

A modification of the saccharine test for nasal mucociliary clearance

Th. Deitmer, Münster, West-Germany

SUMMARY

The saccharine test for assessing mucociliary clearance in the nose is the most practicable method.

As the used sodium salt of saccharine is well water soluble, there is suspicion of interference with the very delicate two-layer-system of mucus or transport merely in the periciliary fluid, thus bringing about methodical errors. This is avoided by using inert tracers such as radioactively tagged ion exchange resin particles, which on the other hand must be observed with expensive equipment.

A synthesis of both methods is demonstrated by using saccharine loaden ion exchange resin particles. The validity of the test is proven in vitro and in vivo.

INTRODUCTION

In 1974 Andersen et al. (1974) described the saccharine test for assessing the clearance of nasal secretions towards the pharynx by the mucociliary system. A piece of the sodium salt of saccharine, blended *ana partes* with a food dye was placed behind the head of the inferior turbinate and the time was measured, until the subject tasted the saccharine and the spot of dye was seen in the pharynx (Andersen, 1984). The test was designed as a screening method with the advantages of a great simplicity. No laboratory equipment such as gamma cameras was necessary. A very sophisticated method of viewing mucociliary transport was described by Quinlan et al. (1969): anion exchange resin particles were radioactively labelled and used for mucociliary transport studies with a gamma camera.

For clinical routine use in examination of nasal complaints the saccharine test must be preferred, because of the simplicity of the method.

The mucociliary transport system depends on normal ciliary activity and a delicately balanced two-layer-system of mucus with a certain degree of viscoelasticity (Giordano et al., 1978). As the sodium saccharine is well water soluble it can easily be imagined, that the mucus system is disturbed, resulting in an impairment of mucociliary transport. We therefore dissected a canine larynx immediately post mortem, and applied sodium saccharine. Under the operating microscope the crystals dissolved, but no mucociliary transport could be observed.

A blend of sodium saccharine *ana partes* with the dye indigotine showed transport. Already Antweiler mentioned in 1958 that hydrophilic substances impaired the transport. For this reason Passali et al. (1985) performed mucociliary transport studies with an inert tracer and used vegetal coal powder. By application of a blend of that coal powder with sodium saccharine they found a dissociation of transport rates as was similarly reported by Duchateau et al. (1985) and Brondeel et al. (1983). They presumed that the inert tracer was carried by the gel layer and that the soluble tracer dissolved in the periciliary fluid. The disadvantage in using inert dye tracers required repeated inspections of the pharynx every minute.

We tried basic saccharine which was less soluble in a canine larynx, but saw only traces of colliquation necrosis.

METHOD

In order to achieve a synthesis of the advantages of an inert tracer and the sweet taste, we coupled saccharine to an anionic exchange resin. A column of Dowex-1-chloride, $1 \times 4 - 100$, cross-linkage 4% and dry mesh 50-100 was eluted with an aqueous solution of sodium saccharine. The product was subsequently washed several times each with water, ethanol, and ether and dried thoroughly in high vacuo. Under the microscope the particles showed no clumping and their size was measured between 80 μm and 285 μm . A tiny amount of the powdery substance tasted sweet.

RESULTS

We applied the saccharine loaden resin particles to a freshly excised canine larynx and trachea and could observe a good mucociliary transport rate.

Furthermore we took the tracer and applied it following the rules of the "classic" saccharine test. We tested normal persons after informed consent, who were taken into our department for neither nasal nor malignant diseases and who had no common cold since three weeks.

Twenty tests were done. The time until a sweet taste arrived ranged from 3 min 30 sec to 19 min 15 sec with a mean value of 10 min 12,5 sec.

The arrival of the particles in the pharynx is visible but not easy to detect on the posterior pharyngeal wall.

We tested persons suffering from common cold or chronic rhinitis. During common cold and one to two weeks after the symptoms the transport time was prolonged essentially beyond 20 min. If transport was absent the particles could be observed at the region of application after more than 20 min without movement.

DISCUSSION

Although the saccharine test using sodium saccharine gives good results, we know few about the interactions of the good water soluble substance and the mucus layer of the nose. On the other hand it should be stressed, that by using saccharine coupled to an ion exchange resin it cannot be excluded, that saccharine-anions dissociate and form water soluble salts. Under equilibrium conditions however the coupled saccharine should predominate considerably.

The transport studies in the canine larynx are convincing, and the test group showed results within the ranges of mucociliary transport measured by radioactively labelled resin particles.

This new approach combines the advantages and the simplicity of the saccharine method with the inert tracer property of the resin method and avoids their mutual disadvantages. Thus we propose this new tracer substance to be compatible for routine testing in practice.

ZUSAMMENFASSUNG

Der Saccharintest ist die praktikabelste Methode, um den mucocilaren Transport in der Nase zu überprüfen. Da das benutzte Natriumsalz des Saccharins gut wasserlöslich ist, wird vermutet, daß es beim Test zu Störungen der empfindlichen zweischichtigen Schleimlage kommt, oder daß das Saccharin nur in der zellnahen Sollage transportiert wird. So sind methodische Fehler möglich, die bei Verwendung einer inerten Markiersubstanz, wie z.B. radioaktiv markierten Ionenaustauscher-Harzpartikeln vermieden werden können. Letztere müssen hingegen mit einer aufwendigen Anlage verfolgt werden.

Als Synthese beider Methoden wird der Gebrauch von Saccharin beladenen Ionenaustauscher-Harzpartikeln angegeben. Diese neue Markiersubstanz wurde in vitro und in vivo überprüft.

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Dr. med. Thomas Deitmer
H.N.O.-Klinik der Westfälischen
Wilhelms-Universität
Kardinal-von-Galen-Ring 10
D-4400 Münster
West-Germany