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Ringer's Lactate versus Isotonic Saline: The Nasal Irrigation Solution of Choice in Chronic Rhinosinusitis

Urmila Gurung[1], Anuj Devkota[1], Shishir Pokhrel[2], Bibhu Pradhan[1]

Author(s) affiliation

[1]*Department of ENT-Head and Neck Surgery, Maharajgunj Medical Campus, Tribhuvan University Teaching Hospital, Institute of Medicine, Kathmandu, Nepal*

[2]*Rapti Provincial Hospital, Tulsipur, Rapti, Nepal*

Corresponding author

Anuj Devkota, MBBS, MS
anujdevkota@gmail.com

ABSTRACT

Introduction

Nasal douching is a simple and highly effective treatment option for chronic rhinosinusitis. This study aimed to compare the efficacy of Ringer's lactate versus isotonic saline for nasal irrigation in treating chronic rhinosinusitis (CRS) with or without polyposis using the SNOT-22 score.

Methods

This prospective quasi-experimental study was conducted at the Department of ENT and Head & Neck Surgery, Tribhuvan University Teaching Hospital, from September 2020 to November 2021. Seventy-eight patients aged ≥ 16 years with CRS were included in the study. Patients were grouped into either isotonic saline or Ringer's lactate groups based on the clinician's preference. Nasal irrigation was prescribed for four weeks. Pre- and post-irrigation SNOT-22 scores were analyzed using paired t-test and Student's t-test.

Results

A significant improvement in the SNOT-22 scores before and after nasal irrigation was observed in both the Ringer's lactate and isotonic saline groups ($p<0.05$). However, the difference in post-nasal irrigation SNOT-22 scores between these groups remained statistically insignificant ($p=0.27$). Common symptoms such as nasal blockage and thick nasal discharge showed substantial improvement. The most common side effect was fluid pooling in the paranasal sinuses.

Conclusion

Both isotonic saline and Ringer's lactate have been shown to effectively enhance the quality of life in patients suffering from chronic rhinosinusitis, with studies indicating no significant difference in their efficacy, making either solution a suitable choice for nasal irrigation in the management of the CRS.

Keywords

Chronic rhinosinusitis; isotonic saline; nasal irrigation; Ringers' lactate; SNOT-22

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INTRODUCTION

Chronic rhinosinusitis (CRS) is a common rhinological condition with symptom-based prevalence ranging from 5.5 to 28%.[1] One of the pathophysiology of CRS includes decreased mucociliary clearance (MCC), which results in stagnation of dust, crusts, and other micro-organisms on the mucous membrane.[2] This occurs due to the reduction of airway surface liquid volume secondary to overexpression of the anion exchanger pendrin (SLC26A4).[3]

Nasal irrigation and intranasal corticosteroids are considered the main first-line treatment for chronic rhinosinusitis as per the European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS) 2020. EPOS 2020 advocates using isotonic saline or Ringer's lactate as the nasal irrigation solution.[4] . Normal saline is a commonly used nasal irrigating solution. However, Ringer's lactate is considered more physiological. There is a lack of consensus on the effectiveness of Ringer's lactate with normal saline in the management of chronic rhinosinusitis.[4]

Sinonasal outcome test 22 (SNOT 22) is a validated 22-item CRS-specific quality of life (QoL) instrument. It has different domains: nasal, ear/facial, sleep, function, and emotion.[5] It can be self-reported by patients within five minutes.[6] It facilitates highlighting the impact of CRS on a patient's QoL, guiding different forms of treatment, and measuring the intervention outcome.[7]

This study thus compared the effectiveness of Ringer's lactate with isotonic saline as nasal irrigation solutions in CRS patients, using the SNOT-22 questionnaire to evaluate outcomes.

METHODS

This prospective, longitudinal, quasi-experimental study was conducted from September 2020 to November 2021 in the Department of ENT-Head and Neck Surgery, Tribhuvan University Teaching Hospital, Kathmandu, Nepal.

Ethical approval was obtained from the Institutional Review Committee of the Institute of Medicine, Kathmandu, Nepal (reference no. 131 (6-11) E 2 077/078). Informed consent was obtained from all patients prior to enrollment in the study.

Purposive sampling, a non-probability sampling method, was used in this study. The sample size was calculated based on the formula for testing the difference between two means, with an additional 10% to account for non-response, loss to follow-up, or missing data.[5] Hence, the total sample size was 78, with 39 patients in each group.

Patients aged 16 years and older with chronic rhinosinusitis with up to grade 1 polyps (as per the modified Lund Kennedy endoscopic grade) and without nasal polyps as defined by EPOS 2020 were included. Those with recent use of oral steroids within the last three weeks, antibiotics within the last two weeks, decongestants, antihistamines, or montelukast within the last week were excluded. Additionally, non-compliance with nasal irrigation, unilateral sinonasal disease, suspicion of a nose or paranasal sinus tumor or granulomatous disease, prior nose and paranasal sinus surgery or radiotherapy to the head and neck region, and those lost to follow-up were excluded.

Figure 1. *Nasal irrigation using a commercially available neti pot.*

Nasal endoscopy was performed to ensure that enrolled patients met the inclusion criteria. The patients were familiarized with the SNOT-22 form by the treating clinician. The patient then filled the form with assistance by the treating consultant when necessary. All participants completed the SNOT-22 form before starting treatment. Patients in both groups were prescribed intranasal mometasone furoate nasal spray 100mcg twice daily as a standard-of-care treatment for CRS.

For nasal irrigation, a commercially available neti pot was used. The patients were explained the technique and its potential side effects. They were allocated either isotonic saline or Ringer's lactate solution based on the treating clinician's preference. The same quantity and frequency of nasal irrigation were performed irrespective of the irrigating solution (Figure 1).

The plastic neti pot was filled with 125 ml of irrigation solution using a 50 ml syringe. The nozzle was inserted into one nostril, and the patient's head

was turned on the opposite side. The procedure was performed over a tap basin or a wide-mouth container to avoid spillage. The fluid was allowed to flow slowly, increasing the flow rate by tilting the pot as needed. After rinsing one side, the procedure was repeated on the other side using 125 ml of fluid again. Patients were advised to gently blow their nose at least 5-10 times at the end of the procedure to clear the nasal cavity and prevent pooling of fluids in the sinuses. Nasal irrigation was performed twice daily for at least four weeks.

Follow-up was performed two and four weeks after the start of nasal irrigation. Follow-up in the second week was intended to check the patient's compliance for nasal douching and to clarify any doubts regarding the procedure. The SNOT-22 score was reassessed in both groups after four weeks. Side effects of nasal irrigation, if any, were noted at the end of four weeks in both groups.

Data were entered into Microsoft Excel and statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 23 software (IBM Corp., Armonk, NY). The normality of the data was tested using the Shapiro-Wilk test. For data with normal distribution, the mean, standard deviation, frequency, and percentage were calculated. For non-normally distributed data, median and interquartile ranges were calculated.

Comparisons between groups was done using Student's t-test for independent data and the paired sample t-test for related data as parametric tests. Non-parametric tests included the Mann-Whitney U test for independent data and the Wilcoxon signed-rank test for paired data. The Chi-square test was used to examine the relationships between categorical variables. Statistical significance was set at $p < 0.05$.

RESULTS

Initially, a total of 83 patients were enrolled in the study. However, four were lost to follow-up and one was excluded due to repeated epistaxis. Hence, 78 patients (39 in each group) were finally included in the study. There were 22 males and 17 females, with ages ranging from 29 to 33 years.

The distribution of patients based on age, gender, type of CRS, and pre-nasal irrigation SNOT-22 score in both the isotonic saline and Ringer's lactate irrigation groups was similar. Likewise, distribution of patients between the CRSwNP and CRSsNP groups was also comparable (Table 1).

A statistically significant change in the SNOT-22 score between pre- and post-nasal irrigation was observed in both the groups. In the isotonic saline irrigation group, the mean SNOT-22 score decreased from 24.64± 11.12 to 12.58 ± 6.62 while in the Ringer's lactate irrigation group, it decreased from 26.76 ± 14.07 to 14.41 ± 7.92. The difference remained statistically significant even among the subgroups, namely, CRSwNP and CRSsNP, in both groups (Table 2). The difference in post-nasal irrigation SNOT-22 scores between the groups was not statistically significant (Table 3).

Of the 78 patients, 41 (52.6%) reported fluid pooling in the paranasal sinuses, 36 (46.2%) experienced nasal irritation, 32 (41%) had nasal discomfort, three (3.8%) reported otalgia, and one (1.3%) had epistaxis. The distribution of side effects was similar between the two groups (Table 3).

In the isotonic saline group, significant improvement was observed in most symptoms, except for cough, dizziness, ear pain, frustration/restlessness/irritability, sadness, and embarrassment (Table 4). In the Ringer's lactate group, significant improvement was seen in most symptoms, except for cough, ear fullness, dizziness, ear pain, and reduced productivity (Table 5).

Table 1. *Patient demographics and clinical characteristics*

Characteristics	Isotonic saline irrigation (n=39)	Ringer's lactate irrigation (n=39)	p value
Age in years (mean)	29	33	0.17
Gender			
Male	22	22	
Female	17	17	
Types of CRS			
CRSsNP (number, %)	26 (66.7%)	24 (61.5%)	0.22
CRSwNP (grade 1) (number, %)	13 (33.3%)	15 (38.5%)	
Pre-nasal irrigation SNOT- 22 score (Mean ± SD)	24.64 ± 11.12	26.76 ± 14.07	0.46
	CRSwNP	**CRSsNP**	0.22
	23.17 (± 10.20)	27.12 (± 13.72)	

Table 2. SNOT- 22 score pre and post-nasal irrigation

Group	SNOT-22 score (Mean ± SD)		p value
	Pre-nasal irrigation	Post-nasal irrigation	
Isotonic saline irrigation (n=39)			
- CRSwNP (n=13)	25.23± 10.00	12.84± 6.55	<0.001
- CRSsNP (n=26)	24.34± 11.83	12.46± 6.77	<0.001
- Overall	24.64± 11.12	12.58± 6.62	<0.001
Ringer's lactate irrigation (n=39)			
- CRSsNP (n = 24)	30.12± 15.19	16.08± 8.66	<0.001
- CRSwNP (n = 15)	21.40± 10.37	11.73± 5.87	<0.001
- Overall	26.76± 14.07	14.41± 7.92	<0.001

Table 3. Comparison of post-nasal irrigation SNOT-22 score and side effects in both groups

-	SNOT-22 score (Mean ± SD)		p value
	Isotonic saline irrigation (n=39)	Ringer's lactate irrigation (n=39)	
Post-irrigation SNOT- 22 score (Mean ± SD)	12.58 ± 6.62	14.41±7.92	0.27
Side effects			
Nasal irritation	19 (48.7%)	17 (43.6%)	
Nasal discomfort	15 (38.5%)	17 (43.6%)	
Epistaxis	0 (0)	1 (2.6%)	
Otalgia	2 (5.1%))	1 (2.6%)	
Pooling of fluid in PNS with subsequent drainage	21 (53.8%)	20 (51.3%)	

Table 4. Outcome of SNOT-22 symptoms post-nasal irrigation in isotonic saline group (n=39).

	SNOT -22 Symptoms	Outcome			p value
		Improved	No change	Worsened	
Nasal	1. Need to blow nose	32	6	1	<0.001
	2. Nasal blockage	37	2	0	<0.001
	3. Sneezing	19	20	0	<0.001
	4. Runny nose	25	14	0	<0.001
	5. Cough	7	30	2	0.070
	6. Postnasal discharge	12	27	0	0.002
	7. Thick nasal discharge	36	3	0	<0.001
	8. Decreased sense of smell/taste	17	22	0	<0.001
Ear/Facial	9. Ear fullness	12	27	0	<0.001
	10. Dizziness	1	38	0	0.32
	11. Ear pain	0	38	1	0.32
	12. Facial pain/pressure	13	23	0	<0.001
Sleep	13. Difficulty falling asleep	19	20	0	<0.001
	14. Wake up at night	14	25	0	<0.001
	15. Lack of good night's sleep	13	26	0	<0.001
	16. Wake up tired	14	24	1	<0.001
Function	17. Fatigue	8	31	0	0.007
	18. Reduced productivity	5	34	0	0.034
	19. Reduced concentration	9	30	0	0.005
Emotion	20. Frustrated/restless/ irritable	3	36	0	0.10
	21. Sad	2	37	0	0.16
	22. Embarrassed	2	37	0	0.16

Table 5. Outcome of SNOT-22 symptoms post-nasal irrigation in Ringers' lactate group (n=39).

	SNOT -22 Symptoms	Outcome			p value
		Improved	No change	Worsened	
Nasal	1. Need to blow nose	29	8	2	<0.001
	2. Nasal blockage	36	3	0	<0.001
	3. Sneezing	19	20	0	<0.001
	4. Runny nose	18	21	0	<0.001
	5. Cough	8	28	3	0.11
	6. Postnasal discharge	15	24	0	<0.001
	7. Thick nasal discharge	33	6	0	<0.001
	8. Decreased sense of smell/taste	25	14	0	<0.001
Ear/Facial	9. Ear fullness	5	34	0	0.034
	10. Dizziness	0	39	0	1.00
	11. Ear pain	1	36	2	0.56
	12. Facial pain/pressure	24	15	0	<0.001
Sleep	13. Difficulty falling asleep	19	20	0	<0.001
	14. Wake up at night	17	22	0	<0.001
	15. Lack of good night's sleep	10	29	0	0.004
	16. Wake up tired	8	30	1	0.02
Function	17. Fatigue	8	31	0	0.009
	18. Reduced productivity	1	38	0	0.32
	19. Reduced concentration	6	33	0	0.02
Emotion	20. Frustrated/restless/ irritable	7	32	0	0.01
	21. Sad	8	31	0	0.009
	22. Embarrassed	12	27	0	<0.001

**Wilcoxon signed rank test*

DISCUSSION

Nasal irrigation as an add-on to intranasal corticosteroid, is a well-established, cost-effective treatment modality for alleviating CRS symptoms without the side effects associated with oral medications.[8] Not only has nasal irrigation been an important element for nasal cleansing in yoga practice since ancient times, but it has also been described in Western medicine for a long time.[9]

Nasal irrigation improves nasal mucosa function through several physiological effects. It helps in the mechanical removal of mucus and crusts, disruption, and removal of antigens, biofilms, and inflammatory mediators. It also enhances ciliary beat frequency, thereby improving mucus clearance. In addition, it can act as a carrier to transport medication into the sinuses.[8] Thus, the consequent clinical effects of nasal irrigation include clearance of nasal secretion, improved nasal congestion, decrease in post-nasal drip, improvement in sinus headache, taste and smell, and sleep quality.[10,11]

Isotonic saline is preferred over hypertonic saline as the latter releases mucosal substance P and is likely to cause pain, burning sensation and nasal irritation.[12,13] Hence isotonic saline is better tolerated. Isotonic saline supports mucociliary function by enhancing hydration in the sol layer; however, its higher sodium content slightly reduces its effectiveness by competing with calcium ions, which may impact ciliary beat frequency and healing. [11,14–16] In contrast, Ringer's lactate, with a composition closely resembling extracellular fluid and a lower sodium content, promotes mucociliary clearance more effectively and reduces inflammation.[15]The calcium in the solution increases ciliary beat frequency whilst the potassium repairs epithelium and has anti-inflammatory action. It has no local or systemic side effects.[16] Although, normal saline is the standard nasal irrigating solution, Ringer's lactate is more physiological. However, there is no consensus on which solution is better. Hence, this study compared the efficacy of both solutions in managing CRS as an add-on to intranasal corticosteroids.

Nasal irrigation methods can be categorized according to volume and pressure. The 2016 International Consensus Statement on Allergy and Rhinology strongly endorses high-volume nasal irrigation (>200 mL) as a supplemental treatment for CRS, noting that irrigation volumes under 60 mL provide no therapeutic benefit for the condition.[17] It has been found that using large-volume irrigation (>100 ml) with the correct head

position can effectively reach all areas of the postoperative sinonasal cavity, enhancing the delivery of medications.[18–20] In our study, neti pot with capacity of 125 ml was used to irrigate each side of the nose. High-volume irrigation, especially with low pressure, is more effective in penetrating sinuses and improving symptoms. Low-volume, low-pressure methods, such as the neti pots used in our case, are gentler and cause less discomfort but may not be as effective in thoroughly cleansing the nasal cavities, particularly in more severe cases.

Our study included both CRSsNP and CRSwNP. However, only grade 1 polyps in CRSwNP were included for uniformity of symptoms with CRSsNP and to avoid doubtful effectiveness of irrigation with netipots in severe cases. In this study, nasal irrigation effectively reduced the cardinal symptoms of CRS. In the isotonic saline group, nasal blockage improved maximally, followed by thick nasal discharge, need to blow nose, runny nose, and sneezing. Similarly, in the Ringer's lactate group also, the maximum improvement was observed for nasal blockage followed by thick nasal discharge, need to blow nose, and decreased sense of smell/taste. Some of the non-rhinological symptoms like cough, dizziness, ear pain, frustrated/restless/irritable, sad and embarrassed, and reduced productivity did not improve significantly attributing them as a manifestation of other unrelated diseases rather than exclusively of chronic rhinosinusitis. On comparing the overall SNOT-22 scores before and after nasal irrigation, both isotonic saline and Ringer's lactate group showed a significant improvement. This was applicable for both CRSwNP and CRSsNP. However, there was no statistical difference in the post-irrigation SNOT-22 scores between the groups (p-value=0.274). The result of this study thus indicated no difference in the effectiveness between the two nasal irrigation solutions in managing CRS. Interestingly, most of the literature has focused on its effect after surgery rather than purely as medical management for CRS. Low et al. found that Ringer's lactate solution significantly improved 6-week symptom scores and 1-week disease-specific health-related quality of life (HRQL) scores compared to isotonic saline and hypertonic saline following functional endoscopic sinus surgery.[1] Unal et al. reported that mucociliary clearance times were statistically significantly better with Ringer lactate solution compared to isotonic saline following nasal septal surgery, highlighting its potential advantage in postoperative recovery.[15]

Transient adverse reactions to nasal irrigation, such as nasal irritation, discomfort, otalgia, and fluid pooling, occurred in 10-20% of cases using high-volume devices.[21] David et al. reported that fewer than 10% of patients using saline nasal irrigation experienced adverse effects, which included self-resolving ear fullness, stinging of the nasal mucosa, and rare instances of epistaxis.[21] In our study, 52.6% reported fluid pooling, 46.2% nasal irritation, 41% discomfort, 3.8% otalgia, and 1.3% epistaxis. The symptoms were transient and improved over time. However, one patient was excluded due to recurrent epistaxis.

The limitations of this study include the inclusion of both CRSsNP and CRSwNP patients. However, to avoid heterogeneity, only grade 1 polyps were included in the study. The similar SNOT-22 scores reflected the similarity in symptoms in both groups. Response bias was mitigated by familiarizing patients with the SNOT-22 form by the treating clinician and assisting them in filling the form only when necessary. A short four-week follow-up barred assessment of the long-term effects of nasal irrigation. Future research with a larger sample size and longer follow-up period would help to assess long-term outcomes better.

CONCLUSION

In conclusion, nasal irrigation using both isotonic saline and Ringer's lactate effectively improved the quality of life of patients with CRS, with no significant difference in efficacy. Thus, either solution can be used as a nasal irrigating solution for the management of CRS.

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CONFLICT OF INTEREST

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AUTHOR CONTRIBUTIONS

Conceptualization, Proposal development, Original draft, tool development: Dr. Urmila Gurung, Dr. Shishir Pokhrel, Prof. Dr. Bibhu Pradhan. Methodology, ethical approval, data collection: Dr. Urmila Gurung, Dr. Shishir Pokhrel, Prof. Dr. Bibhu Pradhan. Data analysis, Manuscript development and submission: Dr. Urmila Gurung, Dr. Anuj Devkota, Dr. Shishir Pokhrel, Prof. Dr. Bibhu Pradhan

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