

# **Nasal mucociliary clearance and resolution of otitis media with effusion in children following adenoidectomy**

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## **SUMMARY**

*Numerous workers have studied the relationship between nasal mucociliary clearance and adenoid removal in terms of nasal function. This study was performed to investigate the role of preoperative saccharin clearance time and velocity determination in selecting children with established otitis media with effusion (OME) for adenoidectomy. Testing was not found to be particularly reproducible and there was no statistically significant relationship between mucociliary parameters and the otoscopic resolution of effusion.*

## **INTRODUCTION**

Considerable interest has been shown in abnormalities of mucus transport in children with otitis media with effusion (OME) and also in those with enlarged adenoids. However, there are no studies which have examined the relationship of transport time with the resolution of the middle ear effusion following adenoidectomy. Mucociliary clearance is usually measured by assessing the rate of movement of a marker substance which itself does not impair ciliary function. This can be done under direct vision by observing the movement of particles from the anterior nose into the oropharynx and timing the interval. Other, more sophisticated methods use radioactively labelled particulate tracers such as technetium-99-labelled albumin and its passage through the respiratory tract monitored using a camera sensitive to gamma-radiation (Karja et al., 1982). The simplest clinical estimation, however, is to introduce a small quantity of saccharin onto the anterior end of the inferior turbinate. The time interval that the patient takes to taste it is then recorded, as the substance is transported backwards into the oropharynx and the base of the tongue where a gustatory response is evoked (Andersen et al., 1971). This mucociliary clearance time as an estimate of ciliary function can be made

more accurate by calculating an actual transport velocity obtained from dividing the time to taste by the distance between the medial upper incisor teeth and the inferior border of the soft palate (Maurizi *et al.*, 1984). In a study comparing three methods of measuring mucociliary clearance in adults - using direct visualization of aluminium discs, saccharin tasting, and movement of radioactive technetium - investigators were able to show that transport times determined by the saccharin method were in good agreement with transport velocities obtained by the radio-isotopic method (Puchelle *et al.*, 1981).

Maurizi *et al.* (1984) showed that mucociliary function in children was less than that in adults, but tended to increase with age. In cases with small adenoids adult values were reached at about 8-10 years. With large adenoids clearance velocities were much reduced and this was independent of age. By careful morphological study they were able to postulate that this was due to the overall absence or reduction of the ciliated epithelium which tended to occur in isolated groups in the nasopharynx of those with large adenoids. In contrast this was shown to be a near-continuous sheet when the adenoids were small or non-existent. The same workers have also demonstrated significant improvements in mucociliary clearance following adenoidectomy performed for a variety of conditions (Maurizi *et al.*, 1986), but it is difficult to relate these findings to selecting patients with OME for this operation since no otoscopic clearance, tympanometric and audiometric data were presented following the procedure.

Studies which have examined patients specifically with OME have shown reduced mucociliary clearance from the accepted normal range with impairment of transport down the Eustachian tube (Nuutinen *et al.*, 1983). In addition, when adenoids were removed from children with middle ear effusions, the ciliary beat frequency of the covering epithelium significantly increased. This effect was not seen in those in whom effusions were absent and would suggest that the presence of middle ear fluid in some way depresses nasopharyngeal ciliary function (Ohashi *et al.*, 1988).

The present study was performed to determine the potential use that preoperative mucociliary clearance testing may have in selecting children with OME for adenoidectomy.

## METHOD

Children were selected to undergo mucociliary clearance testing with the consent of their parents if they could co-operate with a brief nasal examination which was a normal part of the outpatient consultation. Clearance of the nose was encouraged by blowing into a handkerchief prior to the test. Approximately 500 µg of saccharin was introduced on the end of a moist Jobson-Horne probe into the most patent nostril immediately behind the anterior end of the inferior turbinate. The child was then instructed to sit quietly without sniffing and to swallow

about once a minute. The time taken for the subject to taste the substance was then noted. In addition, each child underwent a lateral cephalometric radiograph and, for the purpose of calculating the transport velocity, the distance between the roots of the upper incisor teeth to the posterior limit of the hard palate was determined from the film.

### *Reproducibility*

Reproducibility of the technique was determined by comparison of clearance times in nine male and six female children (median age 62 months, range 46-75 months) on two occasions, 12 weeks apart. The tests were performed at similar times of the day and in each case the most clinically patent nostril was used. Not all of these children had established OME.

### *Relationship to outcome*

Saccharin clearance times and velocities were determined in 44 children with established OME selected subject to co-operation with the nasal examination from the clinic. Criteria of established OME for inclusion were as follows:

- subjective hearing problems;
- bilateral effusions on pneumatic otoscopy;
- abnormal bilateral tympanometric tracings (over 95% of which were type B);
- audiometric thresholds in excess of 25 dB at one frequency at least on both sides.

The four criteria were required at two examinations separated by a twelve-week interval. Testing took place and surgery was performed within three weeks of the last visit.

All the children underwent adenoidectomy. In addition, a Shepard ventilation tube was inserted in one side only. Otoscopic clearance of the effusion in the contralateral, unoperated ear was determined one year after operation by a single validated observer using pneumatic otoscopy.

## RESULTS

### *Reproducibility*

The reproducibility of the technique was not found to be high. One child sniffed and one child refused to have the saccharin placed in his nose. These were subsequently excluded from the analysis. Bivariate normal distribution of the data was not assumed, so the measure of agreement between the two sessions for the thirteen children was calculated using Spearman's Rank Correlation Test and is shown in Table 1. Even though the technique was standardized and the testing carried out at similar times of the day, the correlation coefficient was only 0.43 which approached statistical significance at the 5% level. In almost every case the child was reluctant to undergo the investigation for a second time and this is one reason why we did not insist on a postadenoidectomy clearance estimation.



Table 1. Reproducibility of saccharin clearance time tests.

session	clearance time (min)		Spearman's coefficient
	median	range	
1	15	5-34	0.43 ( $p > 0.05$ )
2	19	8-28	

*Relationship to otoscopic clearance*

Of the 44 children who underwent this investigation, one child sniffed, one refused the saccharin, and two others failed to taste anything after 50 min. In one child the incisor teeth had been missed off the radiograph and in a second, the posterior edge of the hard palate was indistinct. As a consequence of this, results from 40 children were used in the analysis of mucociliary clearance time but from only 38 with respect to clearance velocity. Of these 40 children, there were 22 boys and 18 girls with a median age of 64.5 months (range 45-93). The relationship between these parameters and otoscopic clearance in the unoperated ear at one year was investigated using the non-parametric Mann-Whitney U test. This was used because normal distribution of the data was not assumed.

Approximately three-quarters of the unoperated ears were observed to be clear. There were no significant differences with respect to saccharin clearance times or velocities whether or not otoscopic clearance had occurred. The results of this analysis are shown in Table 2. Because of the suboptimal reproducibility of the technique, relatively small numbers of cases and the overlap of data, ranges, a

Table 2. Mucociliary clearance time and velocity in relation to otoscopic clearance (unoperated ear) at one year after adenoidectomy.

time		
otoscopy	dry	fluid
number of ears	28	19
clearance time (minutes)		
median	10.5	10.0
range	3-47	4-37
Mann-Whitney U test statistic: 194.5, $p > 0.05$ ; ns		
velocity		
otoscopy	dry	fluid
number of ears	27	11
clearance velocity (mm/min)		
median	4.1	4.4
range	0.9-13.7	1.2-12.0
Mann-Whitney U test statistic: 129.0, $p > 0.05$ ; ns		

multivariate approach was not pursued. However, the population of those in whom the effusion had cleared were older than those in which it had remained, but this difference was not statistically significant using the Mann-Whitney U test (70 median clear [range 52-93] vs 54.5 median fluid [range 45-80]). Nevertheless, it is likely that the situation is in fact much more complex and other parameters may be important.

## DISCUSSION

The innate problems of poor reproducibility and the difficulty of making a child sit quietly for the duration of the test make this a technique based upon dubious foundations. The fact remains that on this sample of patients mucociliary clearance parameters could not be used to identify those in whom postoperative otoscopic clearance could be expected. Furthermore, a large number of children found the introduction and taste of saccharin crystals unpleasant which was a factor in their subsequent refusal to have the test repeated postoperatively. The reasons why this should be so are not clear. Throughout the testing, temperature and humidity were kept constant and identical at both sessions. The nose is indeed a very sensitive and reactive organ, subject to changes from a variety of influences such as environmental factors and viral injury. It is perhaps not surprising that modifications in the composition of the mucus or in ciliary activity can lead to large intersessional variations of nasal mucociliary clearance. The poor reproducibility does however diminish the usefulness of this parameter in selecting children for adenoidectomy at least on the basis of one single preoperative measurement.

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