Ipsilateral and Contralateral Wideband Acoustic Reflex Thresholds in Adults

REBECCA BURDINE, B.A.
MENTOR: XIAO-MING SUN, Ph.D.

Wichita State University
Doctor of Audiology Research Project

Introduction: The Middle Ear

- Middle Ear Muscle Reflex

Introduction: Reflex Pathways

- Ipsilateral reflex: the probe signal and activator are presented in the same ear
- Contralateral reflex: the probe signal is presented in the test ear, and the activator in the non-test ear

Introduction: Clinical Acoustic Reflex Testing (AR)

- Acoustic Immittance Technique:
  - Single-frequency probe signal
    - e.g. 226 or 1000 Hz
  - Tympanometry

- Reflex-activating stimulus
  - Pure tones (0.5, 1, 2, or 4 kHz)
  - Broad band noise (BBN)

- AR: Measure of change in acoustic admittance
- AR threshold

Introduction: Wideband Acoustic Reflex Testing (WAR)

- Wideband Acoustic Immittance Technique:
  - Wideband probe signal (e.g. clicks and chirps)
    - Frequency range (0.226 to 8 kHz)
  - e.g. Energy absorbance measurement
  - Wideband Tympanometry

- WAR: Measure of change in energy absorbance for a range of frequencies
- WAR thresholds

Introduction: Advantages of WAR testing

- Lower intensity activators
  - Reduces risk of hearing loss
  - May allow testing in patients for whom the reflex could not be detected using current AR testing
- No clinician bias
  - Automatic procedure for determining responses and thresholds
- More accurate at detecting middle ear pathologies

Introduction: Purpose

- The primary objectives of this study were to:
  - measure both ipsilateral and contralateral WAR thresholds using all commonly used activators in adults with normal hearing function
  - compare the data to results obtained from clinical AR testing in the same participants

Methods: Subjects

- 50 adults: ages 18–35
- One ear was chosen as the test ear for each participant
- Valid testing was conducted in 38 participants
  - Ipsilateral testing: 37 ears
  - Contralateral testing: 32 ears
  - 11 males & 27 females
  - Mean age: 23.8 years (±3.1)

Methods: Inclusionary Criteria

- No history of middle-ear pathologies/surgeries
- No cold/flu or nasal allergies within two weeks of the experiment
- Negative otoscopic screening
- Single-peak 226-Hz tympanogram with tympanometric peak pressure (TPP) within ±25 daPa
- Normal audiometric thresholds (≤ 20 dB HL)
- Air-bone gaps of ≤10 dB HL at each octave frequency from 0.25 to 4 kHz

Methods: Instrumentation

- Double-walled, sound-treated booth at the Evelyn Hendren Cassat Hearing Clinic
- GSI-61 audiometer
- GSI Tympstar tympanometer
- A computerized WB Tymp research system connected to an Interacoustics AT235 tympanometer.

Methods: Screening Procedures

1. Medical history questionnaire
2. Otoscopy
3. Tympanometry (226 Hz)
4. AC hearing thresholds: octave frequencies from 0.25 to 8 kHz.
   BC thresholds: 0.25 to 4 kHz.
Methods: Experimental Procedure (I)

- WAR and AR testing
- Ipsilateral and contralateral testing (Ipsi-, Contra-)
- Testing was conducted at TPP
- Determining thresholds:
  - AR: 0.03 mmho criterion change in admittance
  - WAR: automatically determined by the WB system using comprehensive statistic analysis
  - \( f_{LF} \): 0.38-2.8 kHz
  - \( f_{HF} \): 2.8-8 kHz

Methods: Experimental Procedure (II)

- Probe signals:
  - WAR: clicks
  - AR: 226 Hz tone
- Reflex Activators for WAR:
  - 0.5, 1, 2 kHz: 60-105 dB SPL
  - 4 kHz: 50-105 dB SPL
  - BBN: 45-90 dB SPL
- Reflex Activators for AR:
  - The upper limit of activator level was set for 110 dB HL
  - In the data analyses, the upper limit was converted to SPL so that the AR thresholds were equivalent to WAR thresholds

Results: WAR Thresholds

- Fig. 1: The median and interquartile range of Ipsi- and Contra-WAR thresholds measured in normal hearing young adults at TPP for each activator type for both \( f_{LF} \) (0.38-2.8 kHz) and \( f_{HF} \) (2.8-8 kHz).

Results: Detectability of WAR and AR (I)

- Table 1: Detectability of WAR and AR thresholds in young adults tested at TPP. The Ipsi-testing was validly conducted in a total of 37 ears. For WAR, both low frequency (WAR) and high frequency (BBN) thresholds are shown.

Results: Detectability of WAR and AR (II)

- Table 2: Detectability of WAR and AR thresholds in young adults tested at TPP. The Contra-testing was validly conducted in a total of 32 ears. For WAR, both low frequency (WAR) and high frequency (BBN) thresholds are shown.
Discussion

- The present study tested WAR in normal hearing adults with both ipsilateral and contralateral approaches for all commonly used activators.
- This is the first study on the comparison between WAR and AR thresholds for all commonly used activators in both Ipsi- and Contra-testing.

Conclusion

- This study reveals:
  - WAR has significantly lower thresholds than AR for both Ipsi- and Contra-testing.
  - WAR has higher detectability than AR for all activators except for 2 kHz tone for Ipsi-testing.

References


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Questions?