Mild blast injury: vertigo complaints analysis

Abstract. The data about vestibular disorders resulting from blast injury are contradictory. To disclose the problem of vestibular disorder as the consequence of blast injury, we have done present investigation. One hundred and nine patients were examined: 65 Anti-Terroristic Operation (ATO) participants, who survived mild and moderate blast injury without cranial trauma, and 44 non-ATO patients (rhinitis, pharyngitis, otitis). Questionnaire “Types of dizziness” has been used according to the International Clinical Protocol on Vestibular Disorders (Dizziness). Complaints of dizziness (distortion of perception of space, movement and time) have been revealed in 70.77 % (46) ATO and 43.18 % (19) non-ATO patients: F-test = 0.51, T-test = 0.004, thus, showing that this complaint is not specific for mild traumatic brain injury (mTBI). Objective vertigo (sensation of subjects moving around the patient) met in 26.15 % (17) ATO and 11.56 % (5) non-ATO patients: F-test = 0.027, T-test = 0.046. So, we have two different qualitative groups. These complaints are specific for the patients, who survived blast injury. Complaints of vertigo are also typical for the patients, who survived blast injury. Complaints of giddiness are specific for the patients, who survived blast injury. Imbalance and drop attacks are not typical for ATO patients. Complaints of kinetosis are specific for the patients, who survived blast injury. Orthostatics (discomfort sensations that appear after sudden standing up) has been revealed in 76.92 % (50) ATO and 47.73 % (21) non-ATO patients, this complaint is not specific for mTBI. Vestibular system organizes space orientation tetrad: vestibular, somatosensory, visual and hearing information to percept, orient and interact with environment. Acro-, nycto- and ascendophobia have appeared to be of no importance. Agoraphobia (Greek αγώρα — market, supermarket syndrome, discomfort in open, public places or crowds) has been detected in 33.85 % (22) ATO and 15.91 % (7) non-ATO patients. This complaint is not specific for mTBI. Claustrophobia (discomfort appearing in small, closed spaces) is met in 20.00 % (13) ATO and 9.09 % (4) non-ATO patients: F-test = 0.024, T-test = 0.10. Thus, we have two different qualitative groups. This is also interesting case, when we reveal qualitative difference without quantitative one. This is the argument to use F-test in our study. So, complaints of claustrophobia are specific for the patients, who survived blast injury. The same situation is with descendophobia (discomfort during walking down the hill or descending the staircase, patients note the necessity of visual control. It has been shown that among other signs, there is a positive correlation with age, imbalance, ascendophobia and dyspnea). The results are discussed from the point of view of the severe vestibular impairment due to the blast injury. Conclusions. 1. MBTI from blast injury is accompanied by severe stress, objective and subjective vertigo, giddiness and kinetosis, which are considered to be the symptoms of vestibular damage. 2. Dizziness, orthostatics and agoraphobia are quantitatively significantly increased in mTBI, but it might not be considered specific for blast injury consequences. 3. Giddiness, claustrophobia and descendophobia in ATO patients have no quantitative changes compared to the ENT patients, but are specific for mTBI after blast injury. 4. It is important to use matrix Fisher test in statistical examinations.

Keywords: blast injury; vestibular disorder; vertigo; dizziness; giddiness; kinetosis
Introduction

Blast injury is a complex type of physical trauma resulting from direct or indirect exposure to an explosion. Blast injuries occur with the detonation of high-order explosives as well as the deflagration of low-order explosives. These injuries are compounded when the explosion occurs in a confined space [7].

During last century, blast injury is crucially increasing [3]. Primary blast injuries result from the over-pressurization wave and typically affect gas-filled body structures (e.g., lungs, gastrointestinal tract, middle ear) resulting in injuries such as blast lung, tympanic membrane rupture, abdominal hemorrhage, and concussion [2].

Researchers and clinicians have estimated that approximately 300,000, or about 20%, from 1.6 the million of USA military staff deployed to Iraq and Afghanistan have experienced mild traumatic brain injuries (mTBI) [5].

The data about vestibular disorders resulting from blast injury are contradictory. Among ear outcomes, some authors pay attention to subjective hearing loss (57.14%), tinnitus (80.36%), ear fullness (80.36%), hyperacusis (32.14%) and vertigo (3.57%) [4]. In the Report of the Department of Veterans Affairs (USA) 2016, N. Greer and coauthors have recognized that information about true prevalence of blast trauma among deployed military personal of USA and its consequences is limited in the literature. On the one hand, hearing loss has been considered to be clinically significant while vestibular effects were “unremarkable” [3]. This seems to be rather equivocal because vestibular analyzer is just the movement sensor and it has to produce the most significant reaction. On the other hand, about 20% patients have complained of mild-to-moderate dizziness/vertigo. Most of the patients have complained of high-pitched tinnitus. It is remarkable that frequently these patients were complaining of tinnitus without objective hearing loss [9]. Other authors presented from 15 to 40% of patients complaining of dizziness, vertigo with diplopia [6]. At last, some researchers consider dizziness, vertigo instability, postural deficit and space orientation to be the most frequent symptoms of blast injury [1].

The purpose: to disclose the problem of vestibular disorder resulting from blast injury.

Materials and methods

One hundred and nine patients were examined: 101 males (62 were the Anti-Terroristic Operation (ATO) participants, who survived mild and moderate blast injury without cranial trauma), and 8 females (three of them ATO). In total, there were 65 ATO and 44 non-ATO patients (rhinitis, pharyngitis, otitis). The groups have been matched by age, weight, height and other vital parameters.

To standardize complaints, the questionnaire “Types of dizziness” has been used according to the International Clinical Protocol on Vestibular Disorders (Dizziness) [8]. Statistics: standard Excel kit for Windows has been used. To obtain quantitative difference, asymmetrical two-tailed Student test has been studied (T-test), qualitative — Fisher matrix test (F-test).

Results and discussion

The dizziness complaints and closely related symptoms are presented in the Table 1.

As we can see from Table 1, conscious loss has been reported by 58.46% (38) ATO and 25.00% (11) non-ATO pa-

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ATO mean, %</th>
<th>ATO sigma, n</th>
<th>Non-ATO mean, %</th>
<th>Non-ATO sigma, n</th>
<th>F-test</th>
<th>T-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conscious loss</td>
<td>58.46</td>
<td>38</td>
<td>25</td>
<td>11</td>
<td>0.38</td>
<td>0.0003</td>
</tr>
<tr>
<td>Stress</td>
<td>97</td>
<td>63</td>
<td>27.27</td>
<td>12</td>
<td>5.47E-8</td>
<td>4.88E-13</td>
</tr>
<tr>
<td>Intensity</td>
<td>2.96</td>
<td>1.09</td>
<td>3.5</td>
<td>1.35</td>
<td>0.37</td>
<td>0.28</td>
</tr>
<tr>
<td>Dizziness</td>
<td>70.77</td>
<td>46</td>
<td>43.18</td>
<td>19</td>
<td>0.51</td>
<td>0.004</td>
</tr>
<tr>
<td>Vertigo objective</td>
<td>26.15</td>
<td>17</td>
<td>11.56</td>
<td>5</td>
<td>0.027</td>
<td>0.046</td>
</tr>
<tr>
<td>Vertigo subjective</td>
<td>29.23</td>
<td>19</td>
<td>11.56</td>
<td>5</td>
<td>0.015</td>
<td>0.018</td>
</tr>
<tr>
<td>Giddiness</td>
<td>18.46</td>
<td>17</td>
<td>6.82</td>
<td>3</td>
<td>0.0036</td>
<td>0.06</td>
</tr>
<tr>
<td>Imbalance</td>
<td>64.62</td>
<td>42</td>
<td>45.45</td>
<td>20</td>
<td>0.74</td>
<td>0.05</td>
</tr>
<tr>
<td>Drop attacks</td>
<td>16.92</td>
<td>11</td>
<td>9.09</td>
<td>4</td>
<td>0.07</td>
<td>0.23</td>
</tr>
<tr>
<td>Orthostatics</td>
<td>76.92</td>
<td>50</td>
<td>47.73</td>
<td>21</td>
<td>0.20</td>
<td>0.002</td>
</tr>
<tr>
<td>Kinetosis</td>
<td>44.62</td>
<td>29</td>
<td>15.91</td>
<td>7</td>
<td>0.037</td>
<td>0.0008</td>
</tr>
<tr>
<td>Acrophobia</td>
<td>53.85</td>
<td>35</td>
<td>47.73</td>
<td>21</td>
<td>0.95</td>
<td>0.48</td>
</tr>
<tr>
<td>Agoraphobia</td>
<td>33.85</td>
<td>22</td>
<td>15.91</td>
<td>7</td>
<td>0.08</td>
<td>0.029</td>
</tr>
<tr>
<td>Nyctophobia</td>
<td>30.77</td>
<td>20</td>
<td>15.91</td>
<td>7</td>
<td>0.11</td>
<td>0.067</td>
</tr>
<tr>
<td>Claustrophobia</td>
<td>20</td>
<td>13</td>
<td>9.09</td>
<td>4</td>
<td>0.024</td>
<td>0.10</td>
</tr>
<tr>
<td>Ascendophobia</td>
<td>15.38</td>
<td>10</td>
<td>11.36</td>
<td>5</td>
<td>0.39</td>
<td>0.54</td>
</tr>
<tr>
<td>Descendophobia</td>
<td>24.62</td>
<td>16</td>
<td>11.36</td>
<td>5</td>
<td>0.038</td>
<td>0.07</td>
</tr>
</tbody>
</table>
Complaints of stress were detected in 97.00 % (63) ATO and 27.27 % (12) non-ATO patients: F-test = 5.47E-8 (5.47 × 10^-8), T-test = 4.88E-13. This parameter differs both quantitatively and qualitatively, therefore, we have two different qualitative groups. So, complaints of severe stress are specific for the patients, who survived blast injury.

Complaints of dizziness (distortion of perception of space, movement and time) have been revealed in 70.77 % (46) ATO and 43.18 % (19) non-ATO patients: F-test = 0.51, T-test = 0.004. This complaint is not specific for mTBI.

Objective vertigo (the patient notes the sensation of body movement in space) was reported by 26.15 % (17) ATO and 11.56 % (5) non-ATO patients: F-test = 0.027, T-test = 0.046. Thus, we have two different qualitative groups. So, complaints of objective vertigo are specific for the patients, who survived blast injury.

Subjective vertigo (sensation of the subjects moving around the patient) was detected in 29.23 % (19) ATO and 11.56 % (5) non-ATO patients: F-test = 0.015, T-test = 0.018; thus, we have two different qualitative groups. So, complaints of subjective vertigo are specific for the patients, who survived blast injury (Fig. 1).

Giddiness (sometimes called pseudovertigo: very intense, difficult to describe, patients often tell that something is rotating inside of the head) is met in 18.46 % (17) ATO and 6.82 % (3) non-ATO patients: F-test = 0.0036, T-test = 0.06. Thus, we have two different qualitative groups. This is very interesting case, when we reveal qualitative difference without quantitative one. This is strong argument to use F-test in our study. So, complaints of giddiness are specific for the patients, who survived blast injury.

Imbalance and drop attacks are not typical for ATO patients.

Orthostatics (discomfort sensations that appear after sudden standing up often accompanied by nausea) have been revealed in 76.92 % (50) ATO and 47.73 % (21) non-ATO patients: F-test = 0.20, T-test = 0.002. This complaint is not specific for mTBI.

Many ATO patients have complained of poor tolerability of transportation after blast injury. So, kinetosis (a disorder caused by repetitive angular and linear acceleration and deceleration and is characterized primarily by nausea and vomiting) is met in 44.62 % (29) ATO and 15.91 % (7) non-ATO patients: F-test = 0.037, T-test = 0.0008. We have two different qualitative groups. So, complaints of kinetosis are specific for the patients, who survived blast injury (Fig. 2).

Vestibular system organizes space orientation tetrad: vestibular, somatosensory, visual and hearing information to percept, orient and interact with environment [8]. Therefore, we have studied this problem in our patients.

Acro-, nycto- and ascendophobia have appeared to be of no importance (Fig. 3). Acrophobia (height vertigo, does not belong to true vertigo) is a discomfort that appears at height. It has positive correlation with imbalance. Nyctophobia is a discomfort, unsuresness in darkness and twilights. Ascendophobia is a discomfort while moving upstairs, patients note the necessity for visual control.

Agoraphobia (Greek άγωρα — market, supermarket syndrome, discomfort in open, public places or crowds) has been revealed in 33.85 % (22) ATO and 15.91 % (7) non-ATO patients: F-test = 0.08, T-test = 0.029. This complaint is not specific for mTBI.

Claustrophobia (discomfort appearing in small, closed spaces) is met in 20.00 % (13) ATO and 9.09 % (4) non-ATO patients: F-test = 0.024, T-test = 0.10. Thus, we have two different qualitative groups. This is also interesting case when we reveal qualitative difference without quantitative one. This is another argument to use F-test in our study. So, complaints of claustrophobia are specific for the patients, who survived blast injury.
Descendophobia (discomfort during walking down the hill or descending the staircase, patients note the necessity of visual control. It has been shown that among other signs, there is a positive correlation with age, imbalance, ascensionophobia and dyspnea [8]) is met in 24.62 % (16) ATO and 11.36 % (5) non-ATO patients: F-test = 0.038, T-test = 0.07. So, we have two different qualitative groups. One more interesting case, when we reveal qualitative difference without quantitative one. One more argument to use F-test in our study. So, complaints of descendophobia are specific for the patients, who survived blast injury.

Our data support the statement of F.W. Akin, O.D. Murnane that vestibular component is important in the clinical picture of the consequence of the blast injury [1]. The proof for this is the fact that all the symptoms studied are related to vestibular system [8].

The difference with the data of Greer N. et al. [3] seems to be rather equivocal because vestibular analyzer is just the movement sensor and it has to produce the most significant reaction. The possible explanation might be in the period of imaginable wellbeing, when vestibular damage has no clinical manifestations. Moreover, in the clinical picture of delayed consequences, vestibular symptoms are masked by the disorders of other systems (cardiovascular, endocrine, immune) [8].

Conclusions

1. mBTI from blast injury is accompanied by severe stress, objective and subjective vertigo, giddiness and kineticosis, which are considered to be symptoms of vestibular damage.

2. Dizziness, orthostatic and agoraphobia are quantitatively significantly increased in mBTI, but it might not be considered specific for blast injury consequences.

3. Giddiness, claustrophobia and descendophobia in ATO patients have no quantitative changes compared to the ENT patients, but are specific for mBTI after blast injury.

4. It is important to use matrix Fisher test in statistical examinations.

References


скарга не є специфічною для лЧМТ. Вестибулярна система організовує тетраду просторової орієнтації: вестибулярну, соматосенсорну, зорову та слухову інформацію для сприйняття, орієнтації та взаємодії з навколишнім середовищем. Агорофобію (від греч. ἀγωρα — ринок, синдром супермаркету, дискомфорт у відкритих, громадських місцях чи скупченнях людей) зафіксовано в 33,85 % (22) учасників АТО та 15,91 % (7) не-АТО, ця скарга не є специфічною для лЧМТ. Клаустрофобія (дискомфорт, що виникає в невеликих за-критих приміщеннях) зустрічається в 20,00 % (13) учасників АТО та 9,99 % (4) не-АТО: F-тест = 0,024, T-тест = 0,10. Таким чином, ми маємо дві різні за якістю групи. Це також цікавий випадок, коли виявлено якісну різницю без кількісної. Це аргумент на користь використання F-тесту в нашем дослідженні. Отже, скарги на клаустрофобію характерні для пацієнтів, які пережили вибухову травму. Така ж ситуація з десцендофобією (дискомфорт під час ходьби з гори або спуску по сходах, пацієнти відзначають необхідність контролю зору. Показано, що серед інших ознак є позитивна кореляція з віком, порушенням рівноваги, агорофобією та кінетозом). Результати обговорюються з точки зору тяжкого вестибулярного порушення внаслідок вибухової травми. **Висновки.** 1. ЛЧМТ після вибухової травми супроводжується сильним стресом, об’єктивним і суб’єктивним вертиго, запамороченням і кінамо-том, що розглядаються як симптоми ураження вестибулярного апарату. 2. Запаморочення, дискомфортні відчуття, що виникають після раптового вставання, та агорофобія кількісно значно посилюються при лЧМТ, але це не може вважатися специфічним для наслідків вибухової травми. 3. Запаморочення, клаустрофобія та десцендофобія в учасників АТО не мають кількісних змін порівняно з такими в ЛОР-хворих, але є специфічними для лЧМТ після вибухової травми. 4. У статистичних дослідженнях важливо використовувати матричний критерій Фішера. **Ключові слова:** вибухова травма; вестибулярний розлад; вертиго; запаморочення; кінетоз