

Neuromonitoring on The 3rd Redo Craniotomy for Removal of Infratentorial Tumors

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Abstract

Infratentorial brain tumors such as medulloblastoma have serious neurological implications, particularly in children and adolescents. Re-craniotomy for infratentorial lesions increases the risk of anesthetic complications due to altered anatomy, tissue adhesions, and proximity to vital structures such as the brainstem and cranial nerves. The anesthetic approach must be tailored to support real-time intraoperative monitoring, such as Intraoperative Neurophysiological Monitoring (IONM), to prevent neurological injury. A 16-year-old male with a WHO Grade IV medulloblastoma in the left cerebellum extending to the vermis underwent re-craniotomy tumor removal. The patient presented with balance disturbances, diplopia, and dysphagia. CT scan revealed a solid mass measuring 6.6 × 5.96 × 6.71 cm with peritumoral edema and compression of the fourth ventricle. Anesthetic management included TIVA using propofol TCI Schneider 2–4 mcg/ml, dexmedetomidine 0.2–0.7 mcg/kg/hr, and intermittent rocuronium. The surgery lasted 8 hours and was complicated by cerebral edema managed with mannitol 1 g/kgBW. IONM detected prolonged activation of the left cranial nerve VIII. Intraoperative bleeding reached 1600 ml, managed with 465 ml of PRC. Hemodynamics remained stable with ConnX ranging from 34 to 80. Postoperatively, the patient was admitted to the ICU with mechanical ventilation and continuous sedation. Anesthetic management of infratentorial re-craniotomy requires an individualized approach encompassing hemodynamic stability, neural protection through IONM, and multimodal strategies to prevent postoperative complications. TIVA techniques and ConnX monitoring play an important role in maintaining optimal anesthetic balance and neurological function.

Keywords: Anesthesia management, ConnX, infratentorial, IONM, medulloblastoma, Re-craniotomy

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Introduction

Craniotomy is a common cranial surgical procedure performed for the excision of brain tumors, particularly in infratentorial lesions involving vital areas such as the brainstem and cerebellum. Re-craniotomy, or a repeated craniotomy procedure, increases anesthetic complexity due to risks of tissue adhesion, altered anatomy, and a heightened potential for neurological complications. In this case, the patient underwent a third redo craniotomy. One

of the essential approaches in such operations is the use of Intraoperative Neurophysiological Monitoring (IONM), an electrophysiological monitoring technique designed to prevent injury to neural pathways during surgical manipulation by continuously assessing evoked potentials (motor evoked potential/MEP, somatosensory evoked potential/SEP, brainstem auditory evoked potential/BAEP) in real time.¹ The application of IONM in intracranial neurosurgery is crucial given the variable but significant risk of damage to vital neural structures, which may

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result in postoperative neurological deficits and substantial functional limitations. The proximity of tumors to eloquent areas such as the sensorimotor cortex, language pathways, or visuospatial processing regions traditionally restricts the extent of resection. IONM provides an important opportunity to preserve neural tissue at risk before irreversible injury occurs. Beyond repeated stimulation of neural tracts during surgery, certain modalities also allow stimulation and mapping of critical anatomical structures before the operative intervention begins.²

Epidemiologically, infratentorial brain tumors are more commonly found in males, accounting for 63.2% of 410 analyzed cases, with an M to F ratio of 1.7 to 1.0. Approximately 31.7% of cases occur in children under 18 years of age. The most common subtype in pediatric patients is medulloblastoma, with 84.7% demonstrating the classic histological variant. Meanwhile, vestibular schwannoma represents the most frequently encountered individual infratentorial tumor, comprising 23.9% of all cases. Around 54.1% of these tumors are malignant, with medulloblastoma being the dominant malignant type, accounting for 32.4% of all infratentorial malignancies. Mortality from medulloblastoma reaches 30.5%, underscoring its significant clinical impact and the need for meticulous anesthetic and surgical management.³

Complications such as brainstem injury, hemodynamic instability, and massive bleeding highlight the importance of appropriate anesthesia management. TIVA with propofol and dexmedetomidine supports hemodynamic stability and optimal IONM signal quality.¹ Re-craniotomy also increases the risk of postoperative pain and PONV, particularly in infratentorial surgery, supporting the use of multimodal analgesia, scalp blocks, or intravenous lidocaine to reduce respiratory and extubation-related complications.⁴ This case report aims to describe the comprehensive anesthetic management of a patient undergoing infratentorial re craniotomy, focusing on the anesthetic techniques utilized, intraoperative management strategies, and perioperative outcomes. The report is expected

to provide clinical insights for anesthesiologists managing similar cases in the future.

Case

Anamnesis

The patient reported balance disturbances when standing and walking since one month prior to hospital admission, with a tendency to fall toward the left. The symptoms began with intermittent headaches for one and a half years before admission, which initially improved with oral medication but progressively worsened in the two months prior. The patient also experienced diplopia for one year before admission and difficulty swallowing for the past two months. There were no complaints of facial asymmetry, slurred speech, hearing impairment, or blurred vision. The patient denied any history of seizures, fever, or head trauma. One year before admission, the patient had three episodes of projectile vomiting accompanied by severe headaches that did not improve with oral medication. The patient was hospitalized in private hospitals where a contrast-enhanced magnetic resonance imaging (MRI) of the head (07 February 2024) was performed, establishing the diagnosis of non-communicating hydrocephalus and a brain tumor.

The patient subsequently underwent an endoscopic third ventriculostomy (ETV) on 28 February 2024 with clinical improvement and was discharged after five days of care. Follow-up revealed a residual tumor, prompting a craniotomy tumor removal on 02 May 2024. MRI evaluation (01 October 2024) showed post-ETV status with residual tumor in the left cerebellum. On 10 January 2025, the patient underwent a contrast-enhanced head CT scan which demonstrated an inhomogeneous lesion in the left cerebellum extending to the vermis with peritumoral edema. The patient was then referred to state hospitals where a repeat CT scan (31 January 2025) showed similar findings, and a re-craniotomy tumor removal was planned. There was no history of infectious disease, congenital abnormalities, familial tumors, or masses in other body regions.

Physical Examination

General Status:

A 16-year-old male patient weighing 65 kg and 175 cm tall with a body mass index (BMI) of 20.6 (normal) presented with a GCS of 15. Blood pressure was 110/71 mmHg, pulse rate 77 beats per minute, respiratory rate 19 breaths per minute, temperature 36.7°C, and oxygen saturation 99% on room air. VAS score was 4 out of 10.

Thoracic examination showed equal vesicular breath sounds in both lungs, with no rales or wheezing.

Neurological Status

The patient was fully conscious with GCS 15 and no signs of nuchal rigidity. Pupil examination showed bilateral 3 mm pupils, isocoric, with positive light reflexes (+/+). Visual acuity in both eyes (ODS) was greater than 6/60. Fundoscopic examination revealed optic discs with sharp margins in both eyes. Extraocular movement evaluation showed left CN VI paresis. Cranial nerve examination: CN VII within normal limits, CN VIII within normal limits, CN IX showing dysphagia (+), CN X with positive gag reflex (+), CN XI within normal limits, CN XII within normal limits.

Motor function was graded 5555/4+4+4+4+4+ and 5555/4+4+4+4+4+. Sensory function was within normal limits. Physiological reflexes (+/+), Babinski pathological reflex (-/-). Romberg test was positive with a fall toward the left. Diadochokinesia was within normal limits, while finger-to-nose testing was impaired.

Examinations

Laboratory

Hemoglobin (Hb) 16.1 g/dL, hematocrit (Ht) 49.1%, leukocytes 10,530/ μ L, platelets 250,000/ μ L. Prothrombin time (PT) 12.3 seconds, international normalized ratio (INR) 0.88, activated partial thromboplastin time (APTT) 35.7 seconds. Electrolytes: sodium (Na) 136 mEq/L, potassium (K) 4.4 mEq/L. Liver function: SGOT 16 U/L, SGPT 3 U/L. Urea 27.8 mg/dL, creatinine (Cr) 0.71 mg/dL.

Anatomical Pathology – 03/06/2024

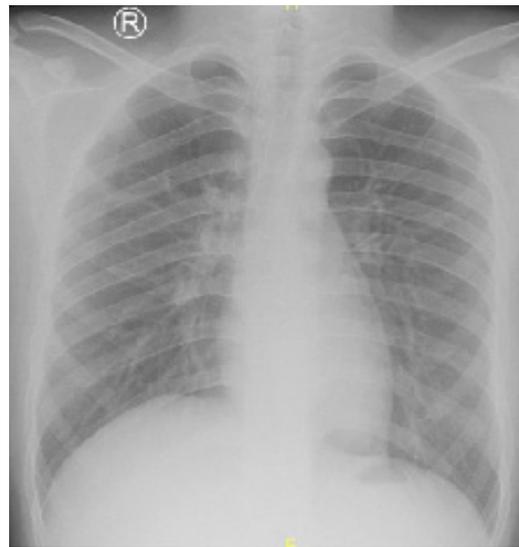


Figure 1. Thorax X-Ray
Thorax X-Ray (30/01/2025)

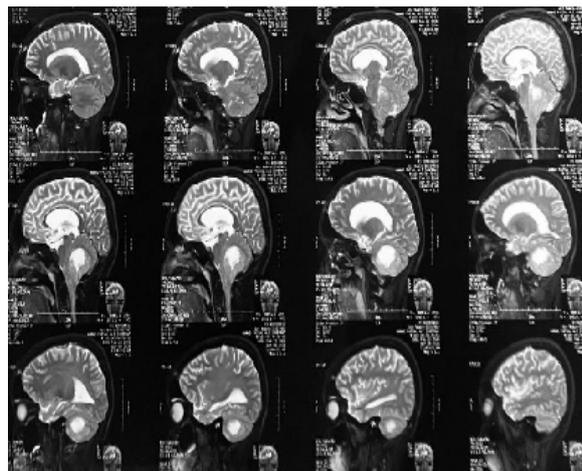


Figure 2. Contrast Head CT-Scan
Contrast Head CT-Scan – (31/01/2025)

Medulloblastoma (WHO Grade IV) at the cerebellar region, GFAP (-), NSE (+).

Findings:

- No broncho pneumonia or pneumonia
- No cardiomegaly

Findings

- Compressed sulci and gyri
- Sylvian fissure not compressed
- Compressed cisterns
- Mixed density lesion in the left cerebellum extending to the cerebellar vermis, markedly inhomogeneous with contrast enhancement
- Peritumoral edema (+)

- Midline shift (-)
- Solid mass measuring $6.6 \times 5.96 \times 6.71$ cm with cystic components, well-defined borders, irregular margins in the left cerebellar hemisphere narrowing the fourth ventricle

Diagnosis

Post Craniotomy Tumor Removal due to Post ETV due to Post Acute Noncommunicating Hydrocephalus due to SOL Infratentorial at Left Cerebellum extend to Vermis Cerebelli due to Medulloblastoma (WHO Grade IV).

Anesthesia Management

Planned Procedure: Redo Craniotomy Tumor Removal

Preoperative

The patient fasted for six hours before surgery. The actual problem identified was a large infratentorial mass. Potential problems included the risk of cerebral edema and risk of bleeding. The patient was classified as American Society of Anesthesiologists (ASA) physical status II, with general anesthesia planned. The patient received maintenance fluids with Ringerfundin at 100 cc/hour. Intravenous access with a threeway system was already in place. Blood preparation for anticipated intraoperative transfusion was arranged, and full anesthetic equipment and monitoring were prepared, including end

tidal carbon dioxide (etCO₂), invasive blood pressure (IBP), non invasive blood pressure (NIBP), peripheral oxygen saturation (SpO₂), electrocardiography (ECG), urine output monitoring, and central venous catheter (CVC). The patient was positioned prone (Figure 3). Postoperative care was planned in the intensive care unit.

Anesthetic Management

Induction was performed with fentanyl 150 mcg, propofol TCI Schneider 4 mcg/ml, rocuronium 50 mg, and lidocaine 90 mg. Maintenance anesthesia consisted of propofol TCI Schneider 2–4 mcg/ml, dexmedetomidine 0.2–0.7 mcg/kg/hour, intermittent rocuronium, and fluid maintenance with Ringerfundin 100 cc/hour.

Intraoperative Course

The surgery lasted eight hours. Upon opening the skull, brain swelling was observed, and mannitol was administered with a total dose of 1 g/kg body weight, leading to improvement in cerebral edema. Tumor mass removal was then performed (Figure 4). During the procedure, intraoperative monitoring (IOM) showed prolongation of the left cranial nerve VIII. Hemodynamics remained relatively stable, with systolic blood pressure ranging from 99–140 mmHg and diastolic blood pressure 50–84 mmHg. Heart rate ranged from 98–117 beats per minute, oxygen saturation 97–



Figure 3. Operation Position

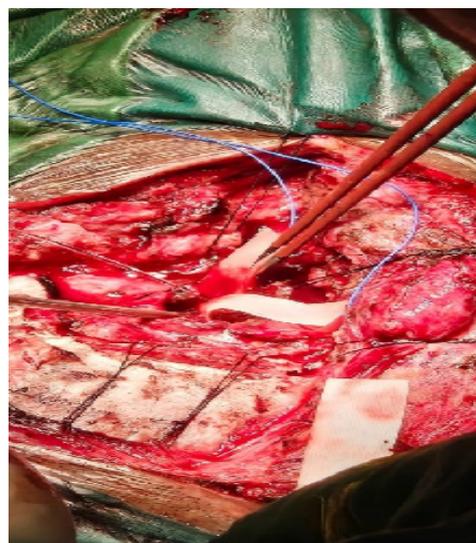


Figure 4. Tumor Removal



Figure 5. Connox

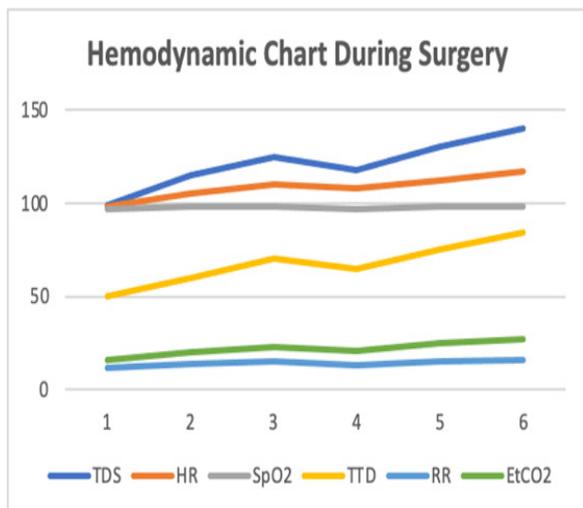


Figure 6. Hemodynamic Chart During Surgery

98%, end tidal CO₂ (EtCO₂) values 16–27 mmHg, and Connox values ranged from 34–80 (Figure 5). Estimated intraoperative blood loss was 1600 ml. Fluid therapy included 2500 ml crystalloids and 1000 ml colloids, with 2 units of packed red cells (PRC) totaling 465 ml administered. Urine output remained stable, recorded sequentially as 200–300–200–100–100–100–100–150 ml.

Postoperative Management

Postoperative Day 1 (ICU)

The patient arrived in the ICU intubated, on ventilator support using SIMV plus pressure support mode with FiO₂ 0.4. Sedation and analgesia were continued with propofol 25 µg/kg/min and dexmedetomidine 0.35 µg/kg/hour.

Hemodynamic parameters were stable (MAP 75–85 mmHg, SpO₂ 98–100%, EtCO₂ 36–40 mmHg). Urine output was 0.7–1 ml/kg/hour.

Initial weaning was performed, including gradual reduction of FiO₂ and assessment with a spontaneous breathing trial (SBT). Mannitol 0.25 g/kg every 8 hours and dexamethasone 5 mg every 8 hours were continued for cerebral edema control. Ondansetron 4 mg every 8 hours was administered for PONV prophylaxis, and paracetamol 1 g every 8 hours for analgesia. A control CT scan was not performed on this day. Neurological monitoring was preserved with GCS E4VtM6.

Postoperative Day 2

The patient was in good general condition. Sedation was gradually reduced until the patient was awake and cooperative. Cough and gag reflexes were positive, with oxygen saturation maintained at ≥98% and adequate spontaneous breathing. Controlled extubation was performed after successful SBT and fulfillment of weaning criteria (PaO₂/FiO₂ > 300, no new neurological deficits). After extubation, the patient received oxygen via nasal cannula at 2 L/min. Analgesia was maintained with ketorolac 30 mg IV every 8 hours and paracetamol 1 g IV every 8 hours.

Postoperative Day 3

The patient remained hemodynamically stable with GCS 15 and no new neurological deficits. The surgical wound was dry, urine output was

normal, and laboratory examination showed Hb 13.8 g/dL, Na 138 mEq/L, and K 4.1 mEq/L. The patient was deemed stable for transfer to the general ward.

Discussion

Infratentorial tumors involve critical structures of the cerebellum, brainstem, and fourth ventricle, producing progressive symptoms such as increased intracranial pressure from CSF obstruction, particularly when the fourth ventricle or aqueduct is compressed.⁵ Medulloblastoma in the posterior fossa, as in this case, presents unique neuroanesthetic challenges due to the confined anatomical space and proximity to vital neural structures.^{6,7} The patient's imbalance, diplopia, and dysphagia reflected compression of cerebellar and cranial nerve structures, while CT imaging showing a large solid mass with peritumoral edema and fourth ventricular compression indicated a high risk of intracranial hypertension.

Fluid management using balanced crystalloids, appropriate anesthetic agent selection, and careful control of ICP were essential perioperative strategies. The prone operative position required additional considerations due to hemodynamic changes, increased pulmonary mechanical power, and risks of airway injury; preloading fluids can mitigate post-induction hypotension.⁸⁻¹⁰ Redo-craniotomy added complexity due to postoperative adhesions and an increased risk of intraoperative bleeding and neurological injury.¹¹ The eight-hour surgery necessitated stable long-term anesthetic management including propofol TCI for titration precision and rapid neurological evaluation.¹² Cerebral edema observed intraoperatively responded well to mannitol 1 g/kg, consistent with guidelines, and significant blood loss (1600 ml) required aggressive transfusion therapy.¹³ Intraoperative Neurophysiological Monitoring (IONM) was crucial for detecting and preventing neural injury in the posterior fossa.¹⁴ Modalities such as EMG, MEP, SSEP, and BAEP provided real-time feedback, with BAEP changes signaling early cochlear or brainstem compromise.^{3,14} Non-surgical factors including hypothermia,

hemodynamic instability, glucose and electrolyte abnormalities, and technical artifacts can affect signal reliability.²

In this case, prolongation of cranial nerve VIII activity indicated excessive traction, enabling timely surgical modification. Continuous EMG significantly reduces cranial nerve injury rates compared to cases without EMG monitoring. IONM also facilitates safer gross total resection (GTR) and decreases postoperative complications by guiding dissection near critical neurovascular structures.^{2,15} Anesthetic technique significantly influences IONM quality. TIVA with propofol and dexmedetomidine is preferable because it minimizes interference with evoked potentials.¹⁶ Dexmedetomidine decreases propofol requirements while maintaining stable signals, although bolus doses may suppress MEP or alter SSEP; titrated continuous infusion is recommended.¹⁷

ConnX (Connectivity Index) provided additional insight into global neural function and depth of anesthesia.¹⁸ In this case, ConnX values fluctuated between 34 and 80, reflecting physiological responses to surgical phases and helping optimize anesthesia balance. Low values suggest excessive neural depression, whereas high values may indicate inadequate anesthesia.¹⁹ Integration of ConnX with other neuromonitoring tools may improve neuroanesthetic assessment, although further research is still needed to standardize its interpretation.²⁰ IONM also detects complications such as cerebral edema and ischemia, allowing early intervention before permanent injury occurs. Postoperatively, intensive care management focused on preventing complications common after posterior fossa surgery including increased ICP, CSF leak, pseudomeningocele, and progressive cranial nerve deficits. Appropriate fluid therapy, rational transfusion, and strict monitoring were critical in ensuring successful neurocritical care.²⁰

Conclusion

Intraoperative Neurophysiological Monitoring (IONM) is a key component in ensuring the

success of anesthetic and surgical management during re-craniotomy for infratentorial tumors. As a neural protection system, IONM enables early detection of functional changes in critical structures such as the brainstem and cranial nerves through multimodal techniques including MEP, SSEP, BAEP, and EMG. In this case, the detected prolongation of cranial nerve VIII activity provided timely feedback to prevent permanent injury. The effectiveness of IONM relies heavily on appropriate anesthetic techniques, with TIVA using propofol and dexmedetomidine maintaining stable electrophysiological signals. Supplementary monitoring with ConnX further supported the assessment of global neural activity and helped balance anesthetic depth with neural preservation. Overall, integrating IONM into neuroanesthesia enhances surgical safety and precision while contributing significantly to maintaining optimal neurological outcomes in patients with infratentorial tumors.

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