

Is mucociliary transport velocity related to symptoms in chronic rhinosinusitis patients?

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Keywords: Chronic rhinosinusitis – Symptoms – Mucociliary clearance – Rhinoscintigraphy – ^{99m}Tc-macroaggregated albumin

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Received:

5 November 2007

Accepted revised:

2 January 2008

Abstract

Mucociliary transport velocity (MTV) measured by rhinoscintigraphy is considered a reliable measure of mucociliary clearance, one of the mechanisms that are distorted in chronic rhinosinusitis (CRS). *The aim* of this study was to investigate possible correlation of MTV with the severity of patients' symptoms. *We have studied* thirty-seven CRS patients who completed the 20-item sinonasal outcome test (SNOT-20) form, a reliable measure of health related quality of life and were also examined by rhinoscintigraphy with technetium-99m macroaggregated albumin. *Our findings* showed that the MTV of our patients ranged from nil to 4.17mm/min with a mean value of 1.74±1.055 mm/min. The SNOT-20 scores varied from 0.3 to 3.7 with a mean of 1.6±0.922. The correlation between SNOT-20 score and MTV was not statistically significant (Spearman's $r=-0.191$). *In conclusion*, although rhinoscintigraphy is widely accepted as a reliable test of mucociliary velocity and clearance, it did not correlate with subjective measures of the severity of CRS.

Hell J Nucl Med 2008; 11(1): 30-32 • Published online: 28 January 2008

Introduction

Chronic rhinosinusitis (CRS) is a common disorder in developed countries, causing significant morbidity in terms of physical and social function and also affecting quality of life [1]. Several objective and subjective measures, used to study the severity of CRS, failed to show any significant correlation with the disease [2-4]. Mucociliary transport velocity (MTV) is considered a reliable index of upper respiratory tract clearance function [5, 6], testing an important protective mechanism of the ciliated epithelium of respiratory pathways. MTV was found significantly decreased in patients with CRS [5, 6], but until now only one study could be identified in the english literature comparing the results of MTV with general nasal health [7]. In this study, the 20-item sinonasal outcome test (SNOT-20), a validated, disease-specific, health and quality of life related questionnaire has been used for the assessment of CRS [7] and has been compared to the saccharine test. This test is applied for mucociliary clearance assessment [8] and also applied as a complementary test to rhinoscintigraphy [9]. Rhinoscintigraphy by the use of technetium-99m macroaggregated albumin (^{99m}Tc-MAA) has been recently shown to be a reliable imaging test for the evaluation of nasal MTV in patients with CRS [5, 6].

Based on the few existing studies as mentioned above, we have studied the possible correlation between nasal MTV and SNOT-20 test in CRS patients.

Patients and methods

Thirty-seven non-allergic patients, 21 men and 16 women, 28 to 66 years old, with a mean age of 41.3±9.8 years, diagnosed as having CRS according to criteria of The European Position Paper on Rhinosinusitis and Nasal Polyps for Research [10], were examined by, rhinoscintigraphy and by the SNOT-20 questionnaire. All patients had a stable disease and no one had received any medication for his/her CRS for at least 10 days. Endoscopic examination revealed edematous mucosa without polyposis and the minority of patients had thick mucus rhinal secretions or crusts. An endoscopic appearance score was not obtained [11]. Patients who had been operated for their disease, patients with nasal polyps, cystic fibrosis, congenital or acquired gross immunodeficiency and congenital mucociliary problems, e.g. primary ciliary dyskinesia, were excluded from the study.

Rhinoscintigraphy was performed after the installation of 15μL of ^{99m}Tc-MAA on the floor of the nasal meatus about 1 cm behind the anterior end of the inferior turbinate. A to-

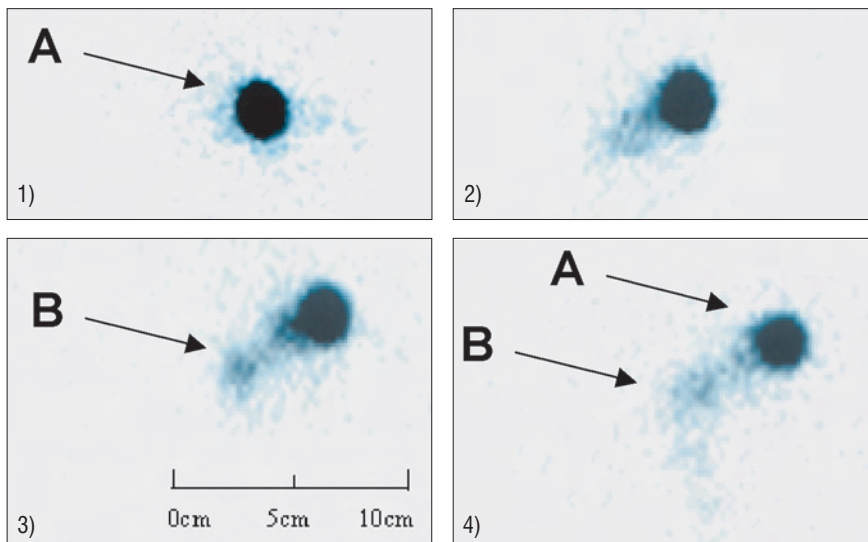


Figure 1. Four rhinoscintigraphic patterns of the same patient at subsequent time intervals showing the transport of radioactive substance to rhinopharynx. (A) indicates the site of installation of the radiopharmaceutical, whereas (B) the region of interest corresponding to the entrance of the pharynx. MTV was calculated as the fraction of time needed for the radiopharmaceutical to cover the distance between A and B to that actual distance in cm.

tal of 3.7 MBq of ^{99m}Tc-MAA was installed in one of the nostrils, whichever had the worst Lund-Mackay score [12]. Patients were positioned in front of a gamma camera (Millenneum VG, GE Medical Systems, USA) equipped with an all-purpose parallel hole collimator, in a neutral sitting position with the nostril tested touching the collimator. The ^{99m}Tc-MAA was then applied and the acquisition was immediately started, storing 30 sec frames until we made sure that a part of the radiopharmaceutical reached the pharynx or until a maximum time of 30 min elapsed. Regions of interest (ROI) were selected and the mean MTV, which is the length in millimeters per min (mm/min) of the radioactive substance transport until the radioactivity entered the pharynx, was calculated. The ROI corresponding to the entrance of the radioactivity in the pharynx was identified as the area where the radioactivity appeared as a downward inclined area at the posterior end of the scintigraphic pattern (Fig.1). Patients with an MTV value greater than 5 mm/min were excluded from the study because of the possibility of passive gravity transport of the radiopharmaceutical.

Before rhinoscintigraphy the patients were asked to complete the Greek version of the SNOT-20 questionnaire. In this questionnaire, developed and validated by Piccirilo et al (2002) [13], the patient is rating the severity of his/her condition using a 0-5 category rating system for each item. The total SNOT-20 score was calculated as the mean score for all 20 items so the possible range of the SNOT-20 score is 0-5, with higher scores indicating greater rhinosinusitis-related health burden.

A Spearman rank test was conducted to investigate a possible relation between MTV and the SNOT-20 score in each patient.

Results

Three patients with MTV values greater than 5 mm/min were excluded. The MTV of our patients ranged from 0 mm/min to 4.17 mm/min, with a mean value of 1.74 mm/min±1.055. The SNOT-20 scores varied from 0.3 to 3.7 with a mean of

1.6±0.922. The correlation between the SNOT-20 score and MTV was not statistically significant. The SNOT-20/MTV correlation coefficient (Spearman’s Rho) was -0.191. A scatter plot demonstrating the relationship between total SNOT-20 score and MTV is shown in Figure 2.

Discussion

Mucus transportation by respiratory cilia, namely mucociliary clearance, is an important protection mechanism of the sinus [14]. Several methods have been used to evaluate the ciliary activity of nasal mucosa. Direct methods such as stroboscopy, roentgenography, and photoelectron techniques require technology not always available or convenient to use, in routine studies. Indirect methods such as the saccharine test or the use of ^{99m}Tc-MAA are safe, easy, fast and reliable studies of mucociliary clearance. Although the saccharine test is easier to perform, a more consistent agreement was found for rhinoscintigraphy when a group of patients underwent duplicate saccharine-dye tests and rhinoscintigraphy [15].

Another interesting fact in CRS, is the lack of correlation of the patients’ symptoms, with objective measures like CT-scans. Recently, several questionnaires have been developed to assess the functional status or health related quality of life of patients with CRS. SNOT-20 is often used, because it is easy to use and also has psychometric characteristics. The mean

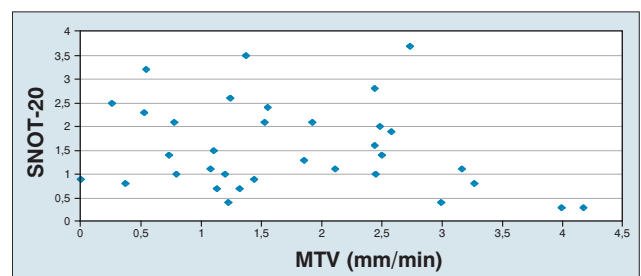


Figure 2. A scatter plot demonstrating no relationship between the total SNOT-20 score and mucociliary transport velocity.

SNOT-20 score in our patients did not differ significantly from the mean score of the same test performed by other investigators [13].

Other investigators have used the SNOT-20 test to investigate a possible correlation of MTV with patients' symptoms in CRS patients and also in volunteers not related to CRS [7]. They did not find any significant correlation between rhinosinusitis' symptoms as assessed by the SNOT-20 scores and mucociliary clearance using the saccharine test which involves the installation of a 4% solution of saccharine on the floor of the nose. The time needed until the first sensation of a sweat taste in the pharynx is recorded as the saccharine or mucociliary clearance time. These findings are in accordance with our results, however, we used a more precise method, like rhinoscintigraphy, because saccharine test can be affected by factors like a mild taste distortion, which is usual in patients with CRS or with other upper respiratory tract infections.

In addition, due to the small number of subjects included in this study, we did not proceed in examining possible correlation of the mean MTV to other factors like nose obstruction, or smoking, or peak MTV. Apart from the small number of patients, the technique used can be regarded as another limitation of this study, because although reliable, rhinoscintigraphy is a sophisticated procedure requiring expensive equipment and materials.

For further evaluation one could consider comparing rhinoscintigraphy with endoscopic findings, like edema, secretions or crusts. Endoscopic appearance scores like those described by others can be considered as useful adjuncts to computer tomography for the objective evaluation of CRS [16].

Finally, the site of installation is a matter of discussion [5, 6]. We used the floor of the nose, as suggested by others [5], considering the epithelium of the nose and of the paranasal sinuses as an entity. It is not known whether installation of the radiopharmaceutical in a different place like the middle meatus or whether installation by a standardized nasal spray, could yield different results.

Others, using the same rhinoscintigraphy technique, have shown an increased MTV in normal subjects, with an average of 4.28 ± 1.42 mm/min [5]. We did not perform rhinoscintigraphy in normal subjects since the difference in the MTV values between normal subjects and CRS patients has already been demonstrated by several investigators [15, 17] and since our scope was to investigate possible relation between symptoms and the rhinoscintigraphic patterns of CRS patients. In order to have a more homogeneous population in our study, we have excluded patients with polyposis and those during exacerbation of the disease because at that time, symptoms scores worsen and thick secretions or crusts in the nasal cavity may well interfere with the MTV of the radiopharmaceuti-

cal. On the other hand, it is our opinion that the severity of CRS symptoms does not correlate with the underlying pathogenic mechanism, namely the impaired MTV.

In conclusion, although rhinoscintigraphy is widely accepted as a reliable test of MTV and an objective test in CRS, it has failed in our study to correlate with subjective measures of the severity of CRS.

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