Nasal pH measurement: a reliable and repeatable parameter

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The nasal mucosal pH is \(\approx 5.5-6.5\), and increases in rhinitis to 7.2–8.3. This knowledge has not led to the widespread measurement of the nasal mucosal pH as an objective clinical parameter. The purpose of this study was to assess whether repeatable measures of nasal mucosal pH could be obtained in the clinical setting. Fifty-four adults without nasal symptoms were prospectively recruited. Using a semi-disposable antimony pH catheter, the nasal mucosal pH was measured in four specific areas of the nose and each reading repeated three times. The patients’ age, sex, smoking habits, nasal anatomical variation and clearest nostril at the time of measurement were also recorded. The data shows that it is possible to obtain reliable and repeatable values for the pH of the nasal mucosa (Spearman–Brown \(R = 0.84\)). Analysis shows there is no significant difference between septal and turbinate mucosal pH. Subset analysis implies that nasal mucosal pH is higher in men than women (\(P < 0.05\)). The other variables did not affect the nasal mucosal pH significantly.

Keywords nasal pH nasal mucosa septum turbinate reliability

Nasal mucosal pH has been the subject of sporadic interest for over half a century. The pH of the nasal mucosa in normal people was reported to be within the range of 5.5–6.5 as far back as 1941.\(^1\) A significant rise in nasal mucosal pH in acute infective rhinitis and allergic rhinitis was also described at the same time.\(^1\) A more recent study has reported the nasal mucosal pH to have a mean of 6.862. In addition, it has been shown that the nasal mucosal pH increases with increasing age.\(^2\) Of greater clinical interest is the finding that a more alkaline nasal mucosa increases the release rate of some common allergens instrumental in precipitating allergic rhinitis from ragweed pollen.\(^3\) Hence, the fact that the pH of the nasal mucosa in rhinitis tends to become more alkaline creates a vicious cycle. It is therefore surprising that there is a recent trend towards treating rhinitic nasal mucosa with buffered alkaline nasal douches.\(^4\) Research has shown this does nothing to encourage a return towards normal pH levels.\(^1\)

In spite of the research based interest in nasal mucosal pH, measurement of nasal mucosal pH has never taken on clinical significance. This is likely because of the time-consuming nature of the procedure. Many pH meters and catheters are extremely sensitive and difficult to calibrate, and most work in fluid only. However, certain modern semi-disposable antimony pH catheters are more robust and easy to use. These are frequently used for oesophageal pH monitoring. Their use in pH monitoring of the nasal mucosa, however, has not been evaluated. This study was therefore designed to evaluate the efficacy of such a measurement system for mucosal pH. Variables believed to have a potential role in altering the nasal mucosal pH were also studied.

Materials and methods

Following ethical committee approval, a group of 54 adult (\(\geq 18\) years of age) volunteers were prospectively collected. Patients who had undergone previous nasal surgery or who were taking any topical nasal medication were excluded. Details of age, sex, smoking habits, which side of the nose was most blocked at the time of recording (a rough indication of phase in the nasal cycle), and anatomical variation were recorded. Ten or more cigarettes a day for \(> 3\) months was judged as a positive smoking history and a septal deflection causing a decrease in the area of the anterior nasal fossa at the valve by \(\geq 50\%\) was judged a significant anatomical variation. Patients with symptoms of rhinitis were excluded. This was judged as troublesome nasal obstruction.

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rhinorrhoea, or sneezing at the time of recording. The nasal mucosal pH was measured using a portable pH meter with a 1.5-mm diameter paediatric monocrystall catheter (Synectics Medical Products pH meter and monocrystall antimony pH catheter). The catheter was firstly calibrated, a procedure taking \(\approx 5\) min. Once this had been done contact with the nasal mucosa gave an immediate reading. After each patient reading the catheter was cleaned with an alcoholic swab rendering it clean but not sterile: all patients were aware of this. The measurements were taken 1 cm along the medial aspect of both inferior turbinates and 1 cm posteriorly away from the maxillary spine on both sides of the nasal septum. All the readings were taken at the same time of day (between 12.00 and 14.00). Each reading was repeated three times at 5-min intervals. The results were recorded and analysed using the SPSS analysis package.

**Results**

Of the 54 patients 43 were women and 11 men. One set of results gave particularly low readings and after the hardware was tested by the suppliers, this was ascribed to deterioration of the probe which was replaced; this set was excluded from the analysis. The ANOVA, and from this the reliability coefficient \((R)\), was calculated for all of the 636 pH readings and found to be 0.64 indicating fair reliability.\(^6\) However, as our method involved taking each measurement in triplicate, using the Spearman–Brown formula \((R_m = mR/1 + R(m-1))\) for \(m\) measurements) the adjusted coefficient of reliability was 0.84, indicating excellent reliability.

Kolmogorov–Smirnoff testing for goodness of fit showed the results for the four groups; left inferior turbinate, left septum, right inferior turbinate and right septum were all normally distributed, and the pH of the nasal mucosa was found to be within the range 5.3–7.0 (mean 6.29, SD 0.37, 95% range for the average of three measurements \(\pm 0.294\)). Paired \(t\)-testing showed that there was no significant difference between turbinate and septal mucosa or between the turbinate mucosa in either side of the nose. Simple factorial ANOVA using the mean pH measurements for each of the four areas of the nose studied showed that sex was the only consistently significant variable \((P < 0.05)\). The variables of smoking, anatomical variation, subjectively clearer nostril, and the continuous covariate age were not consistently significant.

**Discussion**

The results show that it is possible to obtain reliable and repeatable nasal mucosal pH readings. The procedure involved is not time-consuming, in fact the hardware gives virtually instantaneous readings and the initial calibration of the meter takes about 5 min. The study also enabled us to evaluate the effect various other factors have on nasal pH. Although subset analysis is often unwise as the data cannot be random and the numbers are generally small the difference in nasal mucosal pH between men and women is an interesting finding that has not been previously reported and further study is warranted. The other patient variables recorded, smoking, subjectively clearer side, anatomical variation and age do not appear to cause a significant difference. This is contrary to previous evidence that nasal mucosal pH increases with age.\(^3\)

In conclusion, the measurement of nasal mucosal pH is a repeatable and practical method of obtaining an objective parameter for assessing the state of the nasal mucosa in the clinical setting. As it has previously been shown that the pH increases in rhinitis, the logical next step is to study mucosal pH in rhinitis and its alteration after medical treatment.

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**References**