THE 2017 LAKE LOUISE ACUTE MOUNTAIN SICKNESS SCORE

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Introduction

Acute Mountain Sickness (AMS) is the most common form of acute altitude illness and typically occurs in unacclimatized persons ascending to altitudes over 2500 m., although it can develop at lower altitudes in highly susceptible individuals. Established risk factors include rate of ascent, altitude reached, and individual predisposition. After 25 years of use in hundreds of publications, the Lake Louise Acute Mountain Sickness (AMS) score has provided a robust and practical tool for researchers to diagnose and to score the severity of AMS. Recent opinion (Milledge, 2014) and research (Hall et al., 2014; Macinnis et al., 2013) have suggested that updating the Lake Louise AMS score is in order. This paper outlines the brief historical background, reviews diagnostic criteria, describes modifications to the score, and offers suggested experimental procedures that may improve the use of the score in future studies.

Background

At the 1991 International Hypoxia Symposium, the participants executed a consensus process chaired by Peter Hackett and Oswald Oelz (Hackett et al., 1992) to define and quantify the various altitude illnesses. Subsequently at the

1993 conference, all delegates were given the opportunity to have input into the preparation of the document. The score for AMS consisted of the five symptoms (i.e., headache, gastrointestinal upset, fatigue/weakness, dizziness/light-headedness, and sleep disturbance), rated on a scale of severity from 0 to 3. The double-worded terms were to facilitate understanding as well as translation into many languages.(Roach et al., 1993) A total score ≥3, in the presence of a headache, was considered diagnostic for AMS. This definition and severity score has served as the basis for evaluating AMS in numerous publications since its introduction in 1993.

Methods

This effort is the result of online discussions and meetings at the International Society of Mountain Medicine World Congress in Bolzano, Italy in May 2014 and at the International Hypoxia Symposium in Lake Louise, Canada in February 2015. Members of the consensus committee are those who have participated in the online or in-person discussions and are listed in alphabetical order in the footnote.

Rationale for Revising the Lake Louise AMS Score

While use of the scoring system has helped standardize the diagnosis and severity of AMS across research studies, debate has persisted since its inception regarding whether sleep should be included in the diagnostic criteria. Recently this discussion has intensified. Two independent reports in 2013 provided

empirical evidence that sleep disturbance is discordant from other symptoms of AMS.(Hall et al., 2014; Macinnis et al., 2013) Hall et al. used network analysis of data from 292 research volunteers exposed to altitudes from 3650 m to 5200 m to demonstrate that sleep disturbance correlated poorly with other symptoms of AMS. Importantly, sleep disturbance was absent in 40% of cases with severe headache, long considered a hallmark of AMS.(Hall et al., 2014) MacInnis and colleagues applied factor analysis to Lake Louise AMS scores of 491 Nepalese pilgrims at 4390 m and revealed that sleep had only a weak relationship to the other four symptoms in the score.(Macinnis et al., 2013) Milledge also expressed doubt as to whether sleep disturbance was a symptom of AMS, or rather an effect of hypoxia per se, based on his own experience with AMS studies.(Milledge, 2014) Another problem recognized over time is that many studies of AMS have used only daytime exposures, making the sleep component irrelevant. Without a score for sleep in these studies, comparison with overnight studies is difficult. Based on these concerns, the consensus committee recommends that the sleep component be removed from the Lake Louise AMS score.

Diagnostic Criteria and Assessment of Acute Mountain Sickness

AMS is defined as a Lake Louise AMS score total of three or more points from the four rated symptoms including at least one point from headache, in the setting of a recent ascent or gain in altitude.(Roach et al., 2011; West, 2011)(See Table).

Some authors have suggested a higher cutoff for diagnosing AMS.(Bartsch et al., 2004; Maggiorini et al., 1998), but the consensus committee believes that by eliminating the sleep question more people with true AMS will be identified at the threshold of three points including headache. Sufficient research is lacking to divide the score into severity rankings. For those who wish to do so we suggest mild AMS as 3-5 points, moderate AMS as 6-9 points and severe AMS as 10-12 points. Although symptoms can develop within 6 hours of gain in altitude, we recommend assessing AMS score only after 6 hours, to avoid confusing AMS with confounding symptoms from travel or responses to acute hypoxia (e.g. vagal responses). If investigators wish to assess the impact of AMS symptoms on overall function at high altitude the "AMS Clinical Functional Score" is available (see Table).

AMS must not be confused with High Altitude Cerebral Edema (HACE). AMS alone exhibits no neurological findings, and is self-limited. In contrast, HACE is characterized by change in mental status and/or ataxia, occurs usually in a person with AMS or High Altitude Pulmonary Edema, and is a medical emergency. Onset is usually between 24 and 72 hours.(Hackett et al., 2004; Willmann et al., 2014)

Directions for Using the Lake Louise AMS Score

This Lake Louise AMS score is for use by investigators studying AMS. It is not intended for use by clinicians, professional outdoor guides and laypersons to

diagnose or manage AMS. After a recent gain in altitude or induction of hypoxia, and an exposure of at least six hours duration, the AMS score is used as follows:

1. The Lake Louise AMS Score is designed as a self-report questionnaire that the research volunteer completes on their own. However, some investigators prefer to read the question to the volunteer and record the answers, while others use a two-step method where the volunteer first completes the score, then the investigator verbally verifies the answers. These options are acceptable as long as they are clearly described in subsequent reports.
2. The Lake Louise AMS score for an individual is the sum of the score for the four symptoms (headache, nausea/vomiting, fatigue, dizziness/lightheadedness). For a positive AMS definition, it is mandatory to have a headache score of at least one point, and a total score of at least three points.

Example 1: A total score greater than two points but with no headache is defined as NO AMS for research purposes, although absence of a headache does not exclude a diagnosis for clinical purposes.

Example 2: A score of three points for a severe headache, with no other AMS symptoms, is defined as AMS.

We suggest using the AMS clinical functional score and reporting it when

suitable to the study design.(Meier et al., 2017; Roach et al., 1993)

Avenues for Future Research

Further research should focus on the following areas: (1) best methods for Lake Louise AMS Score administration, i.e. is investigator-led scoring different/better than volunteer-completed scores?; (2) the impact of experimental design, the testing environment and expectations of research volunteers (i.e. nocebo; (Benedetti et al., 2014)) on reliability of Lake Louise AMS score; (3) the clinical and functional impact(s) of AMS score severity; (4) best practices for the use of the Lake Louise AMS Score and clinical functional score by non-expert clinicians, mountain guides and laypersons.(Meier et al., 2017; Roach et al., 1993); (5) the impact of disturbed sleep on overall well-being at high altitude, independent of AMS; and (6) the pathophysiology of AMS versus the unusual presentation with nausea/vomiting, fatigue and/or dizziness, but without headache.(Roach et al., 2011; West, 2011) Additionally, we strongly encourage all researchers to publish all individual scores for all volunteers and all symptoms. This will allow other researchers to directly compare patterns of illness, to compile meta-analyses, and to examine the raw data for ideas and observations that will further refine the consensus definition of AMS.

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Table.

Lake Louise AMS Score 2017

Headache:

0 None at all
1 A mild headache
2 Moderate headache
3 Severe headache, incapacitating

Gastrointestinal symptoms:

0 Good appetite
1 Poor appetite or nausea
2 Moderate nausea or vomiting
3 Severe nausea and vomiting, incapacitating

Fatigue and/or weakness:

0 Not tired or weak
1 Mild fatigue/weakness
2 Moderate fatigue/weakness
3 Severe fatigue/weakness, incapacitating

Dizziness/lightheadedness:

0 No dizziness/lightheadedness
1 Mild dizziness/lightheadedness
2 Moderate dizziness/lightheadedness
3 Severe dizziness/lightheadedness, incapacitating

Lake Louise AMS Clinical Functional Score

Overall, if you had AMS symptoms, how did they affect your activities?

0 Not at all
1 Symptoms present, but did not force any change in activity or itinerary
2 My symptoms forced me to stop the ascent or to go down on my own power
3 Had to be evacuated to a lower altitude