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Research Article

How Effective Is Normal Saline Irrigation in Eradicating Nasal Fungal Flora?

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Abstract

Background: Human exposure to fungal elements is inevitable. Normal inhalation routinely deposits fungal spores within the nose and paranasal sinuses. The incidence of fungal infections is increasing because of the greater use of immunosuppressive agents, increasing incidence of transplantation, chemotherapy, HIV infection, and diabetes mellitus (DM).

Objectives: The aim of this research was to study the effects of nasal irrigation with normal saline on eliminating nasal fungal flora.

Methods: In this pilot study, we studied the clinical efficacy of nasal saline irrigation on healthy individuals. Nasal swabs were used to get the nasal samples from 140 cases, 90 women and 50 men, living in Tehran. Those cases with positive fungal cultures underwent nasal saline irrigation. They were reevaluated with nasal sampling and culture after a week.

Results: Positive fungal culture was detected in 22 cases (15.7%): Saprophyte fungi were the most common (45.4%). After nasal saline irrigation, negative fungal cultures were found in 54.5% of cases (P-value = 0.0009).

Conclusions: This study demonstrates that nasal irrigation with nasal saline is safe and effective in the eradication of nasal fungal flora. So, it may be useful in the prevention and management of all types of fungal rhinosinusitis.

Keywords: Nasal Cavity; Paranasal Sinuses; Saline Solution; Nasal Irrigation; Fungal Infections

1. Background

Rhinosinusitis is a common disease. About 2.1 to 13.8 of people are involved with its symptoms (1). It affects the quality of life and accounts for a large number of healthcare costs (2), leading to more than a million surgical interventions worldwide annually (3). The role of fungi as the causative factor of rhinosinusitis is not clear (4). Fungi spores can be colonized in the hot and humid upper respiratory tract and cause invasive or noninvasive rhinosinusitis, depending on the host immune system competency (5).

Allergic fungal rhinosinusitis (AFRS) is classified as one of the different types of chronic rhinosinusitis (CRS) defined in recent 40 years. It involves immunocompetent patients and causes the common CRS feature with nasal polyposis. Pathophysiology of allergic fungal rhinosinusitis is an allergic or inflammatory reaction to fungal antigens due to immunoglobulin E-mediated immunity. Hypersensitivity reactions to noninvasive fungi are one of the basic pathologic events in AFRS. However, multiple cellular immunity modulators, such as interleukins, cytokines, and chemokines, may be involved as well. Proliferation and colonization of fungi in the sinonasal cavity cause an immune reaction to start and progress. Also, fungi are powerful immunogens that interact with sinonasal epithelium and trigger an inflammatory response (6).

Considering the increased incidence of immunodeficiency disorders, more attention has been paid to the role of fungi in the pathogenesis of invasive fungal rhinosinusitis. Invasive fungal rhinosinusitis most often occurs in immunocompromised patients, such as patients involved with uncontrolled diabetes mellitus (DM), hematologic malignancies, or under immunosuppression therapy. The invasion of sinonasal mucosa by fungal hyphae is the main feature of its pathology (7). The fungal elements invade not only the patients' rhinosinocerebral tissues but also their vessels and nerves directly. So, it usually progresses aggressively and leads to death without in-time, proper management. To prevent its lethal complications, it is very important to effectively treat the

disease (8). Nasal irrigation with normal saline is a simple and effective way for acute or chronic rhinosinusitis (9). If the positive effect of normal saline irrigation is confirmed on eradicating fungal flora in the sinonasal tract, it can be helpful for the prevention and treatment of invasive and noninvasive fungal rhinosinusitis.

2. Methods

The present study was a prospective before-and-after intervention study. The Ethics Committee of Shahid Beheshti University of Medical Sciences confirms the current study (registration code: IR.SBMU.MSP.REC.1399.463). Informed consent forms were signed by all patients who participated in the study. They were aware of possible complications, including infection, allergic reactions, and iatrogenic mucosal trauma. After obtaining informed consent, 140 healthy cases who lived in Tehran entered the study. Exclusion criteria were a history of DM, malignancy, AIDS, transplantation, and systemic or topical use of steroids, antibiotics, or immunosuppressive medicines in the past three months.

The samples were taken from both sides of the nasal cavities with sterile swabs using an endoscope. At first, local anesthesia was applied by cottonoids soaked in a mixed solution of lidocaine 10% (lidocaine 10% spray, Iran Darou, Tehran, Iran) and nasal phenylephrine 0.25% (nasophrin 0.25%, Sina Darou, Tehran, Iran) inserted in the nasal cavity for 10 minutes. After removing them, diagnostic endoscopy was done with a 30-degree endoscope. Sterile swabs were entered in the right and left nasal cavities and middle meatus separately to get sufficient specimens. Then they were kept in cool and sterile distilled water and transferred to the mycology laboratory immediately. The samples were cultured in Sabouraud dextrose agar. After one week, the culture mediums were checked for fungal growth.

Those cases with positive fungal cultures were enrolled in the second phase of the study. They were asked to irrigate each side of their nasal cavities with 10 cc of normal saline using a syringe four times a day for two weeks. After that, the samples were taken again in the same way, and the results were analyzed. The proportion of primary positive fungal cultures and the prevalence of each fungal species before and after treatment were calculated. The obtained data were presented as frequencies and percentages. We conducted statistical analyses by Stata, version 17.

3. Results

One hundred and forty healthy cases, 90 females (64.3%) and 50 males (35.7%), were included in the study. The age ranged from 7 to 70 years old, with a mean of 34.7 (SD = 30). Fungal culture results were positive in 22 cases (15.71%). The most common types of fungi were Alternaria (45.4%) and Aspergillus (27.3%), which involved ten and six patients, respectively (Table 1).

Table 1. Fungal Culture Results from Nasal Cavity Samples Before Normal Saline Irrigation

Test Results	No. (%)
Negative culture	118 (84.29)
Alternaria	10 (7.14)
Aspergillus	6 (4.29)
Yeast	3 (2.14)
Cladosporium	2 (1.43)
Trichoderma	1 (0.71)
Total	140 (100)

Among cases who entered the second phase of the study, negative fungal cultures after nasal irrigation were reported in 54.6% of cases (12 patients). They were Aspergillus or Alternaria positive initially (Table 2). MacNemar's test was used for the assessment of the efficacy of the treatment. P-value showed that irrigation of the nasal cavity with normal saline was significantly effective in eradicating fungal flora (P-value = 0.0009).

Table 2. Fungal Culture Results from Nasal Cavity Samples After Normal Saline Irrigation

Result Tests	No. (%)
Positive culture	10 (45.4)
Negative for Aspergillus	6 (27.3)
Negative for Alternaria	6 (27.3)
Total	22 (100)

4. Discussion

Common causative fungi in fungal rhinosinusitis are Aspergillus, Curvularia, Alternaria, Candidiasis, and Mucormycosis. They can cause invasive fungal infections in immunocompromised patients. In immunocompetent individuals, clinical manifestations of rhinosinusitis with or without polyposis occur due to activated allergic reactions to fungi (10). Fungi are one of the major causative factors in respiratory allergies that threaten public health (11).

There are some studies about common fungal nasal flora. In a cross-sectional study on fungal nasal flora of 100 healthy volunteers in Iran (Kerman), 31% of the samples were positive for fungal culture. The most common positive fungal cultures were Candida (in 12 samples) and Aspergillus (in 8 samples) (12). In another study in Barcelona, nasal fungal flora was studied on 135 healthy individuals, and 41% of the samples were positive. Most of them were Cladosporium (17.6%) (13). Another survey was done in Iran (Hamadan). They analyzed fungal flora in the nasal cavities of 62 patients with chronic rhinosinusitis post-operatively. Sixteen positive fungal cultures were reported. The most common was Aspergillus fumig-

atus (14). In our study, positive fungal cultures were detected in 15.71% of 140 samples. The most common types were Alternaria and Aspergillus spp.

Nasal saline irrigation, as a simple and effective way, has been used for different sinonasal disorders such as atrophic or allergic rhinosinusitis and after endoscopic sinus surgery. Nasal saline irrigation causes improvement in mucosal clearance and enhances ciliary activity, leading to removal of antigens, biofilms, and inflammatory mediators. So it can improve the quality of life (15). Although we found no study about the specific effects of saline irrigation on eradicating fungal flora, there are some reports confirming its effect on improving nasal function.

In 2013, a meta-analysis was conducted on 16 randomized clinical trials. Although the efficiency of saline was proven, the direct effect of the salty solution on the fungal growth was not determined (16). In another meta-analysis, nasal irrigation with normal saline was compared with placebo, and the efficiency of nasal irrigation with normal saline was confirmed (17). Also, morphologic analysis of the epithelial cells revealed that pure water severely damaged normal human epithelial cells, and only isotonic saline did not change their morphologies. According to a randomized, double-blind study on thirty children, hypertonic normal saline increased mucociliary clearance and ciliary beat frequency (18).

In our study, irrigation of the nasal cavity with normal saline was significantly effective in eradicating fungal flora ($P = 0.0009$). The interesting point was that all cases that were Aspergillus-positive became negative after saline irrigation. Aspergillus spp. is a common cause of fungal rhinosinusitis, especially invasive types.

4.1. Conclusions

Nasal irrigation with normal saline was significantly effective in eliminating fungal flora. It seems that normal saline irrigation may be helpful in the prevention and treatment of all types of fungal rhinosinusitis. Particularly, it can be recommended in immunocompromised patients as a prophylaxis for invasive fungal rhinosinusitis.

Authors Contribution:

Study concept and design: Matin Ghazizadeh; analysis and interpretation of data: Matin Ghazizadeh, Maryam Khakbaz, and Nooshin Faraji; drafting of the manuscript: Nooshin Faraji, and Matin Ghazizadeh; critical revision of the manuscript for important intellectual content: Matin Ghazizadeh; administrative, technical, and material support: Matin Ghazizadeh, Maryam Khakbaz, and Nooshin Faraji; study supervision: Matin Ghazizadeh.

Conflict of Interests:

It was not declared by the authors.

Ethical Approval:

The Ethics Committee of Shahid Beheshti University of Medical Sciences confirms the current study (registration code: IR.SBMU.MSP.REC.1399.463). Link: ethics.research.ac.ir/IR.SBMU.MSP.REC.1399.463.

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Informed Consent:

Informed consent forms were signed by all patients who participated in the study.

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