Consequences of Mild Traumatic Brain Injury on Central Auditory Function

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Abstract

Mild traumatic brain injury (mTBI) can result in central auditory nervous system damage and auditory processing deficits. A common complaint of mTBI patients is difficulty with communication, specifically hearing; however, the audiogram, word recognition in quiet, and standardized cognitive tests often do not explain these complaints. We hypothesized that these communication complaints are an emergent property of subclinical auditory impairments and thus are not captured by standard clinical auditory or cognitive measures.

The objective of this study was to identify and characterize hearing complaints using subjective auditory and cognitive communication questionnaires and measures of central auditory function. Two groups of adults with clinically normal hearing thresholds (25 ± 8 dB HL) were recruited: 1) adults with a history of mTBI, and 2) adults without a history of mTBI (control group). Auditory function was measured behaviorally with: 1) the Revised Speech Perception in Noise test; 2) dichotic word recognition; and 3) the 500-Hz masking level difference. Results suggest that some individuals with mTBI have poorer auditory performance relative to the control group on both subjective and objective measures of auditory function.

Introduction

- Traumatic brain injury (TBI) is a disruption to the normal function of the brain that results from a blow to the head, a penetrating head wound, or a concussive blast-related injury.1,2
- A common persistent complaint of adults with mTBI is difficulty in hearing, resulting in poor communication. These complaints, however, are not consistent with results of standard clinical hearing tests.
- Some mTBI adults with clinically normal hearing have substantial suprathreshold auditory deficits, especially in acoustically complex listening situations.3,4 Unless specialized testing is conducted, auditory processing deficits may go undiagnosed.
- Auditory processing deficits often result in difficulty with communication, frustration and fatigue. For individuals with mTBI, these symptoms may be exacerbated (including social isolation and depression).
- The purpose of the present study, therefore, was to target self-perceived hearing and communication difficulty in addition to measures of auditory processing to identify and further characterize auditory processing deficits within the mTBI population.

Methods

Subjects
- Two groups of clinically normal hearing (thresholds ≤ 25 dB HL) adults participated:
  - 23 adults 19-26 years served as the control group (negative history of mTBI)
  - 14 adults 19-59 years with a positive history of mTBI
- Normal cognitive function (Montreal Cognitive Assessment®, score ≥ 26)

Materials/Procedures
- Questionnaires
  - Hearing Handicap Inventory for Adults (HHIA)7
  - 25-items that assess the social and emotional consequences of a ‘hearing problem’
  - Abbreviated Profile of Hearing Aid Benefit (APHAB)8
  - 24-items designed to assess hearing difficulties in various environments
  - Cognitive Difficulties Scale (CDS)9
  - 38-items designed to assess cognitive difficulties in immediate and delayed memory, temporal orientation, attention, language, and psychomotor abilities affected by neurological insult
- The LaTrobe Communication Questionnaire (LCQ)10
- The LCQ-5 is a 38-item questionnaire designed to address communication after TBI

Behavioral Measures
- Revised Speech Perception in Noise Test (R-SPIN)11
- Monaural right and left at -4, 0, +4 dB signal-to-noise ratios (SNR)
- Dichotic Word Recognition12
  - Free recall and directed recall (right and left) condition responses
  - 500-Hz Masking Level Difference (MLD)12
  - MLD was calculated as the difference between the $S_M$ and $S_N$ thresholds.

Results

- Conclusions
  - Not all adults with mTBI complain of hearing problems, nor do they exhibit deficits in auditory processing.
  - Of the 14 mTBI subjects that presented with abnormal high hearing or communication complaints 8% exhibited abnormal performance on at least two of the four behavioral measures.
  - Results suggest that individuals with a history of mTBI that present with clinical hearing and communication complaints should be evaluated beyond the standard audiological testing.

Discussion

- Questionnaires
  - mTBI data points above the upper error bars in Figures 1 and 2 exceed the normal 95% CI and demonstrate that, despite normal pure-tone thresholds, 29% to 57% adults with mTBI experience hearing and communication difficulties.
  - 3/14 (21%) exhibited abnormally high scores on all questionnaires;
  - 5/14 (36%) scored normally on all questionnaires.

Behavioral Measures
- Abnormal auditory processing was observed for 9/14 (64%) of subjects with a history of mTBI (i.e., abnormal performance on at least two of the four measures) – despite normal pure-tone thresholds.
  - 1/14 (7%) performed normally on all behavioral measures;
  - 1/14 (7%) performed abnormally on all behavioral measures.

Conclusion

- The results suggest that individuals with a history of mTBI and normal pure-tone thresholds should be evaluated beyond standard audiological testing.

References


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