

## Research

## The saccharin test in chronic rhinosinusitis at Dr. Saiful Anwar General Hospital Malang

Iriana Maharani, Sarah Tamania Tallane

Department of Otorhinolaryngology-Head and Neck Surgery, Faculty of Medicine,  
Brawijaya University/ Dr. Saiful Anwar General Hospital, Malang

### ABSTRACT

**Background:** The mucociliary system is the main defense mechanism in the respiratory tract as a protector from various particles, including bacteria. The mucociliary system will cause germs that enter to be expelled by coughing or swallowing. This system is greatly affected by many factors, such as respiratory tract infections, inflammation (rhinosinusitis), smoking habits, and pollutants. If the mucociliary system is not in good condition, the clearance time will be prolonged. Evaluation method to determine the function of the mucociliary system is the saccharin test, which is non-invasive, easily reproducible, low cost, and does not require special expertise to perform. **Purpose:** To know the timing of the saccharin test in chronic rhinosinusitis (CRS) patient. **Method:** Observational descriptive study with a cross-sectional design to find the timing of the saccharin test in CRS at ENT Department Dr. Saiful Anwar General Hospital from January-December 2023. **Result:** The most common finding was normal saccharin time in 46 patients (90%), and prolonged saccharin time in 5 patients (12%). The average saccharin time in chronic rhinosinusitis patients is  $7.5 \pm 5.9$ . Most of patients were chronic rhinosinusitis without polyp (81%) with average saccharin test were  $7.1 \pm 5.87$ , and majority were both non polyp and non-allergic rhinitis (43%) with average  $8.2 \pm 6.1$ . **Conclusion:** Saccharin test could be abnormal in chronic rhinosinusitis, but overall patients with chronic rhinosinusitis had a normal average saccharin time, on both polyp and non-polyp rhinosinusitis. The results also showed that the saccharin test time was longer in chronic rhinosinusitis with polyps.

**Keywords:** mucociliary system, rhinosinusitis, saccharin test

### ABSTRAK

**Latar belakang:** Sistem mukosilier merupakan mekanisme pertahanan utama pada saluran pernafasan sebagai pelindung dari berbagai partikel, termasuk bakteri. Sistem mukosilier dapat mengeluarkan kuman yang masuk melalui proses batuk, atau tertelan. Sistem ini sangat dipengaruhi oleh berbagai faktor, seperti infeksi saluran pernapasan, peradangan (rinosinusitis), kebiasaan merokok, dan polutan. Jika sistem mukosilier tidak dalam kondisi baik, maka waktu pembersihan akan lebih lama. Metode evaluasi untuk mengetahui fungsi sistem mukosilier adalah dengan uji sakarin, yang bersifat non-invasif, mudah direproduksi, biaya rendah, dan tidak memerlukan keahlian khusus untuk melakukannya. **Tujuan:** Menilai sistem mukosilier pada rinosinusitis kronis. **Metode:** Penelitian deskriptif observasional dengan desain potong lintang, untuk melihat lama waktu uji sakarin pada pasien rinosinusitis kronis, di bagian THT RSUD Dr. Saiful Anwar, pada Januari-Desember 2023. **Hasil:** Temuan terbanyak adalah waktu uji sakarin normal pada 46 pasien (90%), dan uji sakarin berkepanjangan pada 5 pasien (12%). Rerata uji sakarin pada pasien rinosinusitis kronis adalah  $7.5 \pm 5.9$ . Sebagian besar pasien adalah rinosinusitis kronis tanpa polip (81%) dengan rerata uji sakarin adalah  $7.1 \pm 5.87$ , dan mayoritas adalah non polip dan non rinitis alergi (43%) dengan rerata  $8.2 \pm 6.1$ . **Kesimpulan:** Uji sakarin dapat menjadi abnormal pada rinosinusitis kronis, namun secara keseluruhan pasien dengan rinosinusitis kronis memiliki rerata waktu uji sakarin normal, baik pada rinosinusitis polip maupun non-polip. Hasil penelitian juga menunjukkan bahwa waktu uji sakarin lebih lama pada rinosinusitis kronis dengan polip.

**Kata kunci:** sistem mukosilier, rinosinusitis, uji sakarin

**Correspondence address:** Sarah Tamania Tallane. Department of Otorhinolaryngology-Head and Neck Surgery, Faculty of Medicine, Brawijaya University/ Dr. Saiful Anwar General Hospital, Malang. Email: tallanesarah@gmail.com

## INTRODUCTION

The surface of the human respiratory tract is always exposed to various particles and microorganisms which can have a negative effect on health. The mucociliary system is the main defense mechanism in the respiratory tract as protection from various particles, including bacteria. The mucociliary system will cause germs that enter to be expelled by coughing or swallowing.<sup>1,2</sup>

The effectiveness of the mucociliary defense system depends on two main mechanisms, first the ciliary transport and second the mucus secretion systems.<sup>3</sup> These two systems will work together to prevent particles from entering further into the airways. Mucus is useful for retaining inhaled microorganisms, and the cilia will continue to move regularly to drain the mucus towards the nasopharynx.<sup>4</sup>

The function of the mucociliary system is not always in good condition. The work of this system can be influenced by various things, including acute upper respiratory tract infections, inflammation (rhinosinusitis), smoking habits, and pollutants.<sup>2,3</sup> If the mucociliary system is not in good condition, the time required for this system to carry out its duties will be prolonged.<sup>5</sup>

The pathophysiology of obstruction of the mucociliary system depends on the disease. In rhinosinusitis, for example, the inflammatory process produces cytokines that inhibit ciliary pulsation and excess mucus production.<sup>6</sup> Meanwhile, patients with nasal polyps cause a reduction in the ciliated epithelium. These processes then disrupt the mucociliary system in the nose, causing the nose to take longer to carry out the “cleaning” process.<sup>7</sup>

Evaluation of the mucociliary system is performed for clinical and functional screening of individuals. One well-known method for determining the function of the mucociliary system is the saccharin test.<sup>1-3</sup>

The saccharin test is used to evaluate mucociliary clearance as they are non-invasive, easily reproducible, with low cost, and non-toxic. It is a very simple procedure by placing only small particles of saccharin into the nasal mucosa, and further instructs the subject to report when they noted any bitter-sweet taste, and recording the time it takes. The prolonged time is interpreted when patients need more than 10 minutes to feel the sweet sensation.<sup>8</sup>

## METHOD

This was a descriptive observational study with a cross-sectional design to examine the timing of the saccharin test in chronic rhinosinusitis (CRS) patients at Dr. Saiful Anwar General Hospital (DASHG), Malang, in the period January 2023-December 2023.

This research was carried out at DSAHG Malang, in April 2024 using patient medical record data for the period January 2023-December 2023.

The inclusion criteria in this study were patients who underwent a saccharin test during the research period as an evaluation of the timing of the mucociliary system at DSAGH Malang, and the exclusion criteria were incomplete medical record data.

The saccharine tablet (approximately 2.5 mg) was put on inferior turbinate. The times of sweet taste perceived was noted.

Throughout the test, subjects were instructed to avoid to sniff, sneeze, eat, drink, walk, talk, cough, scratch, or blow their nose.

Data collected included age, gender, main complaint, and diagnosis of chronic rhinosinusitis.

This study was approved by the ethical committee of the Dr. Saiful Anwar General Hospital (No: 400/179/K.3/102.7/2024).

## RESULT

The number of chronic rhinosinusitis sufferers who underwent a saccharin test in Department of Otorhinolaryngology-Head and Neck Surgery (ORL-HNS) Dr. Saiful Anwar General Hospital, in the period January 2023-December 2023 were 46 patients. The research results were presented by describing the characteristics of age, gender, complaints, and diagnosis of chronic rhinosinusitis, with or without polyps.

**Table 1. Characteristics of research subjects**

Characteristics	n (%)
Age (year)	
Mean $\pm$ SD	40 $\pm$ 16.15
Age group	
18-27 y o	6 (14)
28-37 y o	11 (25)
38-47 y o	17 (40)
48-57 y o	9 (21)
Gender	
Female	27 (53)
Male	19 (47)
Symptoms	
Runny nose	18 (40)
Sneeze	5 (10)
Blocked nose	20 (43)
Headache	3 (7)

The characteristics of the research subjects are shown in Table 1. In this study, the mean age of patients was  $40 \pm 16.15$  years with most of the patients were between age 38-47. The demographics of the research subjects are shown in the table. Female gender

dominated the group of patients with chronic rhinosinusitis, while most of the patient came to clinic with symptoms blocked nose dominated their complains.

**Table 2. Nasal mucociliary clearance results for saccharin**

	Percent/mean	N
Saccharin	7.5 $\pm$ 5.9	46
Normal (0-20 minute)	88	41
Prolonged ( $>20$ minute)	12	5
CRS with Polyp	10.14 $\pm$ 5.66	6
CRS Non-Polyp	7.1 $\pm$ 5.87	40
CRS with Polyp + AR	14.0	1
CRS with Polyp + NAR	5.3 $\pm$ 2.3	5
CRS non-Polyp + AR	7.8 $\pm$ 4.3	20
CRS non-Polyp + NAR	8.2 $\pm$ 6.1	21

\*AR: allergic rhinitis

NAR: non-allergic rhinitis

From the data in Table 2, the average saccharin test was found to be  $7.5 \pm 5.9$ ; with demographics of 41 patients with normal saccharin test results, and 5 patients with prolonged results ( $>20$  minutes).

The data was grouped again into CRS with nasal polyp and CRS without nasal polyp, and the mean result was  $10.14 \pm 5.66$  for CRS with polyp, and  $7.1 \pm 5.87$  CRS non-polyp. Cross tabulation was carried out and the results were obtained for CRS with polyp and allergic rhinitis (AR) as 14.0; CRS with polyp and non-AR patients, the result was  $5.3 \pm 2.3$ ; CRS non-polyp and allergic rhinitis as  $7.8 \pm 4.3$ , CRS non-polyp and non-allergic (NAR) as  $8.2 \pm 6.1$ .

## DISCUSSION

Chronic rhinosinusitis (CRS) is inflammation of the sinuses or nasal passages that lasts for more than 12 weeks. This disease can appear as chronic sinusitis without nasal polyps, chronic sinusitis with nasal polyps, and allergic fungal rhinosinusitis.<sup>9</sup>

Based on European Position Paper on Rhinosinusitis and Nasal Polyps 2020 (EPOS 2020), the diagnosis of rhinosinusitis is made by looking at two or more symptoms, one of which is a blocked nose, either anterior or posterior coupled with facial pain, lack of smell, or the discovery of nasal polyps, or mucopurulent fluid from the middle meatus, and/or edema or mucosal obstruction from the middle meatus, or mucosal changes on CT-Scan.<sup>10</sup>

In this study, it was found that the main symptoms most frequently complained of by patients were blocked nose and runny nose, 43 and 40 percent respectively. Almost all patients who came had the main complaint of “major symptoms” according to EPOS. These two complaints were considered the most disruptive to the patient’s activities, causing them to come seeking treatment.

The most common ages for CRS in this study were 38-47 years, which was the productive age. Prevalence tends to increase with increasing age and decreases in the elderly group.

The work of the mucociliary system is influenced by several things, including the number of mucociliary cells per tissue area, the structure of the cilia, the movement of the cilia, and the interaction of the cilia with the mucus. Normal average mucociliary transit time in humans is reported to be 12-15 minutes. Transit times of more than 20 minutes are considered prolonged and are indicative of impaired mucociliary clearance.<sup>3,6,7</sup>

The saccharin test is often used to measure the time of the mucociliary system because it is easy, fast, and cheap. Saccharin tablet (approximately 2,5 mg) is placed in the anterior part of the nose, and the examiner records the time it takes for the patient to feel a sweet sensation.

In this study, the average result was  $7.5 \pm 5.9$ , the results within the normal range. However, there were 12 percent of people with CRS who needed  $>20$  minutes on the saccharin test. This illustrated that some people with CRS might experience prolonged mucociliary clearance time. In several sources, it has been found that patients with CRS were at risk of disruption of the mucociliary system, this was due to reduced ciliary pulsation and mucociliary differentiation of nasal epithelial cells.

In CRS with polyp patients, the results were  $10.14 \pm 5.66$ , while in CRS without polyps, the results were  $7.1 \pm 5.87$ . Although both results were in normal range, there was a difference in the time of the saccharin test in CRS with and without polyps. In research conducted by Slater, quoted by Rodrigues et al.<sup>11</sup>, it was stated that impaired mucociliary function in patients with nasal polyps was not only caused by reduced ciliary beat frequency, but also due to loss of ciliated epithelium, impaired cilia function, or abnormal mucus.

In research conducted by Richa et al.<sup>12</sup>, it was shown that patients with rhinitis allergy had longer time on the saccharin test. This was associated with changes in mucus and the inflammatory process experienced by the sufferer. Our study revealed that patients with allergic rhinitis showed a longer periods of time. It should be noted that samples in non-allergic rhinitis group could have possibilities they were allergic to something, but it could not be proven due to limited reagents in our facility.

In conclusion, the result of saccharin test time in our research patients had a normal

average time on both CRS with polyp and non-polyp, but there were 12% of patients with CRS had prolonged saccharin test time. The results also showed that the saccharin test time was longer in the CRS with nasal polyp patients. There are several assumptions why CRS patients have abnormal saccharine test: from regeneration of cilia, impaired cilia, and movement of the cilia. But there are also other things that should be considered that make the saccharine test time longer, such as age, smoking, septal deviation, and physical activity in daily life.

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