The role of electrocochleography on Menière’s disease diagnosis

O papel da Eletrococleografíai no diagnóstico da Doença de Meniere

Abstract

INTRODUCTION: Menière’s Disease (MD) is a condition characterized by fluctuating hearing loss, tinnitus and vertigo. Many tried to define it, however, a new definition proposed in 2015 by Bárány Society got a broad consensus [1].

MD is recognized as a multifactorial disease characterized by the accumulation of endolymph in the cochlear duct and vestibular organs that may result in endolymphatic hydrops.

Electrocochleography (ECoG) has been used for the detection of endolymphatic hydrops, however its effectiveness is still controversial.

AIM: Evaluate the role of ECoG in the diagnosis of Menière’s Disease

METHODS: Patients undergoing extratympanic electrocochleography between June 2016 and December 2017 were screened and categorized as definite/ probable Menière Disease or healthy according to diagnostic criteria defined on 2015 by the Bárány Society.

Electrochocleography Summating Potential/ Action Potential (SP/AP) ratios were determined, and ratios greater than 0,5 were considered abnormal.

The three groups were compared to access for a correlation between ECoG results and diagnostic criteria of Menière’s Disease.

Statistical analysis was carried with SPSS v.25. Qui-square test, Exact Fisher test, One-way ANOVA and Tukey test were applied. Statistical significance was defined p<0,05.

RESULTS: 162 patients were included in the study, 33 had definite Menière’s disease criteria, 43 had probable Menière’s disease criteria and 86 were included on the healthy group after applying the Bárány Society criteria.

The analysis of the SP/AP shows that EcoG is able to differentiate healthy from probable or definite Menière Disease, however, fails to prove differences between probable and definite MD.

CONCLUSION: ECoG may play a role on early identification but should not play a decisive role on Menière’s Disease diagnosis.

Keywords: Menière Disease; Electrocochleography; Endolymphatic hydrops; SP/AP
Resumo

INTRODUÇÃO: A Doença de Menière (MD) é uma patologia caracterizada por queixas flutuantes de perda auditiva, acufeno e vertigem. Várias foram as classificações e critérios diagnósticos ao longo do tempo, no entanto em 2015 os critérios propostos pela Sociedade Bárány geraram amplo consenso. [1]

MD é uma patologia multifatorial caracterizada pela acumulação de endolinfa no ducto coclear e órgãos vestibulares podendo conduzir a hidrópsia endolinfática.

A eletrococleografia (ECoG) é um exame complementar de diagnóstico que tem vindo a ser utilizado para a deteção de hidrópsia endolinfática, no entanto a sua eficácia tem gerado controvérsia.

OBJETIVO: Avaliar o papel da eletrococleografia no diagnóstico de Doença de Menière.

MATERIAL E MÉTODOS: Pacientes submetidos a eletrococleografia extratimpânica entre Junho de 2016 e Dezembro foram categorizados de acordo com os critérios diagnósticos da Sociedade Bárány como sendo saudáveis, ou com Doença de Menière Definida ou Provável.

Valores Eletrococleográficos da razão Potencial de Soma/Potencial de Ação (SP/AP) foram determinados e razões superiores a 0,5 foram consideradas anormais.

Os grupos de diagnóstico foram comparados com os valores da razão SP/AP para avaliar a correlação entre estes valores e o diagnóstico de Doença de Menière.

A análise estatística foi efetuada recorrendo ao SPSS v.25. Testes de Qui-quadrado, Exacto de Fisher, Oneway ANOVA e Tukey foram aplicados. O valor de significância estatística foi definido para p<0,05.

RESULTADOS: 162 pacientes foram incluídos no estudo, dos quais 33 com critérios diagnósticos de Doença de Menière Definida, 43 com critérios diagnósticos de Doença de Menière Provável e 86 saudáveis segundo os critérios diagnósticos da Sociedade Bárány.

A análise da razão SP/AP demonstra que a EcoG pode diferenciar entre pacientes com Doença de Menière Provável ou Definida e Saudáveis, no entanto demonstra ser ineficaz a diferenciar entre Doença de Menière Definida e Provável.

CONCLUSÃO: A EcoG pode ter um papel na identificação de doentes com doença de Menière, no entanto não deve ter um papel decisivo na definição do diagnóstico.

Palavras-chave: Doença de Menière; Eletrococleografia; Hidrópsia Endolinfática; SP/AP.
INTRODUCTION

Menière’s Disease (MD), is a multifactorial condition where genetics and environmental factors interact and can predispose to the development of the disease [1]. It was firstly described in 1861 by Prosper Menière, but only in 1938 Hallpike and Cairns [2] in England and Yamakawa [3, 4] in Japan suggest for the first time the endolymphatic hydrops as the probable etiology for MD based on temporal bone histopathological studies [2, 3, 5, 6].

There have been multiple diagnostic criteria proposed, but recently, in 2015, the Classification Committee of the Bárány Society, The Japan Society for Equilibrium Research, the European Academy of Otology and Neurotology (EAONO), the Equilibrium Committee of the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) and the Korean Balance Society joined together in an International Classification of Vestibular Disorders (ICVD) and published an widely accepted diagnostic criteria for Menière’s disease [1]. This classification includes two categories: Definite MD and probable MD. The diagnosis of definite MD is based on clinical criteria and requires the observation of an episodic vertigo syndrome associated with low- to medium-frequency sensorineural hearing loss and fluctuating aural symptoms (hearing, tinnitus and/or fullness) in the affected ear. Duration of vertigo episodes is limited to a period between 20 minutes and 12 hours. Probable Menière’s disease is a broader concept defined by episodic vestibular symptoms (vertigo or dizziness) associated with fluctuating aural symptoms occurring in a period from 20 minutes to 24 hours [1].

As previously stated, Menière’s disease is thought to be due to hydrops of the endolymphatic space within the labyrinth from which the Electrocochleography (ECoG) would be an ideal diagnostic test.

ECoG consists in measurement of evoked potentials on the cochlea and the vestibulocochlear nerve. It can identify 3 different values: Cochlear Microphonics (CM), Summating Potential (SP), and Action Potential (AP) [2]. The CM and the SP represent the bioelectric activity of the cochlea, the AP refers to the activity of distal afferent fibers of the vestibulocochlear nerve [7]. In endolymphatic hydrops, there’s a displacement of the basilar membrane and the stereocilia of the hair cells, and consequently an enhanced negative SP occurs. As SP values should not be evaluated by its absolute value, an elevated SP/AP ratio is thought to reflect endolymphatic hydrops [8].

Currently there’s some disenchantment about using ECoG on the diagnosis of MD because of a lack of sensitivity of this test, but few studies (if any) have applied the more recent and widely accepted diagnostic criteria published in 2015 [1].

Our study aims to evaluate the role of ECoG in the diagnosis of Menière’s Disease.
MATERIAL AND METHODS

A retrospective study was performed with screening of all patients who underwent ECoG between June 2016 and December 2017 in a tertiary Hospital. Medical records were reviewed, and demographic, general health, hearing and vestibular symptoms data were collected. ECoG and audiometric results were also included. Those who were diagnosed or suspected of secondary endolymphatic hydrops, had < 18 years old or insufficient data were excluded from the study. All the patients were categorized in three different groups according to the 2015 diagnostic criteria of the ICVD of the Bárány Society.

All the patients included had performed extratympanic ECoG using the Eclipse Interacoustics, EP25 System. Alternating click stimuli of 7,1/s at 90dB of hearing level were presented monaurally. The reference electrode is placed on the forehead, and the ground electrode on the non-test ear lobe.

In the Menière’s Disease group, only the diseased ear was considered. In case of diagnosed bilateral Mèniere’s Disease the lower value was studied, and in the healthy group, the higher SP/AP was evaluated. An SP/AP ratio greater than 0.5 was considered abnormal.

For statistical analysis, we used SPSS v25.0. Qui-square test, Exact Fisher Test, One-way ANOVA and Tukey Test were used to compare the groups. Statistical significance was defined as p<0.05.
RESULTS

One hundred-sixty-two patients were included in the study. Forty-three were male (27%) whereas 119 (73%) were female. Mean age was 52.7 ± 11.2 years. According to the ICVD, 33 patients were classified as having definite Menière’s Disease, 43 were classified as having Probable Menière’s Disease and 86 were classified as healthy. Some demographic characteristics are listed in table 1.

Table 1:
Groups Demographics (Age and Gender).

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Mean Age</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite MD</td>
<td>33</td>
<td>56.48 ± 12.2</td>
<td>74.4% Female</td>
</tr>
<tr>
<td>Probable MD</td>
<td>43</td>
<td>54.09 ± 10.4</td>
<td>75.8% Female</td>
</tr>
<tr>
<td>Healthy</td>
<td>86</td>
<td>51.98 ± 11.1</td>
<td>72.4% Female</td>
</tr>
<tr>
<td>Overall</td>
<td>162</td>
<td>52.7 ± 11.2</td>
<td>73.4% Female</td>
</tr>
</tbody>
</table>

Typical symptoms of MD were assessed in each group of patients (table 2).

Table 2:
Groups symptoms.

<table>
<thead>
<tr>
<th></th>
<th>Healthy</th>
<th>Probable MD</th>
<th>Definite MD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aural Fullness</td>
<td>11.7%</td>
<td>51.2%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Tinnitus</td>
<td>16.2%</td>
<td>37.2%</td>
<td>42.4%</td>
</tr>
<tr>
<td>Hearing Loss</td>
<td>26.7%</td>
<td>39.5%</td>
<td>69.7%</td>
</tr>
</tbody>
</table>

From all patients with definite MD diagnosis, 22 (66%) had unilateral MD (11 right side and 11 left side), and 11 (33%) were bilateral.

The SP/AP was >0.5 in 26.7% of healthy group, 62.8% on Probable MD group and 75.8% on Definite MD group.

Statistically significant differences between the groups regarding SP/AP>0.5 were tested with one way ANOVA test, which confirmed that the 3 groups are different (table 3).
Table 3: Oneway ANOVA analysis

<table>
<thead>
<tr>
<th>Squares sum</th>
<th>F distribution</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>0,501</td>
<td>12,63</td>
</tr>
</tbody>
</table>

To test further SP/AP differences between each group, we used Tukey test, which showed differences between the healthy group and both Definite MD group and Probable MD group (p value<0,05). When considering Definite and Probable MD, the differences weren’t statistically different (p value =0,27) (table 4).

Table 4: Tukey test analysis.

<table>
<thead>
<tr>
<th>Standard error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy Group</td>
<td>Probable MD</td>
</tr>
<tr>
<td></td>
<td>Definite MD</td>
</tr>
<tr>
<td>Definite MD</td>
<td>Probable MD</td>
</tr>
</tbody>
</table>
DISCUSSION

The complexity of MD poses a diagnostic challenge. In 2015, the ICVD classification on MD provided a valuable and widely accepted clinical guide on its diagnosis, but it still constitutes a difficulty, especially on the early disease [7, 8].

MD physiopathology is not yet fully understood. It is argued that the accumulation of endolymph in cochlear duct and the vestibular organs may lead to hydrops and explain MD symptoms. However, endolymphatic hydrops does not explain all clinical features [1] and some wonder if it may be, merely, an epiphenomenon [8].

Not all endolymphatic hydrops is MD. There’s a lot of possible conditions that may cause secondary endolymphatic hydrops such as temporal bone trauma, otologic surgery, syphilis, cytomegalovirus, labyrinthitis, autoimmune diseases, metabolic diseases, central nervous system diseases and others [9]. MD is thought to be an idiopathic form of endolymphatic hydrops.

ECoG has been shown to be effective in detecting endolymphatic hydrops [6, 10, 11], nevertheless, some studies failed to prove a good correlation between MD and ECoG results [12, 13]. None of the previous published studies, as far as we know, have applied the 2015 ICVD classification on MD.

In our study, we access the ability of ECoG to differentiate healthy patients from MD patients using the 2015 ICVD classification on MD. Our results show differences between healthy patients from Probable and Definite MD patients, however, fail to prove differences between Definite MD and Probable MD.

The category of probable MD is broader and may include individuals in MD early stages and this can explain why most of patients with Probable MD may have abnormal values of SP/AP on ECoG (>0,5). There is a substantial clinical overlap between these two entities. While in definite MD there must be a proof of hearing impairment, in probable MD the hearing may be normal. This is the major difference between these two diagnoses according to 2015 ICVD classification. Some argue that probable MD may be an initial phase of MD where there’s not yet cochlear damage, others advocate that they are different diseases where different immune and inflammatory mechanisms may be involved [14]. Dabiri and colleagues study HLA-Cw allele frequency in a sample and found some statistical differences between definite MD, Probable MD and Healthy group but with some allele overlap between probable and definite MD [14]. This clinical overlap may justify why definite and probable MD aren’t statistically different, but more studies must be undertaken to confirm this theory. So, in these patients ECoG may be beneficial on early diagnosis and early control of disease.

It is still important to recognize that even there’s a statistical difference between the healthy group and probable/definite MD, it doesn’t seem to be a good test for screening MD given its lack of sensitivity.

On this trial there were methodological challenges that may intervene with the final results. It is important to state that this is a retrospective study, were all the ECoG studies were requested by different otolaryngology doctors with different intents. We have to recognize that most of the patients, even from the healthy group may have symptoms that can recall MD triad, which can pose some problems on the healthy group definition. This may be responsible for an increased SP/AP ratio in some patients from the healthy group as well as non-recognized secondary endolymphatic hydrops.

It is also important to state that patients have done ECoG on several phases of disease. Some have made
the ECoG with symptoms for several years while some have made the exam on the beginning of the course of their disease. Some have made ECoG while in crisis or symptomatic and others asymptomatic. This may have an invaluable impact on our results. However, Orchik et al in 1998, found that patients with elevated SP/AP ratios on ECoG maintained this elevated ratio after successful treatment [15].

Some authors have been proposing other measures to enhance ECoG accuracy like SP/AP area ratio or tone-burst stimuli evoked potential [16]. Some others state that transtympanic may be more sensitive than extratympanic ECoG [8]. It may be beneficial to further studies clarify the real impact of each modality.
CONCLUSION

Extratympanic ECoG is a non-invasive test that can help to identify endolymphatic hydrops, condition thought to be closely related to Menière Disease.

Our study demonstrates that ECoG is able to differentiate healthy from probable or definite Menière Disease, however, fails to prove differences between probable and definite MD. Yet, it doesn’t seem to be a good screening exam for the detection of Menière disease since there’s a low sensitivity.

ECoG seem to be an exam which can help to raise the MD suspicion; however, it doesn’t confirm neither exclude the presence of disease. Anyway, it can be relevant on early suspicion, diagnosis and treatment of probable MD, when the cochlear symptoms may yet not be present.

The ECoG results must be framed on complete clinical picture of patient. MD is still an exclusion diagnosis, so a thorough history, physical exam and complementary exams must be done for a successful diagnosis. On this regard, ECoG may be another clinical weapon on MD diagnosis.
CONFLICT OF INTEREST DECLARATION AND AUTHOR AGREEMENT FORM

The authors declare that they don’t have any conflict of interest to declare.
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