Name of research institute or organization:

Respiratory Muscle Laboratory, Dept of Asthma, Allergy and Respiratory Science, King's College London, UK

Title of project:

Changes in neural respiratory drive and breathlessness during ascent to high altitude

Project leader and team:

Dr Caroline Jolley, Dr Joerg Steier (project leaders), Dr Nic Cade, Mr Ben Walker, Prof John Moxham (principal investigator)

Project description:

Between 24th-27th November 2007, we performed a series of investigations at the Jungfraujoch High Altitude Station as feasibility studies in preparation for the BREATHE expedition to Mt Aconcagua in January 2008. The aim of this study is to investigate the relationship between respiratory drive and breathlessness at 3 increments of ascent to high altitude, and to make comparisons with the same measurements made at sea level. Specifically, we seek to answer the following question: does the relationship between levels of neural respiratory drive and exertional breathlessness change during ascent to altitude? This should provide data to further our understanding of differing symptomatic responses to hypoxic drive at high altitude, and our understanding of the physiology of breathlessness in general.

Neural respiratory drive was measured by quantifying the diaphragm electromyogram (EMGdi) recorded using a multipair oesophageal electrode catheter and surface recordings of the parasternal intercostal muscles. EMG activity was recorded continuously at rest (5-10 minutes), during a submaximal step test and an incremental cycle exercise in all 4 members of our research team (3 male, 1 female, age 27-34 years, all healthy subjects). Minute ventilation, oxygen saturation (pulse oximetry) and heart rate were also measured concurrently. Breathlessness was assessed using the Borg breathlessness scale at rest, and at each one minute of exercise and a 2-minute recovery phase. EMG signals were amplified and band-pass filtered between 10 Hz and 3 kHz (Biomedical amplifier Pclab-3808, Guangzhou Yinghui Medical), and acquired and digitised using a Powerlab analog-to-digital converter running Chart software (ADInstruments Pty Ltd, Castle Hill, Australia) at a sampling frequency of 2kHz. The recordings were stored for off-line analysis following post-acquisition band-pass filtering between 20Hz and 1kHz using Chart software. A Panasonic Toughbook CF28 laptop was used to acquire and store data. Examples EMG traces recorded at rest and at peak exercise are shown in figure 1.

The studies ran without complication and are, to the best of our knowledge, the first recordings of respiratory muscle EMG activity to be made using this technique at high altitude.

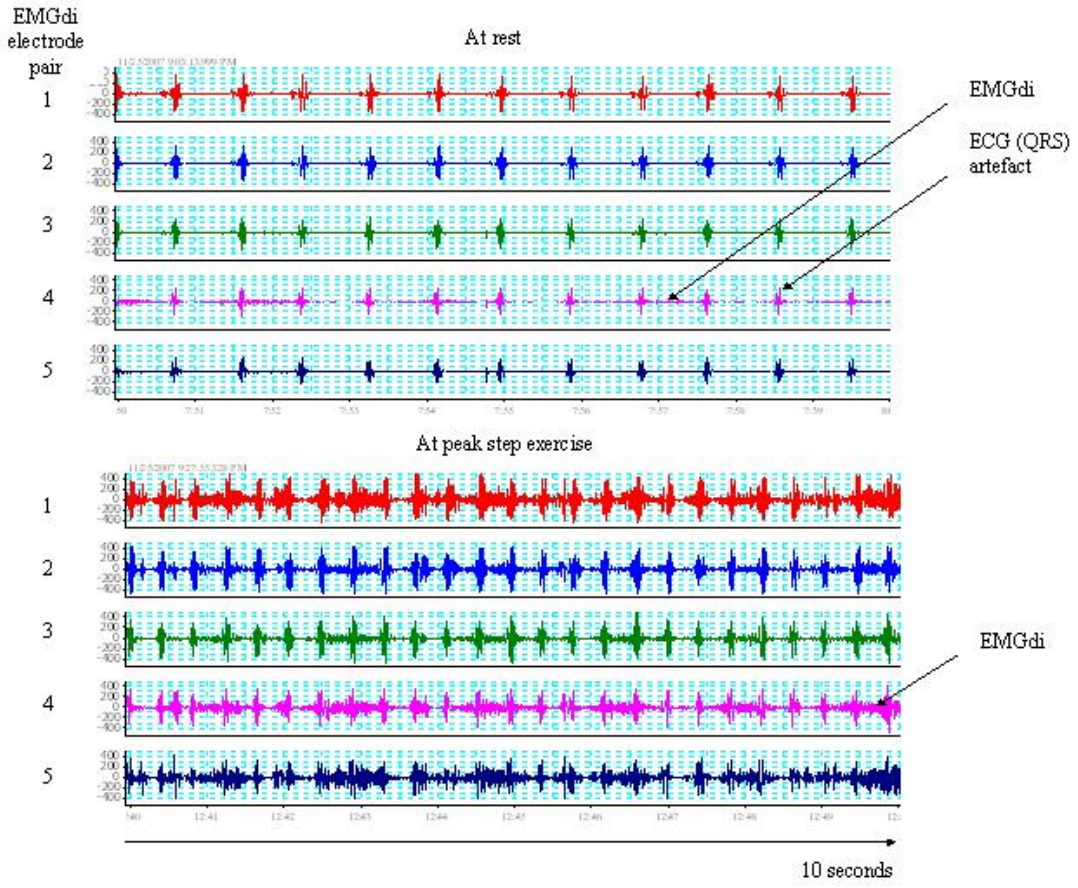

Figure 1
Representative diaphragm EMG (EMGdi) traces recorded using a multipair oesophageal electrode catheter at rest and during a step exercise protocol. The increased amplitude of the EMGdi trace on exertion indicates increased neural respiratory drive. EMGdi units are microvolts.

Key words:

Breathlessness, respiratory muscles, electromyogram, physiology, altitude

Address:

King's College London School of Medicine
Denmark Hill Campus, Chest Unit
Bessemer Rd
London SC5 9RS / UK

Contacts:

Dr. Caroline Jolley, Dr. Jörg Steier