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Original Article

Intraoperative Neurophysiological Monitoring (IONM) of Proximal Occlusion of Vertebral Artery in Arteriovenous Malformation: A Case Report

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Abstract

Posterior fossa aneurysms with vertebral artery as proximal feeder are very difficult to treat due to involvement of vessels including perforators which supply brain stem and cervical cord. Proximal occlusion of the vertebral artery remains a treatment option. It may be done either by endovascular method or open surgical method. There is no report of Intraoperative Neurophysiological (ION) monitored occlusion of vertebral artery in such cases, which appears to safeguard the occlusion against any ischemic complication. This paper reports a case of posterior fossa Arteriovenous Malformation (AVM) in which ION-monitored occlusion of vertebral artery was performed, and discusses relevant literature.

Abbreviations: AVM: Arterio-venous malformation, BERA: Brainstem evoked response audiometry, CT: computerised tomographic, CTA: CT angiography, DSA: Digital Subtraction Angiography, ION: intra-operative neurophysiological, PICA: posterior inferior cerebellar artery, SSEP: Somatosensory evoked potential.

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Introduction

An intracranial arteriovenous malformation (AVM) is a very deleterious condition. More than half of AVM patients have intracranial haemorrhage and 20-25%

have focal or generalized seizures for life that worsen with age (1). Advances in intra-operative neurophysiological (ION) monitoring techniques with the help of proper neuro-anaesthesia technique have improved treatment of such vascular diseases; however, treatment-associated morbidity of posterior fossa AVMs is still high (2). Authors report a case of ION monitored occlusion of vertebral artery in a case of posterior fossa AVM.

Case report:

A 52-year-old male presented with sudden onset of severe headache in the occipital area. He had stiffness in neck and 2 episodes of vomiting for last 2 days. The patient was well oriented to time, place and person and there was no history of head trauma, loss of consciousness, seizures, weakness in limbs or any focal deficits. There was no history of Diabetes Mellitus, Hypertension and other chronic illnesses. Clinical examination did not reveal any neurological deficit except neck rigidity.

Non-contrast Computerised tomographic (CT) scan showed diffuse subarachnoid haemorrhage. CT angiography (CTA) of brain was done, which revealed presence of a tangle of vessels in the left inferior cerebellum suggestive of arterio-venous malformation (AVM). The feeder was from left vertebral artery and venous drainage of the AVM was into the prominent venous sinuses like superior sagittal sinus, bilateral transverse and sigmoid sinuses and the inferior sagittal sinus. No transcranial collaterals were noted. Digital Subtraction Angiography (DSA) revealed a 2.7×2.2×3 cm AVM supplied by the left posterior inferior cerebellar artery (PICA). The left vertebral artery was dilated, dysplastic and had multiple other aneurysms including left PICA. Vertebral artery distal to PICA was small in calibre. No feeder from external and internal carotid vessels were seen. (Figs. 1, 2)

Patient and relatives opted for surgical option out of other treatment options (endovascular and radiosurgery), which were explained. Patient and relatives were explained about the surgical procedure, advanced technologies (including IONM) which were to be used during the surgery and possible complications. Surgical planning was either to

Fig. 1 (a,b): Preoperative CT Angiography axial images showing AVM with nidus (asterisk) in left cerebellum with presence of flow related pseudoaneurysm (white arrow).

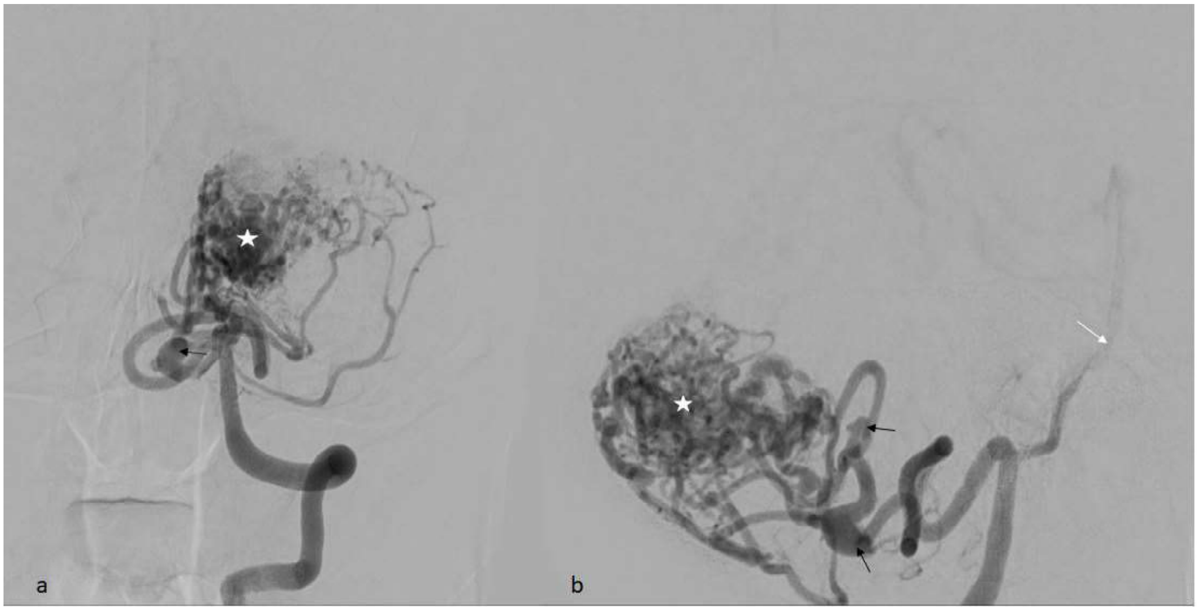

Fig. 2 : DSA AP (a) and lateral (b) view of left vertebral angiogram showing nidus (asterisk) supplied by left PICA (posterior inferior cerebellar artery) with presence of flow related aneurysms (black arrows). Left vertebral artery distal to PICA (white arrow) is faintly opacified.

occlude left vertebral artery extra-cranially under IONM, or surgical excision of AVM if ischemic signs appear on IONM. Patient was explained about the procedure and possible risks (hydrocephalus and infarct in the arterial territory) involved and thereby written informed consent was obtained. In prone position, head fixed in Mayfield head holder, midline sub-occiput and C1 Posterior arch were exposed.

Brainstem evoked response audiometry (BERA) and Somatosensory evoked potential (SSEP) were continuously monitored (Xltek® Protektor 32 IOM, Natus Medical Incorporated, Pleasanton, CA 94566, USA) throughout the surgery. SSEP and BERA were recorded according to guidelines of American Society of neurophysiological monitoring (3, 4). Bilateral median nerves were stimulated for SSEP recordings in which we found latency of 23.3 ms in cortical recordings at C3-Fz and C4-Fz. During recording of BERA we focused on latency of 5th wave. Left vertebral artery was dissected posterior to the left C1 lateral mass and temporary clip was applied. Complete occlusion was confirmed by Doppler probe (Mizuho® 20 MHz Surgical Doppler System, Mizuho, Tokyo, Japan). Baseline study findings of IONM before vertebral artery occlusion and up to 30 minutes after temporary occlusion was done. There was no change in latency or amplitude of cortical responses of SSEP or BERA during 30 minutes of vertebral artery occlusion and vertebral artery was tied in-continuity doubly with silk ligature (Fig. 3).

Postoperatively, the CT showed reduction in size of nidus and non opacification of flow related aneurysm (Fig. 4). The patient recovered without any post-operative complications and there was a significant improvement in his headache. Patient was followed-up 6 week after the surgery. There were no neurological symptoms at 6 weeks follow up.

Discussion

The use of IONM techniques in neurosurgery is constantly growing. There are many studies showing use of IONM in neurovascular surgeries of supratentorial regions, carotid artery and abdominal aorta (5). However, we could not find any report of its use in posterior fossa vascular surgeries (aneurysm/AVM). AVM in posterior fossa is associated with higher chances of re-bleed and intra-operative complications due to critical neurovascular structures (brainstem, medulla, perforators). Vertebral

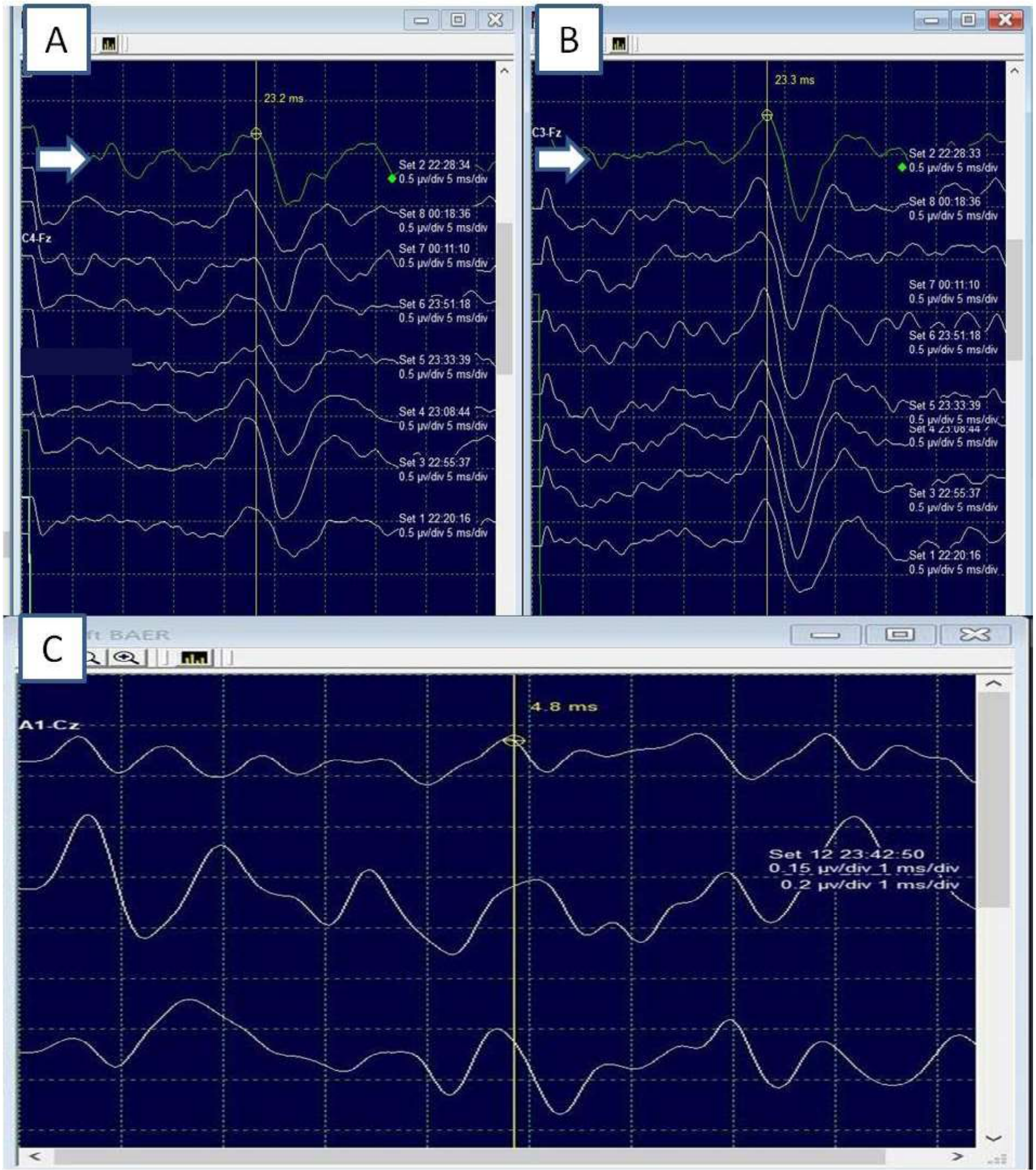

Fig. 3: Intra operative cortical SSEP recordings after stimulating left median nerve (A) and right median nerve (B). Latency was 23.3ms on both sides during 30 minutes of clamping of vertebral artery which was same as the baseline (white arrow). Intra operative cortical BERA recordings (C).

artery, a feeder of AVM in the reported case , gives branches like Posterior inferior cerebellar artery (PICA), anterior and posterior spinal arteries. BERA and SSEP are routinely used for surgeries for various lesions (tumours and craniovertebral junctions anomalies). Surgery was planned to clamp vertebral artery which might lead to ischemia and thereby could affect vital areas and functions of the brain stem including nucleus gracilis and cuneatus. So BERA and SSEP were performed during operation as a clinical tool to monitor, identify and thus reduce the risk of post-operative morbidity (6). In various

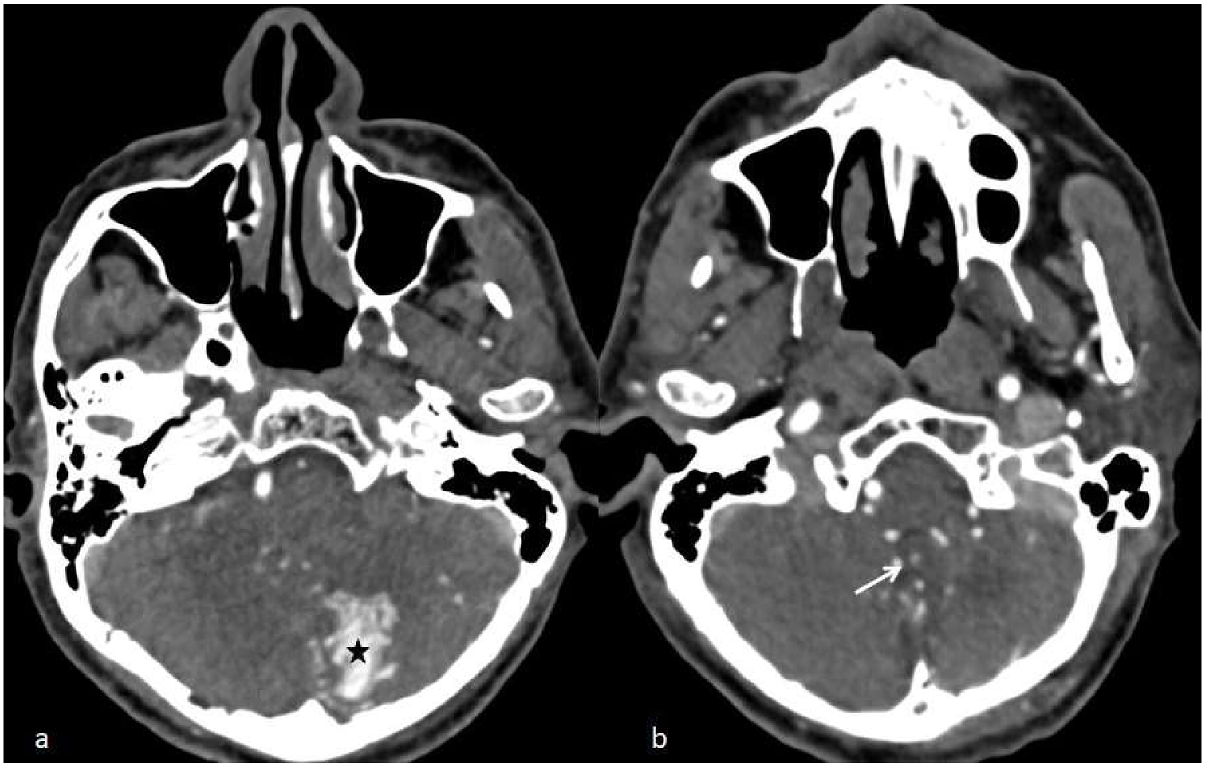

Fig. 4 (a,b): Post-operative CT Angiography axial images showing reduction in size of nidus (asterisk) with non opacification of flow related aneurysm (white arrow).

supratentorial aneurysmal surgeries, before applying the permanent clip, surgeons wait for 2 to 30 minutes to assess the changes in SSEP and BERA (7). Time required for ischemic changes to be reflected in IONM is not available for posterior fossa tumours; so based on the above guidelines we waited for 30 minutes in the present case. Authors feel that utility of IONM should be evaluated using larger studies on vascular lesions where proximal occlusion (either endovascular or surgical) is done to treat vascular lesions. Assessment of safe time limits of occlusions of various intracranial vessels based on Neurophysiological changes too will be helpful for safe surgical/endovascular interventions for such lesions (7).

The role of IONM in endovascular neurosurgical procedures has not been highlighted significantly. Use of IONM techniques is widely used in western countries but in Indian subcontinent, these techniques are not used enough which may be because of lack of awareness about IONM and trained clinical physiologists. We strongly feel that IONM can be an extremely useful tool/technique to monitor patients during posterior fossa tumour surgeries and to prevent post-operative morbidity and mortality.

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