Intraoperative vagal nuclei mapping for a safe entry point in lower brainstem cavernoma

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OBJECTIVE

Brainstem cavernous malformations (BSCMs) can occur in up to 35% of cases. They can bleed and grow, presenting a considerable risk of severe neurological deficit or death. Consequently, it is reasonable to undergo microsurgical removal of BSCMs to relieve mass effect and prevent repetitive bleeding. Operative procedures on the brainstem remain challenging and to facilitate BSCM removal while decreasing the substantial risk of iatrogenic deterioration, there is a need for functional real-time monitoring.

This study aims to present and emphasize the use of intraoperative neuromonitoring (IONM) of brainstem nuclei.

METHODS

We report the case of a 24-year-old female patient who presented with a cavernous malformation of the left medulla oblongata. To identify a safe entry zone, the patient underwent brainstem surgery with IONM and vagal nuclei neuromonitoring.

RESULTS

A combined telovelar and far-lateral approach was designed, and the cerebellar tonsils, the left cerebellar hemisphere, and the lateral and posterior surfaces of the medulla oblongata were exposed.

Intraoperative mapping of brainstem nuclei was applied to identify a safe entry zone. Direct low-current frequency of 0.5mA stimulating the vagal nuclei helped confirm the entry zone. Medullotomy was made under IONM and the BSCM was reached and completely resected without new neurological deficit identified in IONM. The patient had a good recovery with no deficit noticed in the 3-month post-op follow-up.

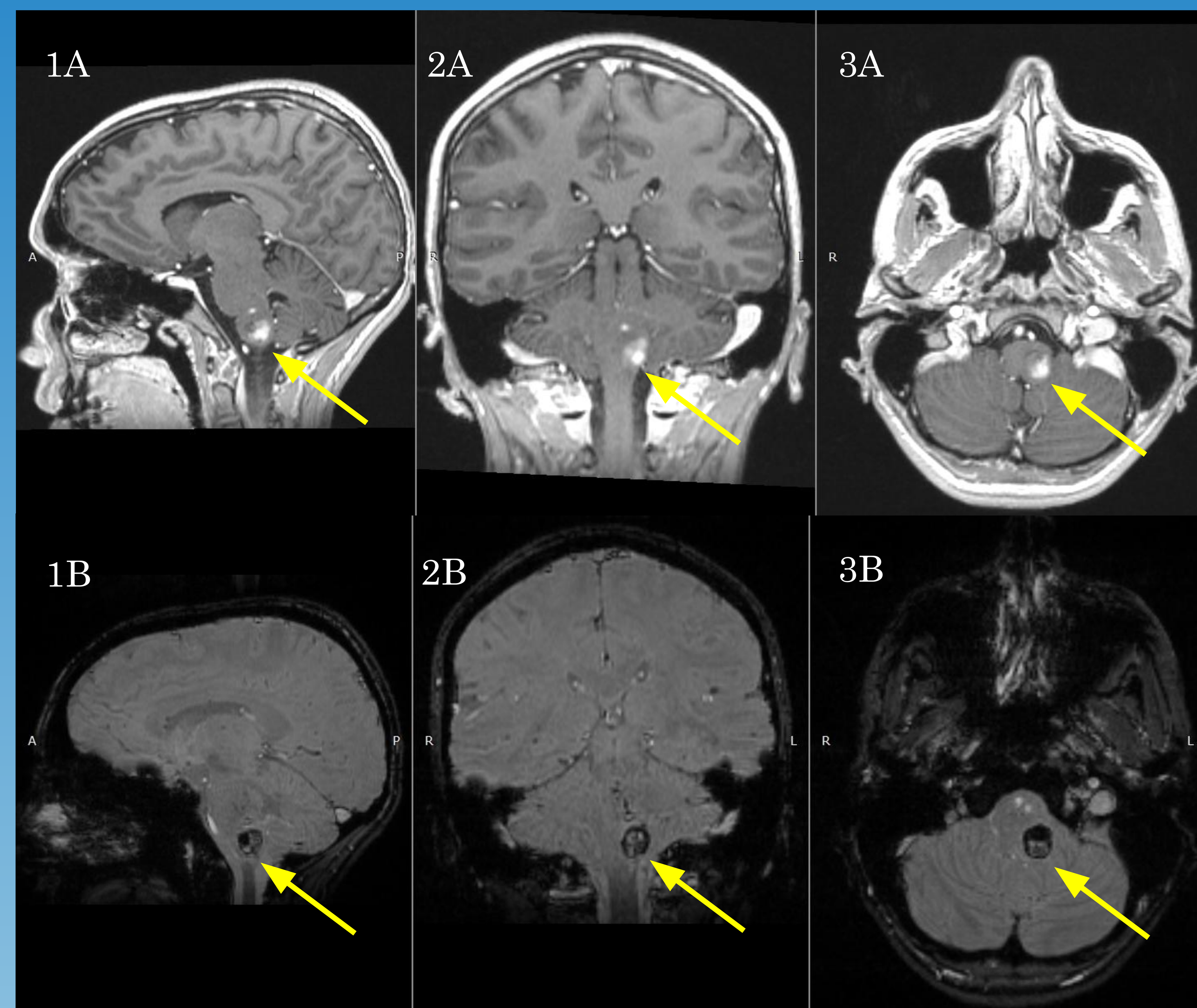
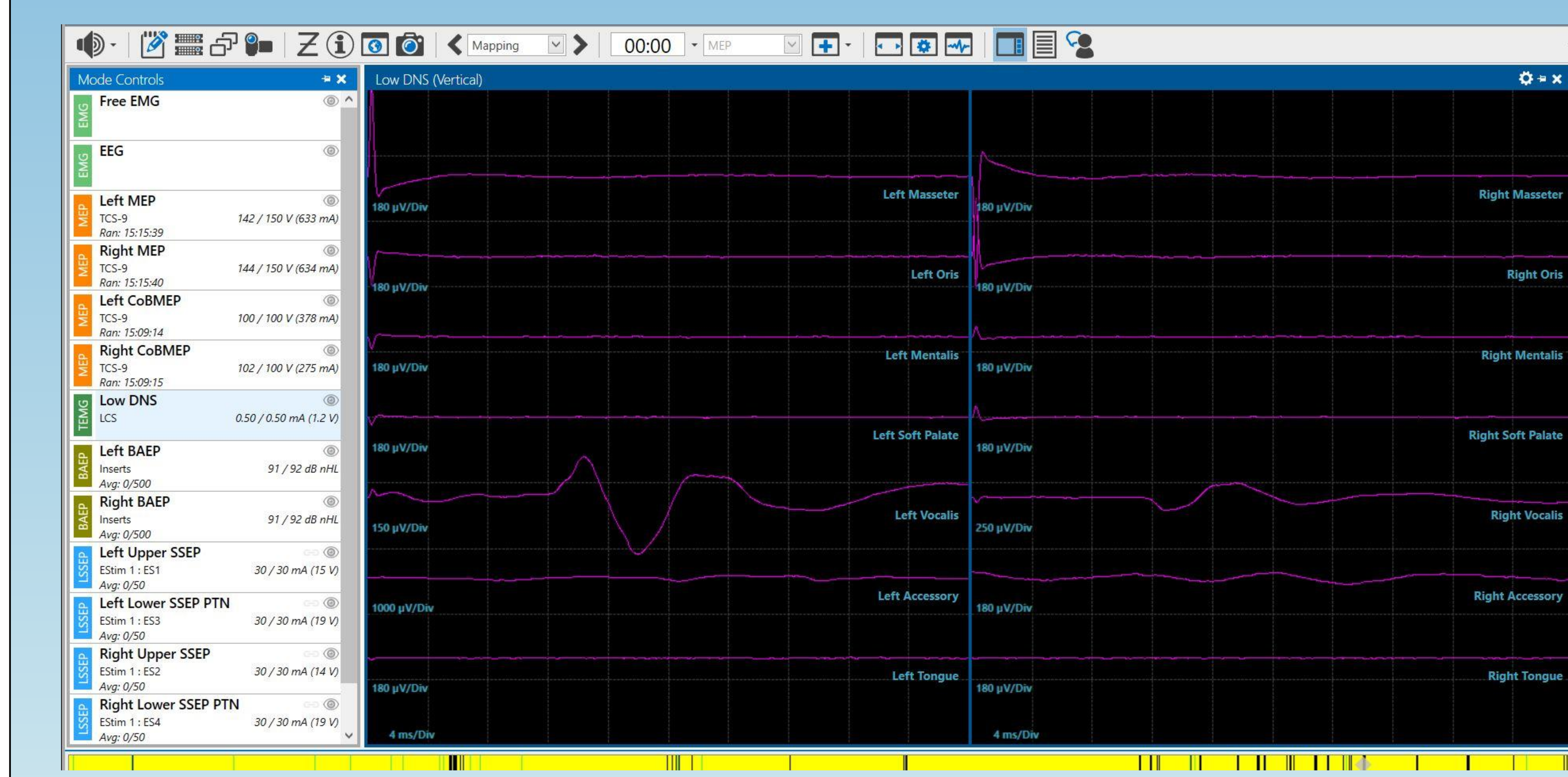


Fig. 1: Sagittal image of the patient's brain MRI at the lesion level. A. T1WI with contrast, and B. SWI
Fig. 2: Coronal image of the patient's brain MRI at the lesion level. A. T1WI with contrast, and B. SWI
Fig. 3: Axial image of the patient's brain MRI at the lesion level. A. T1WI with contrast, and B. SWI
Yellow arrows show the lesion.



The utilization of brainstem stimulation during the surgery allowed for continuous monitoring of neural responses and identification of the functional integrity of critical structures. Upon stimulation, distinct evoked potentials were observed, including brainstem auditory evoked potentials (BAEPs), somatosensory evoked potentials (SSEPs), and motor evoked potentials (MEPs), corticobulbar evoked potentials (CoMEPs), electroencephalograph (EEG) and direct nerve stimulation (DNS). In addition, the elicited stimulation responses helped identify the location of nuclei and tracts. The neurophysiology team communicated real-time feedback to the surgical team, facilitating adjustments in surgical technique and minimizing the risk of inadvertent injury.

CONCLUSION

The application of IONM during BSCM surgery is useful in preventing postoperative new neurological deficit. The direct low-current frequency stimulation of the vagus nerve nuclei helped in identifying a safe entry zone in the brainstem of the case.

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