Electrocochleography & Subjective Measures for the Diagnosis of Ménière’s Disease

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Abstract
This study investigated the inter-method reliability of the diagnosis of Ménière’s disease (MD) between electrocochleography (ECoG) measures and the subjective scores based on the clinical guidelines provided by the American Academy of Otolarygology-Head and Neck Surgery Committee on Hearing Equilibrium (AAO-HNS CHE) and the Gibson’s score (GS). MD potential, potential MD patients who have had their MD-related signs and symptoms documented and ECoG testing completed in the Department of Otolaryngology at Christchurch Hospital were included. A selection of details obtained from both the AAO-HNS CHE and ECoG testing results were examined to allow for the function of these methods as a diagnostic tool for MD. The inter-method reliability between ECoG and the two subjective methods for the diagnosis of MD was found to be high. In addition, patients that tested “positive”, regardless of the diagnostic method used, showed a higher correlation among the four key symptoms of MD. These results demonstrate that ECoG is an effective diagnostic tool but should not be used as the sole assessment for the diagnosis of MD. This research provides empirical evidence in support of using ECoG as an effective tool as part of the differential diagnosis of MD.

Introduction
Ménière’s disease (MD) is an idiopathic inner ear disorder (Ries, Rickert, & Schlauch, 1999). It is characterised by episodes of vertigo, roaring tinnitus, fluctuating sensorineural hearing loss, and a sense of aural fullness that can fluctuate over months and years (Sajjadi & Paparella, 2008). The variability of symptomological changes renders it difficult to diagnose.

The diagnosis of MD is almost universally made using the clinical guidelines set by the American Academy of Otolarygology-Head and Neck Surgery Committee on Hearing and Equilibrium (AAO-HNS CHE) (Members of the Committee on Hearing and Equilibrium, 1995). An alternative is the 10 point Gibson score (Gibson, 1991). Both of these tests are subjective, symptom-based assessment for MD, classifying patients as “definite MD” or “probable” if a diagnosis of MD is highly indicated and “possible” if not. In addition, it has been suggested that Electrocochleography (ECoG), which is an objective test of the cochlea’s summating potential (SP), can be used for the diagnosis of MD with the parameters outlined by Gibson (1994).

It has been verified through histological studies (Horner, 1991) that individuals with MD exhibited excessive amount of endolymph leading to swelling of the boundaries of scala media in the cochlea (Hall, 2007). However, the change of endolymphatic hydrops (EH) can only be examined through post-mortem biopsies (Roeser, J., Nelsen, D., & Hosford, D., 2000). To monitor the existence of EH in vivo, an ECoG method can be obtained. An increase of EH has been found to result in an increased summation potential (SP) in response to clicks and tone bursts, with individuals with MD often found to exhibit an abnormally large SP (Conlon & Gibson, 2000). The increase of EH can also affect the magnitude of action potential (AP), which represents a collective response from synchronous firing of nerve fibres and is usually larger than the SP (Ferraro & Durrant, 2002; Hall, 2007). These responses are illustrated in Figure 1.

The correspondence between the AAO-HNS CHE and ECoG methods as diagnostic tools for MD is evaluated in this study through report of the between-method reliabilities, including total, point-by-point, occurrence, and non-occurrence reliabilities.

Research Questions
1. How does the method of ECoG compare to the AAO-HNS CHE criteria and Gibson’s score in detecting MD?
2. What are the characteristics of the patients tested “positive” with the ECoG measures as compared with those classified by the other two subjective measures?

Methods
Participants
A total of 250 patients (116 females and 133 males; age range: 9–88 years of age) whose medical records showed inclusion for a diagnosis of Ménière’s disease were examined. The study was conducted between the years of 1993 and 2009. Each subject had their signs and symptoms documented and ECoG testing completed.

Instruments
Electrocochleography: Electrodiagnostic system (Amplaid MK 15, Milan, Italy), including electrodes, stabilised transtympanic needle electrode, phenol, elastic bands, and a supra-aural headphone ring.

Data software: Microsoft Access 2002

Procedure
Patients were examined for Ménière’s disease in the department of Otolaryngology at the Christchurch Hospital. Clinical examination consisted of a hearing test by an Audiologist, evaluation by an Otalaryngologist, and ECoG testing conducted by both an Audiologist and Otalaryngologist. Transtympanic ECoG testing responses were elicited using air conduction tone burst and click stimuli (Figure 2). The assessment records were retrieved and the data entered into a computer database for analysis.

Results
The inter-method reliability between the ECoG method and the two subjective methods (AAO-HNS CHE criteria and Gibson’s score) for the diagnosis of MD was found to be high (Figure 4).

ROC curves were obtained for the two subjective methods and compared with the ECoG measures. The results demonstrated that ECoG measures were highly pertinent to the diagnosis of Ménière’s disease (Figure 3). In addition, patients that tested “positive”, regardless of the diagnostic method used, showed a higher correlation among the four key Ménière’s symptoms. There was also a higher correlation between ECoG measures at adjacent frequencies and a lower variation of SP/AP ratios across frequencies in the “positive” group as compared with the “negative” group.

Conclusion
This study highlighted some important points relating to the assessment of Ménière’s disease using different approaches. It can be concluded that the ECoG method in this study showed a relatively high agreement with the two subjective methods in the diagnosis of MD. Mixed results from previous ECoG studies have had the clinical application of the ECoG method (Gibson, 2009). It was concluded from this study that ECoG is an effective diagnostic tool but it should not be used as the sole assessment tool for the diagnosis of MD as its effectiveness may be dependent on the patient having full symptoms of the disease at the time of testing. It is important that professionals are aware of the disagreement between these three tests and the advantage of using ECoG in combination with other assessment tools for the diagnosis of MD. The finding that patients with a positive diagnosis tended to exhibit higher correlations between ECoG measures across frequencies needs further investigation. Development in the area of MRI may provide better validation for the diagnostic tools of MD and open up this area of research extensively in the future.

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References
Gibson, W. P. R. (1991). The 10 point Glyson score, Area = 0.79
AAO-HNS CHE, Area = 0.66
“Definite” “Probable” “Possible” GS >= 6
GS >= 7

