A Practical Approach to Clinical Electrocochleography (ECochG)

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One of the most popular applications of Auditory Evoked Potentials (AEP) for the adult patient population is ECochG for patient's present with one or more of the symptoms associated with Endolymphatic Hydrops (Meniere's disease). Many ENT physicians would like to use ECochG as a convenient way to obtain an objective confirmation of a Meniere's diagnosis or to help rule it out.

Most clinics do not attempt to use needle electrodes for ECochG. This procedure is considered too invasive and basically not cost effective. All but a handful of our clinicians are using a popular ear canal electrode called a "TipTrode" to acquire the response with conventional AEP systems. (See figure 1.)

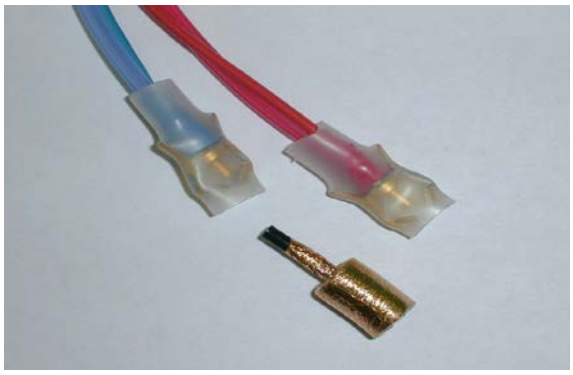

Figure 1 - TipTrodes and TipTrode leads

The TipTrode is simply an insert phone ear tip that is covered with a plastic foil which is coated with 24k gold. It is connected to a special set of leads that have a tube to deliver the stimulus and a gold-plated alligator clip to connect to the gold foil on the TipTrode.

It is extremely important that the clinician insert the TipTrode very deep into the ear canal. Every millimeter closer to the ear drum that the TipTrode is placed increases the amplitude of the response. (See figure 2.) I tell my students/clients to use the small size TipTrode on most adult ears. It is actually the diameter of a pediatric insert ear tip, so it can easily be placed very deep into the ear canal.

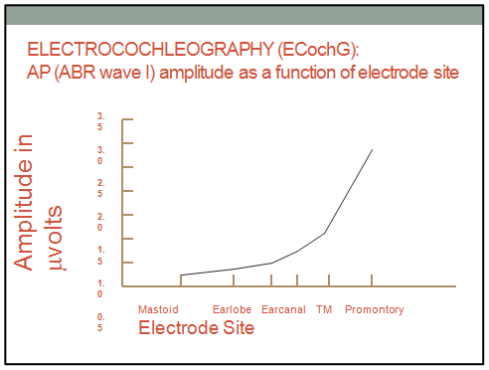

Figure 2 – Response Amplitude vs. Insertion Depth

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Some clinics have tried this method in the past without much success. If that's the case, it is worth taking another look at it. With improvements in digital physiological amplifiers, signal processing and noise immunity, this ECochG procedure can be very effective, provided one adheres to the following protocol.

First of all, it is important to realize the limitations. This procedure should be limited to those patients who fall into the category of the "2k 35 dB Rule." Patients must have hearing thresholds better than 35 dB HL at 2k Hz in order to be viable candidates for this test. Second, always use a "horizontal electrode montage." This will provide the highest possible Action Potential amplitude. Next, always use the highest possible click stimulus intensity available on the equipment. It should be no less than 95 dB nHL. Of course, don't forget about the insertion depth as discussed above. The protocols we use are shown in figures 3 & 4.

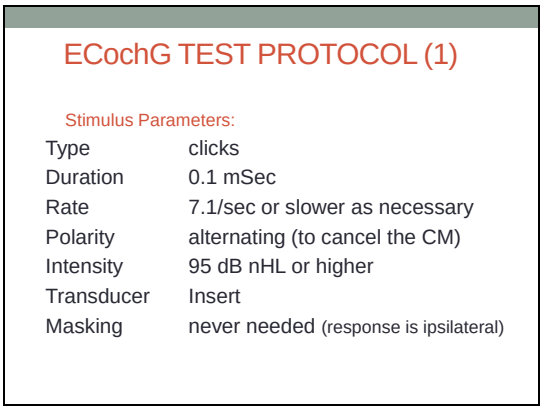

Figure 3 – EcochG Test Protocols

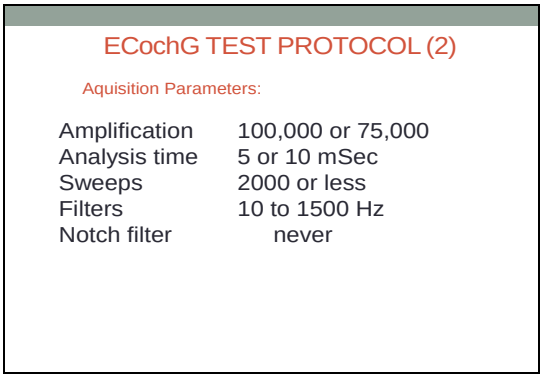

Figure 4 – ECochG Test Protocols

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Figure 5 explains what is meant by a "horizontal TipTrode montage."

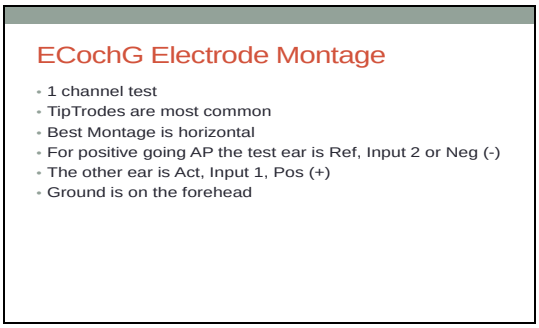

Figure 5 – Horizontal TipTrode Montage

The ECochG response analysis is tied to the ratio of the amplitude of the Action Potential (ABR Wave I) to the amplitude of the Summating Potential (immediately prior to the Action Potential). This is commonly called the SP/AP Ratio. Normal SP/AP Ratio is less than .5. The SP/AP Ratio is determined via the following formula: Summating Potential (SP) Amplitude in microvolts OVER (divided by) the Action Potential (AP) Amplitude in microvolts. The result of this division will be less than one. All AEP software systems include a simple utility for this calculation.

The most common way to display the ECochG response is with positive-going waves as shown in Figure 6. The most efficient method for marking the ECochG is to identify the Action Potential (ABR Wave I) first. It should be clear and repeatable at about 1.5 milliseconds. The SP is about .5 milliseconds before (to the left of) the Action Potential, and is often actually "riding" on the leading slop of the AP. Lastly, the Baseline must be marked. It is the trickiest part and requires experience. It is the leading trough of the SP.
See figure 6.

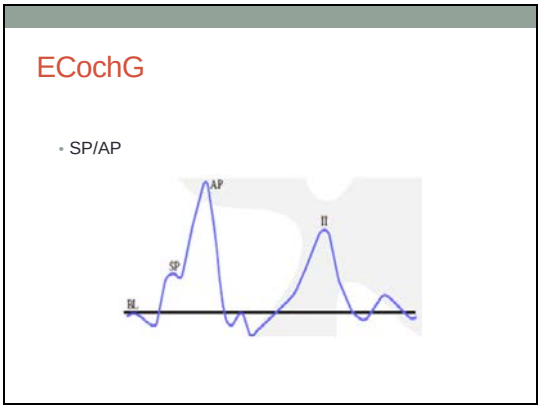

Figure 6 – Positive-going ECochG

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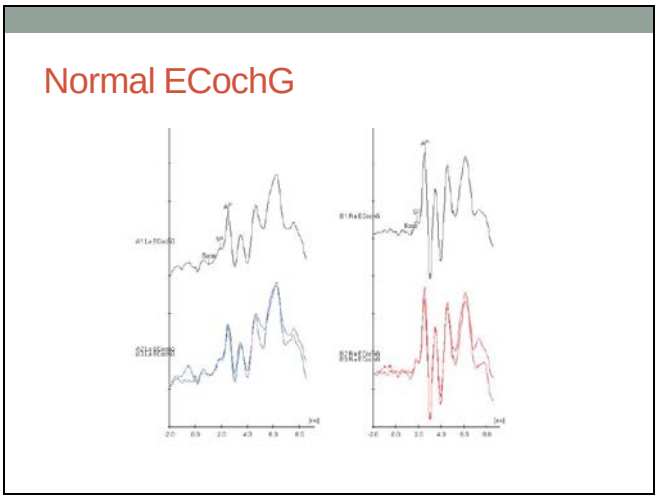
Figure 7 (below) shows a normal ECochG response that is properly marked.



In this case (above) the clinician ran two repeatable responses and then added them together in order to obtain the best possible waveform definition. Figure 8 shows an abnormal ECochG response in the right ear (with a SP/AP amplitude ratio of greater than .5) and a normal response in the left ear.

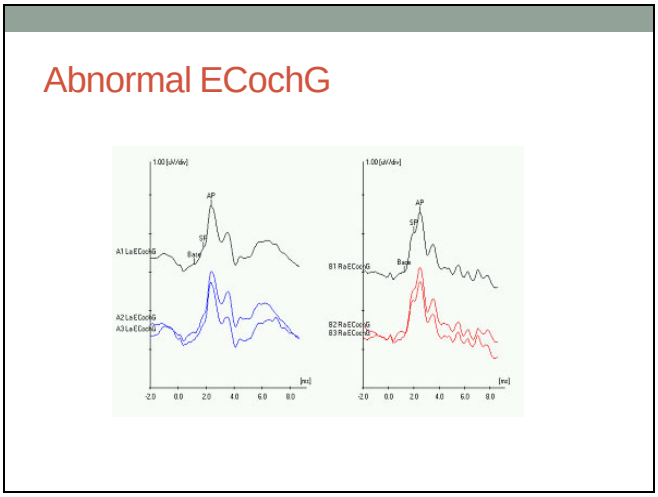


Figure 8 – Normal SP/AP Ratio in the left ear with an abnormal Sp/AP in the right ear

One consistent complaint about ECochG (other than it being contra-indicated by hearing loss) is it's relatively low sensitivity. That is why ECochG (like many other tests) should never be performed in isolation. Instead, it should be a part of a test battery used to compliment an analysis of the patient history and the examination by the physician as well as other relevant audiological tests.

There is evidence that the addition of the "area under the curve" measurement can increase the overall sensitivity of the test. (See figure 9.) Studies suggest that the addition

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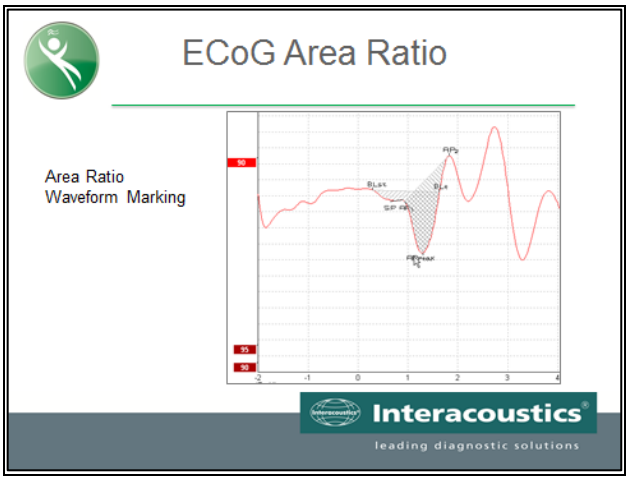
of this measurement could increase the sensitivity from around 60% to approximately 83%. Several equipment manufacturers (for example: Interacoustics) have added this utility to the ECochG function on their equipment.



In our experience, the information presented in this article can help the average diagnostic audiology clinic make good and practical use of a simple and fast AEP test. Many physicians would like to add this test to the list of diagnostic tools available to assist in the diagnosis of patients who present with one or more symptoms of Meniere's disease.

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