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CHANGES IN THE COGNITIVE STATE IN HYPOBARIC HYPOXIC CONDITIONS IN PAKISTAN

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ABSTRACT

Objective: To assess any change in the cognitive state in individuals working at high altitude. Study Design: Descriptive study.

Place and Duration of Study: Conducted in the heights of the northern areas of Pakistan, from January to May 2005.

Patients and Methods: A total of 129 volunteers were selected from the individuals on duty at high altitude. Mini Mental State Examination were administered to this cohort, while on their heights of deployment.

Results: Cognitive efficiency was found to be reduced in these individuals. This deficiency was mostly in the range of 'mild' cognitive disturbance.

Conclusions: Exposure to High Altitude can lead to problems with various domains of the cognition.

Keywords: High altitude, cognition, MMSE.

INTRODUCTION

For decades now Pakistan has been defending its frontiers, at what is known as the highest battle ground in the world, popularly known as Siachen. The hardships that the defense personnel have to face are well known and include personal, environmental and altitudinal predicaments. Many physiological changes surface at HA (High Altitude) including changes in blood pressure, respiratory rate, heart rate, peak flow, and blood oxygen saturation[1].

Human brain too, faces a reduced supply of oxygen, just like all the other organs of the human body. This has known to cause various neurological and psychological problems[2], in addition to various general medical conditions involving the eyes, skin, GIT, respiratory tract and heart[3]. Researchers world-over have come forward with interesting statistics, but most of it is based on data from mountaineers, pilots, and simulated hypoxia and artificial, experimental situations. Very little data is available on the military personnel 'in vivo', i.e. when they are actually deployed and performing their duty at HA. This issue is of more importance to us in Pakistan, than to most of the regions of the world that do not have glaciers or heights that need to be guarded.

Hypothesized structural changes in the brain after acute or chronic exposure to HA or hypobaric hypoxia, by various authors include peri-ventricular damage, fronto-temporal changes, cortical atrophy and Virchow-Robin spaces enlargement in up to 92% of the HA climbers with an increased risk in amateurs versus professional climbers[4,5].

Some of the proposed functional consequences include effects on memory (registration, recall, short term memory, verbal memory[6]), language, aphasia, organizing information[7], cognitive flexibility, attention and concentration, increased reaction time[8], simple arithmetic[9], learning, vigilance[10], recalling proper names[11] and spatial memory[12]. Cognitive impairments may depend on the period of stay at HA, the height above sea level and the speed of ascent. Individuals who develop cognitive impairments are the ones who may later develop acute mountain sickness[13]. This harm may be transitory or permanent, lasting from a few days to years[8,14]. Evidence is present that impaired neuropsychological functioning may occur even at comparatively low heights[15].

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We were motivated to undertake this research because of the fact Data from Pakistan on the subject is very scant. In this paper focus on the cognitive state of the individuals at HA.

PATIENTS AND METHODS

This study aimed at measuring the changes in cognitive state of the troops deployed at a high altitude. It included a total of 129 participants, deployed at a height of 4500 -5500 meters AMSL (Above Mean Sea Level). It was conducted from January to May 2005.

We did not wait for the participants to descend to ground or a lower height to administer the test. The author himself interviewed all the participants at their place/ height of deployment. Written consent was obtained from all individuals after explaining the purpose of study. A semi – structured interview was conducted with the participants to rule out any underlying latent psychiatric disorder. All military personnel of all ranks, deployed at a high altitude. Individuals having a past or present history of psychiatric illness, history of psychotropic drug use, or a current history of any general medical condition, were pre-excluded from the study to minimize bias. MMSE (Mini Mental State Examination) a reliable and validated instrument for detecting cognitive impairment was utilized. This instrument is used in a variety of situations and surveys apart from dementia (which was the primary objective of developing this instrument). It checks the domains of orientation (time, place, person), registration, immediate recall, short term verbal memory, attention & calculation, language (naming, repetition, 3-stage command, reading, writing) and construct ability[16]. The scores of MMSE are adjusted according to age and education levels of the individuals[17]. The alertness level is also recorded on the scale but not scored.

Sampling was done by convenience non-probability technique. The administration of this instrument took on an average of 15 minutes. A Proforma was also prepared and completed for each participant, recording the demographical details and the time period for which the individual has been on the current height. Whether suffering from any type of ailment, any past medical history, family psychiatric and medical history, were also recorded.

Other issues or stressors that came up during these interviews were communicated to the concerned authorities; special assertion was given to problems common to a large number (these issues are beyond the scope of this article).

The MMSE is the most widely used standardized instrument for cognitive impairment, which been cited on thousands of occasions. It is used in every continent, with all cultures and has translations in many languages. It is named Mini-Mental because it does not include assessment of mood and thoughts. The most widely accepted cut off score for cognitive impairment is 23. A score between 27 and 30 is considered normal, 21 to 26 mild, 11 to 20 moderate and 0 to 10 severe cognitive impairment.

Data was analyzed through SPSS version 15. Descriptive statistics were used. Mean and standard deviation (SD) were calculated for quantitative variables. Qualitative variables were described through frequency and percentages. Bivariate correlation coefficient was calculated to study the relationship of MMSE score with different variables. *p*-value <0.05 was considered as significant.

RESULTS

The consciousness level of all the participants was 'Alert'. A total of 129 male defense personnel were interviewed. The mean age of the individuals was 28.32±6.61 years, ranging from 18 to 41 years. The mean length of stay on HA was 111.44±33.43 days ranging from 45 to 170 days.

Majority (86.8%) (n=112) of the participating servicemen hailed from low lands/ plains.

Sixty nine (53.5%) of them were married. Education levels ranged from no schooling to 14 years, coming to a mean of 10.26 ± 2.72 years of schooling.

The overall mean score of the MMSE in the group was 25.96 ± 2.35. The values ranged from

20.50 to 30 (out of a total score of 30). The overall MMSE scores increased with increase in education status but the correlation was weak and nonsignificant (r = 0.153, p = 0.083). The overall MMSE scores increased with increase in age of the individual. Correlation with age was a weak one but significant (r = 0.188, p = 0.033). The overall MMSE scores increased with increase in the time period the individual stayed at the height but this correlation is weak and nonsignificant (r = 0.114, p = 0.197). The MMSE score remained same in individuals who had resided at HA previously in the last one year (r = 0.072, p = 0.415).

DISCUSSION

The abnormal overall scores in the cognitive functions largely fell in the range of mild cognitive impairment, as per the interpretation consensus of MMSE. Only 13.9% (n=18) volunteers achieved a perfect score. The rest all scored in a lesser shade than perfect. Remaining at a high altitude previously in the last one year, irrespective of the number of times the volunteer had done so did not have any remarkable effect on the cognitive state. The standing operating procedures followed including the time periods given for stay after each segment of ascent, rest and recuperation periods in between and precautionary measures in vogue may have been helpful here. The popular hearsay that remaining on HA for a longer period makes one more forgetful and predisposes to decreased concentration was still left unanswered. Although the overall scores of the cognitive state, in our population appeared to increase with the length of stay at HA, however this was a weak and nonsignificant relationship and has been proven to be a problem when investigated in the long term[2]. The cognitive deficiencies are said to be quite prominent when tested immediately after the ascent, especially a rapid one[13]. However if ascent is graded and slow the chances of developing cognitive impairments decrease[18]. A significant relation was found between the age and cognitive functions. It was found that the cognitive functions improved as the age of the mountaineer increased. Point to note is that our sample included young patients, who were not above 41 years (mean age = 28.32 years). Better education appeared to be a protective factor, but was proved to be nonsignificant in our sample.

Scores on the subsets of the scale used are given separately in table 1.

Highest problematic area was observed to be the repetition task. Here the volunteers scored the least points amongst all the subsets. The least amount of disturbed score were seen in the domains of orientation (year), writing and reading.

Picking up a cohort for examination was the first step. We need to follow these volunteers prospectively and revaluate their cognitive states after 3, 6, 9 and 12 months. We need to evaluate these HA climbers especially for memory problems, as has been documented before[14].

In most of the previous studies the data was collected after descent to base camps, or ground levels, in contrary to our study where we collected data at the levels of deployment.

Updating, refining and adhering to the acclimatization protocols, can always improve the efficient functioning at HA[19]. Some medicines have also been recommended for prophylaxis of HA illnesses. They include acetazolamide, flunarizine, gingko biloba, and dexamethasone[20-22].

Limitations: No control data was utilized in our study, which would have increased the reliability of our data. Research was conducted at a ceiling of 5500 meters AMSL. Some areas in our country are even higher than this elevation; data from these heights could also be useful.

MMSE lacks in sensitivity to mild cognitive impairment. It is not a diagnostic tool. Unusual scores point out the need for advanced assessment.

CONCLUSION

Exposure to High Altitude and performing duties in such a difficult environment leads to an overall mild decrease in the cognitive efficiency of the individual. Existing procedures should be adhered to, and steps should be taken to improve and facilitate them. Further

research is needed to ascertain other possible causes so that they may be alleviated.

Declaration of Interest: None.

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