Anaesthesia at High Altitude

I spent my medical elective studying anaesthesiology at the Hospital Antonio Lorena in Cusco, the former heart of the Incan Empire, which sits at 3362m above sea level. As such, it is considered an area of high altitude. Cusco is a popular area for tourists as it is within an easy proximity of the Inca Trail and provides a place to acclimatise. In order to appreciate this alternate side to the provision of medical care in the area, I also spent time in the O₂ Medical Network Clinic which provides health care solely to tourists.

Ascending to altitudes of this height can have a number of physiological effects on the un-acclimatised individual. Firstly, hyperventilation occurs in order to combat hypoxia, as a result of the reduced partial pressure of oxygen in the air, by elevating the alveolar oxygen tension. Secondly, hypoxia stimulates increased red blood cell production over the following months. Thirdly, pulmonary hypertension occurs due to pulmonary arterial constriction secondary to hypoxia. Hypervolaemia and polycythemia may also play a minor role in this process. It is this increase in pressure that can, in turn, lead to High Altitude Pulmonary Oedema. Finally, hypoxia at high altitude can lead to cerebral vasodilation resulting in decreased cortical functioning¹.

Anaesthetics have been administered at a wide variety of altitudes throughout history. However there is a lack of reports of anaesthetic complications encountered throughout this time². It is currently thought that when conducting anaesthesia at high altitude the following points must be considered: the risk of peri-operative hypoxia is greater than at sea level; there is greater risk of volume overload occurring with fluid resuscitation; there is likely to be greater blood loss than at sea level as a result of the high venous pressure and the increased volume; patient will be less able to control their body temperature due to the already hypothermic conditions at high altitude¹.

During my elective I encountered one particular anaesthetic practice that sparked my interest. While I was volunteering in the tourist clinic in Peru I encountered a patient who had suffered a bowel obstruction whilst on holiday and had undergone surgery. On reading his notes I noticed that one of the
anaesthetic agents that had been used was Ketamine. Although always kept to hand in the drug cupboard, Ketamine is a drug that I have rarely seen used in the UK. I attempted to ask the clinic doctor and the surgeon why this particular drug had been used but they were unable to enlighten me. The anaesthetist, who only attended the clinic on an ‘ad hoc’ basis, was unfortunately no longer on site. So, I decided to look further into the use of Ketamine under these conditions.

In 1995, Nunn suggested that Ketamine may be a suitable anaesthetic for use at high altitudes but was not able to back this up with evidence from any trials. Following this, Bishop et al. presented a series of 11 cases in 2000 documenting the use of Ketamine anaesthesia at 3900 metres. They concluded that Ketamine is a safe and effective means of anaesthesia at high altitude on account of the fact that, as a dissociative anaesthetic, it does not suppress ventilation or laryngeal reflexes when given in low doses. They also felt that they had overcome the problem of emergent nightmares by pre-medicating the patients with Midazolam.

In 2007, Grocott and Johannson presented the case of a 22 year old woman with post-partum haemorrhagic shock who had been given Ketamine as an emergency anaesthetic. Although the patient did suffer deep anaesthesia and apnoea with a dose normally associated solely with analgesia at sea level, as well as confusion and visual hallucinations upon wakening, they too concluded that Ketamine anaesthesia was suitable for use at high altitude in low doses. They even extended their conclusions to include its use as safe as an emergency anaesthetic. They did, however, qualify these conclusions with the statement that “it is probable that the benefits outweigh the risks only where life or limb are acutely threatened”. This was as a result of the increased sensitivity to lower doses at high altitude. In response to this case report, Moser wrote that a number of agents, not just Ketamine, result in impaired respiration at high altitude at doses which have no effect on respiration at low altitude. They both advised extreme caution when using any anaesthetic agents at high altitude.

WORD COUNT = 737
REFERENCES