

JAMES RENNIE BEQUEST

REPORT ON EXPEDITION/PROJECT/CONFERENCE

Expedition/Project/Conference Title: Cardiorespiratory coupling and sleep at altitude

Travel Dates: 07/08/03 – 06/10/03

Location: Chacaltaya Laboratory, Bolivia

Group Member(s): Nina Rzechorzek, Alexander Phythian-Adams.....

Aims: To carry out a descriptive study of sleep at altitude in normal subjects

OUTCOME (not less than 300 words):-

The objective of our travel was to take part in Apex 2, one of the world's largest controlled-ascent high altitude research expeditions. Apex 2 involved over 104 volunteer research subjects who participated in a range of investigations into human physiology in hypoxic conditions at the Chacaltaya laboratory, Bolivia. My assistant, Alex, and I contributed as research subjects, but we were primarily involved with the expedition as Team Leaders as well as to carry out a study into sleep at altitude.

The study comprised 27 male subjects who underwent full polysomnography (PSG) both at sea level (SL), and at 5200m in Bolivia in the world's highest laboratory. The aim of the investigation was to provide a descriptive study of sleep at altitude, looking in particular at the phenomenon of Periodic Breathing (PB), which is characteristic of sleep in such conditions. PB occurs when a series of inspirations that increase to a maximum level subsequently decrease in force and length until apnoea is reached. Consequently, hyperventilation follows and the cycle begins again. PSG involved the subjects being 'wired up' to a number of electrodes measuring various parameters such as eye movements (electrooculogram, EOG), abdominal and thoracic movements, oxygen saturation, nasal air flow (a thermistor), leg and jaw movement (electromyogram, EMG), heart rate (electrocardiogram, ECG) and brain activity (electroencephalogram, EEG). Data collection was successful, with subjects being monitored for a full night at SL and on the first and last nights spent at high altitude.

As it had previously been demonstrated that obstructive apnoeas in healthy travellers increase in number on exposure to high altitude, we hypothesised that PB in our normal subjects might involve a significant and measurable obstructive component. One focus of the study was to be the obstructive apnoeic component of PB, as many questions remain about its role in breathing pattern. In addition, we were to look at possible changes in cardiorespiratory coupling, a temporal coherence between the cardiac and respiratory rhythms noted commonly during rest, sleep and anaesthesia. Impairment of this coherence is apparent in some patients with congestive heart failure (CHF) at SL, and we were interested to see if a similar impairment occurred in healthy subjects upon ascent to the lab. We proposed that changes in cardiorespiratory coupling could be detectable at altitude and that these might be related with apnoeas during sleep.

Whilst data collection is yet to be completed for a few subjects at SL, preliminary analysis shows that there were many occurrences of PB during sleep at altitude in the majority of subjects. As our analysis proceeds, the focus remains upon the description of obstructive apnoeic episodes as well as the significance of cardiorespiratory coupling at altitude. The vast amount of data that can be collected by PSG methodology means that data analysis will be a time-consuming process. However, and most importantly, it allows many variables to be assessed in each of the sleep studies. There is huge potential for correlations to be found between the parameters we measured as well as those that featured in over twenty other research projects that took place during the expedition. We aim to publish the results of our study later this year and produce further publications that extend our understanding of the mechanisms of PB, sleep at altitude and how these might relate to the development of Acute Mountain Sickness (AMS).

We are indebted to the James Rennie Bequest whose generous donation towards our travel costs meant that we were able to undertake our study in the unique environment provided by the excellent facilities at the Chacaltaya Laboratory. We also owe many thanks to the other researchers on the expedition who helped with data collection and to the volunteers themselves for taking part. As our work proceeds we will endeavour to update The Bequest with the results of our analysis. The Bequest has made a pivotal contribution to our interests in high altitude medicine for which we are extremely grateful.

Nina Rzechorzek (Team Leader, Apex 2)
Alexander Phythian-Adams (Team Leader, Apex 2)