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Clinical Pearls

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Paradoxical embolism to the central nervous system in a young Polish woman on a trek in the Himalayas

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Case Presentation

A 30-year-old Polish woman noticed a sudden loss of visual field on her right side while at 4450 m on the eighth day of trekking around Annapurna in the Himalayas (Figure 1). Later came slight weakness of her right limbs and confusion with a moderate headache. That day she had climbed 1500 m in altitude and had drunk only 1 l of fluids. During the whole trekking, which was realized according to the established acclimatization plan (Figure 2), she did not present any symptoms that could have suggested altitude illness. She had a history of smoking starting 10 years earlier and used oral contraception before her trip.

She was taken down to 4150 m on the evening the symptoms occurred. She was able to walk but was carried on horseback. The next day she reached a Himalayan Rescue Association (HRA) post at 3350 m. High-altitude cerebral oedema (HACE) was suspected, so she received oxygen, dexamethasone and acetazolamide, and then was transported by helicopter to hospital in the capital of Nepal. There head CT was performed, which showed ischaemic lesions in the left hemisphere of her brain. No significant pathologies were found in carotid and vertebral Doppler ultrasonography, in transthoracic echocardiography or in laboratory blood tests. The final diagnosis was ischaemic stroke of unknown aetiology. The patient was discharged and acetylsalicylic acid was recommended.

After returning to Poland the woman was referred to the Department of Neurology at Medical University of Gdańsk to establish the aetiology of the stroke. She presented with a persistent neurological deficit: right hemianopia and right hemiparesis. An MRI of the head confirmed an ischaemic stroke in the left occipital lobe and the left thalamus (Figure 3). Contrast

Figure 1. Annapurna, Himalayas: picture from the archives of the corresponding author.

transcranial Doppler was ordered for further diagnosis, which revealed numerous signals of microembolization bilaterally in the M1 segment of the middle cerebral artery—a symptom of a severe right-to-left shunt (Figure 4). Transoesophageal echocardiography (TEE) showed trace leakage of contrast in the central part of the atrial septum and during a Valsalva manoeuvre a clear right-to-left shunting was observed, as in a patent foramen ovale (PFO). The diameter of PFO measured by TEE was 6 mm.

No other potential causes of ischaemic stroke were found, therefore the most likely aetiology of stroke was considered to be the mechanism of paradoxical embolism through PFO. The woman has since undergone successful percutaneous PFO closure.

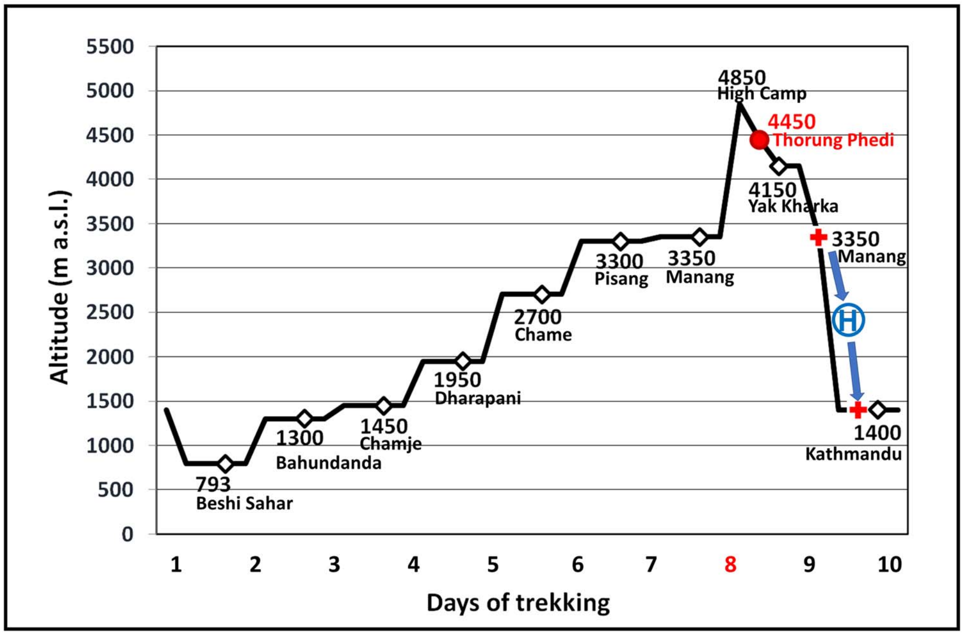

Figure 2. The rate of ascent of the described patient. Legend: white diamonds—sleeping altitude; red circle—the onset of symptoms; red cross—medical post/hospital; H—helicopter.

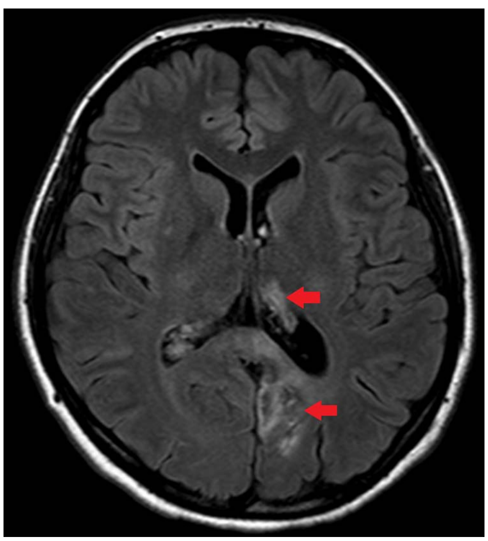

Figure 3. Head magnetic resonance imaging scan with posterior circulation infarct [red arrows] in the described patient.

Discussion

In the case of the described patient the diagnosis of HACE at the HRA post was not correct. The most common symptoms of HACE, which is usually preceded by 24–48 h of progressing acute mountain sickness, include: disturbed consciousness, ataxia, severe lassitude, anorexia and headache.[1] HACE is almost never associated with lateralizing or focal findings and those signs should immediately suggest a cerebrovascular accident (transient ischaemic attack and stroke) or space-occupying lesion.[2] Brain tumours may also become suddenly symptomatic upon exposure to high altitude.[3]

Migraine, vasospasm, hypocapnic vasoconstriction or hypoxia in the watershed zones of minimal cerebral blood flow zones may be operative in strokes at high altitude and should be taken into consideration. Looking for rarer causes of ischaemic stroke, especially in young people, paradoxical embolism through PFO should be also considered.[4] If an embolic stroke of undetermined source occurs in someone at high altitude, then screening for a PFO would be appropriate.[5] It should be remembered that a patent foramen ovale has been reported to be an important risk factor for cardioembolic cerebrovascular accidents through paradoxical systemic embolization.[4]

Hypoxia, dehydration, haemoconcentration, low temperature and immobilization due to forced inactivity after exposure to high altitude might lead to a hypercoagulable state and predispose a person to thromboembolic events, including stroke.[6] High-altitude exposure is also associated with an increase in pulmonary vascular resistance and pulmonary hypertension[7] that in subjects with PFO intensifies the right-to-left shunting.[8]

Summarizing above, a sojourn at high altitude could be a cofactor that increases the possibility of paradoxical embolic cerebral ischaemia in people with PFO. Paradoxical embolism should be considered in the differential diagnosis of HACE.

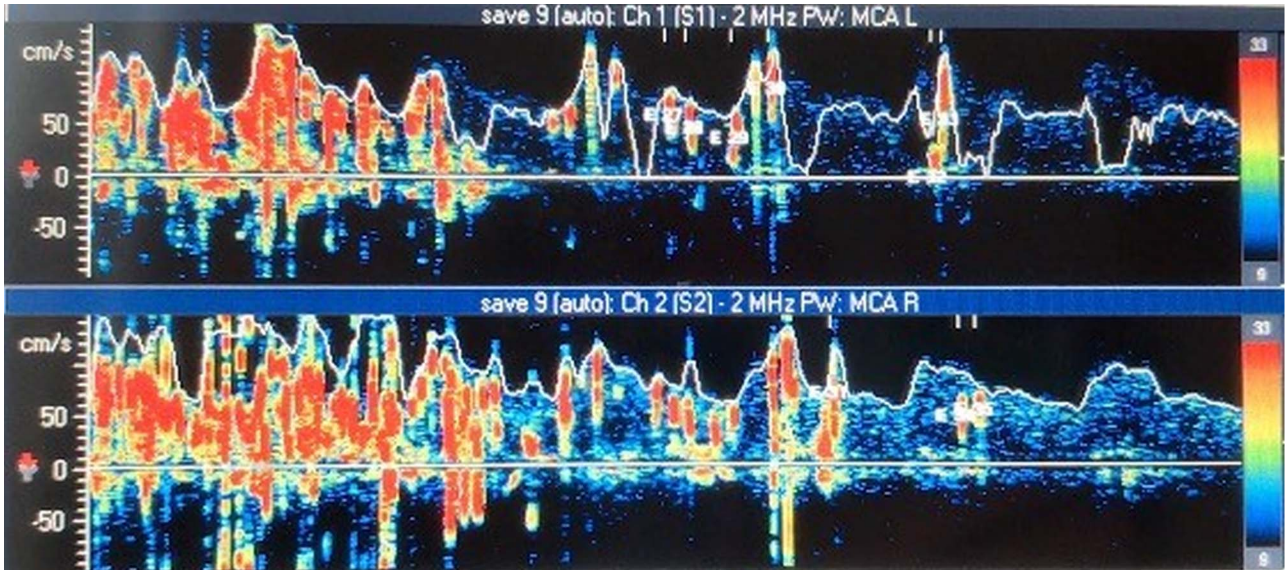

Figure 4. Microembolic signals (HITS—high intensity transient signals [red vertical spikes]) in the contrast transcranial Doppler of the middle cerebral arteries in the described patient.

Patient consent

Written informed consent was obtained from the patient for the publication of this report.

Authors' contributions

M.S. and R.S. contributed to acquisition of data and drafting of the manuscript.

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