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Effect of Saline Nasal Irrigation in Patients with Sinonasal Symptoms

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Abstract

Nasal irrigation with saline is frequently used as an alternative therapy for sinonasal diseases since it effectively reduces sinonasal symptoms and improves the quality of life when measured by various subjective instruments. The mechanisms of action of saline irrigation remain unclear, but some hypotheses attribute the direct physical cleansing of thick mucus, allergens, and pollutants. This study aimed to determine the effect of nasal saline irrigation on the nasal mucosa using the modified Lund-Kennedy endoscopic score as the objective evaluation. This pre-post-experimental study was conducted at PKU Muhammadiyah Gamping Hospital Yogyakarta, Indonesia, from May to June 2023. The study included 18 individuals presenting with sinonasal symptoms. Participants meeting the inclusion and exclusion criteria who provided informed consent were trained in nasal saline irrigation. Patients were assessed at baseline and one week after nasal saline irrigation using endoscopy, TNSS, and MCC time. Results revealed that the mean of endoscopic scores before and after saline irrigation were 6.89±1.1 and 5.33±1.4, respectively (p-value 0.006), while the mean of TNSS scores before and after saline irrigation was 6.17±2.3 and 4.28±2.6, respectively (p-value 0.006). Thus, nasal saline irrigation significantly improves the endoscopy and TNSS scores, but not the MCC time.

Keywords: Allergen, endoscopy, human, nasal mucosa, quality of life

Introduction

The history of nasal irrigation is believed to be from the ancient Hindu practice of Ayurveda, the yogic system of body cleansing techniques in India, during the mid-first millennium BC. The procedure of jala neti involves flushing the nasal cavity by using water poured into one of the nostrils and out into the other. Over the past two decades, Western medicine has adopted nasal irrigation, gaining popularity worldwide.[1] Some extensive study have been conducted to assess the beneficial effect of nasal irrigation in treating sinonasal diseases, the recent development of the basic science behind and the emergence of new technologies.

Nasal irrigation has been an easy procedure, physiotherapy, inexpensive budget, and safe as an adjuvant treatment for sinus and nasal conditions for many years. It is still recommended by physicians for sinonasal diseases such as acute rhinitis, allergic rhinitis, rhinosinusitis, and post-sinus surgery. Nasal irrigation successfully lessens the symptoms and indicators of sinonasal disorders. Additionally, it was recommended to cure and avoid developing upper respiratory infections. Every sinonasal condition should have a different approach to saline irrigation to achieve therapeutic benefits; large, volume devices are more effective for allergic rhinitis, but low-volume devices are for children. Nasal saline irrigation is more beneficial for children with acute rhinosinusitis, although it is also an option for adults.[2]

The mechanism of nasal irrigation on nasal mucosa is divided into physical and biological or physiological activity.[1] The physical impact of clearing the mucosa of excessive secretion minimizes the concentration of particle pollutants and pathogens.[3] The biological effect depends on the ion activities on the mucosal cells.[4] Saline solutions will hydrate and moisten the nasal mucosa, causing mucous to change from gel to sol, requiring less energy for cilia to beat and enhancing mucociliary clearance.[5] Many minerals showed another effect, such as

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boosting the viability of cells and minimizing inflammatory conditions.[6]

The measurement of sinonasal medical treatment efficacy using standardized related patient-reported outcomes (symptom scores, medication scores, disease control scores, and satisfaction or quality-of-life scales) is widely used as a subjective assessment.[7] The modified Lund-Kennedy endoscopic score is one of the validated objective outcome measures used to stage the inflammation of sinonasal mucosa.[8] This research combine subjective assessment and objective assessment, provides by assessing the impact of nasal irrigation with saline on nasal mucosal using an endoscopic assessment score.

Methods

A quasi-experimental pretest-posttest design study was conducted at PKU Muhammadiyah Gamping Hospital Yogyakarta, Indonesia, from May to June 2023. The study hypothesized that saline nasal irrigation significantly improved nasal mucosa condition. The assessment performed an endoscopy examination to test the hypothesis, with mucociliary function as the objective outcome and total nasal score symptoms (TNSS) as a subjective outcome.

The participants were recruited using a consecutive sampling method considering the inclusion criteria, such as adult patients, females, and males who complain of sinonasal symptoms and are willing to participate with an informed consent sign. At the same time, the exclusion criteria included those who suffer sinonasal complications, including polys nasi and rhinosinusitis. The sample in this study was calculated using the research sample size formula for paired numerical comparative analytical tests for 2 groups, and added with 10% dropout criteria. The results obtained for the number of samples for preliminary research was 20 participants.

The instrument of the primary outcome assessment using endoscopy examination and endoscopic scoring was utilized using the modified Lund-Kennedy system with three domains; the first domain was discharge (0 = no discharge; 1 = clear thin discharge; 2 = thick purulent discharge), the second domain was swelling (0 = no swelling; 1 = mild swelling; 2 = severe swelling), and the third domain was polyp (0 = no polyp; 1 = polyp only in the middle nasal meatus; 2 = polyp exceeding the middle nasal meatus).[9] The secondary outcome of nasal function was examined using a saccharin test to measure mucociliary clearance time. The subject sat straight, and 2 mm saccharin powder was applied to the anterior end of the inferior turbinate, 1 cm beneath the top of the inferior concha. The subject's first sense of a sweet taste was documented.

The Total Nasal Symptoms Score (TNSS) questionnaire was used to assess the subjective outcome, which comprised four symptom categories: rhinorrhea, nasal obstruction, nasal itching sensation, and sneezing. There is a 4-point scale for each symptom category: 0 is none, 1 is mild, 2 is moderate, and 3 is severe.[10] Adverse events and troubles related to nasal irrigation were also monitored using participant self-report.

Before standardized nasal irrigation was performed, participants were given training first. Participants performed nasal washing using a solution they made by mixing 0.9% NaCl from clear sodium chloride dissolved in 3.1 grams with boiled water into 300 ml in a flowing nasal rinse bottle. Both nasal cavities were irrigated using 150 ml on each side once a day for one week. Before treatment, the participants blew their mucous; then, their heads were positioned forward. The bottle's cannulas were laid on the nostril and slowly flowed into the nasal cavity. The saline solution emerged through the mouth after entering the nasopharynx. The other nasal cavity received similar irrigation.

The participants who completed the study were used to analyze the efficacy assessments. The quantitative results were reported as mean and standard deviation and the qualitative information was percentages. Before analyzing the data, a data normality test was conducted to determine what type of analysis would be used. This study used the Shapiro-Wilk normality test because the number of respondents was less than 30. For comparing quantitative data before and after the test, the student's paired t-test was utilized; a p-value of 0.05 was interpreted as statistically significant.

The Faculty of Medicine and Health Sciences Research Ethics Committee of Universitas Muhammadiyah Yogyakarta granted formal approval for this study with the reference number 115/EC-KEPK FKIK UMY/II/2023.

Results

This study involved 18 participants (2 participants lost of follow-up), which

Table 1 Characteristic of Subjects

	Characteristic Respondents	n=18	%	Total
Gender	Male	8	44.4	18
	Female	10	55.6	
Age	18–25	0	0	18
	26–35	8	44.4	
	36–60	10	55.6	
SFAR	≥7	13	72.2	18
	<7	5	27.8	
SPT	+	13	72.2	18
	-	5	27.8	
Sibling number	1–2	13	72.2	18
	3–4	3	16.7	
	>4	2	11.1	
Resident	Urban	5	27.8	18
	Rural	13	72.2	
Pet	Yes	7	38.9	18
	No	11	61.1	
Smoke	Yes	3	16.7	18
	No	15	83.3	
Exercise	0	4	22.2	18
	1–2	11	61.1	
	3–4	2	11.1	
	>4	1	5.6	

SFAR=score for allergic rhinitis; SPT=skin prick testing

resulted from consecutive recruitment from ENT polyclinic. According to Table 1, these respondents included eight males (44.4%) and ten females (55.6%) aged 26–60. Participants with sinonasal symptoms, according to Score for Allergic Rhinitis (SFAR), 13 (72,2%) had a≥7 total score, and 5 (27.8%) had a <7 total score. From skin-prick test results, 13 (72,2%) were positive, and 5 (27.8%) were negative (Table 1). The outcomes of the pre-and post-nasal irrigation with saline at seven days in terms of TNSS, endoscopic score, and MCC are shown in Table 2.

Discussion

In this study, nasal saline irrigation showed significantly decreased symptoms of allergic rhinitis according to TNSS scores, it's in line with a previous report that in comparison to no saline irrigation, saline irrigation may lessen the

Table 2 The Outcomes of the Pre-and Post-Nasal Irrigation

Type of Examination		Mean	Std. Deviation	Std Error Mean	p[a]
Endoscopic score	Before	6.89	1.132	0.267	0.006
	After	5.33	1.414	0.333	
Mucociliary clearance time	Before	82.48	154.550	36.428	0.65
	After	105.24	115.578	27.242	
TNSS score	Before	6.17	2.383	0.562	0.006
	After	4.28	2.608	0.615	

TNSS=total nasal symptom; [a] =t-test

severity of disease as reported by the patient in both adults and children. Most sinonasal diseases require to be treated with nasal saline, although each condition should have an optimal delivery device and best solution. Most sinonasal diseases could be treated with nasal saline, although each condition should have an optimal delivery device and best solution.[2] Additionally, it offers a safe, simple, and effective therapy option for pregnant women with seasonal allergic rhinitis.[11]

Nasal saline irrigation has been accepted as adjuvant therapy for sinonasal disorders, including Allergic Rhinitis. It's effective for decreasing nasal symptoms and minimizing the over-usage of medication in both adults and children.[12] Commonly, the clinical success of therapy for sinonasal diseases is measured using validated patient-reported outcome measures and clinical, physiologic measures. The primary outcomes related to sneezing, rhinorrhea, nasal itching, and nasal obstruction were evaluated by the subjective assessment, including Total Nasal Symptom Score (TNSS), Sinonasal Outcome Test (SNOT-22), and Visual Analog Scale (VAS).[13] The objective results help assist in diagnosing and treating a nasal obstruction in sinonasal diseases; they use peak nasal inspiratory flow (PNIF), acoustic rhinometry (AR), and rhinomanometry (RM) to measure various aspects of nasal obstructions.[14] Another objective measurement of nasal condition was an endoscopic score that figured the inflammation process on the nasal mucosa.[8] Nasal saline irrigation may improve endoscopy scores attributed to mechanical intervention on the nasal mucosa. Experts suggest that the way nasal saline irrigation works is by cleaning the nasal mucosa directly. The mechanical action of nasal saline irrigation will help remove inflammatory mediators as well as antigens responsible for allergic reactions, modify the ciliary beat frequency in order to enhance mucociliary clearance (MCC), and soften and remove mucus.[15]

The prevalence of allergic rhinitis in this study was similar between females and males, which aligns with epidemiological research indicating that males are more likely to develop allergic rhinitis during childhood. Conversely, females are more likely to develop it during adolescence, with no significant gender distinction in adulthood.[16]

This study also revealed that 72.2% of respondents were from rural areas. According to the hygiene hypothesis, allergic diseases are typically less frequent in rural regions compared to urban areas. However, it is noteworthy that some rural areas also experience high levels of air pollution, which may contribute to the prevalence of allergic rhinitis. Another reason the rural environment is protective against atopic disease is a rural farming type, the protective effect linked with intimate contact with animals, the consumption of unpasteurized milk, and rising endotoxin exposure is now being investigated, and the hypothesized gene-by-environment interactions involving essential innate immune genes give perspectives on probable mechanisms. It is also similar to the epidemiology report from China that the prevalence of confirmed allergic rhinitis is comparable between rural dan urban locations.

In correlation with sibling number, 72.2 % of respondents have 1–2 siblings, so it's consistent with the hygiene hypothesis theory that smaller families may provide a more sanitary environment and less exposure to microorganisms for young children. Minimal exposure to the environment in childhood could be a risk factor for developing immune hypersensitivities later in life.[17] The Hygiene Hypothesis at that time was consistent with the emerging general theory that non-inherited/ non-communicable diseases like allergies and asthma develop as a result of an improper interaction between environmental exposures and a particular genotype that results in the formation of a particular (disease) phenotype.[18]

Objective endoscopy assessment showed significant improvement in the nasal mucosa of allergic rhinitis according to modified Lund-Kennedy scores (p=0.006). Previous studies showed that using Lund-Kennedy endoscopy scores, high-volume budesonide irrigation is better and safer than normal saline for the post-sinus operation of rhinosinusitis disease.[19]

The respiratory epithelium produces mucus, which collects particles, retaining moisture and ciliated cells (moving numerous cilia to transport mucus into the pharynx). Some studies suggest nasal irrigation directly affects secretions mobilization and increases mucociliary clearance rates.[4,20] Mucociliary Clearance (MCC) time refers to the duration required for cilia to transport particles and mucus out of the nasal cavity. Previous research indicates that the average MCC time ranges from a minimum of 8 minutes to a maximum of 19.2 minutes. Several factors can influence MCC time, including posture, age, sleeping habits, and gender.[21] However, this study found that MCC scores remained similar before and after nasal saline irrigation. The study has several limitations,

including the small sample size and the pre-post-test design. These limitations suggest the need for a larger randomized controlled trial to validate the findings. Based on the research results, the study concluded that there is a significant improvement in the mean endoscopic score following the use of nasal saline irrigation.

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