

## Suggested operating schedules for sudden induction of unacclimatized or partially acclimatized aircrew for air operations at high altitude

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**Abstract:** Indian Air Force (IAF) is the first Air Force in the world, to have all types of sustained air operations for long periods, from high altitude airfields and helipads. Existing instructions on "Effects of cold and high altitude and their prevention" do not cater for fighter, transport, helicopter aircrew and supporting airmen aircrew operating in and out of high altitude airfields. A prudent policy with clear cut directives is required to seize the issues involving the safety of unacclimatized aircrew, required to operate at high altitudes for operational reasons. The situations which require solution are sudden induction of Fighter, Transport, Helicopter aircrew to high altitude on detachment, Transit aircrew that arrive at high altitude for short period of time, Transit aircrew that are forced to stay at high altitude for more than normal required period, Aircrew permanently based at high altitude and Personnel on detachment to high altitude. An analysis of the statistics of HAPO cases in Armed forces to decide the maximum safe period that an unacclimatized individual can spend at high altitude, on being inducted by air was conducted at WAC. Cases were taken from High Altitude Medical Research Centre (HAMRC) Leh and from the database at Armed Forces Medical College (AFMC) Pune to ascertain the minimum period for development of high altitude pulmonary odema (HAPO) symptoms. Present statistics cannot give the time period in hours but it is confirmed that unsatisfactory acclimatization induces HAPO even on the first day of induction. The recommended operating schedules for sudden induction of unacclimatized or partially acclimatized aircrew and the basis of recommending the schedules to IAF have been discussed in this paper.

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**Key Words :** aircrew at high altitude; acclimatization; HAPO; air operations at high altitudes

### Introduction

Indian Air Force is the first Air Force in the world, to have all types of sustained air operations for long periods, from high altitude airfields and helipads. Logistic and operational air support continues throughout the year, to sustain military bases in climatically very hostile terrains. In winters, it is the air links, which sustain military positions at the highest battlefields in the world. There is no similar example in the military history for such an air endeavor, simply because there is no such geographical location on earth, where armed forces are holding positions permanently. The terrain altitude for IAF operations ranges from sea level to 6000m.

### Key altitude ranges and acclimatization schedules

The key altitude ranges, as defined by the

Indian Army which are used, for its very famous acclimatisation schedules, for its foot soldier are 2700m - 3600m, 3600 m - 4500 m and > 4500m.

The three stage acclimatisation schedules for soldiers extend up to 14 days for Stage III to reach altitudes of > 4500m. Stage I acclimatisation lasts for 6 days for altitudes range of 2700m to 3600m. To achieve Stage II additional 4 days are required, which is considered appropriate for altitudes 3600m to 4500m. For re-entry to high altitude, after 10 -30 days of break at lowland, 4 days at each stage need to be spent. After break of > 30 days full acclimatization schedule as fresh inductees needs to be followed.

### Inherent risk in air operations at high altitudes

Such time schedules are obviously not tenable for air operations. Fighter aircrew fly their

aeroplanes from lowland bases and need to start their activities almost immediately from high altitude bases. Similarly, transport and helicopter aircrew need to operate multiple sorties, not only from lowland base to high altitude airbase but to continue on the same day from high altitude to higher altitude for hopping sorties. Ground crew also needs to dovetail their activities with flying activity, at the earliest. It is this group of aircrew and ground crew who have to operate at high altitudes, in timeframe much shorter than that available to the army for the purpose of acclimatisation. Air operation at high altitudes, therefore has an inherent risk for its crew from the physical, physiological and psychological disturbances, which may occur in a healthy lowlander on sudden inductance to high altitude by air. The spectrum of such effects may range from subtle mood and cognitive changes to life threatening situation, which develop rapidly. Mildest of such effect may become significant in precision flying that is required in the valleys and glaciers to landings on matchbox helipads where winds change, the weather deteriorates and the aircrew is very lonely.

### **Issues which required answers**

Many instructions exist on the “Effects of cold and high altitude and their prevention” but they do not cater for fighter, transport, helicopter aircrew and supporting airmen aircrew operating in and out of high altitude airfields. A study was required to seize the issues involving the safety of the unacclimatised aircrew, required to operate at high altitudes for operational reasons. The situations which needed to be covered in such air operations were sudden induction of fighter, transport, helicopter aircrew to high altitude on detachment, Transit aircrew that arrive at high altitude for a short period of time, Transit aircrews that are forced to stay at high altitude for more than normal required period, Aircrew permanently based at high altitude and Personnel on detachment to high altitude. While

formulating the schedules following issues were also considered:

- 1 Risk of high altitude illness need to be weighed against the safe completion of operations.
- 1 We are the first country in the world to operate from such high altitudes.
- 1 World literature on the subject is scanty
- 1 Effect of drugs used as preventive measures, on the aircrew performance is uncertain.

### **Aim**

The aim of this study was to suggest safest operating schedules for sudden induction of partially or unacclimatised aircrew for air operations at high altitude.

### **Material & Method**

An analysis of the statistics of HAPO cases in Armed forces to decide the maximum safe period that an unacclimatised individual can spend at high altitude, on being inducted by air was conducted at Western Air Command (WAC). Cases were taken from HAMRC Leh and from the database at AFMC Pune to ascertain the minimum period for development of HAPO symptoms.

### **High Altitude Sickness**

Lack of sufficient time for acclimatisation, increased physical activity, and varying degrees of health may be responsible for the acute, sub acute and chronic disturbances that result from hypoxia on exposure to altitudes greater than 2000 meters (6560 feet) for general population. Marked individual differences in tolerance to hypoxia exist. Patients with sickle cell disease are at high risk of painful crises from altitude-induced hypoxemia. Acute mountain sickness (AMS), acute high-altitude

pulmonary odema (HAPO), high altitude cerebral odema (HACO), sub acute mountain sickness and chronic mountain sickness (Monge's Disease) are known clinical entities, which occur at high altitudes.

### **HAPO Incidence and other salient Epidemiological features from Armed Forces Epidemiology & Surveillance Centre (AFCEC), AFMC (Jan2003 to Apr2003)**

There were total of 86 cases of HAPO reported during the period. Four of these cases were Air Force Personnel (1 Officer, 3 airmen). Onset duration in hours after high altitude area was not available. Onset in Days and other salient epidemiological features were:

- o 46 (53.5%) of the reported 86 cases of HAPO were labeled as "Unsatisfactory Acclimatisation"
- o 43 of these unacclimatised cases had entry to high altitude area by air, while 3 cases had entry by road.
- o 26 cases (56.5%) had onset of symptoms within 1 Day (24 hrs) of entry. Only 2 of these cases had entry by road while 24 cases entered by air.
- o 20 cases (43.5%) had onset within 2 to 5 days of entry to high altitude area.
- o All 4 Air Force personnel affected by HAPO had "Unsatisfactory Acclimatisation". All four had entry by air. Two cases had onset within a day (24hrs) of entry, while two other had onset within 2 to 3 days.

The above statistics cannot give the time period in hours but it is confirmed that unsatisfactory acclimatization induces HAPO even on the first day of induction. Therefore a **six-hour period** as a relatively safe period for unacclimatised pilot on oxygen and not doing any physical strain was taken

as benchmark for formulation of schedules for aircrew. It also conforms to the daytime flight duty time limitations for high intensity flying.

### **Suggested Operating Schedules for Aircrew for High Altitude Operations**

The following Five Schedules were recommended:

#### **1 Schedule 1 OPERATING SCHEDULE FROM HIGH ALTITUDE FOR FIGHTER AIRCREW FOR EXPOSURE LESS THAN 06 HOURS (Transiting aircrew fighter)**

- o Physical exertion to be barest minimum.
- o Aircrew to breath 100% oxygen from base altitude to high altitude.
- o Aircrew to breath 100% oxygen the moment he sits in the cockpit for take-off from high altitude airfield.
- o Aircrew to be transported from ac to restroom and back by aircrew van.
- o Availability of oxygen at aircrew room for breathing oxygen whenever possible during waiting period of maximum of 06 hours.
- o Drink water/ fluids and small meals/ fruits during period of transit
- o Plan take off from high altitude to lower altitudes within 6 hours period at altitude.
- o Report to MO if any abnormal symptoms are felt like fatigue, breathlessness, cough, headache, nausea or any type of illness.
- o If delayed at altitude by more than 06 hours follow Schedule - 4 as given for detachment aircrew.

z Note: (i) Transiting aircrew fighter means that the ac is brought from lowland airfields to land at altitude higher than

2700m to take off again for low land base with in six hours.

z Note: (ii) Exposure time to high altitude of 6 hrs and less is in a cycle of 24 hrs.

**z Schedule 2 OPERATING SCHEDULE FROM HIGH ALTITUDE FOR TRANSPORT AIRCREW FOR EXPOSURE LESS THAN 06 HOURS (Transiting aircrew transport)**

- o Physical exertion to be barest minimum.
- o Aircrew to breath 100% oxygen from base altitude to high altitude.
- o Aircrew to breath 100% oxygen the moment he sits in the cockpit for take-off from high altitude airfield.
- o Aircrew to be transported from ac to restroom and back by aircrew van.
- o Provision of oxygen cylinders or oxygen concentrations at aircrew room for breathing oxygen whenever possible during waiting period of maximum of 06 hours.
- o Drink water/ fluids and small meals/ fruits during period of transit.
- o Can take off for another airfield on 100% oxygen as long as he takes off for lower altitudes/ home base within total of 06 hours period from his first landing at high altitude airfield.
- o Report to MO if any abnormal symptoms are felt like fatigue, breathlessness, cough, headache, nausea or any type of illness.
- o If delayed at altitude by more than 06 hours follow Schedule - 4 as given for detachment aircrew.

z Note: (i) Transiting aircrew transport means that the ac is brought from lowland airfield can do multiple landings at high

altitude airfields within 06 hours period and takes off for home base or low land airfield on 100% oxygen at the end of 06 hours mission at high altitude airfields.

z Note: (ii) Exposure time to high altitude of 6 hrs and less is in a cycle of 24 hrs.

**Schedule 3 OPERATING SCHEDULE FROM HIGH ALTITUDE FOR HELICOPTER AIRCREW FOR EXPOSURE LESS THAN 06 HOURS (Transiting aircrew helicopter)**

- o Physical exertion to be barest minimum.
- o Aircrew to breath 100% oxygen from base altitude to high altitude.
- o Aircrew to breath 100% oxygen the moment he sits in the cockpit for take-off from high altitude airfield.
- o Aircrew to be transported from ac to restroom and back by aircrew van.
- o Provision of oxygen cylinders or oxygen concentrations at aircrew room for breathing oxygen whenever possible during waiting period of maximum of 06 hours.
- o Drink water/ fluids and small meals/ fruits during period of transit
- o Can take off for another airfield on 100% oxygen as long as he takes off for lower altitudes/ home base within total of 06 hours period from his first landing at high altitude airfield.
- o Report to MO if any abnormal symptoms are felt like fatigue, breathlessness, cough, headache, nausea or any type of illness.
- o If delayed at altitude by more than 06 hours follow Schedule - 4 as given for detachment aircrew.

z Note: (i) Transiting aircrew helicopter

means that the Hc is brought from lowland airfield can do multiple landings at high altitude airfields within 06 hours period and takes off for home base or low land airfield on 100% oxygen at the end of 06 hours mission at high altitude airfields.

z Note: (ii) Exposure time to high altitude of 6 hrs and less is in a cycle of 24 hrs.

**Schedule 4 OPERATING SCHEDULE FROM HIGH ALTITUDE FOR FIGHTER/TRANSPORT/HELICOPTER AIRCREW ON DETACHMENT (Altitude Exposure of > 6 h)**

- o No flying to be undertaken for the first 48 hours and aircrew to take maximum rest.
- o After 48 hours:
  - z Aircrew to fly familiarization sorties.
  - z Aircrew to breathe 100% Oxygen from ground and for duration of the sortie.
  - z Aircrew be transported to the aircraft by aircrew van.
  - z Physical exertion to be barest minimum.
- o Report to MO if any abnormal symptoms are felt like fatigue, breathlessness, cough, headache, nausea or any type of illness.

**Schedule 5 OPERATING SCHEDULE FROM HIGH ALTITUDE FOR ALL AIRCREW IN TRANSIT & FOR LONG DURATION STAY**

- o Aircrew in transit: Aircrew transiting through high elevation bases for short durations need to take certain precautions and may fly without acclimatization, provided they do not display symptoms of High Altitude Sickness (HAS), like fatigue, breathlessness, cough, headache, nausea or any other type of ailment. If the stay at the

high elevation base is more than 6 hours but less than 12 hours, a medical check is mandatory before flight. If the stay at high elevation bases gets extended beyond 12 hours, aircrews are to go through the acclimatization schedule as given below. No concession is to be given in this regard.

- o Long Duration Stay: Aircrew arriving at high elevation bases for dett or posting are not to fly for first 48 hours. They are to report for and be cleared by a pre-flight medical examination prior to commencement of flying. When such aircrews return to air bases at a lower level, their acclimatization is valid for 7 calendar days: i.e. aircrew returning to high altitude within 7 calendar days need not to go through the 48 hours of acclimatization mentioned above, unless High Altitude Sickness symptoms are noticed.

**General Precautions at High Altitude**

- o Personal physical fitness is the best antidote to avoid High Altitude Sickness. Aircrew operating to high elevation locations should be well rested and avoid alcohol intake at least 24 hours prior to such sorties.
- o Physical exertion is to be kept to a minimum. Mechanical Transport is to be used to the extent possible, for movement between crew room, domestic accommodation, etc.
- o Aircrews are to breathe 100% oxygen as soon as practicable on ground (before or after start up) and be on ac oxygen for the entire duration of the sortie.
- o To reduce symptoms of High Altitude Sickness, aircrews are to drink water or other fluids in plenty and eat fruits and/or

small meals during transit halts. Do not consume alcohol.

- o Aircrews are the best judges of their own physiological condition. High Altitude Sickness symptoms (fatigue, breathlessness, nausea, headache, etc) are to be brought to the notice of the MO as these may not be readily discernible externally.
- o Self-medication is to be avoided at all costs.

### **Conclusion**

Operations from high elevation helipads, airfields and ALGs require special attention to physiological conditions of all personnel. In the case of aircrew this requirement needs greater emphasis as flying in this region requires superior skill and alertness. Repetition of general precautions in above schedules is intentional not to miss relevant precautions at the field level. Schedule 5 has found most favourable response from the aircrew.

**Conflict of interest: None**

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