

Effect of Hot Steam Inhalation on Microcirculation of Nasal Mucosa

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ABSTRACT

Background and Objectives : Nasal inhalation of hot humidified air may alleviate nasal symptoms associated with rhinologic disease. Thus, hot steam inhalation is often recommended as a home remedy for various nasal disorders such as the common cold and allergic rhinitis. But the mechanism of its effect is not fully known and correct guidelines for implementing hot steam inhalation have not been settled. We studied microcirculation of nasal mucosa using the nasal Laser Doppler Flowmetry (LDF) in ten healthy subjects in order to evaluate normal physiologic reactions to hot steam. **Material and Methods** : 10 healthy volunteers inhaled hot steam (about 42 °C) 10 times, 20 times, 30 times, 50 times and 100 times respectively. Nasal LDF was then performed using a Peiflux 4001 (Perimed, Jartalla, Sweden) and the microcirculatory parameters perfusion, velocity, and concentration were each recorded at base line immediately, 15 minutes, 30 minutes, 60 minutes, 90 minutes and 120 minutes after hot steam inhalation. **Result** : Microcirculatory perfusion was highest at 15 minutes after hot steam inhalation regardless of how many times inhalation occurred. It was found that at 15 minutes, there was a significant increase of microcirculatory perfusion in subjects inhaling 50 times and 100 times ($p < 0.05$). But, at 120 minutes, significant increase of microcirculatory perfusion was only seen in subjects inhaling 100 times ($p < 0.05$). **Conclusion** : After inhalation of hot steam, an increased microcirculatory perfusion of nasal mucosa was registered. Up to inhaling of 100 times, it leads to effective increment of microcirculation of nasal mucosa.

KEY WORDS : Hot steam inhalation · Mucosal microcirculation · Nasal laser · Doppler flowmetry.

INTRODUCTION

Inhalation of humidified hot steam has long been regarded as an effective conservative therapy of rhinologic diseases. Many people perceive transient amelioration of nasal obstruction during or immediately following hot steam inhalation.

Hot steam inhalation is reported effective in reducing nasal obstruction of rhinologic disease such as the co-

mon cold, allergic rhinitis, or chronic sinusitis.¹⁻³⁾

This has been used as an effective therapy, which the patient can practice with ease at home by himself. Its usefulness is proven where the hot steam brings about change in nasal mucosal microcirculation.⁴⁾ But, until now, its efficiency has usually been evaluated by subjective questionnaires regarding the improvement of the patient's symptoms or by assessing nasal patency with rhinomanometry or acoustic rhinometry.⁵⁾⁶⁾ Therefore, in order to find out what effect hot steam inhalation has on nasal mucosal microcirculation, it was necessary to suggest a reasonable method of doing hot steam inhalation to improve nasal obstruction.

In our previous study (unpublished data), we compared nasal mucosal microcirculation in a patient with allergic rhinitis with that of a healthy person, and found out that nasal Laser Doppler Flowmetry (LDF) shows good reproducibility, and this non-invasive technique has the advantage of providing continuous and instantaneous measurements of the changes of nasal mucosal

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microcirculation.

The aim of this study was to measure the microcirculation of nasal mucosa using nasal LDF in healthy subjects following hot steam inhalation and was to formulate guidelines for an effective method of hot steam inhalation.

MATERIALS AND METHODS

Materials

We used 10 healthy people (8 males, 2 females, age range : 25 - 33 years) who had neither past history of nasal disease such as allergic rhinitis, sinusitis, or vasomotor rhinitis, nor abnormal nasal symptoms such as rhinorrhea or nasal obstruction, and also who turned out to be normal in physical examinations including anterior rhinoscopy.

The subjects were confined to age of the late twenties and the early thirties, which is of no significant age difference in terms of microcirculation.

Nasal laser doppler flowmetry

An electric coffee pot (Keobookpyo pot, Taeyu Corp, Korea) was used as a device, which could generate a constant flow of steam directed to the nasal passages. The subjects were instructed to breathe by inhaling hot steam from the electric coffee pot (Keobookpyo pot, Taeyu Corp, Korea) through the nose and by exhaling through the mouth. During continuous hot steam inhalation, the subjects were instructed to place their nasal cavity 25 cm away from the top of the coffee pot where the temperature measured 42 °C on the assumption that the thermometer be placed inside the vestibule of nose.

Each subject inhaled hot steam 10 times, 20 times, 30 times, 50 times and 100 times respectively every other day. Each time, nasal LDF was performed at base line and immediately, 15 minutes, 30 minutes, 60 minutes, 90 minutes and 120 minutes after hot steam inhalation.

Nasal LDF was performed using a Periflux 4001 laser-doppler perfusion meter (Perimed, Jartalla, Sweden). The wavelength of the laser beam was 780 nm. Nasal LDF is a direct optical method where the subject's head is secured to a frame by means of an individually adapted dental splint. After having done this procedure, left inferior turbinate was exposed using a

suspension rhinoscope. Then, the LDF probe was dropped at a distance of 0.2 mm from the anterior end of left inferior turbinate so that it was perpendicular to the surface of the mucosa and then, using a locking device, the probe was fixed to this position.

The locking device held the probe with support against the frame of the LDF apparatus touching the surface of the mucosa of left inferior turbinate at the 0.2-mm distance. The precise adjustment of the distance between the probe and the mucosa of left inferior turbinate-taking care not to exert pressure on the mucosa-was performed using a micromanipulator.

The microcirculatory parameters perfusion, concentration and velocity were recorded for 30 seconds after stable signals were made. The readings were expressed in arbitrary units : perfusion units (PU ; microcirculatory perfusion), velocity units (VU ; microcirculatory velocity) and concentration units (CU ; RBC concentration). The signal was fed into an IBM-compatible computer using the Perisoft software program.

Statistical analysis

One-way ANOVA was used for evaluation of changes in mucosal microcirculation. Significance was $p < 0.05$.

RESULTS

We were mainly interested in the changes of microcirculatory perfusion (PU) after hot steam inhalation among the three-microcirculatory parameters (PU, VU, and CU) of nasal LDF.

Average baseline microcirculatory perfusion in all subjects ranged from 146 PU to 154 PU, no significant difference. The maximal microcirculatory perfusion was achieved at 15 minutes after hot steam inhalation and showed statistical significance when inhaling 50 times and 100 times were compared with subjects who inhaled fewer than 50 times.

After 15 minutes, microcirculatory perfusion gradually decreased and in the case of inhaling less than 50 times, it returned to its baseline level after two hours. However, when inhaling 100 times, even after two hours, there was a significant increase from the baseline level ($p < 0.05$), (Table 1-5, Fig. 1).

But, the change of microcirculatory velocity (VU) and RBC concentration (CU) was not statistically sig-