagittal (D) and axial (E) views. Postoperative contrast-enhanced MRI: axial (F), sagittal (G), and coronal (H) views.*

The lesion was completely resected, and histopathology confirmed a WHO grade I hemangioblastoma. Postoperative MRI (axial, sagittal, and coronal reconstructions) showed the expected postsurgical changes and cerebral edema, without hydrocephalus or other complications (Figure 1F-H). Her course was favorable, with no adverse events. She was discharged on postoperative day 7 and remains under outpatient follow-up in the neurosurgery clinic.

3.2. Case 2

A 42-year-old right-handed woman from a rural area, who holds a degree in dentistry and had no relevant medical history. Since the age of 15 she had suffered recurrent episodes of loss of consciousness triggered by stressful situations, with no aura or prodromal symptoms. Witnesses described episodes lasting

from seconds to minutes. A year before admission, after an episode of dengue fever, she had a similar event, and more recently she lost consciousness again after overeating, which prompted her to seek specialized care. She was referred to the Institute of Neurology and Neurosurgery for etiological work-up and treatment.

On examination her Glasgow Coma Scale score was 15 (eyes opening spontaneously, oriented, and obeying verbal commands), and muscle strength was 5/5 in all muscle groups on the Medical Research Council scale. The blood count showed leukocytosis (15.7 $\times 10^9$/L), neutrophilia (82.8%), hemoglobin of 111 g/L, and platelets of 244 $\times 10^9$/L. Blood glucose, renal function, and liver and lipid profiles were acceptable.

Contrast-enhanced MRI revealed a tumor in the fourth ventricle measuring 18 × 17 mm, with variable signal intensity, hypointense areas consistent with gliosis, no restricted diffusion, and intense postcontrast enhancement (Figure 2A-C). A polypoid lesion of 12 × 13 mm was also found in the right maxillary sinus, along with nasal turbinate hypertrophy.

The tumor was completely resected, and pathology confirmed a WHO grade I choroid plexus papilloma of the fourth ventricle. Postoperative non-contrast MRI showed surgical changes in the occipital and midline regions, with hyperintense foci next to the fourth ventricle that could represent residual bleeding or tumor remnants (Figure 2D-F). Contrast-enhanced MRI showed postsurgical changes in the posterior fossa and a functioning ventricular shunt system, with no signs of residual lesion or recurrence. Her clinical course was favorable and uncomplicated, and the surgical wound showed no signs of infection. She was discharged on postoperative day 6 and remains under outpatient follow-up.

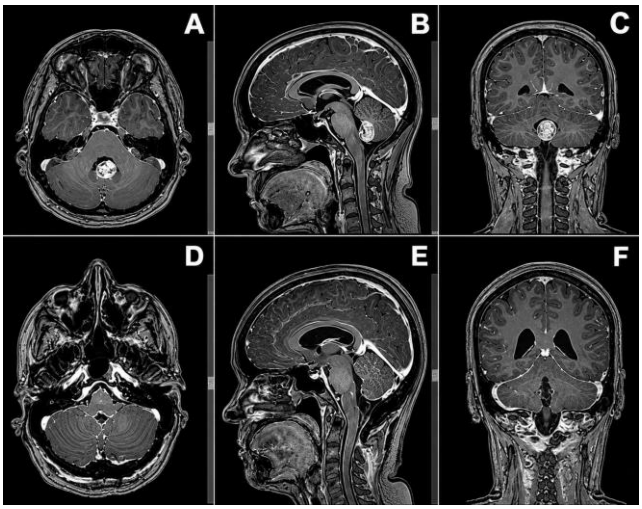


Figure 2. *Case 2: preoperative and postoperative contrast-enhanced magnetic resonance imaging (MRI). Preoperative MRI: axial (A), sagittal (B), and coronal (C) views. Postoperative MRI: axial (D), sagittal (E), and coronal (F) views.*

3.3. Case 3

A 24-year-old white right-handed woman from an urban area, with no relevant medical history. In July she developed a severe holocranial headache, worse in the morning and resistant to conventional analgesics, accompanied by autonomic symptoms: profuse sweating, pallor, tachycardia, nausea, and general malaise. She vomited food once after a bout of nausea. At her local polyclinic she was treated with dimenhydrinate (50 mg intramuscularly) and diclofenac sodium (3 mL intramuscularly) with partial relief, but a moderate headache persisted for about a week. A computed tomography (CT) scan at Hermanos Ameijeiras Hospital showed a space-occupying lesion in the posterior fossa, and she was referred to the Institute of Neurology and Neurosurgery for further evaluation.

She was alert, oriented, and cooperative, with a Glasgow Coma Scale score of 15/15 and a Karnofsky Performance Status of 100. No focal neurological deficits were found. The blood count and biochemistry were within normal limits (hemoglobin 119 g/L, leukocytes 7.7 $\times 10^9$/L, blood glucose 5.1 mmol/L, creatinine 86.1 µmol/L, and transaminases and lipid profile without significant alterations).

Preoperative contrast-enhanced MRI showed an extra-axial lesion in the cisterna magna with a late subacute hemorrhagic component, calcifications, and signs of angiogenesis, with intense enhancement after gadolinium administration (Figure 3A).

The lesion was completely resected, and pathology confirmed a WHO grade II ependymoma of the fourth ventricle. Postoperative non-contrast CT showed no significant structural abnormalities, and non-contrast MRI showed postsurgical changes in the posterior fossa without complications or residual lesion (Figure 3B). Her clinical and neurological course was favorable; she was discharged on postoperative day 6 and remains under outpatient follow-up in the neurosurgery clinic.

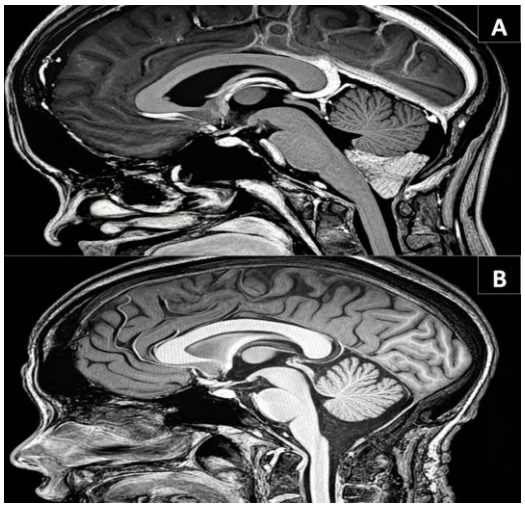


Figure 3. *Case 3: preoperative and postoperative magnetic resonance imaging (MRI). Preoperative contrast-enhanced MRI, sagittal view (A). Postoperative non-contrast MRI, sagittal view (B).*

4. Discussion

Surgery remains the treatment of choice for fourth ventricle tumors, both because of their potential clinical aggressiveness and because they lie so close to critical neuroanatomical structures. In this setting the telovelar approach has gained wide acceptance as the preferred technique: it gives anatomically respectful access, avoids splitting the cerebellar vermis, and lowers the risk of complications such as cerebellar mutism syndrome [4, 5].

The approach gives direct exposure of the aqueduct of Sylvius, the foramina of Luschka and Magendie, and the region of the calamus scriptorius, which facilitates complete tumor resection in up to 80–90% of cases in several clinical series [4, 6, 7]. More recent studies suggest that preserving the cerebellar architecture is associated with fewer permanent neurological deficits and a shorter duration of postoperative assisted ventilation [5, 8].

The risks inherent to surgery in this region remain, however. Hydrocephalus is a frequent complication, reported in up to 30–50% of patients. Brainstem dysfunction is less common with the telovelar approach but continues to be a concern, particularly in lesions with ventral extension or pontine infiltration [6, 9].

Our experience is consistent with these reports. In our three patients, the approach allowed complete resection of tumors with different histology, without major complications and with hospital stays of six to seven days. Direct visualization of the ventricular floor, together with preservation of the vermis and the neurovascular structures, was in our view the main advantage of the technique. In the Cuban context, where resources may be limited, we consider it a reproducible and anatomically respectful option.

Regarding diagnosis, contrast-enhanced MRI remains the imaging modality of choice, since it characterizes the location, extent, and vascularity of the tumor and its relationship with adjacent structures [10, 11]. Spinal MRI is also essential when leptomeningeal dissemination is suspected, particularly with tumors such as ependymoma [12-14].

Several technical variants of the telovelar approach have been explored. Transcranial neuroendoscopy improves visualization of the upper fourth ventricle without the need to remove the posterior arch of C1 [6, 8], and intraoperative neurophysiological monitoring and external ventricular drainage have been reported to reduce complications such as dysarthria, dysphagia, and focal motor disturbances [9]. Both the telovelar and transvermian routes are performed through a midline suboccipital craniotomy, with or without C1 laminectomy [15]. In adults with a choroid plexus papilloma of the fourth ventricle, the extent of resection is regarded as a key prognostic factor, and near-total resection may be appropriate when the tumor is adherent to critical structures [16].

This report has clear limitations: it is retrospective, it includes only three patients with different histological diagnoses, and it has no comparison group. Our findings should therefore be read as a description of our experience and not as evidence of superiority over other approaches.

In summary, the telovelar approach is a safe and effective surgical strategy for fourth ventricle tumors, with anatomical and functional advantages over the transvermian route. Its use should still be individualized according to the characteristics of the tumor, the anatomy of the patient, and the experience of the surgical team [4, 5, 7, 9].

5. Conclusions

In our experience, the telovelomedullary approach allowed complete resection of fourth ventricle tumors through a direct, wide corridor that respects the surrounding neurofunctional structures and gives good visualization of the ventricular floor, the lateral walls, and the aqueduct of Sylvius. Patients had low morbidity and a favorable early recovery. These results support its use as a first-line option for tumors of this region, although larger series with longer follow-up are needed to confirm them.

Author Contributions

Duniel Abreu Casas: Conceptualization, Investigation, Writing – review & editing

Francisco Felix Goyenechea Gutierrez: Formal Analysis, Metodology

Orestes Ramon Lopez Piloto: Project administration

Lismary Martinez Valdes: Funding acquisition

Wilfredo Alfonso Fernandez Nunez: Investigation, Writing – original draft

Tsunami Martinez Aguilar: Investigation, Visualization, Writing – original draft

Conflicts of Interest

The authors declare no conflicts of interest.

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