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ORIGINAL RESEARCH

Visual Analog Scale (VAS) for Assessment of Acute Mountain Sickness (AMS) on Aconcagua

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Objective.—The Lake Louise AMS Self-Report Score (LLSelf) is a commonly used, validated assessment of acute mountain sickness (AMS). We compared LLSelf and visual analog scales (VAS) to quantify AMS on Aconcagua (6962 m).

Methods.—Prospective observational cohort study at Plaza de Mulas base camp (4365m), Aconcagua Provincial Park, Argentina. Volunteers climbing in January 2009 were enrolled at base camp and ascended at their own pace. They completed the LLSelf, an overall VAS [VAS(o)], and 5 individual VAS [VAS(i)] corresponding to the items of the LLSelf when symptoms were maximal. Composite VAS [VAS(c)] was calculated as the sum of the 5 VAS(i).

Results.—A total of 127 volunteers consented to the study. Response rate was 52.0%. AMS occurred in 77.3% of volunteers, while 48.5% developed severe AMS. Median (interquartile range, IQR) LLSelf was 4 (3–7). Median (IQR) VAS(o) was 36mm (23–59). VAS(o) was linear and correlated with LLSelf: slope = 6.7 (95% CI: 4.4–9.0), intercept = 3.0 (95% CI: −10.0–16.1), $\rho = 0.71$, $\tau = 0.55$, $R^2 = 0.45$, $p < 0.001$. Median (IQR) VAS(c) was 29 (13–44). VAS(c) was also linear and correlated with LLSelf: slope = 5.9 (95% CI: 4.9–6.9), intercept = −0.6 (95% CI: −6.3–5.1), $\rho = 0.83$, $\tau = 0.68$, $R^2 = 0.73$, $p < 0.001$. The relationship between the 5 VAS(i) and LLSelf(i) was less significant and less linear than that between VAS(o), VAS(c), and LLSelf.

Conclusions.—While both VAS(o) and VAS(c) for assessment of AMS appear to be linear with respect to LLSelf, the amount of scatter within the VAS is considerable. The LLSelf remains the gold standard for the diagnosis of AMS.

Key words: acute mountain sickness (AMS), visual analog scale (VAS), altitude, altitude sickness, mountaineering

Introduction

Acute mountain sickness (AMS) is a constellation of common symptoms including headache, nausea and vomiting, fatigue, dizziness or lightheadedness, and sleep disturbances in the setting of a recent ascent by an unacclimatized person.[1] The indistinctness and prevalence of these symptoms renders a standard, reproducible definition of AMS difficult. Because AMS may precede potentially fatal conditions such as high-altitude cerebral edema or high-altitude pulmonary edema, valid and reliable diagnosis of AMS is important. A tool that clinicians and researchers utilize to assess AMS is the Lake Louise AMS Symptom Score (LLS), which includes a self-reported questionnaire and a standardized clinical assessment.[2,3] An abbreviated version of the LLS, the Lake Louise AMS Self-Report Score (LLSelf), has become the gold standard of assessing AMS by nonclinicians, including expedition leaders and commercial guides who often make decisions about a climber's ability to continue trekking. The LLSelf queries 5 symptoms: headache, nausea and vomiting, fatigue or weakness, dizziness or lightheadedness, and sleep. Each symptom

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On the day you felt the worst, please circle the box corresponding to your symptoms:

	0	1	2	3
68. Headache	None	Mild	Moderate	Severe, incapacitating
69. GI symptoms	None	Poor appetite, nausea	Moderate nausea or vomiting	Severe, incapacitating nausea & vomiting
70. Fatigue / weakness	None	Mild	Moderate	Severe, incapacitating
71. Dizzy / lightheadedness	None	Mild	Moderate	Severely lightheaded, fainting, passing out
72. Sleeping	Slept well	Did not sleep as well as usual	Woke many times, poor sleep	Could not sleep at all

Figure 1a. LLSelf component of the English version of the postcard used in the study.

is scored on a 4-grade ordinal scale from 0 (none or not present) to 3 (severe or incapacitating) for a combined minimal score of 0 and maximal score of 15.

The visual analog scale (VAS) has been suggested as a method for assessing AMS due to its use in other clinical settings.[4] The VAS is a 100-mm horizontal line that may be used to quantify symptoms in a continuous fashion from 0 to 100. It is easy to use and requires very little written language. There is a large body of literature on application of the VAS to medicine, and clinically significant measurements on the VAS are established for pain, nausea, fatigue, and sleep quality.[5-8] These attributes suggest that the VAS may perform well for the evaluation of AMS.

Because of its simplicity, brevity, and lack of reliance on written language, a continuous measure of AMS such as the VAS may be easier to utilize and offer equivalent performance to a categorical measure such as the LLSelf.[4] The purpose of this study was to compare the VAS to the LLSelf on Aconcagua [6962 m (22,841 ft)], the highest mountain outside of Asia and one of the Seven summits. Our first objective was to determine if a single VAS for overall AMS [VAS(o)] correlates in a linear relationship with the LLSelf(o). Our second objective was to determine if the 5 individual VAS [VAS(i)], correlate in a linear relationship with the 5 items, LLSelf(i), that comprise the LLSelf. Our third objective was to determine if a composite VAS [VAS(c)], calculated as the sum of the five VAS(i), correlates in a linear relationship with the LLSelf(o). Our fourth objective was to determine if a single VAS(o) distance could accurately define severe AMS on Aconcagua.

Methods

STUDY SETTING AND STUDY VOLUNTEERS

Enrollment was conducted at Plaza de Mulas base camp [4365 m (14,321 ft)] on the normal route to the summit of Aconcagua [6962 m (22,841 ft)] in Aconcagua Provincial Park, Mendoza, Argentina. Data collection occurred concurrently with a prospective study of the predictive value of postexercise SpO_2 following completion of a 6-minute walk test for the outcome of successfully summiting Aconcagua.[9] Inclusion criteria were adult climbers (age 18 years and older) who hiked the normal route of Aconcagua, checked in with park rangers at base camp during the study period, and spoke English, Spanish, French, or German. Park authorities require climbers to check in with park rangers upon arrival to base camp on ascent and upon exiting the park upon descent. For climbers who met the inclusion criteria and consented to participate, there were no exclusion criteria. Enrollment occurred during 9 nonconsecutive days from January 15, 2009 to January 31, 2009.

DATA COLLECTION

Two investigators (JDV, MPL) obtained informed consent, collected basic demographic information, and distributed study postcards when climbers checked in with base camp physicians. Study materials were available in English, Spanish, French, and German. Volunteers proceeded towards the summit at their own pace with instructions to complete the postcard on the day of the expedition that they felt worst. The postcard contained a LLSelf and multiple VAS (Figures 1a and 1b for the English version). Six different standard 100-mm VAS lines with the word "none" at the left end of the line and "severe" at the right end of the line were utilized in this study. There were no other words, marks, or divisions on the line. For the VAS(o), volunteers were instructed to:

b

Please put a single slash mark on the line at the place that best represents the magnitude of your overall altitude sickness on the day you were feeling worst:

none severe

Please put a single slash mark on the lines at the place that best represents the magnitude of each of the following symptoms on the day you were feeling worst:

none **Headache** severe

none **GI symptoms** severe

none **Fatigue / weakness** severe

none **Dizzy / lightheadedness** severe

none **Sleeping** severe

Figure 1b. VAS of the English version of the postcard used in the study.