Investigating the probability of brain injury in the shell shock injured soldiers, and comparing with prisoners of war with PTSD, patients with brain penetrating injuries, and normal persons

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Received January 9, 2010; revised February 19, 2010; accepted March 4, 2010

Abstract

Introduction: The purpose of this study was to examine the likelihood of brain injury in shell shock (blast) injured soldiers by comparing their cognitive function to three groups of Patients with Brain Penetrating Injuries, freed prisoners of war affected by Post Traumatic Stress Disorder, and normal individuals.

Material & Methods: To carry out the present study a total of 20 subjects were assigned randomly to four groups. All groups were administered Wechsler Memory Scale, Benton visual Retention, Dailler Cancellation, Smith Digit Symbol and Wisconsin Card Sorting Test. The data were analyzed using the statistics of analysis of variance and Tukey Test.

Results: The findings showed that in the most of the neuropsychological tests there was a significant difference between the blast injured group and freed prisoner of war affected by Post Traumatic Stress Disorder.

Conclusion: it seems necessary to modify the treatment methods of blast injured soldiers.

Keywords: blast wave, Traumatic Disorders, Prisoners of war, Neuropsychological, Impairment, brain Injury.

1. Introduction

Human behavior consists of a complex interaction of brain responses to environmental stimuli. A change in behavior often indicates a brain injury. Many researchers believe that the early diagnosis of neurological condition is related to this stubborn complex problem that these patients' complaints are similar to those of functional disturbances patients, a condition generally considered as a neurotic reaction to the stress. One area in which this problem can be considerably observed is related to the soldiers exposed to blast wave in the battlefield.

The sources of blast injury include artillery shells, mines, aerial bombs, improvised explosive devices (IEDs), and rocket-propelled grenades (Anderson, 2008). Historical accounts note that as more powerful explosives came
into general use in warfare, a condition was described in which soldiers were rendered dazed or unconscious by an explosion that caused no external visible injury. Retrograde and antegrade amnesia were commonly present upon regaining consciousness or awareness, as were severe headache, tinnitus, hypersensitivity to noise, and tremors (Mott, 1916 and Fabing, 1947). Injuries occur as a direct result of blast wave-induced changes in atmospheric pressure (primary blast injury), from objects put in motion by the blast hitting people (secondary blast injury), by people being forcefully put in motion by the blast (tertiary blast injury) (Mayorga, 1997, Wightman and Gladish, 2001 and DePalma, Burris, Champion, and Hodgson, 2005) and by all other explosion-related injuries and complications, such as burns, crush injuries, and respiratory Problems (quaternary blast injury) (Taber, Warden, and Hurley, 2006, Elsayed, 1997). The brain is clearly vulnerable to secondary, tertiary and quaternary blast injury. A still unresolved controversy is whether primary blast forces directly injure the brain. Usually high-energy explosive detonation results in extremely rapid conversion of a solid or liquid into gases and changes in atmospheric pressure (DePalma, et al 2005, Mayorga, 1997 Taber, et al 2006). The gases expand rapidly, forming a pulse of pressure, or "blast overpressure," from the compression in the surrounding air. With continued gas expansion, the pressure drops, creating a relative vacuum referred to as "blast underpressure." Thus, the blast wind initially moves away from the explosion, but as atmospheric pressure drops below normal, the blast winds are reversed. These extreme pressure differences (blast-induced over- and underpressure) that occur as the blast wave reaches the body result in stress and shear waves. Primary blast injury is thought to result from these blast wave-induced changes in atmospheric pressure, which is a form of barotrauma. Shear and stress waves from the primary blast could potentially cause traumatic brain injury (TBI) directly (e.g., concussion, hemorrhage, edema, diffuse axonal injury). In addition, blasts have been postulated to damage the brain through elevations in cerebrospinal fluid (CSF) or venous pressure due to compression of the thorax and abdomen and by propagation of a shock wave through the blood vessels or CSF (Clemedson, 1956). Brain injuries also are usually accompanied by injuries to organs that are even more vulnerable to blast, including lung, long bones, gastrointestinal tract, and heart. Damage to these organs can produce air emboli, fat emboli, and hypoxia/ischemia that some authors have argued are more damaging to the brain than the direct effects of the blast (Mayorga, 1997).

Charles Myers, a British psychiatrist practicing in France, introduced the term “shell shock” to describe the condition of blast injured soldiers of the British Expeditionary Force in late 1914 (Macleod, 2004 and Howorth, 2000). However, Myers soon realized that shell shock was a misleading term. By 1941, a disorder was characterized by headache, dizziness, fatigue, tinnitus, memory impairment, poor concentration, and nervousness. Some researchers believe that this combination of physical, cognitive and affective defects is assigned to traumatic brain injury and a specific condition named Post Concussion Syndrome (PCS) (Mc Allister, 1992). Fulton concluded that "the problem of distinguishing organic concussion resulting from blast is delicate and often difficult" (Jones, Fear and Wessely, 2007), latter for explanation of the status of war related patients affected by blast wave the diagnosis of Post Traumatic Stress Disorder (PTSD) has been used.

In a research veterans with chronic posttraumatic stress disorder were evaluated for a history of blast concussion, controlling for confounding conditions. A difference was found in discriminate scores between veterans with and without blast concussion. More members of the blast group had attentional dysfunction. The authors hypothesize that these constitute a type of chronic post concussive syndrome that has cognitive and mood symptoms overlapping those of posttraumatic stress disorder. (Trudeau, et al, 1998)

In a study two groups of mental patients were compared regarding memory attention and concentration, creativity and judgment (Mitrushina, Abara and Blumenfeld, 1995). The results showed that the performance of those mental patients without any organic trauma was at the level of normal individuals while the performance of mental patients affected by organic trauma was much weaker.

Some studies point to long term problems of traumatia and brain injuries. In a study by Wilson (1992) he surveyed twenty nine patients affected by traumatic brain injury (TBI) who were suffering from cognitive problems for the past 5 to 10 years. In a standard memory test 11% of the subjects were affected by severe memory loss, 58% showed no positive change, and 31% revealed relative recovery. Various researchers concluded that the subjects affected by Post Traumatic Stress Disorder (PTSD) are very similar to normal individuals in there cognitive functions (Brenner, Scott and Delaney, 1993). Yet researchers who have faced some cognitive failures in these patients in their studies believe that these cognitive traumatia are most likely due to a kind of coincident brain injury along whit PTSD (Sutker, Galina, West and Allain, 1990).
Various studies have approved the validity of the tests used in this study to differentiate between patients affected by brain injury and those not affect by such injuries.

The present study hypothesized that blast wave in war injured soldiers induced invisible minimal brain damage which can cause various neuropsychological impairment that seen in PCS.

**Material & Methods**

This was a case-control study in which the population consisted of chronic veterans of Iran and Iraq war injured patients (1981-1988) due to blast wave, organic brain injury and captivity (prisoners of war affected by PTSD). The control group including normal individuals was selected from the staff of treatment center of war injured patients in Shiraz city. The study included 4 groups as the following: two groups each including 20 war patients affected by mental symptoms due to blast wave and organic brain injury, one group including 20 freed prisoners of war affected by PTSD, and one group including 20 normal individuals. All of the subjects were examined in a seven month period from first January 1997 to the end of July 1998. The subjects of the first group (blast injured soldiers) were selected using simple random sampling. The other three control groups were matched to this group rewarding variables as age, education level, IQ and socioeconomic status. The disease in groups of blast wave, organic brain injury and also freed prisoners of war had started in the initial years of war and has changed in to a chronic disease at the time of this study. The age' mean and variance of the four groups in order were 31.40 (3.76), 31.20 (3.94), 32 (3.52), and 31 (4.62). The average shock wave rate in the blast injured group was 1.3 and they didn't experience any visible organic brain injury. The organic brain injury group was mostly affected by the entrance of small metal particles in to the brain at the frontal, temporal and parietal areas. The average length of captivity period in the group of freed prisoners of war affected by PTSD was reported to be 52.6 months. The subjects were selected from military personnel. Consumed drugs among the three groups of the patients were included antidepressant, benzodiazepines, carbamazepine, propranolole and perphenazine. The instruments used in this study were: Wechsler Memory Scale (WMS) and Benton Visual Retention Test (BVRT) for assessing memory, Diller Cancellation Test (DCT) and Smith Digit Modalities Test (SDMT) that are used for measurement the level of attention and concentration (Lezak, 1983) and Wisconsin Card Sorting Test (WCST) used for measuring information processing and abstract thinking. To control the intelligence variable in different groups the Ravens' scale of Standard Progressive Matrices Test (SPMT) and Vocabulary Subtest (VS) of Wechsler Adult Intelligence Scale- Revised (WAIS-R) has been used. The validity and reliability of the tests mentioned have been approved in different studies (for example Reid and Kelly, 1993).

**Results**

The findings of the study revealed that there was much similarity in neuropsychological performance of blast wave and organic brain injury groups. The results also showed that the performance of blast wave injured soldiers in different cognitive functions was statistically weaker than the group of freed prisoners of war affected by PTSD in most tests(P<0.01). Finally the cognitive performance of the group of freed prisoners of war affected by PTSD was similar to normal subjects. Table 1 present the Analysis of Variance (ANOVA) and Tucky Test of the scores on the tests used in the four groups.

**Discussion**

Regarding the fact that the cognitive deficiencies of blast wave injured soldiers is more than the predicted level; the probability of the minimal traumatic brain injury seems to be quite logical in this group. On the basis of the findings of this research it seems that the blast wave injured patients are affected by special cognitive deficiencies in the chronic stage of the disease seen in organic disorders specially post concussion syndrome yet the etiology of this syndrome is complex and controversial. Regarding the etiology of this syndrome there has been the fluctuating emphasis on the psychological and organic theories. Some experts have even put forward the issue of secondary gain and malingering however some researchers have definitely asserted that the health care personnel usually overestimate the rate of malingering and don’t believe that only a few patients may exaggerate their symptoms due to profiteering.
An earlier study found that veterans with PTSD who had been exposed to blast had EEG abnormalities and attentional difficulties consistent with mild TBI (Trudeau, et al, 1998).

Thus, the clinical evidence to date suggests a similar range of neuropsychiatric impairments as seen with other traumas (e.g., accidents, assaults). In many cases, TBI clearly resulted from secondary and/or tertiary blast injuries. The vulnerability of the human brain to primary blast injury is controversial and an area of active research (Cernak, 2005).

Lezak (1983) believes that the problems of minimal brain injury patients is the ultimate product of the complex interaction among neurological failures, the expectation of the environment from the patient, preformed behavioral models and his continuous reactions against these characteristics. Brain injury usually causes a group of symptoms as headache, vertigo and fatigue undoubtedly these symptoms emerge from organic brain factors but it seems that in the course of time a series of psychological barriers bring about some difficulties in the way of the natural process of recovery (Lishman, 1988). These barriers include the patients' psychological nature, unexplained worries, anxiety and especially economic problems. A Patient feeling depressed faces contradiction regarding the compensation issue. If there are too many problems the patient will suffer from secondary neurosis. Van Zomeren and Van Den Burg (1985) have also proposed adjustment theory as another explanation for the states of these patients. On the basis of this theory when there are too many environmental demands from the patient stressful reaction in him or her will increase fatigue and pressures due to responses to environmental demands may intensify the physical sign of PCS including headache and vertigo. The interactive theory mentioned in relation to the cause of the emergence of the symptoms of PCS and the method of their continuation is considered as a appropriate interpretation for the status of war patients affected by blast wave effects.

Because the blast survivors from Iraq and Afghanistan frequently have complex physical injuries and emotional trauma, they represent a new medical challenge to military physicians and therefore Military personnel returning from combat must receive a thorough neuropsychological evaluation to guide rehabilitation, including medical and psychosocial interventions for their long term care (Elder, and Cristian, 2009 and Anderson, 2008).

For health professionals dealing with polytrauma patients, the daily challenges can be overwhelmingly complex and demanding at times. Thus, much of their attention has been directed toward meeting the daily medical and

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Table 1. The Analysis of Variance (ANOVA) and Tucky Test of the scores on the tests used in the four groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Blast Wave injured</th>
<th>Organic Brain Injured</th>
<th>PTSD</th>
<th>Normal</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>WMS</td>
<td>50.18</td>
<td>9.33</td>
<td>48.33</td>
<td>11.90</td>
<td>60.87</td>
<td>10.52</td>
</tr>
<tr>
<td>BVRT</td>
<td>5.85</td>
<td>1.30</td>
<td>5.65</td>
<td>1.66</td>
<td>6.95</td>
<td>1.23</td>
</tr>
<tr>
<td>DCT (correct responses)</td>
<td>56.50</td>
<td>19</td>
<td>59.35</td>
<td>23.40</td>
<td>82.10</td>
<td>20.97</td>
</tr>
<tr>
<td>SDMT (correct responses)</td>
<td>22.60</td>
<td>8.39</td>
<td>26.50</td>
<td>13.37</td>
<td>34.75</td>
<td>9.10</td>
</tr>
<tr>
<td>WCST (Correct groups)</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>2.80</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>WCST (perseveration errors)</td>
<td>10.30</td>
<td>3.59</td>
<td>10.65</td>
<td>6.08</td>
<td>6.60</td>
<td>2.16</td>
</tr>
<tr>
<td>WCST (other errors)</td>
<td>4.65</td>
<td>4.73</td>
<td>6.45</td>
<td>5.32</td>
<td>3.05</td>
<td>2.76</td>
</tr>
</tbody>
</table>

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psychosocial needs of the patients. However, the time has come for clinicians to work closer with researchers to define knowledge gaps in our treatment protocols and to organize emerging research evidence so that more effective standards of care can be designed and implemented. Clinical insights and lessons learned from the medical setting could inspire researchers to design and conduct studies leading to better treatment protocols (Kocsis, and Tessler, 2009).

References