

Requirements of acclimatization: Physiological and psychological perspectives

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The posting of pilots for flying operations in high-altitude areas has raised the issue of assessing the requirements of acclimatization. High-altitude stress of terrestrial altitudes is observed to result in sympathetic hyperactivity, cerebral cortical depression, deterioration in hypothalamic thermoregulation efficiency, disturbance in sleep, increase in anxiety, and decline in cognitive functions, during the initial phase of induction. Five days of acclimatization have been proposed at about 3500 m to prevent altitude maladies as well as for optimal flying efficiency. The salient findings of the series of studies conducted on physiological and psychological aspects of acclimatization are reviewed.

Keywords: High altitude. Acclimatization.

In aviation high altitude (HA) usually refers to flight altitude. India has the distinction of having an airfield at an altitude of 3500 m in the Western Himalayas, and carries out aviation operation at that HA by positioning squadrons of transport aircraft, fighters and helicopters. Terrestrial HA poses stresses like hypoxia, cold and psychological factors of isolation, monotony, sensory deprivation and fear of the unknown. Flight operations in such regions pose additional problems of labile and uncertain weather conditions. In view of the above, the question arises whether there is a requirement for a proper acclimatization schedule. This paper deals with the physiological and psychological responses of men on acute induction to HA and during the initial phase of acclimatization. Based on these findings, an acclimatization schedule has been proposed.

Physiological responses during acute induction

Autonomic nervous system. Sympathetic hyperactivity and increased catecholamines secretion

observed at HA leads to many adaptive autonomic and metabolic responses. Hyperventilation brought about through chemoreceptor activation is one of the important responses for initial acclimatization. Increase in heart rate, blood pressure, core temperature, catecholamines and fall in mean skin temperature indicate sympathetic overactivity immediately on arrival at HA. This activity reaches the peak between 48 and 72 h after arrival at HA. Thereafter, there is a gradual decline in sympathetic hyperactivity, which remains higher even after 5 weeks of acclimatization.

Cerebral cortical activity. There exists cerebral cortical depression as seen from the increase in alpha index and averaged amplitude on day 2. This is primarily due to hypocapnea, resulting from hyperventilation, which has a dampening effect on the ascending reticular activating system. After one week of acclimatization, there is a gradual build-up in EEG towards normalcy. This is very important from the point of view of flight operations. During the first week of stay at HA, the existence of autonomic disturbance and cerebral cortical depression warrants a proper acclimatization before regular flight operations.

Orthostatic tolerance. Flight in fighters demands an optimal level of orthostatic tolerance. The cardiovascular regulation during orthostasis is impaired during the first week of stay at HA, primarily due to hypocapnic effect on cardiac and vasomotor centres. This function improves during the second week of acclimatization.

Sleep disturbance. There are frequent short bursts of arousal during sleep at HA, along with reduction in stages 3 and 4 of non-REM sleep. The sleep quality is recovered after 2 weeks of

acclimatization. The decline in sleep quality may also impair the flying efficiency, as observed from the critical flicker frequency (CFF), decline in concentration and psychomotor performance.

Psychological responses

The anxiety levels as measured using PF-16 questionnaire showed increase during the first week of induction. The concentration and psychomotor performance were lower during the first two weeks of stay at HA. The emotional composure, security/insecurity and extroversion/introversion scales showed instability during the initial period.

Acclimatization schedule

Based on the autonomic responses, CNS functions and psychological profile during the initial period of induction, a seven-day schedule of acclimatization is proposed:

- Day 1 : Complete bed rest.
- Day 2 : Minimal physical activity.
- Day 3-7 : Progressive increase in physical activity.

It would be preferable for pilots or ground crew to stay for a minimum period of 3 months at HA once posted for flying operations at HA to utilize the full benefit of acclimatization. If they return from the plains after leave/duty, they will also need to undergo 5 days of acclimatization.

- Day 1 : Complete bed rest.
- Day 2 : Minimal physical activity.
- Day 3-5 : Progressive increase in physical activity.

Facilitation of acclimatization

The process of altitude acclimatization can be facilitated by some of the methods like yoga, Indian herbal composites and vitamin C supplementation. Psychological support to the fresh inductees by appropriate leadership and social milieu can also facilitate the process of acclimatization. Some screening tests based on chemoreceptor sensitivity to hypoxia and hypercapnea may also be used for predicting the susceptibility to maladaptation. This can be used for emergency operations.

Recommendations

1. Formulation of a specific acclimatization schedule for pilots and ground crew to be posted at HA is necessary.
2. Tenure of posting needs to be optimal to have the benefit of acclimatization for improving operational efficiency.
3. Use of yoga, Indian herbal composites or vitamin C can be considered for facilitating the process of acclimatization.
4. Assessment of chemoreceptor sensitivity may be useful for predicting susceptibility to maladaptation at HA.

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