

Nasal pH and saccharin clearance are unrelated in the physiologically normal nose*

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SUMMARY

A group of 56 asymptomatic non-smoking men was prospectively recruited to study the relationship between nasal mucosal pH and saccharin clearance rate. No significant relationship was found between the two variables (Pearson correlation coefficient = -0.105 , $p = 0.44$). This finding suggests that in vivo mucociliary flow rates are resistant to change within the pH range of the physiologically normal nose.

Key words: alkaline nasal douching, nasal pH, rhinitis, saccharin clearance

INTRODUCTION

The pH of the nasal mucosa has been the subject of sporadic research interest over the years. As early as 1941 it was demonstrated that nasal mucosal pH increases in acute infective rhinosinusitis (Fabricant ND, 1941). In addition, it has been shown that ciliary beat frequency falls in rhinitis with a concomitant rise in mucociliary transport time (Karnitzki G *et al.*, 1993), although the latter finding is as much dependent on altered mucus rheology as altered ciliary function (Moriarty BG *et al.*, 1991). In spite of the relationship between rhinitis and increased pH, the use of nasal douching solutions buffered alkaline is commonly recommended (Weir N, Golding-Wood DG, 1997). This project studies the relationship between mucociliary flow rate and nasal mucosal pH in the physiologically normal nose.

MATERIALS AND METHODS

Fifty-six male patients attending the outpatients clinic with non-rhinological problems were prospectively recruited. No patient reported a previous history suggestive of rhinitis, and no patient had had previous nasal surgery or had used any nasally administered medication in the preceding three months. The saccharin clearance time and nasal pH of each patient was recorded. The saccharin clearance time was used as a simple, previously validated measure of mucociliary flow (Stanley P *et al.*, 1984). It was measured by applying half a saccharin tablet to the medial aspect of the right inferior turbinate, one centimeter posterior to its most anterior insertion, and recording the time from application to first taste of the saccharin. All patients were instructed not to sniff or blow their noses during the test. The

nasal pH was measured three times at five minute intervals on the medial aspect of the left inferior turbinate one centimeter posterior to its most anterior insertion using a semidisposable antimony paediatric monocrystalline pH catheter. This method has previously been shown to be statistically valid for repeatability and reliability (coefficient of reliability = 0.84 using the Spearman-Brown formula indicating excellent repeatability and reliability (England RJA *et al.*, 1999). It has also previously been shown that there is no statistically significant difference between the surface mucosal pH of either turbinate at any fixed moment in time (England RJA *et al.*, 1999). The results were statistically analysed using the SPSS program package.

RESULTS

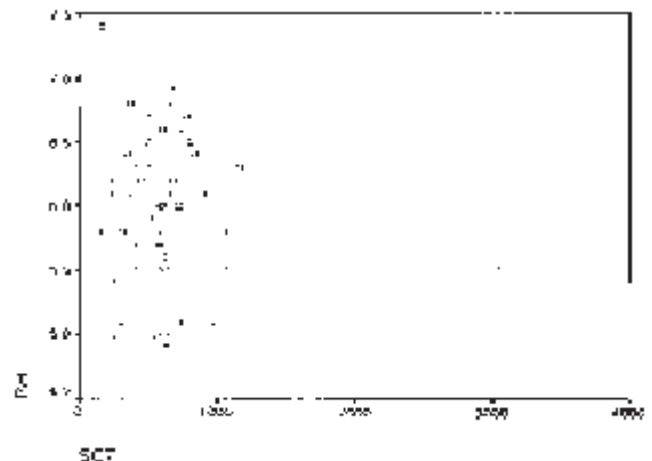


Figure 1. Scatter plot of nasal mucosal pH (pH) against saccharin clearance time (SCT).

The patients ages ranged from 19-77 years (mean 40 years). The nasal pH ranged from 4.9-7.4 (mean 5.9, S.D \pm 0.55) and the saccharin clearance ranged from 120 to 3060 seconds (mean 606 seconds, S.D \pm 414 seconds) (see Figure 1). The readings for saccharin clearance were shown by the Kolmogorov-Smirnoff test to have a skewed distribution and were therefore log transformed for normality. The nasal pH readings were normally distributed. Analysis of the relationships between the variables after log transformation using Pearson's correlation revealed no significant association between the two variables (Pearson correlation coefficient = -0.105, $p=0.44$).

DISCUSSION

This study measures nasal mucosal surface pH in physiologically normal noses and suggests that the intrinsic surface pH of healthy nasal mucosa does not affect mucociliary function. It is potentially flawed as it uses a soluble substance as the test medium and particulate matter may give a more accurate assessment of outer mucus layer flow. However, the use of saccharin clearance rate as a measure of mucociliary function has proven reliable in past work (Sakakura Y *et al.*, 1983).

In vitro studies have similarly shown that ciliary beat frequency is relatively pH resistant remaining constant between pH 7.0 and 9.0, which appears to be the optimal range (Luk CK and Delfano MJ, 1983). The pH range recorded in our patient sample is wider than the range previously cited as normal (Fabricant ND, 1941) and its upper limit is within the range of that previously recorded in rhinitis. The use of nasal douching agents has been advocated for many years. Their use in the post surgical nose to clear crusting and in the management of rhinitis has been repeatedly shown to be of benefit (Levine HL and May M, 1993). However, alkalinisation of the douching fluid is of dubious benefit. This "benefit" was questioned by Fabricant who demonstrated an increase in nasal mucosal surface pH in rhinitis (Fabricant ND, 1941). As previously mentioned, *in vitro* studies have lent weight to the controversy showing that ciliary beat frequency is relatively pH resistant and in fact optimal over the pH range recorded in rhinitis (Luk CK and Delfano MJ, 1983). However, mucociliary function is also dependent on mucus rheology and it is conceivable that the alkalinity of the douching solution exerts its beneficial effect on the mucus layers themselves. This possibility is unsupported by recent *in vivo* work which suggests that alkalinising a hypertonic douching solution confers no additional benefit and it is the hypertonicity

of the douching solution which confers the benefit (Homer JJ *et al.*, 1999).

In conclusion, although this study involves the physiology of normal nasal mucosa, the upper level of the normal range recorded is within that recorded in rhinitis. No relationship between saccharin clearance rate and surface mucosal pH is evident. When added to other work there is growing evidence that within physiological boundaries, the pH of the nasal mucosa does not affect mucociliary function. If this is the case, and with the knowledge that nasal mucosal pH rises in rhinitis anyway, the alkalinisation of nasal douching solutions is of dubious benefit.

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