Three journeys to high altitude: medicine, Tibetan thangkas, and Sepu Kangri

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ABSTRACT – This article begins by highlighting the work of several pioneers of altitude medicine, and their achievements in physiology and clinical observation. Tibetan medicine of the 17th century is then introduced, particularly the medical paintings (thangkas) and the conduct of traditional physicians. Finally, I mention recent British mountain exploration in central Tibet during 1996, 1997 and 1998 and the challenge of Sepu Kangri which, at 6,995m, is the highest peak of the eastern Nyangla Qen Tangla Shan.

Man's struggle with the high altitude environment has been a story not only of physical endeavour but of physiological enquiry, into which have been dovetailed astute clinical observations. In the 30 years during which I have been climbing and working as a doctor on expeditions to the great ranges, I have witnessed fundamental changes in our understanding of the mechanisms and medical effects of hypoxia. In particular, there is increasing awareness of high altitude pulmonary and cerebral oedema as important causes of serious illness and of death when they occur above 13,000ft (4,000m).

This article seeks first to unravel some highlights in the quest for knowledge about hypoxia. Second, and by way of contrast, it introduces the traditional medicine of the high altitude plateau, which I have studied (albeit as a novice) during several journeys in Tibet. Although the literature of Tibetan practice contributes little to altitude medicine, it provides a clear view of the mechanisms of illness and the behaviour of doctors, seen through the eyes of the traditional physicians in the 1700s. Third, I have been fortunate to take part in the quest for new mountain challenges. In this age of rapid air transport and satellite communications, there is still an opportunity for true terrestrial exploration in central Asia. I record briefly our recent mountain exploration in central Tibet.

Observations on altitude medicine and physiology

China and the Andes

From the earliest times it was known that travel to altitudes above 11,500ft (3,500m) was associated with illness – the transient headaches, malaise and fatigue of acute mountain sickness. Tookim, a Chinese civil servant in the time of the Chinese Emperor Ching-Te (37 to 32 BC) warned his general, Wang Fung, who was preparing to make a journey to the far west of the empire, of the following:

The Chinese Commission will in such circumstances be left to starve among the hills and valleys. Again on passing the Great Headache Mountain, and the Little Headache Mountain, the Red Land and the Fever Slope, men's bodies become feverish, they lose colour and are attacked with headache and vomiting. The asses and cattle being all in like condition.

Death at altitude, after foaming at the mouth, was also recorded in the Chinese literature of the 5th century AD. Some 11 centuries later, the Jesuit priest Father Joseph de Acosta wrote of similar illnesses after crossing the Andes.

19th-century British mountaineers

In the English speaking world of the late Victorian era, when visits to high altitude had become a regular reality, the literature of mountain exploration dwells more on physical achievement than on scientific discovery and medicine. Edward Whymper, who had shot to fame aged 24 with the disastrous first ascent of the Matterhorn in 1865, continued in later life with a scientific expedition to South America. In 1892, Sir Martin Conway had carried out extensive exploration in the Himalayas. Neither did much more, in scientific terms, than record the unpleasant effects of their high altitude journeys.

Angelo Mosso

Meanwhile, in the Italian Alps – at that time visited less than Switzerland – important studies into hypoxia were already in progress. Angelo Mosso, professor of physiology in Turin, established in 1892 the scientific laboratory in the Capanna Margherita on the Punta Gnifetti, one of the summits of Monte Rosa. This working laboratory, sited at 14,937ft (4,554m), survives to this day. Professor Mosso had the royal patronage of Regina Margherita, wife of King Umberto I of Italy. While present day historians tend to dwell on the Italian royal family's alliances with reactionary
conservatism, the mountaineering community prefers to recall that the Queen of Italy herself climbed Monte Rosa to visit the laboratory at its inauguration.

Mosso devoted 20 years to the study of hypoxia, concentrating upon cardiovascular and respiratory physiology. His seminal work of 1897, Fisiologia dell'uomo sulle Alpi, translated into English in 1901 as Life of man in the High Alps, documents his research. Mosso believed that acute mountain sickness was probably caused by hypocapnia rather than hypoxia.

Mosso had a lifelong fascination with the changes in the brain. In his previous book, La Fatica, he left a compelling account of his first subject, Bertino. As a result of trauma, Bertino had a 2cm aperture in the frontal region of the skull (Fig 1). Mosso covered this with a gutta percha membrane and studied the changes in the transmitted cerebral pulsation. He found (not unsurprisingly, even at that time) that when both carotid arteries were firmly compressed, Bertino lost consciousness and the pulse stopped. Mosso was able to carry out this experiment at sea level only, with Bertino breathing air. However, in his early work, Mosso seemed convinced that changes must occur in the circulation of the brain to account for the clinical symptoms experienced at great heights.

Later, Mosso studied a 13 year-old woodcutter, Emanuele Favre, who while helping chop wood, had bent too close towards the block. The axe of his master struck Emanuele on the head. He fell unconscious to the ground but recovered his senses shortly afterwards, and was able to walk several kilometres home. Emanuele developed a hole in his skull. Mosso attached him to a gas chamber, and simulated the air at different altitudes by varying the oxygen mixtures. When he had recovered from the ordeal, Emanuele recounted to his new master (who was scarcely less dangerous than the woodcutter) that he had felt drunk and had had a headache when acute travel to over 5,000m was simulated. Mosso concluded quite correctly from these experiments that a sudden decrease in the oxygen tension had little effect on the cerebral circulation or transmitted pressure, as he was able to measure them, and that any changes he did record were unlikely to account for the severe headaches of acute mountain sickness.

Mosso's dearest wish, to find a man with a hole in his skull who would have been willing to come to the summit of Monte Rosa, remained unfulfilled. Had he been able to achieve this and study his subjects over a longer time, he might have found an increase in transmitted pressure from the brain - that is, the rise in cerebrospinal fluid pressure that was only recognised some 80 years later by the papilloedema seen in high altitude cerebral oedema.

In Life of man in the High Alps, Mosso also left us an astute clinical observation. In 1891, a Dr Jacottet, a previously fit, 28 year-old doctor from Chamonix, died accompanying a scientific expedition to the summit observatory on Mont Blanc. Charles Matthews, president of the Alpine Club, simply recorded the death as 'in delirium'. Mosso, however, researched the clinical history of an illness characterised by sudden, severe breathlessness, including the autopsy performed by a Dr Wizard in Chamonix. He concluded that the immediate cause of Jacottet's death was 'catarrh, accompanied by acute oedema or fluid in the lung'. Acute pulmonary oedema was rediscovered around 70 years later.

Alexander Kellas

Much of our understanding of hypoxia, as in other fields of medicine, exemplifies that advances in physiology have rarely been mirrored by the recognition of clinical events, and vice versa. This theme, echoed regularly by clinicians, was one well rehearsed by Dr Samuel Gee (f1 Barts 1878–1911). Gee wrote as one of his aphorisms: I say in the first place that Physiology owes more to Medicine than Medicine to Physiology. It is Nature and Surgeons who perform vivisections for us. The greater and the better part of what we know is derived from pathological observation and not from physiological experiments... When the greatest of discoveries in Physiology had been made, namely the Circulation of the Blood, thoughtful men were surprised to find that no corresponding improvement in medical treatment followed. So little does therapeutics depend upon Physiology.

A second altitude physiologist, Dr Alexander Kellas, was born in 1868 in Aberdeen, and gained his doctorate at Heidelberg in 1897. In 1900, Kellas was appointed lecturer in chemistry at the Middlesex Hospital, a post he is said to have served with diligence until 1919. During this period
Kellas managed to go on no fewer than six major Himalayan expeditions. Each lasted five months, and Kellas usually climbed alone with local porters. By 1920 he was the most experienced high altitude mountaineer of his era, but he remained a reclusive figure, both in mountaineering and medical circles.

As if to confirm Samuel Gee's remarks, Kellas's contribution to clinical medicine was peripheral. He worked out from basic principles that man should be able to reach the summit of Everest (29,021ft; 8,048m) without supplementary oxygen, at a time when it was still widely believed that survival was only possible up to around 25,000ft (7,621m). He calculated the atmospheric pressure at the summit of Everest, the composition of alveolar air at the summit, the maximal rate at which oxygen could be consumed and the greatest rate of ascent at these altitudes - around 350ft (107m) per hour. That man could indeed climb Everest without bottled oxygen was proved correct in 1978 by the Austro-Italian pair, Peter Habeler and Reinhold Messner. Four years later the American Medical Everest Expedition, led by Professor John West and accompanied by Dr Jim Milledge (its only British member and a Fellow of the Royal College of Physicians), measured Kellas's predicted values, and found them largely accurate. Kellas has another reason for being remembered in the annals of mountaineering. Having achieved his rightful place on the first 1921 British Everest expedition, he started on the approach march, but died soon after reaching the Tibetan plateau, at Kampa Dzong in southern Tibet. He was buried in sight of the mountains he loved so much. His nephew, Arthur Kellas, maintained his uncle's connection with the Himalayas by becoming British Ambassador in Kathmandu nearly 50 years later.

The British Everest expeditions

There was little medical progress during the British Everest expeditions of the 1920s and 1930s, despite much heated debate about the use of bottled oxygen. Even by 1953, the year of the first ascent of Everest, the clinical medicine of hypoxia had advanced little: the emphasis remained on physiology. The late John Hunt's The ascent of Everest records faithfully a meticulously executed expedition, the success of which was partly due to good physiological planning, training and acclimatisation. While the expedition was a Commonwealth success in the coronation year, the medical appendix of Hunt's book gives no inkling of the story of the effects of oxygen lack as it was to unfold in the next 20 years. However, much important physiological work was done, both on Everest in 1953 and in its aftermath. Scientific expeditions led by the late Griffith Pugh contributed greatly to our knowledge of acclimatisation, and, especially, the hypoxic ventilatory response. Medically, however, it was only acute mountain sickness that was clearly on the map: the more sinister effects, pulmonary and cerebral oedema, were neither recognised nor suspected by most climbing doctors of the era.

Charles Houston

A mountaineering doctor, Dr Charles Houston (Fig 2), who was also at high altitude in 1953, received far less international acclaim than John Hunt, Edmund Hillary or Sherpa Tenzing Norgay after the triumph on Everest. In July of that year, an American team led by Houston had made a bold attempt on K2, the second highest mountain in the world, and a peak far harder than Everest itself. The expedition, which failed to reach the summit, was marred by avalanche, illness and death.

While no medical advances were made to offset these catastrophes, Charlie Houston subsequently devoted his efforts to high altitude medicine, and never climbed another major peak. Seven years later, in a single case report, he described the condition of high altitude pulmonary oedema (Fig 3). He recognised clinically in a survivor what Mosso had recorded in 1891, and others had suspected in the 1930s. As mountain tourism increased, pulmonary oedema, or HAPE as it is known in the United States, has become frequently recognised, both in the Alps (where it is usually self limiting) and in the Himalayas (where it remains a potent cause of death above 13,000ft (3,963m)).

By 1975, it had become clear, again through clinical observation, that pulmonary disease was not the only ailment suffered by climbers and high altitude trekkers. Some
developed a neurological illness, becoming sleepy, confused and unsteady, sometimes with papilloedema. Charles Houston, with a British colleague Dr John Dickinson, working in Kathmandu, described the clinical features and the pathology (Fig 4) of high altitude cerebral oedema. Further observations have contributed to knowledge about retinal changes and the high incidence of stroke at high altitude. There have been advances in treatment, with the recognition of the value of steroids in brain oedema and acute mountain sickness, and of nimodipine in pulmonary oedema. Portable pressure chambers are now used widely on expeditions. Much has been learned in difficult circumstances, at the extremes of altitude and cold; but rarely, as Gee commented, in this story of medical discovery has a clinical advance been made through physiological experiment.

Tibetan traditional medicine

Tibetan traditional medicine, which developed between the 8th and 17th centuries, was held in the highest esteem throughout Asia. While much of the knowledge within Tibet was mirrored in the ancient practice in the courts of India, China and the Middle East, several factors have conspired to leave a peculiarly clear picture of how Tibetan physicians carried out their art. The first was Tibet’s isolation – a continuous medical training curriculum was maintained into the early 20th century. Secondly, Tibetan medicine was pictorial. A series of 80 medical paintings or thangkas encompassing the entirety of Tibetan medical knowledge was assembled in the late 17th century by sDe-srid Sang-ra ryGya-mtsho, physician and regent to the 5th Dalai Lama, during the Qing dynasty. Three sets of these thangkas survive today and have been used as teaching aids for many generations of Tibetan medical students, principally in Lhasa. The clinical illustration and imagery in these thangkas is especially unabashed and lacking in reticence. This may be partly because Tibetans dealt with their dead by chopping up the corpses before exposing them to nature, to be devoured by vultures, dogs and wild animals... or, one supposes, to be scrutinised by anatomists.

The leaders of the Tibetan medical world were also intimately related to the courts of the ruling deities, the Dalai Lamas; the borders between medicine, public morality, religion and law were therefore blurred. Physicians often held senior positions within the religious state. The preservation, or, through different eyes, stagnation, of Tibetan Buddhism into the mid-20th century undoubtedly encapsulated traditional medical practice, leaving the medical historian with a vignette of how doctors thought, behaved and treated patients 300 years ago.

By the 12th century, anatomy was highly developed, and the skeleton understood and documented. The Tibetans already had an armamentarium of surgical tools, for abdominal operations and bladder and cataract surgery. There was an understanding of the division of the vascular system into pulsating vessels (ro-ma-rtsa) and non-pulsating vessels (rkyang-ma-tsa), and rudimentary diagrams of a circulation with the heart at its centre. There was an understanding too of embryology, in the sense that the union of semen and the contents of the womb was recognised – and there are detailed illustrations of the developing fetus. The organs of digestion are documented in the thangkas and there was a clear appreciation of the three excretory products – urine, sweat and faeces.
Today, the thangkas are housed in the museum of the Tibetan hospital close to the Potala Palace. Many are intricately related to Buddhism and follow the layout of a Tibetan religious painting (Fig 5), with a central figure leading, allegorically, to the different parts. Others follow the form of a tree with branches leading to named leaves. It is, however, in the less anatomical aspects of knowledge that the thangkas provide particular insight into the physician’s art.

The Tree of Diagnosis

The third thangka is the Tree of Diagnosis. It has three stems: Interrogation, or taking a clinical history; the Stem of Inspection, or the initial clinical observation; and the Stem of Palpation. Within the Stem of Interrogation there are 29 leaves depicting symptoms. It is clear that there was recognition not only of physical pain, such as angina (Fig 6), headache, indigestion or abdominal distension but also of psychological symptoms such as restlessness and anxiety (Fig 7). This gives a depth to the thangka far beyond the artistic extravaganza of the leaves in the Stem of Inspection, of the tongue, or of the examination of the urine. Pulsology, with particular attention to the waveform, seen, at least pictorially, as sinusoidal, developed as an entire branch of medicine, with nine thangkas devoted to the careful examination of the radial pulse.

Treatment

Thangka Four is devoted to therapy. The Tibetans separated these into the following four stems: Dietary Therapy, Behaviour, Medicaments and External Treatments. External treatments included cupping, branding, blood letting, cold water baths and enemas. Whilst diets, the Tibetan pharmacopoeia and physical treatments were each highly developed, if somewhat lacking in evidence base, it is in the Stem of Behaviour that we see the insight of the Tibetans into the human situation. The treatment for depression (in rlung disease) is portrayed in the Leaf of Having Delighted Friends, and that for mkhris-pa disease (fatigue syndromes) in the Leaf of Leisurely Rest.

Moral values

Another side of the world of Tibetan physicians, and an example of their influence in matters of state, was their prescription – it seems almost to have been a preoccupation – for the preservation of moral values in society. Deterring
the population from excessive sex, sexual abuse of the young (especially young monks), masturbation and sexual acts with animals was felt to be part of the remit of preventive medicine in Lhasa at the turn of the 17th century. Each is vividly portrayed in the thangkas describing the causes of disease.

Conduct for doctors

The Tibetan medical establishment also had firm views on the conduct of a physician (Thangka Thirty-One). Wisdom, experience, benevolence and mercy, and a knowledge of basic theory are each extolled, with memorable epithets (‘A doctor without basic theory is tantamount to showing something to a blind man’). There was also a certain arrogance, which we must recognise as part and parcel of medical practice in any era. One painting comments that ‘A physician must have good lineage, otherwise it is like giving the throne to a fox’. The section ends with advice about those patients who should be excluded from treatment – for example, those who despise the doctor, those who violate religion, those too ill or too old to treat, and, with a certain familiarity today, those who will not pay. But the clearest insight, that doctors in 17th century Tibet behaved as many do today, concerns communication with patients:

In explaining a disease, when the case is thoroughly understood, one should announce the diagnosis like unfurling a banner from the rooftop of your house, or blowing a conch. But when the situation is confused, one should talk ambiguously, like a snake with a forked tongue.

This is but a glimpse of the wealth of historical material, preserved unchanged from the time it was recorded in 1688. Even a brief visit to the Tibetan hospital in Lhasa is rewarding, but a detailed appreciation requires more than the few days I was able to spend with these remarkable artistic and medical treasures on my way to a remote mountain range.

Exploration of the Nyangla Qen Tangla Shan

While central Asia is fully mapped, and its high altitude plateau inhabited largely by nomads, the detail of its many mountain ranges is still largely unknown to the climbing community. There is enough here, unexplored, to satisfy at least a generation of mountaineers, and to grant the wish that many have had since childhood – to locate, visit and perhaps climb ‘the unknown mountain’. It was with this general theme in mind that Sir Chris Bonington and I set out for central Tibet in the summer of 1996. The eastern Nyangla Qen Tangla Shan stretches through the Tibetan plateau, between 92° to 96°E, 31.5° to 30.5°N, some 300 miles north east of Lhasa. We had first seen this range in March 1982, flying towards Everest from western China. High mountains appeared through the right hand windows of the aircraft as we approached Lhasa. Tiers of peaks stretched towards the northern horizon, and in the far distance the massive hulk of the highest, Sepu Kangri, almost 23,000ft high (6,995m), loomed out of the icy haze. It was only after 15 years of patient negotiation with the Chinese authorities that we gained a permit to explore the area, and to locate the approach to Sepu Kangri – the White Sky God.

The White Sky God, Sepu Kangri

Armed with a tourist map and a resourceful Tibetan interpreter, Pasang Choephel, we crossed the Tibetan plateau by truck from Lhasa for several days, heading north east towards the town of Diru. Here the barren rolling plateau, still freezing at night even in mid-summer, was suddenly replaced by a fertile gorge at the headwaters of the Salween, also known ominously as the Black River of Tibet. It had been at Diru, in the New Year of The Fire Mouse Year (1936) that two Europeans reached the end of a journey on foot from Burma. Ronald Kaulback and John Hanbury-Tracy18,19 had been turned back by the Tibetan authorities because it was deemed too dangerous to proceed through a country on the brink of civil war. Kaulback and Hanbury-Tracy, the only foreigners ever to visit the area, not only failed in their objective to discover the source of the Salween, they failed to catch a glimpse of a mountain range that lay close by to the south. Forests, fields and spectacular monasteries still line the Salween gorge today, but our view south towards Sepu Kangri was always blocked by lower hills.

At Diru, the local area headquarters, a combination of modern science and local knowledge pointed towards Sepu Kangri with remarkable ease. A global positioning system, no larger than a calculator, gave our co-ordinates, while the local postmistress, Mrs Lakpa Tsering Dorje, produced from her handbag a battered snapshot of our mountain with the words: ‘I went there several years ago on a pilgrimage with my parents,’ and told Pasang which passes to cross. This local guidance was invaluable. A week later, with a small yak caravan we stopped at the monastery of Samda, and were given final directions by the lama:

Your mountain, also called Khamsun, stands on the left breast of a nymph. There are nine peaks which surround a lake, from which stream clouds like the manes of white horses blowing in the wind. And from nine lakes flow rivers of ice, like the white silk scarves, used in Tibetan greeting. You can find medicinal herbs there, caterpillar fungus and giant footprints. It is a day's march to the east.

Early next morning we turned the corner of the valley. The lakes and their surrounding glaciers lay before us – Sepu Kangri itself towered some seven thousand feet above (Fig 8).

Some two years later, the mountain of the White Sky God remains unclimbed. Having reconnoitred the area in 1996, we returned in May 1997, but were turned back by heavy snow and dangerous conditions around 20,000 feet. In September and October 1998 the summit itself again eluded our assault team, who were stopped by appalling weather some 400ft from the top.

Mountaineering itself is perhaps a hedonistic pastime, but these three facets of high altitude, the medicine of hypoxia,
glimpses of the traditional practice of Tibet, and exploration itself, have given me a wealth of experience and understanding. Eric Shipton captured the luxury of this sensation.\textsuperscript{20}

A man is lucky who, in the full tide of life, has experienced a measure of the active environment he most desires. In these days of violent change, where the basic values of today are the vain and shattered dreams of tomorrow, there is much to be said for a philosophy which aims at living a full life while that opportunity offers. There are few treasures of more lasting worth than the experience of a way of life that is in itself wholly satisfying. Such, after all, are the only possessions of which no fate, no cosmic catastrophe can deprive us; nothing can alter the fact, if for one moment in eternity, however brief, we have really lived.

I owe a debt to all those in my life who have made these endeavours become reality.

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