Expedition medicine: pushing the boundaries of human physiology

The Expedition Medicine symposium was held on 14 November 2013 at the Royal College of Physicians of Edinburgh

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INTRODUCTION

Providing medical support to adventurous expeditions, particularly those travelling to remote or austere environments, presents a unique array of challenges to the expedition doctor. Extremes of temperature, weather and altitude, compounded by the problems of limited equipment, poor lines of communication and an unreliable evacuation chain all make the practice of medicine in the wilderness wholly different to that in the urban environment. The study of how humans perform at the limits of physiological stress can also add to our wider understanding of how individuals and populations adapt or maladapt to hypoxia and other environmental stressors, much of which is applicable to medicine more broadly.

SESSION 1: EXPEDITION MEDICINE

Infectious diseases remain a major medical issue for expeditions to remote locations. Dr Andrew Simpson (Consultant Medical Microbiologist, Public Health England, Porton Down) provided a comprehensive overview of both the common and more rarely encountered tropical diseases, and provided a framework for approaching fever in the returning traveller. His account of the recent case of Crimean-Congo haemorrhagic fever emphasised the need for a broad differential and appropriate isolation precautions.

Mr Martin MacInnis (PhD student, University of British Columbia, Vancouver, Canada) presented data from a recent research expedition to Gosainkunda in Nepal. His group recruited a cohort of 538 pilgrims travelling to the Janai Purnima Festival at 4,380m and demonstrated that acute mountain sickness (AMS) was more common amongst women (relative risk [RR] = 1.57) and in those aged over 35 years (RR=1.63).[1] He reported that sleep correlated poorly with the other symptoms attributed to acute exposure to altitude, and argued for a reconsideration of the Lake Louise Score currently used to define AMS.[2]

The problems of infectious risks from emerging pathogens was addressed by Dr David Brett-Major (Medical Officer, World Health Organization, Geneva). The novel risks to expeditions posed by Middle East Respiratory Syndrome corona virus (MERS-CoB) and H7N9 influenza A in particular were discussed as examples of developing threats.

SESSION 2: HUMAN ADAPTATION TO EXTREMES

Dr Sundeep Dhillon (Xtreme Everest climbing lead and London-based GP) discussed the great logistical challenges involved in mounting a large-scale research expedition to a remote location. The Caudwell Xtreme Everest Expedition conducted an ambitious programme of hypoxia research, much of it at altitudes above 8,000 m. Perhaps most famously, his group were able to perform arterial blood gas measurements at 8,400 m and demonstrated a mean alveolar partial pressure of oxygen (PaO_2) of 3.28 kPa and carbon dioxide ($PaCO_2$) of 1.77 kPa in four climbers descending from the summit.[3]

Evolutionary adaptation to cope with hypoxia was the subject of Dr Gianpiero Cavalleri's presentation (Biomedical Research Lecturer, Royal College of Surgeons in Ireland). Populations living on the Tibetan plateau (mean haemoglobin [Hb] 15.6 g/dl) have adapted to altitude differently to those inhabiting the Andean altiplano (mean Hb 19.2 g/dl). Two genetic signals have recently been identified by a gene-wide association study (GWAS) – EPAS1 (specific to Himalayan populations)[4] and EGLN1 (shared across high altitude regions); functional studies are ongoing to understand the significance of these.

The prestigious Stanley Davidson lecture was delivered by Dr Stuart Harris (Assistant Professor, Wilderness Medicine, Harvard University). He described wilderness medicine as the provision of resource-limited medicine under austere conditions. The focus on rational use of

resources, reliance on expert history and examination and the development of good clinical judgement have clear application outside the field of expeditions.

SESSION 3: ORIGINAL RESEARCH REPORTS FROM EXPEDITIONS

Miss Laura Nicol (Surgical research Fellow, NHS Highland) reported an incidence of AMS of 16% in trekkers attempting to summit Kilimanjaro. Opinion from the audience supported her assertion that many trekkers attempt the mountain too quickly without consideration of the dangers posed by too rapid an ascent profile.

I presented a new analysis from the Altitude Physiology Expeditions (Apex) group, in which network clustering methodology was used to identify three distinct clusters of symptoms experienced by 293 subjects ascending acutely to altitude.[5] These data supported the conclusions of Martin MacInnis' earlier presentation that sleep correlates poorly with the other symptoms experienced by subjects at altitude.

Dr Matt Wilkes' (ST4, Emergency Medicine, Royal Infirmary of Edinburgh) account of being expedition doctor to the Wings of Kilimanjaro paragliding expedition stressed the ethical obligation doctors have to treat injured or ill local porters to a high standard, sometimes against the wishes of non-medical expedition leaders. Finally, Dr David Crookes (General Practitioner, Edinburgh) recounted how Sgt Mike Beamish (Royal Air Force) rescued him by helicopter following a serious climbing accident in the Scottish Cairngorms. This brought into sharp relief the serious risks associated with adventurous sport in the wilderness, as well as emphasising the skill, teamwork and experience of UK mountain rescue teams.

SESSION 4: GETTING HOME SAFELY

Professor Steve Wigmore (Professor of Transplant Surgery, University of Edinburgh) summarised the medical issues associated with ocean yacht racing. Although seasickness and drowning may be unique to water-based expeditions, many of the other challenges – infection control, cold, trauma, challenging evacuation chains – are familiar problems to all practitioners of wilderness medicine.

Drawing together many of the themes of the day, Mr Jamie Andrews (mountaineer) described a personal tale of evacuation following a serious alpine accident, and the challenges of returning to adventurous sport with significant disability. This provided a sobering reminder that wilderness medicine does not finish with the end of an expedition, and that rehabilitation following accidents in the wilderness may be required for several years subsequently.

TAKE HOME MESSAGE

This symposium underlined the broad scope of practice of doctors involved in supporting expeditions to remote locations. There remains much to be learned about the human body's response to extreme physiological stressors, some of which is analogous to critical illness. Pursuing these scientific questions will support many years of research expeditions for budding wilderness medicine and altitude researchers.

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