



REVIEW ARTICLE

High-altitude headache and acute mountain sickness^{☆,☆☆}

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Received 12 March 2012; accepted 21 April 2012
Available online 23 October 2014

KEYWORDS

Altitude;
Acetazolamide;
Headache;
Lake Louise
Questionnaire;
Cerebral oedema;
Acute mountain
sickness

Abstract

Introduction: Headache is the most common complication associated with exposure to high altitude, and can appear as an isolated high-altitude headache (HAH) or in conjunction with acute mountain sickness (AMS). The purpose of this article is to review several aspects related to diagnosis and treatment of HAH.

Development: HAH occurs in 80% of all individuals at altitudes higher than 3000 m. The second edition of ICHD-II includes HAH in the chapter entitled "Headaches attributed to disorder of homeostasis". Hypoxia elicits a neurohumoral and haemodynamic response that may provoke increased capillary pressure and oedema. Hypoxia-induced cerebral vasodilation is a probable cause of HAH. The main symptom of AMS is headache, frequently accompanied by sleep disorders, fatigue, dizziness and instability, nausea and anorexia. Some degree of individual susceptibility and considerable inter-individual variability seem to be present in AMS. High-altitude cerebral oedema is the most severe form of AMS, and may occur above 2500 m. Brain MRI studies have found variable degrees of oedema in subcortical white matter and the splenium of the corpus callosum. HAH can be treated with paracetamol or ibuprofen. Pharmacological treatment of AMS is intended to increase ventilatory drive with drugs such as acetazolamide, and reduce inflammation and cytokine release by means of steroids.

Conclusions: Symptom escalation seems to be present along the continuum containing HAH, AMS, and high-altitude cerebral oedema.

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PALABRAS CLAVE

Altitud;
Acetazolamida;
Cefalea;
Cuestionario Lago
Louise;

Cefalea de elevada altitud y mal de altura

Resumen

Introducción: La cefalea es la complicación más frecuente de la exposición a la altitud y puede aparecer de forma aislada o bien asociada al mal de altura (MA). El objetivo de este artículo es revisar los aspectos relacionados con el diagnóstico y tratamiento de la cefalea de elevada altitud (CEA).

[☆] Please cite this article as: Carod-Artal FJ. Cefalea de elevada altitud y mal de altura. Neurología. 2014;29:533–540.

^{☆☆} This study was presented as a lecture to the Headache Study Group at the 63rd Annual Meeting of the Spanish Society of Neurology, November 2011, Barcelona.

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Edema cerebral de altitud;
Mal de altura

Desarrollo: El 80% de las personas presentan CEA por encima de los 3.000 m de altitud. La segunda versión de la *Internacional Classification of Headache Disorders (ICHD-II)* incluye la CEA en el capítulo «Cefalea atribuida a trastornos de la homeostasia». La hipoxia desencadena una respuesta neurohumoral y hemodinámica que provoca un aumento de la presión capilar y edema. La vasodilatación cerebral inducida por hipoxia es una causa probable de CEA. El síntoma cardinal del MA es la cefalea, que se suele asociar con trastornos del sueño, fatiga, mareo e inestabilidad, náuseas y anorexia. Parece existir una cierta susceptibilidad así como una gran variación interindividual. La forma más grave es el edema cerebral de altitud y puede suceder por encima de los 2.500 m. Estudios de resonancia de encéfalo han mostrado la presencia de edema en sustancia blanca y esplenio del cuerpo calloso. La CEA puede tratarse con paracetamol e ibuprofeno. El tratamiento farmacológico del MA tiene la finalidad de incrementar la respuesta ventilatoria, mediante fármacos como la acetazolamida, y reducir los procesos inflamatorios y de liberación de citocinas, mediante el empleo de esteroides.

Conclusiones: Parece haber una progresión en la expresión de los síntomas entre la CEA, el MA y el edema cerebral de altitud.

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Introduction

The first written record about high-altitude headache dates back to 30 BCE and is owed to Too Kin, an officer of the Imperial Chinese Army. Too Kin, along with his troops, experienced an episode of altitude sickness in a mountain range in Afghanistan which he named the Great Headache Mountain and the Little Headache Mountain.¹ Two millennia went by before Paul Bert, the chair of physiology at the Sorbonne after Claude Bernard, developed the modern discipline of altitude physiology.² In 1913, Thomas Ravenhill provided the first clinical descriptions of signs and symptoms associated with rapid ascent to high altitude in the north of Chile, and reported on both high-altitude cerebral oedema and high-altitude pulmonary oedema.³

Headache is the most common complication of exposure to high altitude, and it can appear as isolated high-altitude headache (HAH) or in conjunction with acute mountain sickness (AMS). HAH is a global health problem whose incidence has increased over the past decades due to different factors. These include more opportunities for travel, exercise, and tourism which therefore expose thousands of tourists, travellers and sports enthusiasts to a rapid increase in altitude, frequently with no previous acclimation.⁴ Exposure to altitude is considered high for subjects at elevations of 1500 to 3700 m above sea level, very high at 3700 to 5500 m, and extreme above 5500 m.⁵

However, a person with high altitude exposure can experience different types of headaches in addition to headache associated with altitude. This being the case, episodic migraine crises precipitated by hypoxia and altitude, as well as headache linked to acute mountain sickness, must be considered. The purpose of this article is to review several aspects related to diagnosis and treatment of HAH and AMS. To this end, we searched the Medline database for all articles published in English or Spanish up to February 2012, using the keywords 'headache altitude' and 'acute mountain sickness'.

High-altitude headache

Epidemiology

It is estimated that at least 25% of non-acclimated individuals exposed to altitudes of 1859 to 2750 m experience high-altitude headache. At altitudes above 3000 m, 80% of individuals will have HAH and almost 100% will experience headache at 4500 m or higher.⁴

Definition, clinical presentation and risk factors

The second edition of the International Classification of Headache Disorders (ICHD-II)⁶ includes high-altitude headache (subsection 10.1.1) in chapter 10 (Headache attributed to disorder of homeostasis), section 10.1 (Headache attributed to hypoxia and/or hypercapnia). Diagnostic criteria are listed in [Table 1](#).

HAH can appear as an isolated symptom within the first 24 hours of exposure to altitudes above 2500 m without previous acclimation, or it may present along with more varied

Table 1 Diagnostic criteria for HAH

- | |
|---|
| A. Headache must present with at least 2 of the following characteristics and fulfil criteria C and D: <ol style="list-style-type: none"> 1. Bilateral 2. Frontal or frontotemporal 3. Dull or pressing pain 4. Mild to moderate intensity 5. Aggravated by exertion, movement, straining, coughing, or bending down |
| B. Ascent to altitudes above 2500 m |
| C. Headache develops within 24 hours after ascent |
| D. Headache resolves within 8 hours after descent |

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