



EFFICACY OF NASAL IRRIGATION WITH ISOTONIC AND HYPERTONIC SOLUTIONS AFTER ENDOSCOPIC SINUS SURGERY FOR CHRONIC RHINOSINUSITIS WITH NASAL POLYPOSIS

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SUMMARY – Endoscopic sinus surgery (ESS) is often involved in the treatment of patients with chronic rhinosinusitis with nasal polyposis (CRSwNP). Nasal irrigation after ESS is recommended to improve healing and nasal symptoms in these patients. This study compared the efficacy of nasal irrigation with either an isotonic solution of 0.9% NaCl or a hypertonic solution of 2.3% NaCl comprising algal extracts. This was a randomized cohort study that included patients with CRSwNP after ESS who used isotonic solution and hypertonic 2.3% solution enriched with algal extracts (*Undaria pinnatifida* and *Spirulina platensis*). Patients filled out the total nasal symptom score (TNSS) questionnaire on visual analog scale of five symptoms, i.e., nasal obstruction, nasal secretion and/or postnasal discharge, sense of pressure in the face, headache, loss of the sense of smell preoperatively, and on postoperative days 7 and 14. Endoscopic Lund-Kennedy (LK) score was also recorded. The study included 54 patients with CRSwNP that had undergone ESS, mean age 49.5 years. There were 53.7% of male patients. Thirty (55.56%) patients had other comorbidities such as allergic rhinitis, allergy to food, or/and asthma. Five (9.25%) patients had CRSwNP, asthma and allergy to nonsteroidal anti-inflammatory drugs. TNSS improved after 7 and 14 days in both groups; greater improvement of TNSS and LK score was observed in the group of patients that used hypertonic solution with algae, but it did not reach statistical significance. Improvement in particular symptoms was also recorded in the hypertonic solution group both on postoperative days 7 and 14, especially of sneezing and itching. The results of this study confirmed therapeutic benefits of nasal irrigation in CRSwNP patients following ESS. Patients who used hypertonic solution enriched with algae experienced greater improvement in sneezing and itching over the 14-day period.

Key words: *Nasal polyposis; Endoscopic sinus surgery; Nasal irrigation; Hypertonic solution; Chronic rhinosinusitis; Seaweed extract*

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Received February 14, 2025, accepted March 13, 2025

Introduction

Chronic rhinosinusitis (CRS) is a prevalent condition characterized by persistent inflammation of the nasal and paranasal sinus mucosa. There are different phenotypes and endotypes of CRS. Chronic rhinosinusitis with nasal polyposis (CRSwNP) involves 2%-10% of the population in different countries^{1,2}. It significantly impairs patient quality of life and leads to substantial healthcare costs^{3,4}. Treatment of CRSwNP consists of nasal irrigation, use of intranasal and peroral corticosteroids, surgical treatment, and biological therapy. Endoscopic sinus surgery (ESS) is a commonly employed surgical intervention for the management of CRSwNP. Following surgical treatment, nasal irrigation with saline solutions is often recommended as an adjunct therapy to promote healing and provide symptomatic relief^{1,2}.

Currently, both isotonic (0.9% NaCl) and hypertonic (>0.9% NaCl) solutions are being used in practice. Isotonic solutions work by washing away mucus and harmful substances, e.g., dust, debris, pollutants, allergens, microbes, inflammatory mediators, and excess mucus from the nose and sinuses. Hypertonic solutions offer an additional osmotic action where the solution can reduce inflammation and edema by drawing excess fluid out of the nasal and sinus mucosa that results in decongestion of the nasal cavities⁵⁻⁷.

While both solutions are being used in the management of CRS and their efficacy has been the subject of on-going research, comparative efficacy of these two approaches after ESS for nasal polyposis remains less clear⁸⁻¹². This clinical study aimed to investigate comparative efficacy of nasal irrigation with either an isotonic solution of 0.9% NaCl or a hypertonic solution of 2.3% NaCl comprising algal extracts in improving symptoms, objective outcomes, and postoperative healing of sinonasal mucosa following ESS in CRSwNP patients. We specifically wanted to observe if there was a difference in sinonasal symptoms, time and quality of healing in patients treated with the two solutions and compare their action.

Patients and Methods

Study design

This study was a prospective, single-center, real-life, randomized cohort study. The study was conducted between September 2023 and April 2024 in the Department of Otorhinolaryngology and Head and Neck Surgery according to the principles published in the Helsinki Declaration and with Institutional Review Board approval. Written informed consent was obtained from all participants.

Study patients

We included patients diagnosed with CRSwNP according to the European Position Paper on Rhinosinusitis and Nasal Polyposis (EPOS) 2020 guidelines¹. All patients underwent bilateral ethmoidectomy with maxillary antrostomy, and opening of frontal and sphenoidal sinuses bilaterally for nasal polyposis with the same extent of surgery. All operations were performed by 5 surgeons who participated in the study. After the surgery, absorbable hemostatic material was placed in each nostril for the prevention of bleeding. None of the patients had nasal packing and there was no bleeding requiring hemostasis in study participants.

Exclusion criteria were patients younger than 18 and older than 65 years; patients with antrochoanal polyps, systemic diseases that manifest in the nose and paranasal sinus area; pregnancy and breastfeeding; and patients with acute upper and lower airway disease.

Preoperative assessment of patients

Preoperatively, all patients had to fill out a questionnaire scoring the total nasal symptom score (TNSS) on the visual analog scale (VAS) from 0 to 10 cm (0 = absent to 10 cm = maximum intensity of nasal symptoms) of 5 symptoms: nasal obstruction, nasal secretion and/or postnasal discharge, sense of pressure in the face, headache, and loss of the sense of smell. The nasal symptom score was then calculated as the sum of these symptoms. Also, the endoscopic Lund-Kennedy (LK) score was recorded as follows: polyp presence (0 = absence of polyp, 1 = polyp in middle meatus, 2 = beyond middle meatus), edema (0 = absent, 1 = mild, 2 = severe), nasal discharge (0 = no discharge, 1 = clear, thin discharge, 2 = thick, purulent discharge), scarring

(0 = absent, 1 = mild, 2 = severe), and crusting (0 = absent, 1 = mild, 2 = severe)¹³.

All findings were recorded upon hospital admission and on postoperative days 7 and 14.

Postoperative care

Postoperatively, patients performed nasal irrigation with either an isotonic seawater solution (0.9% NaCl) or a hypertonic 2.3% NaCl solution enriched with algal extracts (*Undaria pinnatifida* and *Spirulina platensis*), administered as one puff in each nostril, three times *per day*. The usage of the solution started on postoperative day 1, and assessment was made on postoperative days 7 and 14.

Statistical analysis

All data were extracted from questionnaires and the Microsoft Excel program was used to calculate mean, percentage and standard deviation. We used Friedman ANOVA analysis on statistical evaluation of results.

Results

The study included 54 patients with CRSwNP having undergone ESS. There were 53.7% (29/54) of male and 46.3% (25/54) of female patients, mean age 49.5 years. Thirty (55.56%) patients had other comorbidities such as allergic rhinitis, allergy to food, or/and asthma. Five (9.25%) patients had CRSwNP, asthma, allergy to nonsteroidal anti-inflammatory drugs, and aspirin-exacerbated respiratory disease (Fig. 1).

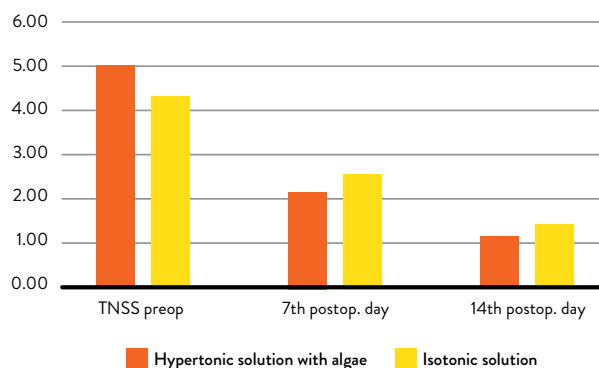


Fig. 2. Total nasal symptom score (TNSS) in hypertonic and isotonic solution group.

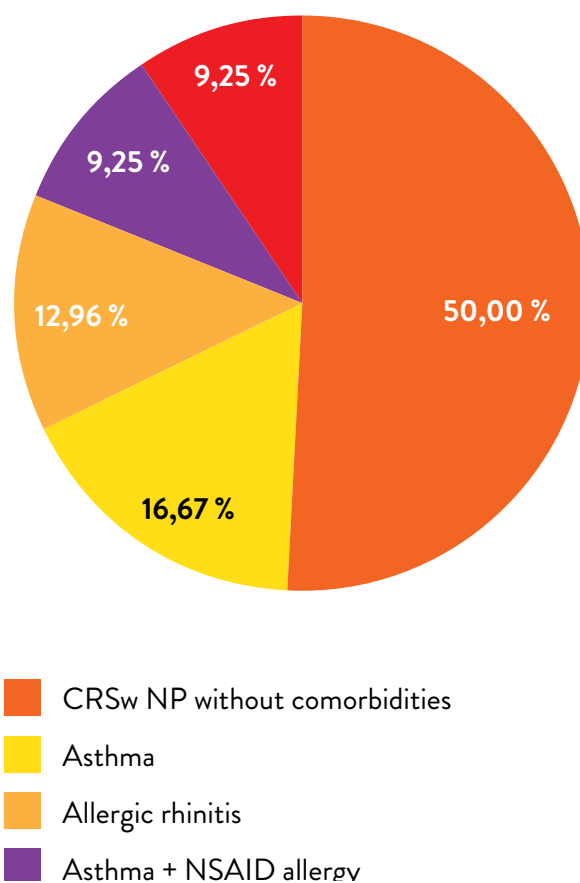


Fig. 1. Comorbidities in study patients.

CRSwNP = chronic rhinosinusitis with nasal polyposis; AR = allergic rhinitis; NSAID = nonsteroidal anti-inflammatory drugs

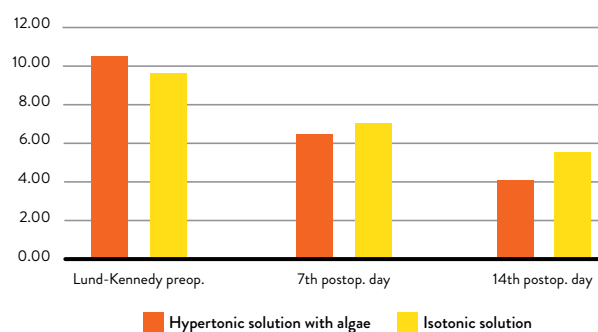


Fig. 3. Lund-Kennedy total score dropdown in hypertonic (green) and isotonic (blue) group.

Patients in both groups had higher TNSS (Fig. 2) or LK total score (Fig. 3) preoperatively than after the surgery. Although there was greater postoperative reduction of TNSS and LK scores in the hypertonic *versus* isotonic group, the observed between group differences were not statistically significant.

When we evaluated each individual symptom of TNSS in patients who used isotonic solution, there was a marked difference between preoperative and day 14 postoperative results in several symptoms including rhinorrhea (5.42 to 2.04), postnasal secretion (5.23 to 1.85), nasal blockage (7.92 to 1.84), hyposmia (8.03 to 4.50) and headache (5.38 to 1.92). Smaller/minor changes were observed in sneezing, itching and nasal irritation. Reductions in individual nasal symptom scores were even more evident in the group that used hypertonic solution. These patients had much lower

scores in rhinorrhea (6.47 to 1.89), postnasal secretion (6.36 to 2.25), nasal blockage (8.64 to 1.39), hyposmia (8.50 to 3.86), sneezing (4.07 to 1.11), itching (3.04 to 0.46) and headache (5.79 to 1.39). A minor change was observed in nasal irritation (Fig. 4).

When we compared groups according to individual symptoms mentioned above, we observed that on postoperative day 7, there were lower scores in patients that used hypertonic solution enriched with algal extracts as compared to the isotonic group of patients. Similarly, most symptom scores were lower in the hypertonic group on postoperative day 14. However, there were no statistically significant differences between the groups according to individual symptoms (Fig. 4).

Discussion

Nasal irrigation is an important part of care for endoscopic sinus surgery patients. Studies show that usage of nasal irrigation results in better mucociliary clearance, reduction of local edema and nasal obstruction, crusting and dryness. It also seems to increase the number of days without symptoms of CRSwNP and to reduce the need of additional medicine^{6,7,10-12}.

The results of this study confirmed therapeutic benefits of nasal irrigation in CRSwNP patients following ESS; both isotonic and hypertonic solutions reduced TNSS and LK symptom scores over the 14-day treatment period after ESS. Assessing individual symptoms, patients in both groups experienced progressive and profound amelioration of most symptom scores. However, patients who used isotonic solution had small/minor improvements in sneezing, itching and nasal irritation over the 14-day period. Similarly, patients who used hypertonic solution had minor improvements in nasal irritation.

Comparing the results obtained with the two solutions, we observed a trend of improved symptomatic outcomes and endoscopic findings in the group using hypertonic saline irrigation *versus* the isotonic group. However, due to the small size of the study sample, the differences did not reach statistical significance.

Previous studies have suggested that hypertonic solutions are superior to isotonic ones in patients with ear-nose-throat conditions including CRSwNP

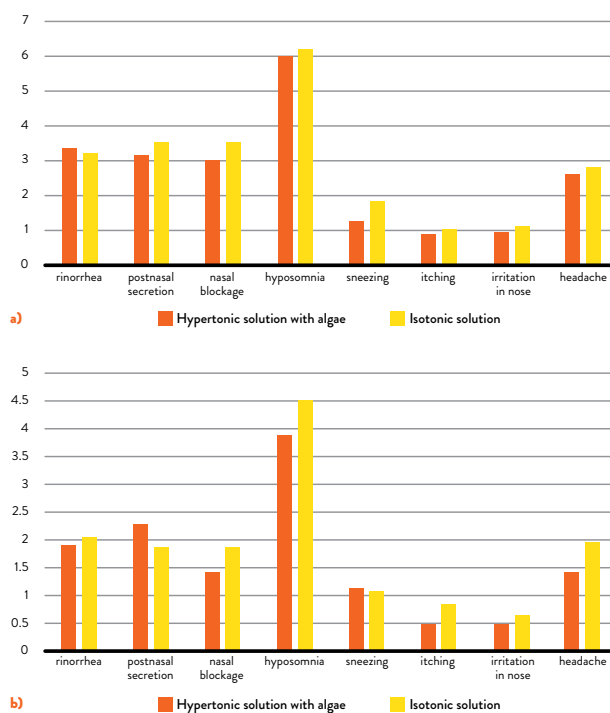


Fig. 4. Symptom score for each symptom in TNSS questionnaire in hypertonic solution enriched with algae group and isotonic solution group: (a) symptoms on postoperative day 7; (b) symptom score on postoperative day 14.

TNSS = total nasal symptom score

patients. Briefly, Perić *et al.* showed that a hypertonic solution of 2.3% NaCl significantly lowered total symptom score on postoperative days 7 ($p=0.009$), 14 ($p=0.003$), 21 ($p<0.001$) and 28 ($p=0.001$). The hypertonic solution group also had lower total endoscopic score on days 21 ($p=0.002$) and 28 ($p=0.001$), lower nasal obstruction, facial pain/pressure, headache and trouble sleeping, and lower nasal mucosal edema, nasal secretion and nasal crusting¹⁴. Two additional studies with the same hypertonic solution comprising algal extracts in patients undergoing surgery have shown superiority over isotonic saline irrigation^{15,16}. Interestingly, patients receiving hypertonic solution comprising algal extracts after ESS had a significant increase in the concentration of epidermal growth factor and decrease in the levels of transforming growth factor- α and interleukin-8 in the mucus suggesting better effects in the nasal mucosa healing after surgical treatment¹⁶. Similar results in symptom improvement were also observed with hypertonic solutions comprising the same algal ingredients in a series of clinical studies conducted in patients with allergic rhinitis, upper respiratory tract infections, and acute rhinosinusitis¹⁷⁻²². Besides symptom relief, these patients had markedly improved quality of life with reduction of fatigue, comprised productivity, sleep disturbances, and emotional exhaustion. One of the additional benefits in patients who used hypertonic solution enriched with algae was reduction in medication consumption, which was already observed in previous studies with hypertonic solutions^{6,7,23-26}. Overall, in these studies, the hydrating effects of algal extracts, and the osmotic action of hypertonic solutions were considered responsible for the observed differences *versus* isotonic solutions^{7,22}.

In our study, we did not observe any adverse effects such as irritation or itching in patients using hypertonic solution after surgery. These findings are in agreement with the results of other clinical studies with the same solutions.

The study had certain limitations, namely, it was conducted in a single center and had a small sample size. Overall, additional studies should be planned to provide more accurate results on the beneficial effects of hypertonic solutions enriched with algae in patients.

Conclusion

The results of this study suggest that postoperative douching of the nasal cavity helps reduce symptoms and promotes postoperative healing in CRSwNP patients. A hypertonic 2.3% NaCl solution comprising algal extracts seems to be more effective than isotonic solution in this setting. Additional clinical testing is needed to further characterize the postoperative action of these solutions.

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Sažetak

UČINKOVITOST ISPIRANJA NOSA IZOTONIČNOM I HIPERTONIČNOM OTOPINOM NAKON ENDOSKOPSKE SINUSNE KIRURGIJE U BOLESNIKA S KRONIČNIM RINOSINUSITISOM S NOSNOM POLIPOZOM

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Endoskopska sinusna kirurgija (ESK) jedan je od modaliteta liječenja bolesnika s kroničnim rinosinusitisom s nosnom polipozom (KRSsNP). Nosna irigacija nakon ESK preporuča se kako bi se poboljšalo cijeljenje sluznice i olakšali nosni simptomi kod ovih bolesnika. Ovo istraživanje uspoređivalo je učinkovitost ispiranja nosa izotoničnom (0,9%) i hipertoničnom otopinom (2,3%) koja sadrži ekstrakt morskih alga. U tu svrhu proveli smo randomizirano kohortno istraživanje koje je uključivalo bolesnike s KRSsNP koji su nakon endoskopske sinusne kirurgije ispirali nos 0,9% izotoničnom otopinom ili 2,3% hipertoničnom otopinom obogaćenom ekstraktima morskih alga (*Undaria pinnatifida* i *Spirulina platensis*). Bolesnici su ispunili upitnik o nosnim simptomima (zbroj nosnih simptoma) koje su rangirali na vizualno-analognu ljestvicu (poput nosna opstrukcija, nosna sekrecija i/ili postnazalni iscjedak, osjećaj pritiska u licu, glavobolja, gubitak njuha) prijeoperacijski te 7. i 14. poslijeoperacijskog dana. Zbroj endoskopskih znakova bolesti prema Lund-Kennedyju (LK) također je zabilježen prije i poslije operacije kod svih bolesnika. Istraživanje je uključilo 54 bolesnika s KRSsNP nakon ESK prosječne dobi od 49 godina. Bilo je 53,7% muškaraca. Druge bolesti, kao što su alergijski rinitis, alergija na hranu i/ili astma, bile su prisutne u 30 (55,56%) bolesnika, a pet (9,25%) bolesnika imalo je KRSsNP, astmu i alergiju na nesteroidne anti-reumatske lijekove. Zbroj nosnih simptoma popravio se 7. i 14. dana poslijeoperacijski u objema skupinama; veće poboljšanje ukupnog zbroja i LK zbroja zabilježeno je u skupini koja je ispirala nos hipertoničnom otopinom obogaćenom morskim algama, iako nije bilo statistički značajne razlike. Poboljšanje pojedinih simptoma također je zabilježeno u skupini koja je ispirala nos hipertoničnom otopinom, osobito simptoma poput svrbeža nosa i kihanja. Rezultati ovog istraživanja potvrdili su učinkovitost nosne irigacije nakon ESK u bolesnika s KRSsNP. Bolesnici koji su upotrebljavali hipertoničnu otopinu obogaćenu ekstraktima morskih alga imali su smanjenje kihanja i svrbeža nosa kroz 14-dnevno razdoblje.

Ključne riječi: *Nosna polipoza; Endoskopska sinusna kirurgija; Nosna irigacija; Hipertonična otopina; Kronični rinosinusitis; Ekstrakt morskih alga*