Monitoring Brainstem Auditory Evoked Responses (BAER) for Resection of a Vestibular Schwannoma

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45 year old male who presents with tinnitus in his left ear for over one month. When examined by his ENT surgeon he was found to have diminished hearing in that ear by audiogram. He was sent for the MRI displayed below.
Is this a common presentation for a vestibular schwannoma AKA acoustic neuroma?

A. TRUE  
B. FALSE
Sorry – I disagree

Try again
CORRECT !!
A vestibular schwannoma, synonymous with an acoustic neuroma, is a benign slow-growing tumor that arises from the sheath covering the vestibulocochlear nerve. As the tumor grows, it expands from the internal auditory canal out into the cerebellopontine angle. Initially, the tumor presents with hearing loss in the affected ear, but may be associated with tinnitus, unsteady gait, and/or dizziness. As the tumor expands, it can affect the trigeminal and facial nerves leading to facial numbness/weakness. Eventually the tumor will compress the pons and medulla effacing the 4th ventricle, leading to hydrocephalus and persistent headaches.
Prior to the use of CT and MRI scans to diagnose vestibular schwannomas, Brainstem Auditory Evoked Responses (BAER) were utilized.

A. TRUE
B. FALSE
Sorry – I disagree

Try again
CORRECT !!
The waveforms of the brainstem auditory evoked response have an anatomical relationship with the auditory pathway. (Figure 1 – next slide)

Auditory conduction abnormalities are found in patients with a vestibular schwannoma even if the patient may be asymptomatic and audiometric studies / neural imaging are normal.

The characteristic BAER changes are prolonged interpeak latencies of waves I-III or I-V.

As the tumor grows in size and hearing is more affected, all waves after wave I may become unobtainable. This pattern is not consistent with other tumor types in the cerebellopontine angle.
<table>
<thead>
<tr>
<th>Wave</th>
<th>Anatomic Correlation</th>
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<tbody>
<tr>
<td>VIII</td>
<td>Primary Auditory Cortex</td>
</tr>
<tr>
<td>VII</td>
<td>Thalamocortical Radiations</td>
</tr>
<tr>
<td>VI</td>
<td>Medial Geniculate Nucleus</td>
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<tr>
<td>V</td>
<td>Inferior Colliculus</td>
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<tr>
<td>IV</td>
<td>Lateral Lemniscus</td>
</tr>
<tr>
<td>III</td>
<td>Superior Olivary Complex</td>
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<tr>
<td>II</td>
<td>Cochlear Nucleus</td>
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<tr>
<td>I</td>
<td>Cochlear Nerve</td>
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</tbody>
</table>
The loss of hearing, preoperative or intraoperative, leads to the inability of utilizing the BAER as a functional monitor of brainstem integrity during vestibular schwannoma resection.

A. TRUE
B. FALSE
Sorry – I disagree

Try again
CORRECT!!
BAER waveforms I and V carry the most clinical significance utilizing the parameters of waveform presence, amplitude and interpeak latencies to predict postoperative hearing. If normal or reduced auditory function remains, the BAER is useful for assessment of the 8th nerve function during resection of a cerebellopontine (CPA) tumor. As noted in figure 2, bilateral integration of BAER in the brainstem may still be used as an intraoperative monitor despite loss of hearing in one ear. The auditory pathways in the brainstem (waves III, IV and V) represent components that are bilateral, however, waves I and II are from structures primarily ipsilateral to the ear stimulated.
The BAER is a more global monitor of brainstem integrity by virtue of its bilateral integration. In the patient with a right side Vestibular Schwannoma, stimulating the left ear continues to give you bilateral BAERs (Waves I-V on the left and Waves III-V on the right. Stimulating the right ear on the side of the Vestibular Schwannoma you have no discernible waveforms. The intraoperative loss of bilateral or contralateral BAER would indicate a more ominous neurologic prognosis.
During resection of a vestibular schwannoma, BAER....

A. are robust and are not affected by extraneous stimuli such as drilling and extraneous noise
B. are significantly altered by both intravenous and inhalational anesthetics
C. Waves I and V presence are the best correlates to postoperative hearing preservation
D. provide immediate real-time monitoring of 8th Nerve and brainstem integrity
Like other evoked potential monitoring, the BAER is affected by extraneous artifact, such as electrocautery and cavitation ultrasonic surgical aspirating devices. To prevent bone conduction of the click to the non-stimulated ear, “white” noise is utilized in the contralateral ear to prevent cross contamination of the stimulus.
Short-latency BAER located in the brainstem utilized for monitoring during resection of a vestibular schwannoma are not significantly altered by intravenous or inhalational anesthetics. Longer latency BAER found in the cortex are sensitive to anesthetic doses to the point they have been utilized as depth of anesthesia monitors.
Similar to somatosensory evoked potentials, BAER require multiple responses to be averaged leading to a delay therefore not providing “immediate” real-time monitoring of the 8th nerve and brainstem integrity.

Sorry – I disagree
CORRECT !!
When monitoring BAER, Waves I, III and V carry the most clinical significance. Changes in their morphology such as decreased amplitude, increased interpeak latency and wave presence are clinically significant changes. The maintenance of waves I and V have been consistently shown to correlate with better postoperative hearing preservation rates.