CHRONIC OCCUPATIONAL STRESS EXPOSURE MAY INCREASE THE VULNERABILITY TO ACOUSTIC TRAUMA IN MILITARY PROFESSIONALS

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CHRONIC OCCUPATIONAL STRESS EXPOSURE MAY INCREASE THE VULNERABILITY TO ACOUSTIC TRAUMA IN MILITARY PROFESSIONALS (Abstract): Today little is known about the connection between chronic stress exposure and hearing loss. These effects cannot be explained by differences in HPA axis response but recent studies saying that chronic stress induced limbic system alterations spread to nonlimbic areas affecting auditory system might be the key. On the other hand we know that subjects exposed to chronic stress may prove hypersensitivity to novel stressors. The aim of this study is to confirm that occupational chronic stress (OCS) exposure determines vulnerability to acoustic trauma and to establish a method to identify individuals at risk prior to their exposure to high intensity acoustic stimulus. Material and methods: 60 military personnel with known acoustic trauma injury evidenced through audiograms and occupational chronic stress exposure quantified through validated questionnaires were exposed to mild novel stressor: occupational medicine evaluation and clinically assessed for maladaptive cardiovascular response (MCVR). Employees were split in two groups, group 1 (MCVR) and group 2 (non MCVR). Results: We found positive correlation between level of perceived OCS and level of hearing loss on entire group and between groups with values of parameters significantly higher in group 1. Subjects exposed to OCS with hypersensitivity to novel stressor evidencediated through maladaptive cardiovascular stress response may be more vulnerable to high intensity acoustic stimulus and consequently acoustic trauma. Conclusions: Establishing methods and biomarkers that help us indentify individuals at risk of developing acoustic trauma might decrease the high burden of hearing loss. Keywords: CHRONIC OCCUPATIONAL STRESS, HYPERSENSITIVITY, NOVEL STRESSOR, ACOUSTIC TRAUMA

Hearing is a critical sensor for survivability and lethality in military operations, the ability to accomplish unit’s mission being directly proportional to ability to communicate effectively. Besides the roles of hearing in a peace operation: identifying sound source, understanding verbal orders, radio communications, in a combat we have to take in account the chaotic environment, the complexity of problems encountered and the reaction time required, so a mild impairment of hearing in a peace operation might be judged differently in a combat situation (1). Hearing loss (HL) was considered an invisible injury viewed as acceptable by product of military service with little impact on military operations but 55864 veterans compensations cases between 2001-2006 summing 900 ml $ made HL a primary disability second only to
Tinnitus and a huge burden (2). In a combat sound is often the first source of information before direct contact. Information carried by sound comes from all directions, through darkness and over or through visual obstacles. Aggressive action produces sounds that cannot be camouflaged. The ability to hear and recognize combat relevant sounds is a vital component to situational understanding and provides tactical advantage. So noise induced hearing loss is a tactical risk and threatens both individual and unit combat effectiveness and preserving hearing capabilities of an unit is an important challenge for the medical team involved in prevention (1). Any factor that may influence good hearing capability should be thought of and considered in situations, peace and combat.

Recent studies pointed out that chronic stress determines limbic system alterations that spread to non limbic areas affecting specific sensory systems such as auditory system and complex cognitive functions (3). Moderate or high stress levels at the time of acoustic trauma might play a pivotal role in the vulnerability of the cochlea to acoustic damage (4). Chronic stress induces dendritic atrophy in auditory cortex thus influencing complex cognitive behavior with impact on auditory attention and decision making processes and decrease in environmental adaptation. We might so easily imagine a scenario in which a chronic stress exposed military with maladaptive cardiovascular stress response (MCVSR) or white coat effect pattern with subsequently exaggerated alarm reaction is put in front of the wide variety of stressors in an operational theater (5, 6, 7, 8, 10). His impaired processing sound characteristic transforms him in a possible candidate for noise induced hearing loss or worse affecting direct performance and safety of the military operation (1, 2, 11).

That is why best preventive measures must be taken before the units are involved in high-stress, high-risk actions (9).

Following this logic we thought that we can identify individuals at risk of developing hearing loss prior to their exposure to high intensity acoustic stimulus by looking at their cardiovascular stress response pattern.

MATERIAL AND METHODS

Our study is open label randomized type of study done on 60 military personnel, all males, recruited during routine occupational medical evaluations in the occupational medical office from Emergency Military Hospital, Iasi. The selection was based on inclusion and exclusion criteria. The inclusion criteria were bilateral acoustic trauma with hearing loss disability ≥30dB in 4,000 Hz with age correction factor (Romanian occupational health diagnostic standards for acoustic trauma), healthy with no relevant personal or family history, BMI<25, level of perceived work stress > 5 (significant level of perceived occupational stress) on occupational stress evaluation validated questionnaires and exclusion criteria were unilateral acoustic trauma, cardiovascular disease, endocrine disease, neurologic disease, obesity and level of perceived work stress < 5.

We considered the occupational medicine routine evaluation a mild novel stressor and cardiovascular dysfunctions discovered (arterial blood pressure ≥ 140/80 mm Hg and rest heart beat >80 bpm) an exaggerated alarm reaction and anxious behavior of a chronic occupational stressed hypersensitive subject. We divided the entire group in two, group 1 being the MCVSR
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group with cardiovascular dysfunctions and group 2 being the non MCVSR group with normal cardiovascular stress response and normal values of cardiovascular parameters. Than we studied the differences between the two groups and the entire group in terms of level of stress, level of exaggerated alarm reaction (values of cardiovascular parameters) and hearing loss levels. We were looking in our research for confirmation or not that chronic occupational stress exposure determines increased vulnerability to acoustic trauma and if the answer was positive to establish a method to identify individuals at risk of developing it prior to their exposure to high intensity acoustic stimulus.

RESULTS AND DISCUSSION

We used descriptive statistic and inferential statistic parameters from SPSS 11.0. We found a high level of work stress: 7.1 ±0.89 on entire group with positive significant correlation of medium strength: r-0.455 between hearing loss level and level of work stress on entire group and positive significant correlation of high strength- r-0.695 between hearing loss level cardiovascular parameters modifications on entire group.

TABLE I

Comparative values between the two groups (MCVSR-group1 and non MCVSR-group2) in hearing loss and occupational stress level

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>HLBE</th>
<th>HLWE</th>
<th>MHL</th>
<th>OccSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCVSR-group 1</td>
<td>28</td>
<td>45.96±9.98</td>
<td>59.78±9.36</td>
<td>52.87±8.47</td>
<td>7.42±0.74</td>
</tr>
<tr>
<td>nonMCVSR-group 2</td>
<td>32</td>
<td>37.03±5.04</td>
<td>42.37±6.52</td>
<td>39.70±5.20</td>
<td>6.81±0.93</td>
</tr>
</tbody>
</table>

HLBE- hearing loss best ear; HLWE- hearing loss worst ear; MHL- medium hearing loss; OccSL- occupational stress level; MCVSR- maladaptive cardiovascular stress response.

The differences found between the two groups in terms of hearing loss and occupational stress levels suggest that military exposed to chronic stress with exaggerated alarm reaction and maladaptive cardiovascular pattern might have a vulnerability to acoustic trauma with higher levels of hearing loss thus confirming the existed data in scientific literature and recent studies. Cardiovascular stress response can be used to early identify individuals at risk of developing noise induced hearing loss prior to their involvement in high-stress and high-risks operations. We need to confirm the relationship with broader studies and in larger groups.

CONCLUSIONS

We found out that military subjects exposed to high level of work stress that have maladaptive cardiovascular stress pattern may be more vulnerable to high intensity acoustic stimulus and consequently acoustic trauma, this being in accord with recent scientific data. The pattern can be easily recognized and used as biomarker for early identification of individuals at risk of developing hearing problems prior of their deployment.

Establishing methods and biomarkers that help us identify individuals at risk of
developing acoustic trauma might decrease the high burden of hearing loss and preventive interventions as part of military health strategies might decrease the occurrence of stress related hearing problems.

REFERENCES