

Dynamic Pulmonary Function Tests as a Predictor of Acute Mountain Sickness

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Categories: Emergency Medicine, Environmental Health, Pulmonology

Keywords: high altitude, pulmonary function tests, acute mountain sickness

How to cite this poster

Juul N, Lipman G, Pomeranz D, et al. (2017) Dynamic Pulmonary Function Tests as a Predictor of Acute Mountain Sickness . Cureus 9(2): e.

Abstract

Background: Flow and volume metrics of pulmonary function have been found to vary with ascent to high altitude and acute mountain sickness (AMS). This study aimed to corroborate prior findings and determine whether the pathophysiological changes associated with acute AMS were reflected in pulmonary function tests (PFT).

Methods: The study was conducted as part of a randomized controlled trial comparing budesonide to acetazolamide to placebo for the prevention of AMS in August 2016. Healthy adults were enrolled at 1,240 m (4,100 ft), drove to 3,545 m (11,700 ft), then hiked to and slept at 3,810 m (12,500 ft). PFT were measured using standard technique with a portable pneumotachometer at low altitude and again at sleeping altitude the evening of, and morning after ascent. The device was calibrated before each round of measurements.

Results: Results: 103 participants were enrolled with well-matched baseline demographics ($p > 0.09$) with no significant differences between the drugs and control groups at both baseline and change on ascent for incidence of AMS ($p > 0.05$). AMS prevalence was 73%. Examining the entire cohort as a single group, there were no significant changes in peak expiratory flow (PEF), forced expiratory volume in one second (FEV1), or forced vital capacity (FVC) on ascent or in those diagnosed with AMS. Analyzed in combination, PFT had a 72% accuracy for predicting AMS from low altitude baseline, with PEF the most important variable (ROC = 0.65).

Conclusion: Rapid ascent to high altitude did not impact dynamic pulmonary function. Pulmonary function testing overall had a weak prediction for the development of AMS, with peak expiratory flow the most important variable with good accuracy.

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Published 02/19/2017

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Funding sources: American Alpine Club, Institute for Altitude Medicine, Wilderness Medical Society Herbert N. Hultgren Grant

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Problem

Studies of the effects of ascent to high altitude and acute mountain sickness (AMS) have had varied results.

This study aimed to:

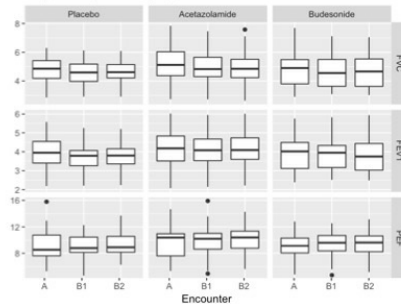
- Corroborate prior findings of changes in pulmonary function with altitude and AMS
- Determine if preventative medicines for AMS affected pulmonary function at altitude
- Determine if baseline metrics of pulmonary function were predictive of AMS

Approach

- This study was conducted on participants of ASPECT, a randomized controlled trial comparing budesonide to acetazolamide to placebo for the prevention of AMS over 4 weekends in August 2016.
- 103 healthy adults were enrolled at 1,240 m (4,100 ft), drove to 3,545 m (11,700 ft), then hiked to and slept at 3,810 m (12,500 ft).
- PFTs were measured in the the morning just prior to ascent, the evening just after ascent, and the following morning after sleeping at altitude.



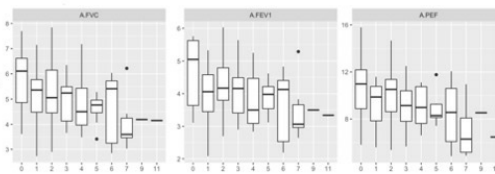
PFT metrics at each of three time points (A: baseline; B1: evening after ascent; B2: morning after ascent) divided by treatment group:



Results

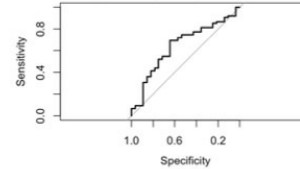
- 103 participants were enrolled with well-matched baseline demographics ($p \geq 0.09$) with no significant differences between the drugs and control groups at both baseline and change on ascent for incidence of AMS ($p > 0.05$).
- Total AMS incidence was 73%.
- Examining the entire cohort as a single group, there were no significant changes in peak expiratory flow (PEF), forced expiratory volume in one second (FEV1), or forced vital capacity (FVC) with altitude or AMS.
- Predictive ensemble methods had a 68 – 72% accuracy overall for predicting AMS from low altitude baseline values, with PEF the most important variable (ROC = 0.65).

PFT metrics measured the evening after ascent by Lake Louise Questionnaire score



AMS (B1 or B2) using A metrics - SVM

ROC curve developed using a support vector machine to predict AMS the evening (B1) or morning (B2) after ascent based upon PFT metrics prior to ascent (A):



Conclusion

- Rapid ascent to high altitude did not impact dynamic pulmonary function within the first 24 hours of exposure.
- Pulmonary function testing was a poor predictor for the development of AMS.
- Budesonide and acetazolamide did not affect changes in PFTs with altitude
- Those with AMS did not have significantly different changes in pulmonary function than those who did not have AMS.



Funded by: American Alpine Club, Institute for Altitude Medicine, WMS Herbert N.Hultgren Grant