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Assessment of Post-Surgical Recovery using Multi Modal Intraoperative Neuromonitoring in Posterior Fossa Surgery Patients

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ABSTRACT

Multimodal intraoperative neuromonitoring (IONM) plays a critical role in enhancing the safety of posterior fossa and cerebellopontine angle (CPA) surgeries, where dense neurovascular structures place patients at high risk of neurological deficits. This case series evaluates the utility of combined corticobulbar motor evoked potentials (CoMEP), somatosensory evoked potentials (SSEP), and transcranial motor evoked potentials (TcMEP) in assessing intraoperative neural integrity and predicting postoperative outcomes. Six patients undergoing posterior fossa procedures were monitored using standardized anesthetic and neuromonitoring protocols, with baseline, intraoperative, and closure recordings compared for amplitude and latency changes. Stable CoMEP, SSEP, and TcMEP signals were associated with intact postoperative neurological function, while altered responses correlated with transient or persistent cranial nerve deficits, particularly involving facial and lower cranial nerves. These findings support multimodal IONM as an essential adjunct in posterior fossa surgery, enabling early detection of neural compromise and timely corrective surgical interventions.

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INTRODUCTION

Neurosurgery in the cerebellopontine angle (CPA) poses extraordinary technical challenges and requires advanced surgical skills, due to the crowding of key neuro-vascular structures in this compartment. From an anatomical viewpoint, the cerebellopontine angle contains three neurovascular complexes in a relatively narrow space. In detail, the upper complex is built up by the superior cerebellar artery, the midbrain, the superior cerebellar peduncle, the tentorial surface of the cerebellum, and the oculomotor, trochlear, and trigeminal cranial nerves; the middle complex includes the antero-inferior cerebellar artery, the pons, the middle cerebellar peduncle, the petrosal surface of the cerebellum, and the abducens, facial, and vestibulocochlear nerves; and, finally, the lower complex comprises the postero-inferior cerebellar artery, the medulla oblungata, the inferior cerebellar peduncle, the suboccipital surface of the cerebellum, and the glossopharyngeal, vagus, spinal accessory, and hypoglossal nerves.[1]

Preservation of facial nerve function (FNF) during neurosurgery for cerebellopontine angle (CPA) tumors is paramount in elderly patients. Corticobulbar facial motor evoked potentials (FMEPs) allow assessment intraoperatively of the functional integrity of facial motor pathways, thus improving safety. [1]

METHODS

The patient was Pre-medicated with Inj. Fentanyl 2 mcg/kg. The patient was then induced with Inj. Propofol 2 mg/kg and Rocuronium 1mg/kg and intubated. The patient was then mechanically ventilated with oxygen, air and sevoflurane with a MAC of 0.6. Bispectral index monitors were place post intubation.

The SSEP electrodes, Transcranial Cock screw electrodes, and Corticobulbar electrodes(of the respective cranial nerves) were inserted after intubation and before positioning the patient for surgery. 30 minutes after intubation the patient was started on Total Intravenous Anaesthesia (TIVA) to facilitate neuromonitoring, with inj. Propofol according to the Schneider model (3-5 mcg/ml Plasma site concentration) and Dexmedetomidine at the rate of 0.5 mcg/kg/hour and ventilated on Volume control mode of ventilation (Tidal Volume: 5ml/kg, PEEP: 3 cm H20, Respiratory Rate 15/min). The patient was kept normothermic during the surgery and any metabolic derangements were corrected by performing arterial blood gas measurements when indicated.

Corticobulbar Motor Evoked Potentials (CoMEP), Somatosensory Evoked Potentials (SSEP) (from the upper limb and lower limb) and Transcranial Motor Evoked Potentials were taken both at baseline, during the surgery (after dura opening, during tumour resection, after tumour resection, dural closure) and final readings were taken during the skin closure. The baseline and final readings were assessed for any reduction of amplitudes or delay in latencies.

Post-surgery, the patient was extubated after confirming airway reflexes intact and shifted to the post-operative recovery room.

Stimulus Parameters used in IONM-

SSEP:

Stimulus 200–300 µs, 3–5 Hz, 20–40 mA; recorded at C3’, C4’, Cz; filters 30–1000 Hz. Used to assess dorsal column integrity.

TcMEP:

Multipulse (5–7) train, 50–75 µs, 250–400 V via C1–C2; filters 10–1500 Hz; recorded from upper/lower limb muscles for corticospinal monitoring.

CoMEP:

Same stimulation as TcMEP but via C3-C4 ; recorded from CN V–XII–related muscles.

RESULTS

Serial No.	Age/Sex	Pre-Operative Neurological Deficits	Surgery	Baseline IONM measurements	Final IONM Measurements	Comments
1.	11 years/Female	Right Side Facial Nerve Palsy. CN 7. Right Abducens Nerve Palsy. CN 6. Right sided incoordination. Ataxia leaning towards the left.	Posterior Fossa Craniotomy and Drainage of Brainstem Cyst. Fig. 1.1	Baseline MEP from Upper Limb and Lower Limb Set. CoMEP shows minimal amplitude from the upper branches of right facial and no response from right 6th CN. Baseline SSEP from right median and PTN set Fig. 1.2	Final response shows no prolongation of latency or decrease in amplitude from the baseline recordings of all the modalities used.	Left sided SSEP from median and PTN are poorly formed as depicted in Fig. 1.2
2.	27 years/Male	Imbalance while walking	Posterior Fossa craniotomy and resection of neoplasm Fig. 2.1	Baseline MEP from upper limb and lower limb Baseline CoMEP from B/L CN 9-12 Baseline SSEP from B/L median and PTN nerve .	Final recordings taken had no change in amplitude and latency and were consistent throughout the surgery. No image reference.	

				Fig. 2.2		
3.	31 years/Male	No Pre-operative Deficits. Cranial Nerves Intact.	Left suboccipital craniotomy and excision of left CP Angle meningioma. Fig 3.1	Upper limb SSEP: Median Nerve SSEP: Tibial Nerve. MEP: UL and LL. Corticobulbar MEP: Left 7th to 12th CNs. Right side: Reference. CN 8: BERA Fig. 3.2	Final recordings taken had no change in amplitude and latency and were consistent throughout the surgery. No image reference.	
4.	43 years/Female Body weight: 117 kg	Right sided sensorineural hearing loss.	Right Sub Occipital Craniotomy and Excision of Schwanomma Fig 4.1.	Baseline MEP, Corticobulbar MEP, Upper Limb SSEP Set. SSEP from Lower limb poorly elicited. Auditory Evoked potential from right side not reproducible. (Fig 4.2) DNS at 0.5mA during initial tumour resection showed responses from CN 9,10 and mild response from CN 12 (Fig 4.3) DNS at 0.2 mA – to identify CN 7 (Fig. 4.4)	Fig.4.5 Final response shows no prolongation of latency or decrease in amplitude from the baseline recordings of all the modalities used.	SSEP from Lower Limb Poorly elicited due to Pedal Oedema.
5.	79 year/ Female	Dizziness, Imbalance while walking	Left Sub-Occipital Craniotomy for Left CP angle tumour. Fig 5.1	MEP from UL and LL, CoMEP from Left CN 5-12 with SSEP from B/L Median nerve and Posterior Tibial Nerve. (Fig 5.2) DNS done at 0.2mA -	Final response same as baseline no image reference.	

				responses obtained from CN 7 and 10 (Fig 5.3)		
6.	33 years/ Female	Malfunctioned VP shunt tip traversing along the midline of posterior fossa. No neurological deficits and cranial nerves are intact. Fig 6.1	Repair of pseudo-meningocele in the posterior fossa and cranioplasty. (S/p removal of arachnoid cyst in the left cerebellar region followed by VP shunt)	MEP from Bilateral UL and LL, CoMEP from bilateral CN 7-12 with SSEP from Bilateral Median nerve and Posterior Tibial Nerve. Fig. 6.2	Fig.6.3 Final response shows no prolongation of latency or decrease in amplitude from the baseline recordings of all the modalities used.	

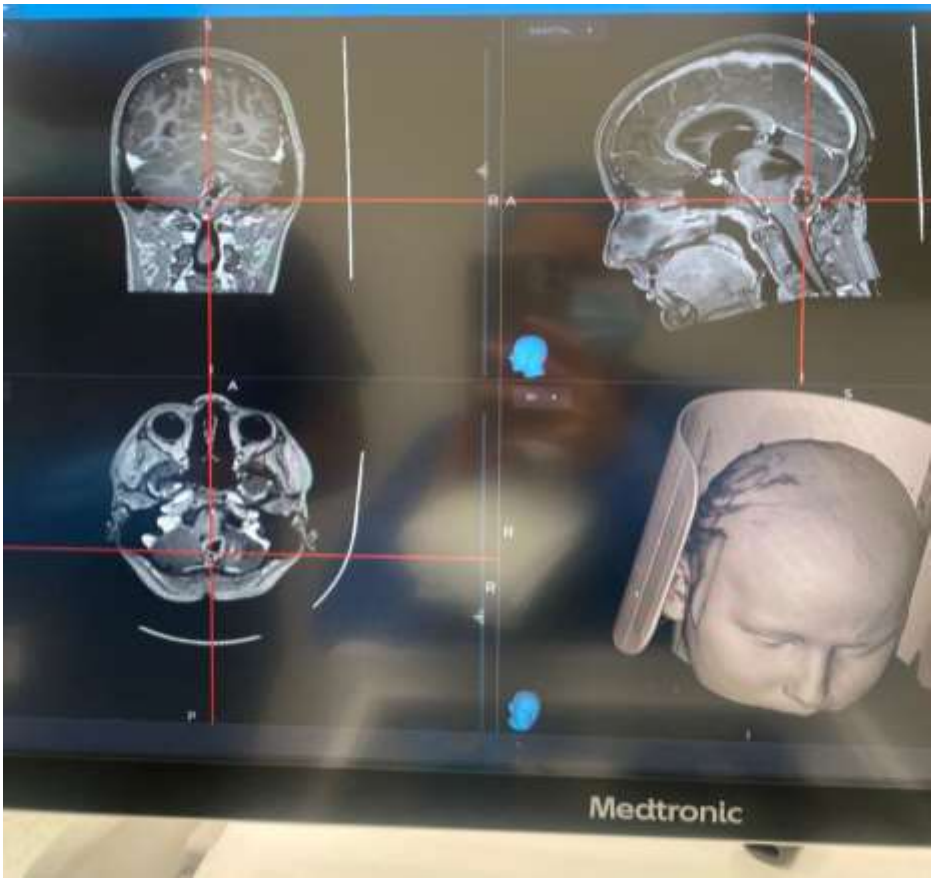

Fig. 1.1

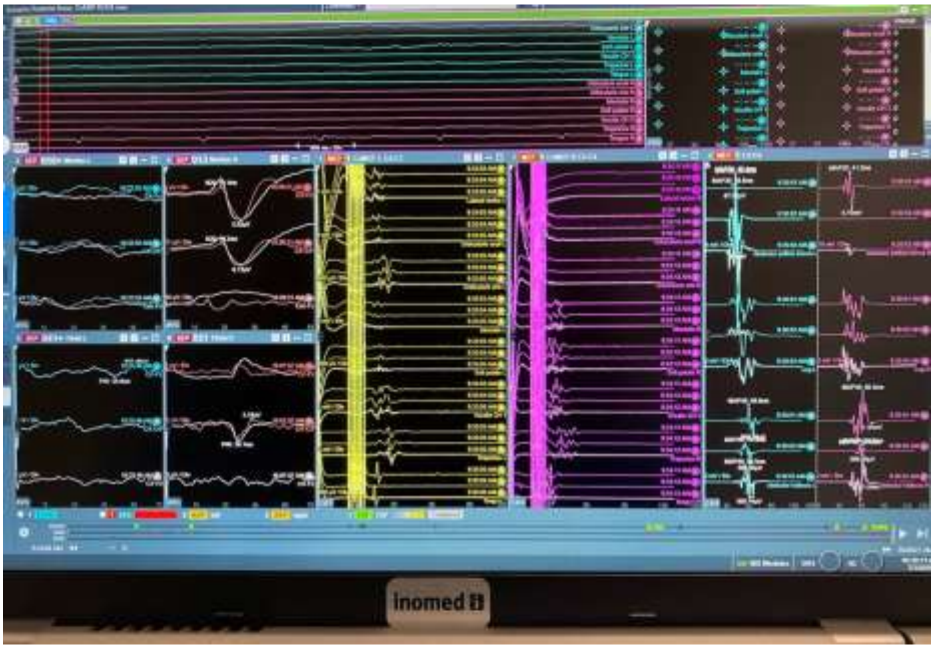

Fig 1.2: Baseline MEP from Upper Limb and Lower Limb Set. CoMEP shows minimal amplitude from the upper branches of right facial and no response from right 6th CN.

Baseline SSEP from right median and PTN set. Left sided SSEP from median and PTN are poorly formed.

Fig 1.3: Final Response.

Fig 2.1

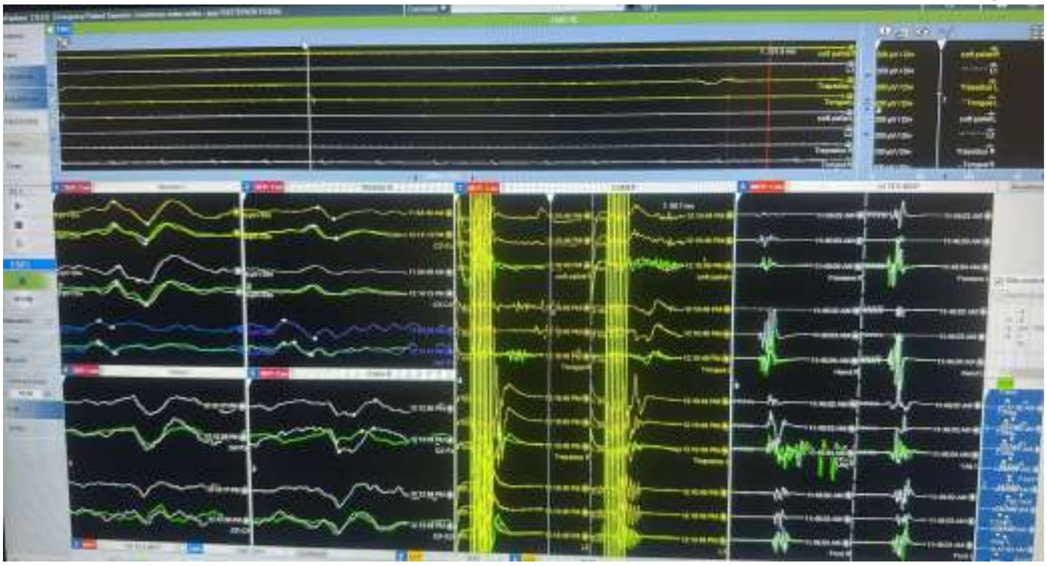

Figure 2.2

Figure 3.1

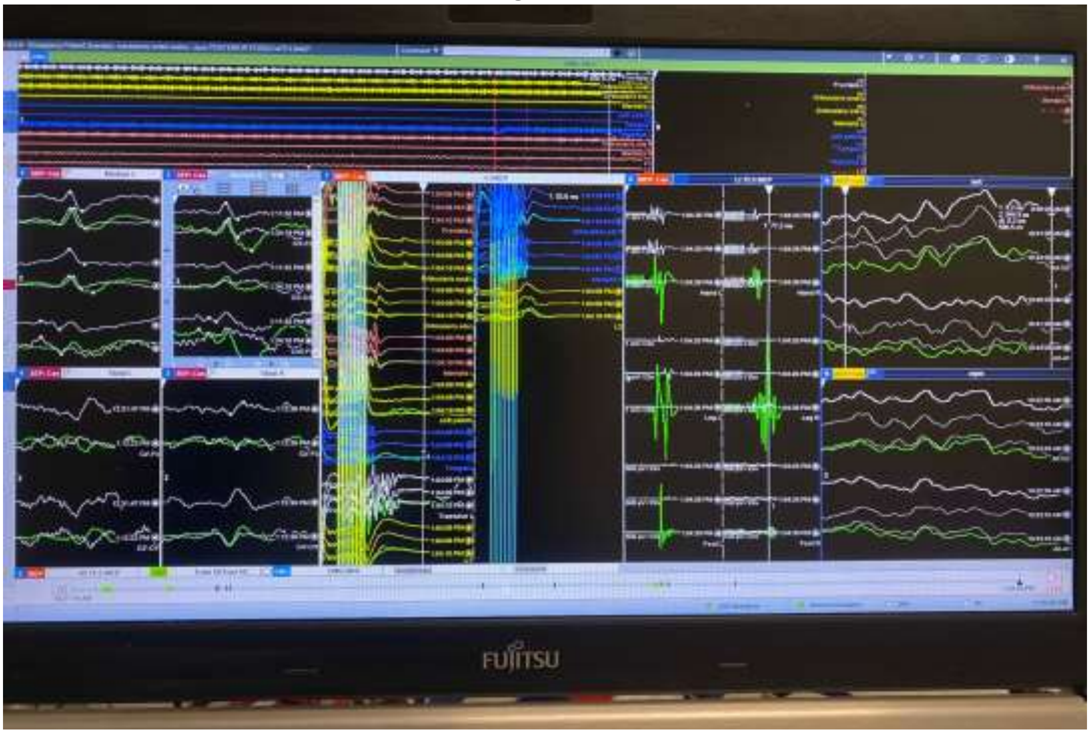

Figure 3.2

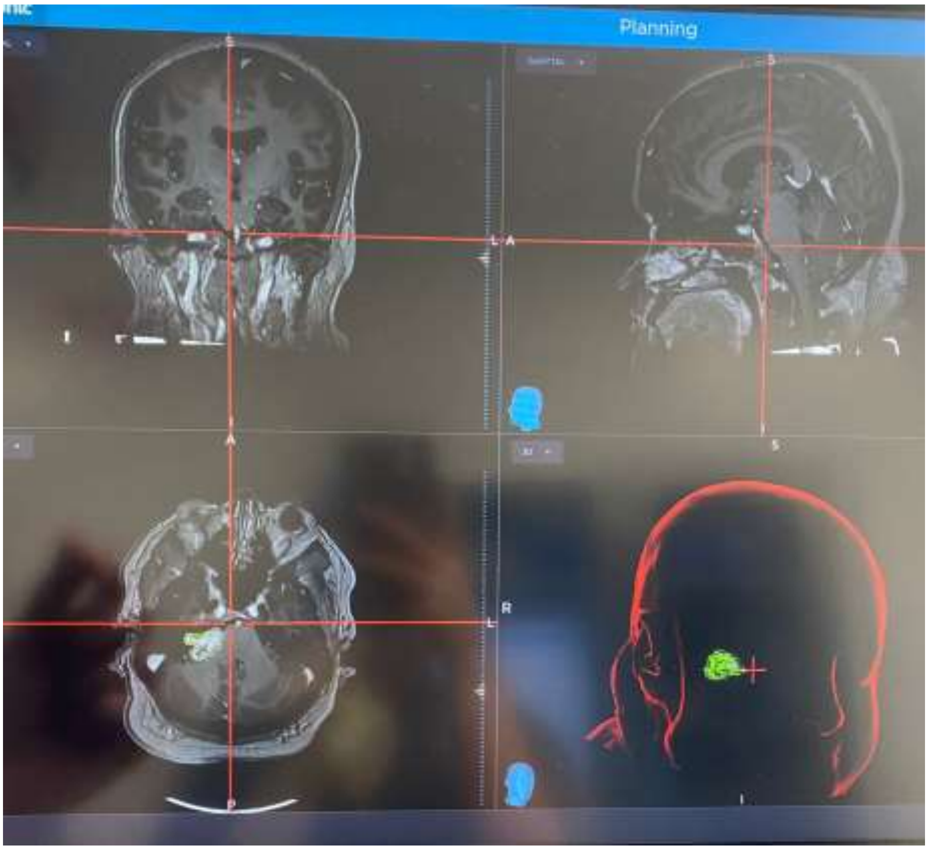

Fig 4.1

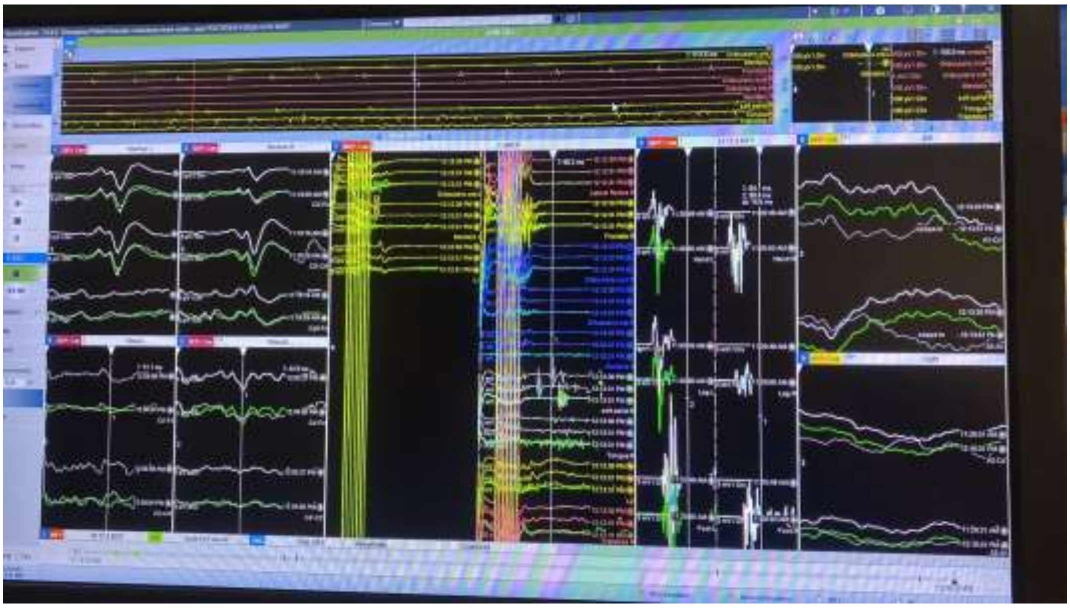

Fig 4.2

Fig 4.3 – DNS responses from lower CNs

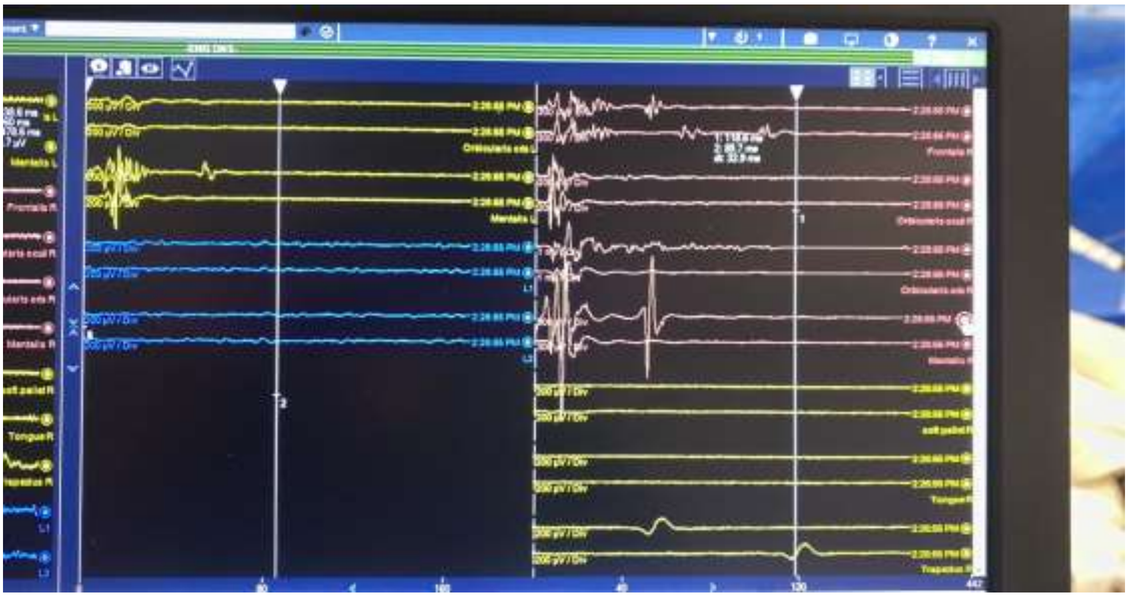

Figure 4.4 – DNS responses at 0.2mA – CN 7 identified

Fig 4.5 – final response

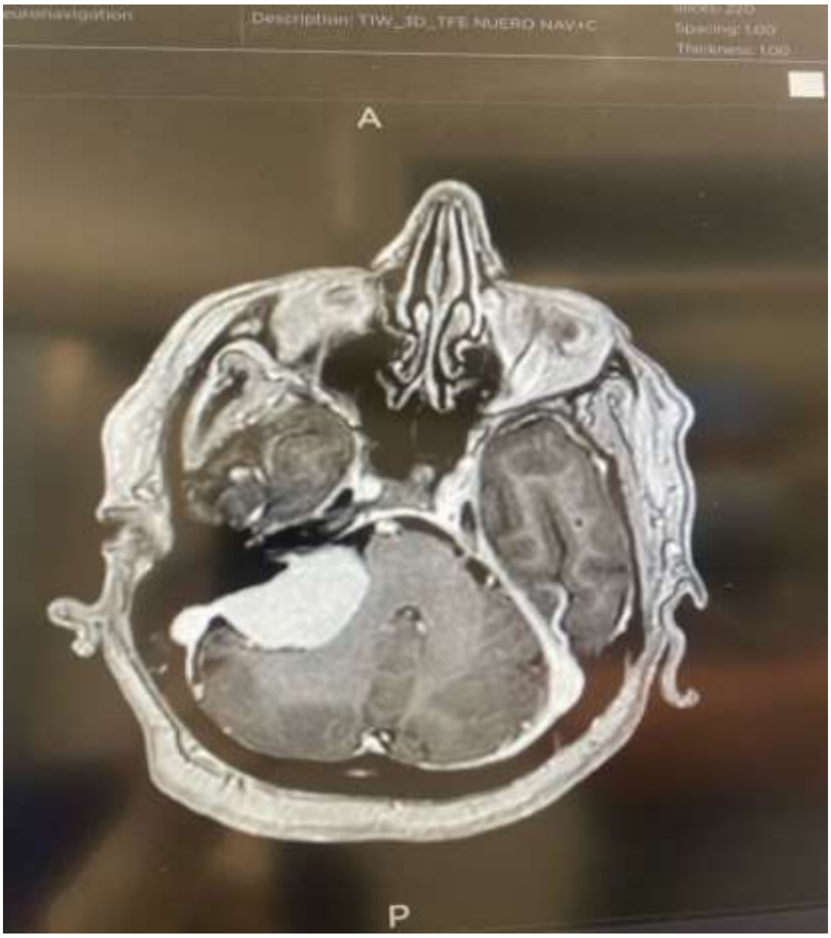

Figure 5.1

Figure 5.2

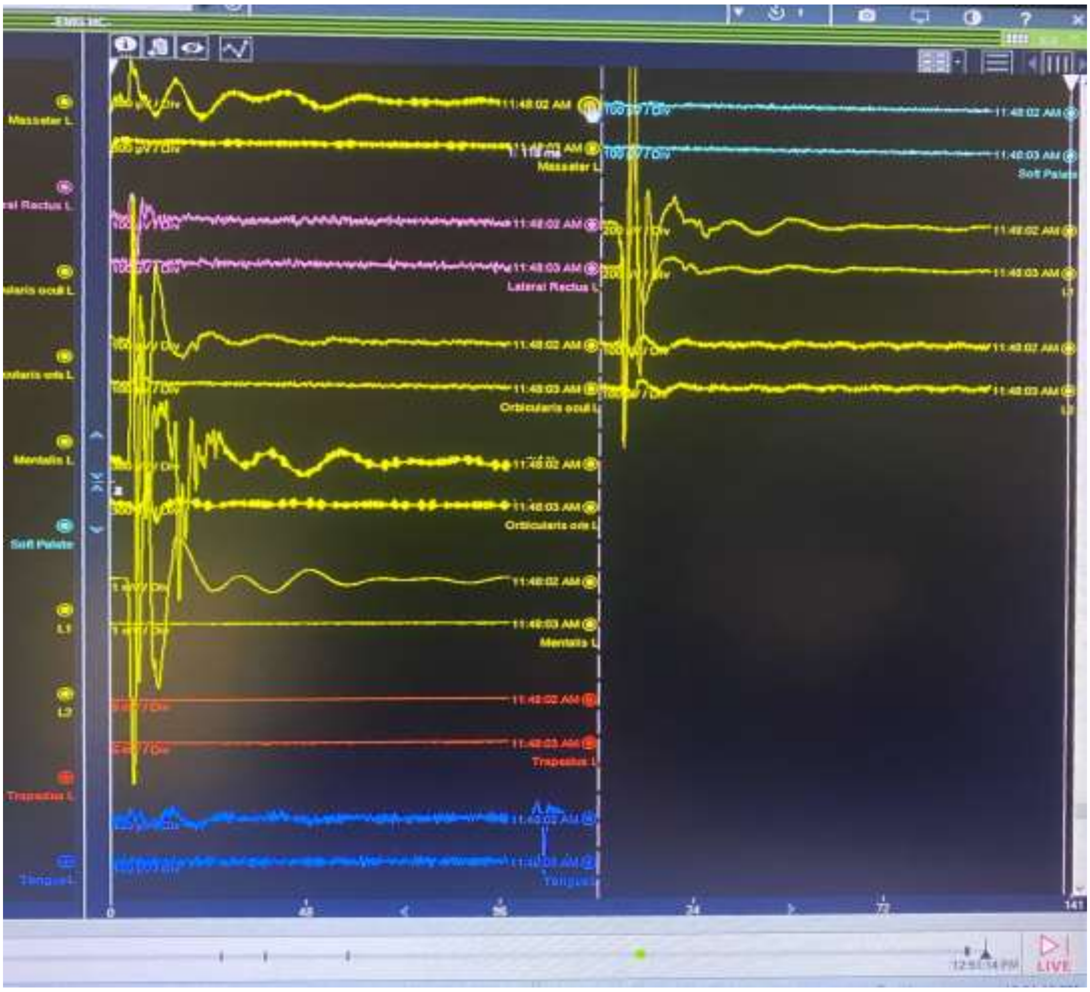

Fig 5.3 DNS done at 0.2mA - responses obtained from CN 7 and 10

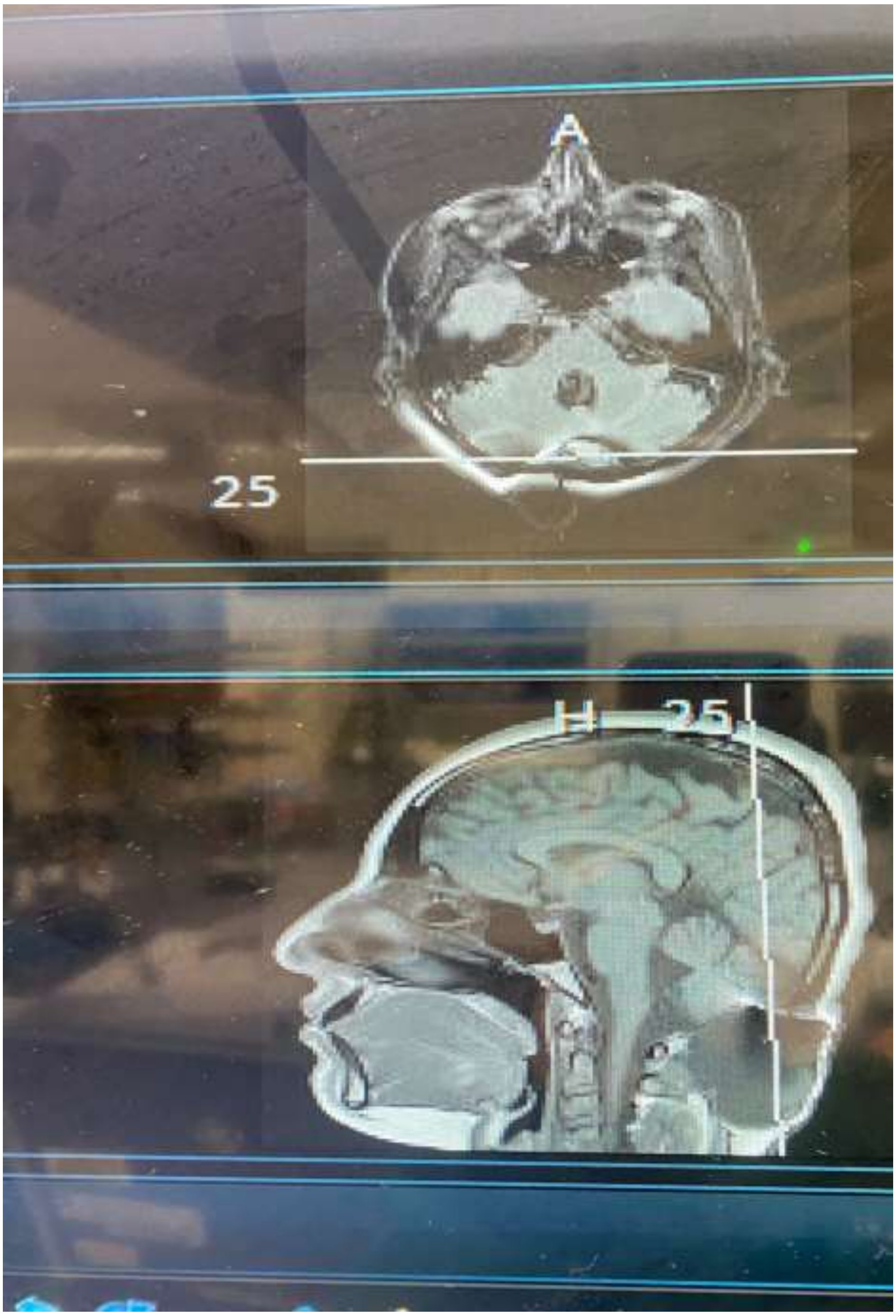

Fig 6.1

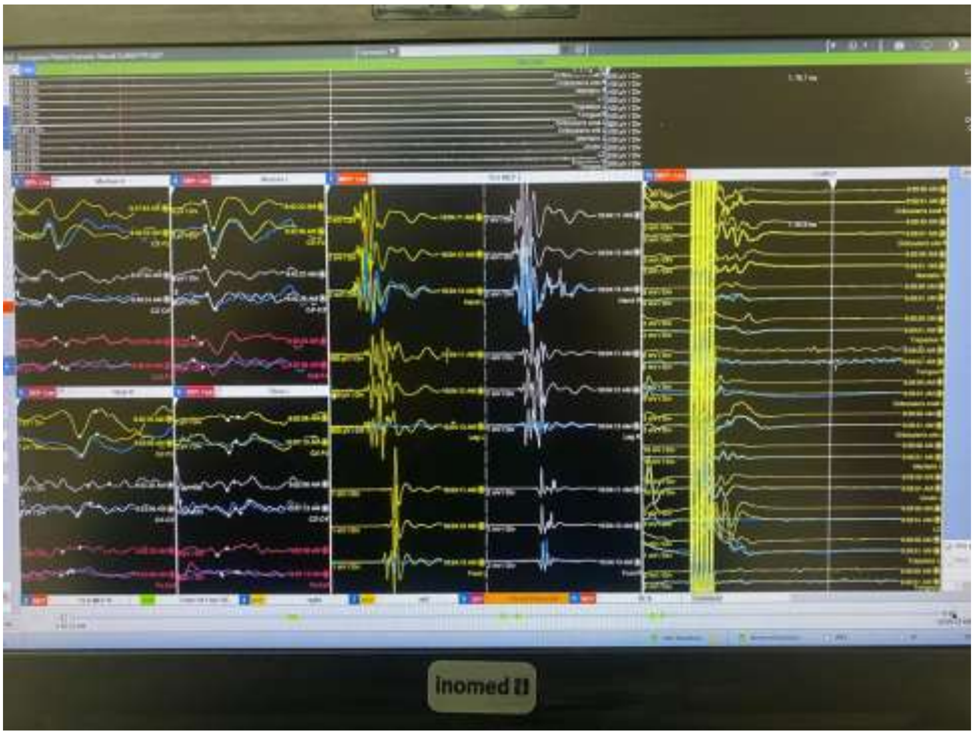

Fig 6.2: Baseline response - MEP from Bilateral UL and LL, CoMEP from bilateral CN 7-12 with SSEP from Bilateral Median nerve and Posterior Tibial Nerve.

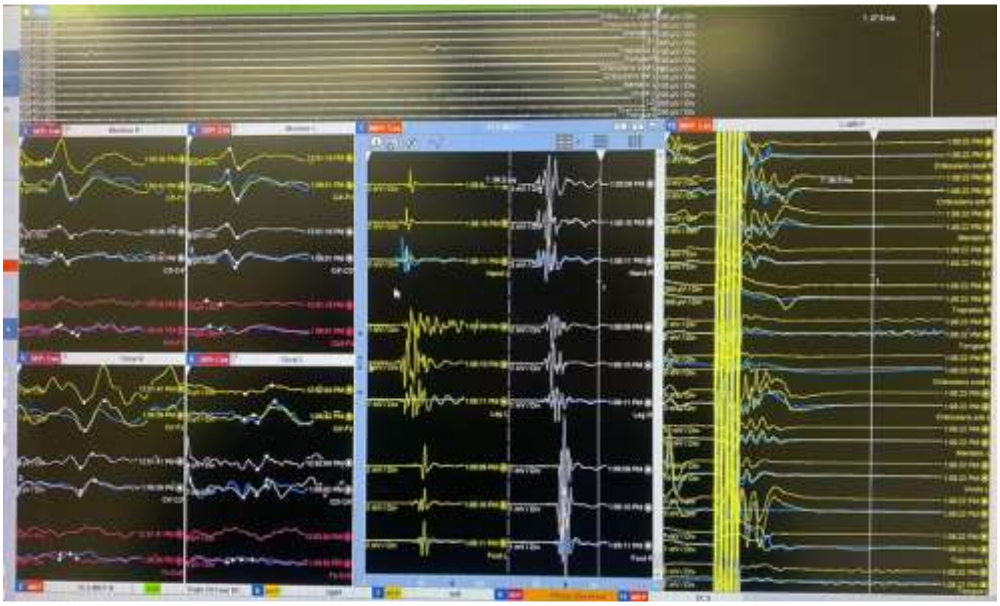

Figure: 6.3: Final Response

DISCUSSION

The integration of multimodal IONM—including corticobulbar motor evoked potentials (CoMEP), somatosensory evoked potentials (SSEP), and transcranial motor evoked potentials (TcMEP)—provides continuous, real-time feedback regarding the functional integrity of both motor and sensory pathways

The present observations highlight how multimodal IONM can detect early functional changes in neural transmission, allowing surgeons to implement immediate corrective measures and thus prevent irreversible injury. In this case series, baseline readings were compared with intraoperative and closure values to evaluate preservation of neural function. Patients demonstrating stable CoMEP and SSEP amplitudes typically exhibited intact postoperative neurological status, while those with intraoperative amplitude reductions or absent responses correlated with temporary or persistent postoperative deficits. This finding is consistent with earlier literature reporting that CoMEP amplitude reductions greater than 50% often predict postoperative facial weakness or lower cranial nerve dysfunction.

Furthermore, the ability of corticobulbar MEPs to monitor cranial nerves (V–XII) proved invaluable in differentiating transient mechanical traction from irreversible injury. The use of dexmedetomidine- and propofol-based total intravenous anesthesia (TIVA) ensured minimal interference with evoked potential recordings and stable anesthetic depth, as verified through BIS monitoring. Maintaining normothermia and correcting metabolic derangements also contributed to signal stability.

The pediatric and geriatric subgroups within this series demonstrated particular benefit, as both age extremes are highly susceptible to neural compromise and delayed recovery. In these cases, multimodal IONM served as an essential guide for intraoperative decision-making, especially when direct visualization of neural structures was limited.

CONCLUSION

Multimodal intra operative Neuromonitoring is especially important in Posterior Fossa surgeries, as real time feedback can be gained about any inadvertent surgical insult. Any corrective measures can be taken immediately to avoid any further complications due to surgery.

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