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## Original Article

# Evaluation of nasal obstruction in lowlander males in high altitude

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## ARTICLE INFO

## Article history:

Received 6 June 2016

Accepted 7 March 2017

Available online xxx

## Keywords:

High altitude

NOSE scale

Rhinomanometry

## ABSTRACT

**Background:** Nasal symptoms are a major problem affecting the quality of life of lowlanders deployed at high altitude. Study was carried out in fresh male inductees inducted in high altitude of 11,500 ft (3500 m) above sea level to evaluate the nasal obstruction using the subjective Nasal obstruction and symptom evaluation (NOSE) score and rhinomanometry during the stay in high altitude.

**Methods:** A prospective study was carried out in 100 males inducted into high altitude. The subjects were evaluated using the subjective assessment tool, NOSE scale and rhinomanometry on induction and after 2 months. The data were analysed for NOSE scale in the 1st and 2nd visit by test for equality of proportions and the total nasal airway resistance (Pa) has been expressed as mean  $\pm$  standard deviation and compared across severity of NOSE score using one way ANOVA and between 1st and 2nd visit using paired t test.

**Results and conclusions:** Out of the 100 subjects, 77 came for the 2nd review after 2 months. There was statistically significant worsening in the subjective feeling of nasal obstruction during the stay in high altitude without any significant change in the nasal airway resistance.

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## Introduction

Ladakh is an arid mountainous region with an average altitude of approximately 11,500 ft (3500 m) above sea level. It has temperatures ranging from  $-30^{\circ}$  C to  $30^{\circ}$  C, relative humidity of 25–55% and reduced partial pressure of oxygen in

atmosphere. The low oxygen pressure increases the respiratory effort and large volume of dry air has to be inspired to maintain the normal oxygen concentration in blood especially during physical stress. This hyperventilation has an impact on the upper airway especially the nose which on exposure to cold and dry air leads to symptoms of excessive dryness, crusting, nasal obstruction, epistaxis and mouth breathing.<sup>1–3</sup>

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<http://dx.doi.org/10.1016/j.mjafi.2017.03.001>

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The duration of stay at high altitude also brings about microscopic changes in the nasal mucosa; according to Rostovshchikov,<sup>4</sup> a stay for more than one month resulted in reversible metaplastic changes of respiratory epithelium into multilayer squamous epithelium.

Nasal obstruction is a complex nasal symptom encompassing the anatomical and psychological factors to it.<sup>5</sup> The nasal airflow is a sensation of flow of air in the nose and various validated subjective scales/questionnaires have been made to measure the nasal symptom. Nasal obstruction and symptom evaluation (NOSE) Scale has been developed and validated by Stewart et al.<sup>6</sup> for subjective assessment of surgical outcome for deviated nasal septum. However the questionnaire has been used in wide varieties of nasal pathologies for evaluation of nasal patency.<sup>7,8</sup> For objective assessment of nasal patency, Rhinomanometer is used. Rhinomanometry is a dynamic measurement of nasal airway resistance to flow of air through the nasal cavity during respiration. Only a few studies have been done till date to evaluate nasal obstruction in lowlander inductees to high altitude. Most of these studies have been done to evaluate the acute changes in the nasal airway from low to high altitude and have shown varied findings subjectively and objectively.<sup>9,10</sup> However the physiological aspect of change in nasal airway resistance during the stay in high altitude is not well understood. So a study was designed to evaluate the severity of nasal obstruction during the stay of two months at high altitude using a validated subjective scale (NOSE scale) and objective tool (active anterior rhinomanometric test) in fresh lowlander males inducted into high altitude.

## Material and methods

An observational study was carried out at ENT centre between September and December 2012 at an altitude of 11,500 ft. The study population comprised of fresh male inductees inducted into high altitude by air route. Exclusion criteria consisted of individuals with history of naso-bronchial allergy, acute/chronic rhinosinusitis, atrophic rhinitis, granulomatous disease of nose or any nasal surgery in the past. Individuals with history of hypertension, diabetes and pulmonary tuberculosis, COPD and cardiac diseases were also excluded from the study. A complete ENT examination was done including an anterior rhinoscopy and nasal endoscopy to rule out deviated nasal septum, septal spur or perforation, nasal polyp/growth or signs of nasal infection. All subjects enrolled in this study were advised not to smoke or consume drugs like oral antihistaminic/decongestants and nasal steroid.

All 100 fresh lowlander male inductees free of the above diseases who initially reported in first 48 h for high altitude induction medical checkup at our centre were selected for inclusion in the study. Informed written consent was taken from all of them. First they were handed over a Performa of Nasal Obstruction and symptom evaluation (NOSE) Scale for self-assessment for their nasal patency. The questionnaire comprised of five questions each was graded in scales from 0 to 4 depending on the severity. No symptom scored 0, score of 1–5 was graded as mild, 6–10 was graded as moderate and 11–20 was graded as severe.<sup>6,8</sup> After having recorded the subjective

assessment of nasal symptoms, the objective measurement of nasal airflow resistance was done using ATMOS Rhinomanometer 300 which is an EN ISO 9001 certified active anterior rhinomanometer. The subjects were explained about the procedure, anterior rhinoscopy was done before the test. Rhinomanometry was performed according to recommendations of the International Standardization Committee of Rhinomanometry (ISCR) for nasal airways. The active anterior rhinomanometry was carried out for both the nasal cavities on inspiration separately. All the inductees who were enrolled in the study were asked to review after 2 months and the tests were repeated in the same manner. The total nasal airway resistance at 150 Pa before decongestion has been evaluated for the present study as all anatomical variation in nasal cavity that will affect nasal patency had been excluded from the study.

The total nasal airway resistance was evaluated and recorded for the purpose of the study and did not use the unilateral nasal airflow resistance as it varied widely with nasal cycle.<sup>11</sup>

Severity of NOSE score was expressed as Number of patients and percentage of patients and compared between 1st and 2nd visit by test for equality of proportions. Total nasal airway resistance at 150 Pa has been expressed as mean  $\pm$  standard deviation and compared across severity of NOSE score using one way ANOVA/unpaired t-test wherever applicable and between 1st and 2nd visit using paired t test. The statistical software SPSS version 20 has been used for the analysis and an alpha level of 5% has been taken, i.e. if any ( $p < 0.05$ ) it has been considered as significant for the study at 95% CI.

## Results

The present study was done in 100 subjects who were fresh lowlander male inducted into high altitude. An analysis of the study population was undertaken and it was observed that the subjects mean age was 28.77 years with a minimum age of 20 years and maximum of 49 years out of which 77 subjects came for the second review.

All the 77 subjects responded to the NOSE scale questionnaire on induction and after 2 months of stay at high altitude. 73 (94.8%) of the 77 subjects expressed mild nasal obstruction on NOSE scale on induction to high altitude. 36 (46.8%) of 77 subjects showed worsening of symptoms on review after 2 months, which was statistically significant (Table 1). The mean of NOSE score on induction was 1.05 and on 2nd visit was 5.78 which was significant worsening of the score.

Based on the questionnaire it was observed that 79% of patients had worsening of nasal blockage in varied severity, 78% had nasal stuffiness and 65% had trouble sleeping (Fig. 1).

**Table 1 – NOSE score using test for equality of proportions: significant change in NOSE score from 1st to 2nd visit.**

NOSE score	1st visit	2nd visit	p value	Significance
Normal (0)	4 (5.19)	0 (0)	0.040	Significant
Mild (1–5)	73 (94.81)	44 (57.14)	<0.001	Significant
Moderate (6–10)	0 (0)	26 (33.77)	<0.001	Significant
Severe (11–20)	0 (0)	7 (9.09)	0.006	Significant

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