Correlation of Otologic Complaints in Soldiers With Speech Disorders After Traumatic Brain Injury

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Summary: Objectives/Hypothesis. To determine the prevalence of otologic complaints in subjects with dysphonia and traumatic brain injury (TBI) in a sample population of the US Army.

Study Design. Cross-sectional study.

Methods. A total of 292 subjects were identified with a new diagnosis of voice disorder during a 3.5-year period at three large military medical centers. Of them, 70 subjects were also identified with TBI and had no history of dysphonia before this time period. In those with voice disorders and TBI, documentation of hearing complaints, hearing loss, tinnitus, or vertigo was recorded. Time to visit an otolaryngologist and audiologist were also recorded.

Results. A total of 70 soldiers were identified with a diagnosis of a voice disorder and TBI. Of these soldiers, 83% had at least one otologic complaint and 50% had more than one. Approximately 60%, 39%, and 44% of the subjects reported tinnitus, hearing loss, or vertigo, respectively. A total of 62% of the subjects with otologic complaints, TBI, and dysphonia were seen by an otolaryngologist. Time until an otolaryngologist evaluated these soldiers varied widely, with an average of 17 months and standard deviation of 12.5 months.

Conclusions. Otologic manifestations are common in soldiers with dysphonia and TBI. Careful consideration of communication impairment from otologic dysfunction in those with speech disorders after TBI is warranted.

Key Words: Dysphonia–Traumatic brain injury–Speech disorders–Otologic dysfunction–Vertigo–Tinnitus–Hearing loss–Blast injury.

INTRODUCTION

Traumatic brain injury (TBI) is common after falls, assaults, motor vehicle collisions, and sporting activities. A TBI results from damage to the brain by external physical force and may produce diminished or altered state of consciousness. According to the 2009 Veterans Affairs (VA)/Department of Defense (DoD) clinical practice guidelines, TBIs are classified as mild, moderate, or severe based on imaging, loss of consciousness (LOC), alteration of consciousness/mental state (AOE), posttraumatic amnesia, and Glasgow Coma Scale (GCS) score.[1] Those with a TBI exhibit a constellation of symptoms ranging from memory and cognitive difficulties to dysphagia, dysphonia, hearing loss, and motor dysfunction that all negatively impact a patient's quality of life. These symptoms may be short lived or permanent, and they may cause mild cognitive impairment or total functional disability.[2] In a 2011 study reviewing the National Electronic Injury Surveillance System data, the Centers for Disease Control and Prevention found a significant increase in sports-related TBIs in children, primarily males aged 10–19 years.[3] In the military, service members are exposed to additional risks of TBI associated with combat, such as blast exposure. With an estimated 15–20% of soldiers from recent conflicts in Iraq and Afghanistan having mild TBI, much attention and research is being directed at optimizing diagnosis and treatment.[4,5]

Speech-language pathologists (SLPs) are well positioned in the US Military to manage voice disorders, often working in TBI clinics to provide multidisciplinary therapy to injured soldiers, sailors, airmen, and marines. The origins of voice disorders encountered range from vocal misuse, neurologic impairment, vocal fold paralysis, or anatomic structural alterations second to trauma. The increase in otologic complaints from a greater percentage of blast injuries and TBI is a challenge recognized by both SLPs and audiologists.[6] The combination of hearing loss and a speech disorder may impede effective rehabilitation.

Madeira and Tomita[7] found that subjects with moderate or greater sensorineural hearing loss (SNHL) had significantly higher voice handicap index values. Bolfan-Stosic and Simunjak[8] determined that children with more than mild SNHL had increased fundamental frequencies, jitter measurements, and comfortable intensity of vowel production levels. Cohen and Turley[9] found a 10% prevalence of both hearing loss and dysphonia in a survey of 248 residents in a retirement community with concurrent disorders associated with greater quality of life impairment. A 2010 analysis of 789 subjects by Cohen[10] revealed an increased likelihood of dysphonia in subjects with allergies or sinus problems, xerostomia, neck pain, gastroesophageal reflux, and hearing loss.

Previous studies demonstrate a high prevalence of otologic complaints in those with TBI, with more than 33% having tinnitus in a review of more than 1600 service personnel serving in a Middle East War Zone.[11] A survey of 2515 soldiers from US Army infantry brigades after deployment by Hoge et al[5] demonstrated increased likelihood of balance problems and tinnitus in those soldiers with TBI. Brenner et al[12] similarly found an increase in dizziness and balance problems in those with a TBI reviewing 1247 soldiers after deployment to Iraq. Up

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to 16% of blast-exposed military personnel have been found to have at least one tympanic membrane perforation, and this blast-exposed population also had increased rates of tinnitus, SNHL, and dizziness.[13]

The purpose of this study is to determine the prevalence of otologic dysfunction in soldiers with speech phonation dysphonia and blast- and nonblast-induced TBI to provide health care professionals with information on potential secondary injuries to consider when treating patients and optimize treatment planning. Because soldiers, sailors, and airmen with TBIs are seen by speech pathologists as part of their workup, understanding the prevalence and potential impact of otologic complaints may allow these providers to make earlier referrals where appropriate.

MATERIALS AND METHODS

The San Antonio Military Medical Center Institutional Review Board and Patient Administration System and Biostatistics Activity center approved the study. The DoD military health system databases containing electronic medical records for service members were reviewed for variables of interest. Using data from a previous retrospective, cross-sectional, query of the database of US Army Soldiers on active duty between January 1, 2008 and March 1, 2012 diagnosed with dysphonia by selected *International Classification of Disease*s (ICD)-9 codes (Table 1), soldiers within this cohort with documented TBI were further evaluated for otologic complaints.[14] Presence of TBI was determined based on a neurological clinical note diagnosing a mild, moderate, or severe TBI or the reference to a previously diagnosed TBI identified in a TBI SPL's clinical note. Determination of TBI status was based on individual chart reviews and not ICD-9 codes to confirm diagnosis and was applied from a unified clinical source relying on consistent diagnostic criteria in this smaller population. The providers determined TBI severity based on the VA TBI guidelines, which were in practice but not published at the start of the study. Mild TBI includes normal structural imaging, LOC between 0 and 30 minutes, AOE up to 24 hours, posttraumatic amnesia from 0 to 1 day, best GCS of 13–15 in the first 24 hours. Moderate TBI includes normal or abnormal structural imaging, LOC for more than 30 minutes and less than 24 hours, AOE for more than 24 hours, posttraumatic amnesia for more than 1 day and less than 7 days, and best GCS of 9–12 in the first 24 hours. Severe TBI includes normal or abnormal structural imaging, LOC for more than 24 hours, AOE for more than 24 hours, posttraumatic amnesia for more than 7 days, and best GCS less than nine in the first 24 hours. Structural imaging focuses largely on identifying contusions or intracranial bleeds, with newer imaging designed to identify diffuse axonal injury to improve TBI classification.[1,15,16] Soldiers whose initial dysphonia diagnosis fell within the study period but whose diagnosis of a TBI occurred before the dysphonia study period were included in the analysis.

TABLE 1.
Selected ICD-9 Codes Used to Query Medical Records

ICD-9 Code	Label
478.30	Unspecified paralysis of vocal folds
478.31	Partial unilateral paralysis of vocal folds
478.32	Complete unilateral paralysis of vocal folds
478.33	Partial bilateral paralysis of vocal folds
478.34	Complete bilateral paralysis of vocal folds
478.5	Other diseases of vocal folds
784.40	Voice disturbance
784.41	Aphonia
784.42	Dysphonia
784.43	Hypernasality
784.44	Hyponasality
784.49	Other voice disturbance
784.51	Dysarthria, other speech disturbance
784.52	Fluency disorder in conditions classified elsewhere
784.59	Speech disturbance

Using the existing sample of 292 soldiers with new dysphonia diagnoses during the study period from soldiers enrolled at Brooke Army Medical Center, Fort Sam Houston, TX; Darnell Army Medical Center, Fort Hood, TX; and Bayne Jones Army Community Hospital, Fort Polk, LA, a total of 70 soldiers were identified who also had a TBI diagnosis. The electronic medical record for each of these soldiers was examined for presence of hearing loss, tinnitus, vertigo, if/when seen by an audiologist, and if/when seen by an otolaryngologist. Deployment status, restricted to the study time period, was determined from information in the initial data evaluation. Demographics including age, sex, and rank were also recorded. Rank was recorded as either officer or enlisted.

Compiled data were analyzed using *SPSS* version 19 (IBM Corporation, Armonk, NY). For statistical analysis, age was categorized as less than 26 years, 26–50 years, or greater than 50 years; and rank was categorized into simply officer or enlisted. Pearson χ^2 testing was used for measurement of independence. A P value less than 0.05 was considered significant. The study design included basic descriptive statistics and contingency tables for variables of interest.

RESULTS

A total of 292 subjects from the three study locations were diagnosed with one or more of the selected dysphonia diagnoses during the study period. Of the 292 total subjects, 70 were also diagnosed with a TBI. The average age of a subject with dysphonia and a TBI was 29 years (standard deviation: 7.5 years). All but two subjects (68/70, 97%) were enlisted soldiers. A total of 64 of the 70 subjects (91%) with dysphonia and a TBI were male.

Review of patient records revealed that 58 of the 70 (83%) subjects had otologic complaints (Table 2). A total of 60% of the subjects reported tinnitus. Around 44% of the subjects reported vertigo or balance disturbance, and 27% reported hearing loss. Of those with an otologic complaint, 50% reported more than one otologic complaint. A total of 61 of the 70 (87%) soldiers had electronic medical record notes from the US Army hearing conservation program. A total of 22 soldiers

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