Validade da prova calórica monotermal em comparação à estimulação bitermal*******

Validity of the monothermal caloric testing when compared to bithermal stimulation

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Abstract
Background: the use of monothermal caloric testing as a screening tool for vestibular asymmetry has been considered as an alternative to bithermal caloric testing. Aim: to evaluate the effectiveness of monothermal stimulation when compared to bithermal stimulation in the diagnosis of labyrinth asymmetry. Method: the results of 389 vectoelectronystagmography, performed between 1998 and 2007, were analyzed. Monothermal stimulation at 30oC and 44ºC with unilateral weakness (UW) cut-off at 20% and 25% was compared to bithermal stimulation with cut-off at 25% (gold standard). The analysis was aimed at finding which kind of monothermal caloric test (30oC or 44oC) and which kind of cut-off (20% or 25%) presented the highest specificity and sensitivity values in comparison with bithermal caloric testing. Results: sensitivity and specificity of monothermal caloric tests were: 84% and 80%, at 30°C with UW at 20%; 78% and 90%, at 30°C with UW at 25%; 81% and 78%, at 44°C with UW at 20%; 76% and 85%, at 44°C with UW at 25%. Conclusion: monothermal caloric testing with 30°C stimulus presented the highest sensibility and specificity values in comparison to the results obtained with bithermal stimulation. However, no significant difference was observed between such values and those obtained with 44°C stimulus. In all of the analyses, monothermal testing presented low sensitivity. Thus, the abnormal result of bithermal caloric testing might be seen as normal in monothermal stimulation. The use of monothermal testing as a screening tool is better recommended for individuals whose medical history suggests a low probability of vestibular disease.
Key Words: Electronystagmography; Caloric Tests; Dizziness.

Resumo
Tema: a estimulação calórica monotermal tem sido considerada como alternativa à prova calórica bitermal para triagem das assimetrias vestibulares. Objetivo: avaliar a confiabilidade da estimulação monotermal em relação à bitermal para o diagnóstico das assimetrias labirínticas. Método: avaliaram-se 389 resultados de vectoelectronistagmografia realizados entre 1998 e 2007. A estimulação monotermal de 30ºC e 44ºC com pontos de corte de predomínio labiríntico (PL) em 20% e em 25% foi comparada à bitermal com ponto de corte em 25% (padrão ouro). Na análise, interessou encontrar qual foi à prova monotemal (30°C ou 44°C) e com qual ponto de corte (20% ou 25%) que apresentou os valores mais elevados de sensibilidade e especificidade quando comparada à prova bitermal. Resultados: a sensibilidade e especificidade da prova monotermal foram respectivamente de: 84% e 80%, a 30°C com PL em 20%; 78% e 90%, a 30°C com PL em 25%; 81% e 78%, a 44°C com PL em 20%; 76% e 85%, a 44°C com PL em 25%. Conclusão: a prova monotermal com estimulo a 30°C apresentou valores mais elevados de sensibilidade e especificidade quando comparada a bitermal. Contudo, não se observou diferença significativa em relação aos valores observados com estímulo a 44°C. Em todas as análises, a prova monotermal apresentou a limitação da baixa sensibilidade, de modo que testes alterados pela bitermal podem passar como normais pela prova monoternal. Ao se decidir pela realização da prova monotermal como triagem, deve-se realizá-la em indivíduos com menor probabilidade de estar com doença vestibular, a partir da história clínica.
Palavras-Chave: Eletronistagmografia; Testes Calóricos; Tontura.

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Introduction

The caloric test is considered an important stage of vectoeletronistagmography (VENG), for it offers an accurate measure of vestibular function1. The most commonly used type is the bithermal caloric test (BCT), which involves stimulations by water irrigations in cold (30ºC) and warm (44ºC) temperature in each side separately2.

The monothermal test, first described by Torok (1969)3, is based on vestibular answers from water stimulation at the same temperature. This technique was suggested as an alternative to the BCT, with the same accuracy in the diagnosis of vestibular conditions, while diminishing the time spent and patient discomfort4-5.

However, researches on the effectiveness of the monothermal stimulation showed varied results with low specificity and high rates of false-negative results6-8. Such variability interferes with the reliability of the monothermal test and is justified, among other reasons, by the difference in cut-off values of unilateral weakness (UW) used in the studies.

Nowadays, there are few studies which propose to clarify the accuracy of monothermal stimulation in vestibular diagnosis. It is interesting to evaluate the validity of this test with the monothermal stimulation for the triage of vestibular disease.

The objective of this study was to verify the validity of monothermal tests compared to the bithermal tests, considering the different values for normal unilateral weakness in the monothermal caloric proof.

Method

This study was analysed and aproved by the Ethic Commitee in Research of The Federal University of Minas Gerais.

It was evaluated the results obtained with the selection randomly made of medical records of 387 medical examinations, referring to 103 male patients and 284 female patients, examined at Ambulatório de Otoneurologia do Hospital das Clínicas da UFMG from 1998 to 2007. The age of the subjects varied between 18 and 91 years old, with an average of 51 years old and standard deviation of 17 years.

It was included the subjects that had complete data of the caloric stimulation acomplished and excluded those that showed vestibular arreflexia and were suspected to have central alterations (oculamotor movements alteration, absence of the ocular fixation inhibitor effect and nystogmoghraphic inversion to bithermal stimulation). In addition, we excluded patients younger than 18 years.

The caloric testing was done through stimulations with water at temperature of 44ºC and 30ºC, using a vectoelectronystagmograph with four channels (Contornic, versão SCV 5.1, Brazil).

During the nystagmus register, the patient stayed in supine position, with the head at 30º for the maximum stimulation of the semicircular lateral channels. The caloric testing was done as follows: right side 44ºC, left side 44ºC, right side 30ºC and left side 30ºC.

In order to interpret the bithermal caloric testing and the calculation of the unilateral weakness (UW), a formula proposed by Jongkess was used9. The monothermal answers were calculated using the following formula10:

$$UW = \frac{\text{Right } 44ºC - \text{left } 44ºC \times 100}{\text{Right } 44ºC + \text{left } 44ºC \times 100}$$

A similar formula was applied to the monothermal stimulation at 30ºC.

In bithermal caloric testing, the levels of normality in absolute angular velocity values of slow component (VACL) was from 3ºC to 50ºC11. Related to the UW values, the value inferior to 25% (cut-off) was considered as normal in the bithermal caloric testing (gold standard) 17.

The results obtained through the bithermal caloric testing were grouped in two categories: symmetric (normal tests or bilateral hyporeflexia or hyperreflexia) and assymmetric (hyporeflexia or hyperreflexia with unilateral labyrinthic domain). These results were compared to the monothermal answers (30ºC or 44ºC) with unilateral weakness (UW) cut-off at 20%7 and 25%.

The program Epi-Info 3.4.2 was used for the data entry and the program Stata 9.2 for the calculation of the sensitivity and specificity, considering the bithermal caloric testing as the gold standard testing.

Results

From the 387 evaluated subjects, the bithermal caloric testing identified 322 medical examinations with normal UW and 65 with altered UW.

Comparing the results of monothermal stimulation at 30ºC with those of the bithermal one, from the 322 medical examinations identified as normal by the bithermal testing, 62 were seen as altered with cut-off to the UW at 2% and 33 to the UW at 25%. From the 65 medical examinations identified as altered by the bithermal testing, 10 were seen as normal by the monothermal testing with cut-off to the UW at 20% and 14 to the UW at 25%.

Comparing the results of the monothermal stimulation at 44ºC with those of the bithermal, from the 322 medical examinations identified as normal by the bithermal testing, 72 were seen as altered with cut-off to the UW at 20% and 49 to the UW at 25%. From the 65 medical examinations identidied as altered by the bithermal testing, 12 were seen as normal by the monothermal with cut-off to the UW at 20% and 15 to the UW at 25%.

The comparative values of sensitivity and specificity to both stimulations with different cut-offs are described in table 1.

TABLE 1. Comparison of the monothermal testing at temperatures of 30ºC and 44ºC with cut-offs at 20% and 25% in relation to the the bithermal testing with cut-off at 25% (gold standard).

NORMALITY CUT-OFF VALUE FOR UNILATERAL WEAKNESS CONSIDERED IN MONOTHERMAL CALORIC TESTING	SENSITIVITY	SPECIFICITY
Stimulus temperature at 30º C		
20%	86% (56/65)	80% (259/322)
25%	78% (51/65)	88% (289/322)
Stimulus temperature at 44º C		
20%	82% (53/65)	78% (250/322)
25%	77% (50/65)	85% (273/322)

Discussion

The monothermal caloric testing is considered as a screening tool in vestibular asymmetry research. When in doubt about the result, the bithermal stimulation must be used10, 14-15. It is known that the objective of any screening tool testing is to be trustful to the ordinary results (greater sensitivity). This reasoning is true for testings that are used as screening tools for infections dieases or postnatal hearing16.

In this study, the results indicated that the trustfulness of the answers demonstrated by the monothermal caloric testing had little variation when the stimulation temperature was at 30ºC or at 44ºC. On the other hand, when the value of the UW was altered from 20% to 25%, a diminishing in the sensitivity rates and na increasing in the specificity were observed. These results agree with the ones

found by Jacobsob et al (1995)14, when they varied the normality value of UW from 24,5% to 29% in the monothermal caloric testing at 44%. In fact, the greater the cut-off of the UW, the greatest the trustfulness of the altered results (greatest specificity). However, the probablility that medical examinations in patients with vestibular diseases that cause minor assymetries are considered normal is also greater (smaller sensitivity). Some examples would be vestibular diseases that don't cause significant vestibular assymetry. In this context, the cut-off of the UW at 20% (and not at 25%) would be considering a greater sensitivity and a smaller risk of considering as normal, medical examinations which would, in fact, be altered. However, even the UW cut-off at 20% is not enough to offer total trustflness in the ordinary result, because the greatest observed sensitivity was at 86% (table 1).

In general, the specificity of the monothermal testings obtained in this study to the stimulation at 30ºC aand at 44ºC was satisfactory, mainly when using the normality cut-off of the UW at 25% as can be seen in table 1. This demonstrates taht the altered results from the monothermal testing are generally confirmed by the bithermal testing (greater specificity). On the other hand, analysing the sensitivity, the UW normality cut-off at 25% would be associated to a greater risk os non-diagnosis (smaller sensitivity). The bilateral vestibular damage caused by the use of drugs toxic to the vestibule such as gentamicin, the frequent use in medicine of aminoglycoside antibiotics, is a typical example of vestibular lesion with UW normal results in caloric testing17-18. In this case, the clinical history and the absolute values of the caloric answer, with bilateral hyporeflexia or areflexia would clarify the diagnosis.

In relation to the directional domain (PD), this study did not focus in tihs kind of evaluation parameter, once its clinical meaning hás been controversial. According to studies, PD alterations can be sbserved in central, peripheral or even in normal subjects20-24. Furthermore, the PD does not represent evidence of assymetry of the vestibular system as the UW represents and does not have values to spot the place of the lesion21-24.

Based on the results of this study, the use of monothermal caloric testing as screening tool is not recommended in clinical routine with patients suspected of having vestibular disease, in agreement to other investigations8,14-15,19. Even considering the patient's comfort and the little time to applying the test, the low sensitivity seen to all cut-off values evaluated in the study could make the validity of monothermal testing doubtful, considering as normal, subjects with labyrinthic disease that causes little assymetry. Thus, whenever possible, using the monothermal testing should be avoided. When necessary, it should be preferably used with a caloric stimlation at 30ºC and normality UW value up to 20%. This cut-off offers more satisfactory sensitivity rates, making the testing more trustful to establish the absence of vestibular disease.

Conclusion

To be considered a screening tool testing, the monothermal caloric testing, with stimulation in cold and hot temperatur, showed low sensitivity value, no matter the UW cut-off used. So, vestibular testing considered alterd in the bithermal caloric testing would pass as normal in the monothermal testing. Despite these limitations, from the clinical history and age of the patients, the monothermal stimulation could be applicable in subjects that are less prone to suffer from vestibular disease.

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