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ORIGINAL ARTICLE

Three New Strategies to Improve the Accuracy of Monothermal Caloric Screening Testing☆

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Abstract
Objective: The objective was to find a way to estimate the value of inter-ear difference (IED) through monothermal caloric screening testing (MCST) that can be used at any laboratory, controlling and minimising the resulting error.
Methods: We retrospectively included in this study 2304 patients from our department to whom a videonystagmography with caloric testing was performed between 2003 and 2011. The IED was calculated in 3 different ways: using the values of the 4 caloric stimulations (bithermal form) and using only the 2 same-temperature values (warm monothermal and cool monothermal forms). We studied 3 strategies to improve the accuracy of MCST: analysis of variables that could impair the prediction, delimitation of a grey area of insufficient prediction and location of a maximum utility cut-off point.
Results: Correcting Jongkees' formula with the value for spontaneous nystagmus makes it possible to include subjects with spontaneous nystagmus or nystagmus inversion. Establishing 2 cut-off points to classify the subjects avoids approximately 38% of bithermal stimulations performed with a sensitivity and specificity of 95%. Maximum utility was obtained diagnosing as healthy those subjects with IED values lesser than or equal to 16% in warm MCST when the pathological IED was set as greater than 20%.
Conclusion: New statistical tools help clinicians to make decisions that affect their patients based on the results of MCST.

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PALABRAS CLAVE
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Recursos de salud

Tres nuevas estrategias para mejorar la precisión de la estimulación vestibular calórica monotérmica

Resumen
Objetivo: Encontrar una forma de estimar el valor de paresia canalicular (PC) a través de la estimulación vestibular calórica monotérmica (EVCM) que pueda utilizarse en cualquier laboratorio, controlando el error que se produce al utilizarla.
Método: Se incluyó en este estudio a 2.304 pacientes de nuestro servicio a los cuales se les realizó una videonistagmografía con pruebas calóricas entre 2003 y 2011. El cálculo de la PC se realizó de 3 formas diferentes: utilizando los valores de las 4 estimulaciones calóricas (forma bitérmica) o exclusivamente con los 2 valores de una misma temperatura (formas monotérmica caliente y fría respectivamente). Se estudiaron 3 estrategias para mejorar la precisión de la EVCM: análisis de variables que empeoran la predicción, delimitación de un área gris de predicción deficiente y localización de un punto de separación entre sanos y enfermos de máxima utilidad.
Resultados: 1) Corregir la fórmula de Jongkees con el valor del nistagmo espontáneo permite incluir como candidatos a la EVCM a sujetos con nistagmo espontáneo o inversión nistágmica. 2) Establecer una zona gris de predicción deficiente evita aproximadamente el 38% de las estimulaciones bitérmicas realizadas, con una sensibilidad y especificidad del 95%. 3) La máxima utilidad de la EVCM se obtiene al considerar como función vestibular normal la de sujetos con valores de EVCM caliente menores o iguales al 16%, suponiendo patológica una asimetría mayor del 20%.
Conclusión: Las nuevas herramientas estadísticas permiten a los clínicos tomar decisiones que afecten al manejo de sus pacientes basados en los resultados de la EVCM.

Introduction

Videonystagmography with caloric testing is a basic complementary test for the study of patients suffering from dizziness. The test is based on detecting nystagmus produced by stimulating the inner ear with water or air at a temperature which is different to that of the body. Fitzgerald and Hallpike formalised this test in 1942, establishing that each ear should be stimulated twice: once with water at 44 °C, and then with water at 30 °C.[1] Their protocol was widely accepted globally, its effectiveness in estimating vestibular function having been demonstrated.[2,3]

However, videonystagmography with caloric testing is the longest test of all the otoneurological tests to perform, as it requires between 25 and 35 min. The 4 vestibular stimulations are not comfortable for the patient undergoing the test, and the results are affected if one of the stimulations is not performed correctly. For these reasons, an attempt has been made to shorten the test by stimulating both ears at only one temperature, using a method called monothermal caloric screening testing (MCST).[4] MCST is faster, more comfortable to perform, and reduces the probability of failing to stimulate the ear properly.

Since the use of MCST was suggested, various studies have attempted to estimate its sensitivity and specificity in order to estimate the inter-ear difference (IED) obtained after bithermal stimulation, with contradictory conclusions.[5] The differences are due to the heterogeneity between the study groups, the differences in the protocols used, and the different cut-off points used to separate a healthy condition from a pathological condition.

The objective of this study was to analyse 3 strategies so that the IED value found using MCST enables clinical decisions to be made that are similar to those enabling bithermal stimulation to be used, so that this value can be used in any laboratory, monitoring and minimising any resulting error.

Material and Method

All the patients of our department who had undergone videonystagmography with caloric testing from 2003 to 2011 were recruited retrospectively. The test protocol was the same for all the patients and is set out in Table 1. Patients who were not able to complete the protocol were excluded from the study.

Caloric stimulation was performed with 2 different air calorisators: a Homoth Medizinelektronik GmbH & CO KG and an Atmos MedizinTechnik Varioair 3. The nystagmatic response was recorded using a Dr. Ulmer's videonystagmograph from Synapsys S.A., and VNG Ulmer software.

The IED value was calculated from the values of peak angular speed of the slow phase of nystagmus from each of the 4 caloric stimulations using Jongkees formula.[6] The IED was calculated in 3 different ways: using the values from the 4 caloric stimulations (bithermal form), which was used as the gold standard, or using only the 2 values from the stimulations at the same temperature (warm monothermal and cold monothermal forms), which were