

Experience of Large-Volume Nasal Irrigation in the Postoperative Period in Severe Nasal Polyposis

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Abstract

To compare the effectiveness and safety of nasal irrigation with a powder solution based on natural salt, baking soda, rosehip, and beetroot extract using various techniques (large-volume irrigation with a squeezable bottle and irrigation via spraying or dripping). A prospective open-label study included 45 patients aged 28 to 49 years, diagnosed with severe, grade 3 chronic rhinosinusitis with nasal polyps. All patients underwent endoscopic nasal polypectomy and endonasal endoscopic opening and revision of all paranasal sinuses. Postoperatively, all patients were advised to irrigate their nasal cavities with a large-volume solution for 14 days. Nasal breathing was assessed using the Visual Analog Scale (VAS), while the physical, functional, and emotional impact of rhinosinusitis was evaluated using the SNOT-22 questionnaire. After the initial irrigation, patients were divided into two groups based on their subsequent care technique: Group 1 (n=33) continued large-volume irrigation using a squeezable bottle. Group 2 (n=12), due to pain experienced during the initial irrigation, used spraying or dripping methods (with a syringe or dropper). Preoperative VAS scores averaged 9.27 ± 2.68 , and SNOT-22 scores were 49 ± 1.28 . On day 14, Group 1 showed a VAS score of 2.11 ± 0.34 and SNOT-22 score of 10 ± 0.56 . Group 2 showed VAS and SNOT-22 scores of 3.85 ± 0.95 and 21 ± 0.94 , respectively. Large-volume nasal irrigation using a 240 ml squeezable bottle with the body bent at a 90° angle was found to be significantly more effective than drip or spray methods in improving nasal breathing, overall patient condition, and reducing the risk of postoperative purulent complications.

Keywords: chronic rhinosinusitis, nasal irrigation, negative pressure, mucociliary clearance.

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Introduction.

Chronic rhinosinusitis (CRS) is a group of diseases caused by the influence of multiple factors, associated with immune and epithelial defense systems, leading to inflammation of the mucous membrane of the

sinonasal area. These conditions develop under the influence of microbiological, environmental, and genetic factors [1]. CRS is divided into two main phenotypes based on endoscopic appearance: CRS without nasal polyps (CRSsNP) and CRS with nasal polyps (CRSwNP). CRSwNP accounts for approximately 18–20% of all CRS cases and is considered the more severe phenotype. The estimated prevalence of CRSwNP is about 1.1% in the United States, while in Europe it ranges from 2.1% to 4.4% [1]. In Russia, the prevalence of CRSwNP is between 1.3% and 5.5% [2], while in Saint Petersburg, this rate is around 0.05% (ranging from 1.3 to 13.1 per 10,000 people depending on the clinic). CRSwNP is observed in 12–13% of patients at outpatient ENT consultations and in 20–30% of cases in ENT departments [2]. Both pharmacological therapy and surgical methods significantly improve the quality of life in CRSwNP treatment, highlighting the importance of proper medical treatment. However, when medications fail to achieve the desired results, surgical intervention becomes a radical treatment method. Surgical treatment is recommended in cases where drug therapy is ineffective and to remove nasal polyps and restore sinus ventilation [1]. Significant complications after nasal surgeries occur in about 1–3% of cases, while minor complications are observed in approximately 15% [3]. According to the 2021 International Consensus Statement on Allergy and Rhinology (ICAR-RS-2021), saline nasal irrigation is recommended as postoperative treatment for both CRSwNP and CRSsNP (recommendation class B) [4]. The 2020 European Position Paper on Rhinosinusitis and Nasal Polyps recommends saline irrigation for 6 to 12 weeks in patients with CRSwNP and CRSsNP (evidence level 1A) [4]. Overall, according to the guidelines of different countries, nasal irrigation is a strongly recommended and evidence-based method in postoperative care [5, 6].

Nasal Saline Irrigation

Nasal saline irrigation helps improve the condition of the nasal mucosa through several physiological effects [6, 7]:

- Cleansing the blood and mucus, which serve as a nutrient medium for bacterial growth;
- Reducing the formation of crusts;
- Removing antigens and bacterial biofilms;
- Eliminating inflammatory mediators and improving nasal symptoms;
- Normalizing mucociliary function;
- Increasing hydration of the mucosa, thereby enhancing mucociliary clearance;
- Preventing the formation of synechiae;
- Accelerating the regeneration of the mucosal lining.

Detailed recommendations on the use of irrigation therapy after endonasal surgery are provided in the clinical guidelines titled *"Irrigation Therapy in Rhinology and Rhinologic Surgery"* [8].

Importantly, nasal irrigation following endoscopic sinus surgery not only accelerates the recovery and regeneration of the nasal mucosa but also reduces the need for additional medications [6]. According to leading Russian otorhinolaryngologists, the “squeeze bottle” device is considered the best method for independent use in postoperative nasal irrigation. This is because devices without adequate pressure may not effectively remove thick secretions from the sinuses after surgery, whereas pressurized rinsing provides optimal cleansing with minimal impact on the damaged mucosal layer [9]. In Russia, an example of a “squeeze bottle” device is **Dolphin®**, which comes with a cleansing solution containing water, baking soda, natural salt, and licorice extract derived from natural sources. According to G.H. Chang et al. [10], licorice extract helps reduce nasal polyps in CRSwNP patients by clearing the nose and exhibits anti-inflammatory effects. Additionally, it may inhibit the MAPK/ERK-1/2 signaling pathway, reducing fibroblast differentiation, extracellular matrix production, and cell migration associated with inflammation. Many studies have confirmed the advantages of large-volume nasal irrigation over other

methods. The most effective technique is considered to be pressurized irrigation using a vacuum-assisted device, as it creates the pressure necessary to change the interaction between gas and liquid environments. As a result, it effectively removes thick mucus, inflammatory cells, allergens, and bacteria from the respiratory tract [11]. The **squeeze bottle device** generates positive pressure from the source by being advanced close to the inner wall of the nasal cavity, prior to engaging with the nasal valve. This natural expansion of the nasal valve facilitates the passage of the irrigation solution through the nasal tissues and cavities [12]. Regardless of the initial condition and other variables, the proper clinical outcomes and future evidence-based practices depend on well-established medical techniques and further important research. The degree to which the irrigation solution reaches different sinuses depends on the patient's body position. The most effective penetration has been observed when the patient's head is positioned at a **90° angle** to the vertical axis [7]. A **prospective, single-blinded, randomized trial** compared the performance of various nasal irrigation devices after closed endonasal surgery. The results showed that **large-volume nasal irrigation** ensured more effective distribution of the irrigation solution in the nasal cavity and led to better cleansing, as evaluated using Lund-Mackay endoscopy, compared to small-volume irrigation [13]. The **positive international experience** with large-volume nasal irrigation before and after sinonasal surgeries, as well as the **practical application of natural solution-based preparations** in Russia, and the **relatively low incidence of significant complications** [9, 13–17], have prompted the goal of this study — to **compare different nasal irrigation techniques** and assess their **safety and efficacy**. These include large-volume irrigation, squeeze bottle devices, and low-pressure rinsing using bulbs or droppers, as well as preparations containing **licorice extract, salt, and rosehip extract**, derived from natural sources.

Materials and Methods:

An open prospective study was conducted from **January 2023 to December 2024** at **State Institution VOKB No. 1** and the **Family Medicine Clinic of VolgGMU**. The study included **45 patients**, aged **28 to 49 years**, all diagnosed with **chronic rhinosinusitis with grade 3 nasal polyposis**. The severity of the disease was evidenced by the recurrent nature of the polyposis process and the widespread involvement of all sinuses. The patients had previously undergone **4 to 11 nasal polypectomy surgeries**, performed either with or without the use of endoscopic technology. The **duration of the disease ranged from 7 to 18 years**. All patients were admitted to **GBUZ "VOKB No. 1"** to undergo **endoscopic nasal polypectomy**. Patients with **bronchial asthma**, other **atopic diseases**, **bacterial sinusitis**, **purulent complications**, **cardiovascular diseases**, or **oncological conditions** were **excluded** from the study. The following examinations were prescribed: **endoscopic examination of the ENT organs**, **computed tomography (CT) of the nose and paranasal sinuses**, evaluation of **nasal breathing using the Visual Analog Scale (VAS)**, and assessment of the **physical, functional, and emotional consequences of rhinosinusitis using the SNOT-22 (Sino-Nasal Outcome Test) questionnaire** (see Table). In addition, patients provided information on **difficulties encountered during the nasal irrigation process**.

Table. Evaluation of nasal breathing and quality of life parameters using VAS and SNOT-22

Nasal irrigation was performed using an **individual Dolfin® bottle**, by dissolving **Dolfin® Powder No. 1** in **240 ml of boiled water at a temperature of 35–36 °C**. The powder contains salt from a natural source, **sodium bicarbonate**, and **dried extracts of rosehip fruit and licorice root**. The **first irrigation** was performed by a physician after the nasal packs were removed; the **second irrigation** was carried out by the patient independently. Nasal irrigation was performed with the **body bent at a 90° angle**. The solution was gently introduced into one nostril and exited through the other. After hospital discharge, irrigations were continued **twice daily**. The total duration of nasal irrigation therapy was **14 days**.

The study protocol for evaluating the effectiveness of nasal irrigation included the following:

- **Day 1** – Patient evaluation;
- **Day 2** – Surgical intervention;

- **Day 3** – Removal of nasal tampons (the day after the procedure);
- **Day 4** – Start of nasal irrigation (after tampon removal), carried out **twice a day** using **240 ml of solution**;
- **Days 5–6** – Collection of complaints, **nasal endoscopy**, assessment of nasal breathing effectiveness using **VAS**, evaluation of quality of life using **SNOT-22**, identification of any difficulties during the irrigation process, and irrigation performed twice daily;
- **Day 6** – Hospital discharge with recommendations to continue **twice-daily nasal irrigation** for **7 more days on an outpatient basis**;
- **Day 14** – Final postoperative follow-up: collection of complaints during a scheduled visit with an ENT specialist, evaluation of nasal breathing using VAS, quality of life using SNOT-22, and documentation of any difficulties experienced.

Results

Among the patients included in the study, there were 19 women and 26 men, with a mean age of 40.58 ± 5.85 years. Before the surgery, nasal breathing efficiency according to the VAS scale ranged from 7 to 10 points, with an average of 9.27 ± 2.68 points, indicating an almost complete absence of nasal breathing in most patients. According to SNOT-22, the patients' subjective condition across four domains averaged 49 ± 1.28 points, primarily reflecting difficulties in reading and emotional impact. In the days following tampon removal, patients rated their condition at 2.44 ± 1.03 points on the VAS (ranging from 1 to 4 points), and 16 ± 0.23 points on the SNOT-22, indicating a high efficacy of the surgical method in treating severe nasal polyposis. During the first irrigation, all patients experienced unpleasant sensations in the nasal cavity. 18 patients (40%) reported pain on the side of the nose, with 12 of them (67%) experiencing severe pain, leading to refusal of further irrigation and switching to alternative nasal care methods. These patients were classified into Group 2. They were advised to rinse the nasal cavity 3–4 times daily using a Dolphin® bottle or a 5 ml syringe.

In Group 1, the first irrigation led to the removal of thick mucopurulent discharge from the nasal cavity, and during the second irrigation, the secretions were less purulent and more mucosal. On days 5–6, patients in Group 1 reported a sense of nasal congestion and crusting. They rated nasal breathing effectiveness at 3.54 ± 0.94 points (VAS) and quality of life at 24 ± 1.13 points (SNOT-22) — primarily due to nasal symptoms. Examination revealed fibrinous-purulent crusts, which were removed with forceps or by irrigation. These patients did not report pain during irrigation but mentioned significant discomfort.

During outpatient treatment, large-volume nasal irrigation did not cause difficulties. Patients adhered to the irrigation regimen and noticed a reduction in crusting by days 10–12.

At the day 14 follow-up, patients had no complaints, reported free nasal breathing, and evaluated its effectiveness as 2.11 ± 0.34 points (VAS) and 10 ± 0.56 points (SNOT-22) — mostly due to mild residual symptoms such as reduced sense of smell, sneezing, etc. Their sleep quality normalized, no nighttime awakenings, and fatigue resolved. In general, normalization of nasal breathing led to the disappearance of other symptoms. Examination of the nasal cavity revealed signs of epithelialization, and no crusts were present in the middle and upper nasal passages.

No postoperative infections were observed among the patients throughout the study period.

Upon completion of large-volume nasal irrigation therapy, it is considered appropriate to initiate topical glucocorticosteroid therapy after 10–12 days in patients with severe nasal polyposis, as by that time crust formation in the nasal cavity has usually resolved.

In Group 2, the postoperative period was more uncomfortable. On days 5–6, patients complained of difficulty in nasal breathing, rating it at 5.08 ± 1.04 points (VAS) and 20 ± 2.12 points (SNOT-22). Despite

frequent irrigation, patients reported no improvement in nasal breathing and persistent crusts. Nasal obstruction was most pronounced in the morning. Examination revealed crusts in the upper nasal regions. After crust removal, nasal breathing improved, but the procedure caused mucosal trauma and mild bleeding. Following nasal cavity cleansing, VAS scores improved to 3.15 ± 1.23 points.

On day 14, complaints about the **presence of crusts in the nasal cavity** persisted. Patients rated **nasal breathing effectiveness at 3.85 ± 0.95 points (VAS) and 21 ± 0.94 points (SNOT-22)** — primarily due to **difficulty in breathing, viscous secretions, sneezing, reduced sense of smell, and decreased attention**. Patients noted that **excessive irrigation led to swelling of nasal crusts**, causing **mild discomfort and a sensation of fullness**. By **days 10–11**, mechanical removal of crusts from the nasal cavity became necessary. Otherwise, the crusts became compacted, which some patients perceived as symptom relief. If large-volume elimination-irrigation methods are required in the nasal cavity, it is advisable to **initiate topical glucocorticosteroid therapy after day 14**. In some cases, consideration should be given to possible delayed crust elimination. Topical glucocorticosteroid therapy should be **prescribed timely and effectively** for optimal treatment.

Discussion

Nasal irrigation with **saline solution** serves to **mechanically remove blood, crusts, inflammatory mediators, and bacteria** from the nasal cavity, thereby helping to **optimize the patient's recovery period** [18–20].

The results of our study confirm the findings of **S. Karpishchenko and colleagues** [9], who showed that **nasal irrigation using the Dolphin® device** provided **better outcomes in several parameters** postoperatively (significant differences were observed between days 5–6 and 10–11), especially in **accelerating the clearance of nasal crusts** compared to using isotonic saline sprays.

Our results support the **conclusions of S. Karpishchenko et al.** [9]: using the **Dolphin® device for nasal irrigation after surgical intervention** produced better outcomes (though not for all parameters), notably **accelerating crust clearance** (with significant intergroup differences on days 5–6 and 10–11) and **reducing discharge** compared to spray application (especially on days 10–11). Other studies have shown that **mucociliary clearance is impaired** after sinonasal surgery, leading to **mucus accumulation** in the sinonasal cavity [21]. Irrigating the sinonasal tract with saline or isotonic solution helps **restore mucociliary clearance**, thus **alleviating the postoperative recovery period** [22]. There are also **other factors** that help improve mucociliary clearance in the nasal cavity: **irrigation with a warm ($32\text{--}37\text{ }^{\circ}\text{C}$), alkaline solution** improves clearance, as **ciliary beating is most active at temperatures above $30\text{ }^{\circ}\text{C}$ and pH between 7 and 9** [23–25]. Therefore, **warm isotonic alkaline saline solution prepared with Dolphin® No.1 powder** contributes to improved nasal cavity conditions during the postoperative period. However, comparison of **different nasal irrigation techniques** in the postoperative period has shown that **bottle irrigation with the head and upper body parallel to the ground** is **more clinically effective** than **drop or jet irrigation**. These results are scientifically substantiated. The surface area of the sinonasal mucosa and the resistance of the nasal cavity walls play an important role in influencing the clinical outcomes of nasal saline irrigation in the postoperative period [22]. When a larger volume of solution is used, the nasal complex is more effectively irrigated, covering a larger area of the mucosa [26]. The area of mucosal healing in the nasal cavity is at least 30% smaller when irrigating with saline compared to larger volumes with significant mucus accumulation [27]. K. Shrestha and colleagues [28] suggested that using a higher volume (up to 400 ml) and greater pressure during irrigation helps improve mucociliary clearance. To ensure effective mechanical clearance, large-volume irrigation with strong saline solutions is required [29]. Thus, research results indicate that flowing saline solutions are superior in clinical efficacy compared to simple sprays or syringes for saline irrigation [30–32].

J. Campos and colleagues [26], in their experiment using a model of the nasal cavity, identified the following optimal parameters for effective nasal irrigation: the irrigating device must firmly attach to the nostril, produce at least 120 mbar pressure, and maintain an at least 5 ml/s flow rate (generated by

compressing the reservoir). Furthermore, the fluid should be directed at a 45° angle upward. The device that best meets these parameters is the "squeeze bottle." Additionally, the "squeeze bottle" allows bilateral irrigation, which helps overcome individual anatomical features, congenital or acquired deformities, as well as inflammation and postoperative absorption conditions [13].

Conclusion.

In patients undergoing surgery for severe CRSwNP (chronic rhinosinusitis with nasal polyps), early postoperative elimination-irrigation therapy is an essential part of nasal care. Comparing the effectiveness of different methods for postoperative nasal cavity irrigation using a mineral-plant solution, it was found that irrigation with a 240 ml squeeze bottle was more effective than using 5 ml syringes for large-volume drops or sprays. This larger-volume irrigation plays a significant role in improving nasal breathing, mechanically clearing mucus, fibrinous fluid, crusts, bacteria, and inflammatory mediators, enhancing mucociliary clearance, and reducing the risk of wound infection after surgery.

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