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Reevaluating the notion of "within normal limits" in tympanometry: implications for alternobaric vertigo and more

Abstract

This editorial explores the notion of "within normal limits" (WNL) in tympanometry, focusing on its limitations in identifying conditions such as alternobaric vertigo (AV) and ground-level alternobaric vertigo (GLAV). Tympanometry is a simple diagnostic instrument that measures middle ear (ME) pressure, compliance, ear canal volume, and the width of tympanogram. While WNL ranges are based on average values from the population, they often do not account for individual differences, leading to possible misdiagnoses. Conditions such as AV, caused by asymmetric ME pressure, can show symptoms even when tympanometry results are within normal ranges. The editorial suggests a more thorough diagnostic approach that includes detailed patient histories, dynamic testing methodologies, and additional hearing and balance tests to improve diagnostic accuracy and patient outcomes. Symmetry in tympanometry data is crucial, and the Valsalva maneuver should be avoided due to potential harm. Future research should aim to improve diagnostic criteria and develop personalized approaches to better understand and manage ME issues.

Keywords: tympanometry, within normal limits, alternobaric vertigo, ground-level alternobaric vertigo, eustachian tube dysfunction, middle ear pressure, audiometric assessments

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Abbreviations: WNL, within normal limits; AV, alternobaric vertigo; GLAV, ground-level alternobaric vertigo; ETD, Eustachian tube dysfunction; ET, Eustachian tube; ME, middle ear

Introduction

Tympanometry has been a cornerstone in the evaluation of ME function since its development in the late 1950s and early 1960s. Initially employed for research, it achieved significant clinical application by the 1970s, when researchers established normal values for tympanometry parameters.[1] By the 1980s, comprehensive normative data had been gathered, resulting in the concept of "within normal limits" (WNL).[2] The major goal of this editorial is to critically assess the WNL concept in tympanometry, focusing on its limits in identifying conditions such alternobaric vertigo (AV) and ground-level alternobaric vertigo (GLAV). GLAV is frequently associated with persistent Eustachian tube dysfunction (ETD).[3] It also intends to emphasize the need for a more comprehensive diagnostic approach that incorporates dynamic testing methodologies, full patient histories, and the significance of symmetry in tympanometry data.

Backgrounds

Tympanometry is a simple test that measures how the tympanic membrane (eardrum) and the ossicles in the ear move in response to changes in air pressure. It checks:

ME Pressure: Measure the pressure in the ME compared to the atmospheric pressure. Normal ME pressure ranges from -100 to +50 daPa.

Compliance (Admittance): Shows how flexible the tympanic membrane and ossicles in response to air pressure. Normal values range from 0.3 to 1.5 ml.

Ear Canal Volume: Measures the volume of air in the ear canal to detect any blockages or holes in the eardrum.

Tympanometry Width: Indicates width of the tympanogram peak, used to check for fluid in the ME.[1]

These normative ranges for these parameters are established based on population averages, providing a framework for clinicians to determine what is considered "normal".[3,4] However, these ranges are derived from large population studies and may not adequately capture individual variations in ET and ME function. For example, factors such as age, gender, and ethnicity can influence tympanometry results, leading to variability that is not accounted for by standard normative data.[5,6]

Furthermore, static measurements taken during tympanometry do not account for dynamic changes in ME pressure that can occur during activities such as swallowing, yawning, or changes in altitude. These dynamic changes are crucial for diagnosing conditions like AV and GLAV, where pressure equalization is impaired.[7,8]

Limitations of the WNL Concept

AV, a condition triggered by rapid pressure changes, like during diving or flying, underscores the limits of the WNL concept.[9] AV occurs due to unequal pressure between the MEs, which can cause vertigo even when tympanometry values are WNL. This highlights a critical gap: tympanometry, as a static test, does not capture the dynamic functionality of the Eustachian tube (ET) in real-time changes in ME.[4,7] GLAV, where similar symptoms occur due to pressure changes at ground level, further shows this limitation and is often linked to chronic ETD.[10]

Moreover, it is a common bias among otolaryngologists to conclude that a patient presenting with symptoms like dizziness, anxiety, swallowing disorders, and gastrointestinal disorders like abdominal pain, who shows a type A tympanometry result, has no ear problems. This bias can lead to missing conditions like AV, where normal tympanometry results do not rule out significant ETD.[11] The

reliance on WNL can lead to misdiagnoses and inadequate treatment plans.

Additionally, the reliance on population-based normative data overlooks individual variations in ETD. Patients can exhibit tympanometry results within the normal range yet still experience significant symptoms under specific conditions, suggesting that WNL is not always a sufficient indicator of healthy ET and ME function.[3,6]

Comprehensive assessment and diagnosis

To address these limitations, a more comprehensive approach to diagnosis is necessary. This includes:

Detailed Patient Histories: Understanding the patient's symptoms, triggers, and history of ME issues.

Dynamic Testing Methods: Assessing ET function under conditions of changing pressure can provide insights into how well the ET can equalize pressure in real-time scenarios, crucial for diagnosing conditions like AV.[12]

Additional Hearing and Balance Tests: Including pure tone audiometry, and potentially imaging studies. Vestibular tests can evaluate the vestibular system's function and help diagnose vertigo. However, vestibular function test results performed in the condition of abnormal asymmetric ME pressures can be just errors.[9]

Implications for clinical practice

A multifaceted approach to diagnosis is essential for accurately identifying and managing conditions like AV. This approach should integrate tympanometry with other diagnostic methods to provide a holistic assessment of ME and ET function. Checking for symmetry in ME pressure is crucial,[10] and the Valsalva maneuver should be avoided due to potential harm.[13]

Future directions

As we continue to learn more about ET and ME function, it is crucial to improve our diagnostic criteria and embrace more holistic assessment methods. Future research should focus on developing dynamic testing protocols and exploring the relationship between tympanometry results and clinical symptoms in greater detail. Additionally, there is a need for more individualized diagnostic approaches that consider patient-specific factors and variations in ET and ME function.[3]

Contribution

While tympanometry remains a valuable diagnostic tool, its limitations must be acknowledged. The concept of WNL, though useful, is not always sufficient for diagnosing dynamic conditions such as AV. A comprehensive diagnostic approach that includes dynamic testing and detailed patient evaluation is essential for accurate diagnosis and effective management. By adopting a more holistic assessment strategy, we can improve patient outcomes and our understanding of ME and ET function.

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Conflicts of interest

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