Nasal Saline Irrigation in Children

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Role in allergic rhinitis

Nasal irrigation has been used for centuries to clean the airways and facilitate nasal drainage. However, its importance in the prophylaxis and treatment of upper respiratory tract diseases has not been precisely defined. Most of the studies of nasal irrigation have involved subjects with acute or chronic rhinosinusitis, but they have been criticized mainly because of their small patient populations and the fact that their enrolment methods are subject to bias and therefore influence the interpretation of the results. Nevertheless, the studies of Garavello and Li suggested that nasal irrigation may be useful in controlling the symptoms of childhood allergic rhinitis and reducing the need for traditional oral antihistamine or intranasal steroid therapy, although it was not been clearly established whether normal or hypertonic saline should be preferred, or what procedure is best for ensuring good compliance even in younger children. It is also unclear whether nasal irrigation can be effective in reducing the comorbidities associated with childhood allergic rhinitis.

Allergic rhinitis (AR) is a very common disease that affects up to 40% of children and, particularly in moderate to severe cases, is associated with a significant reduction in the patients' quality of life, sleep disorders, emotional problems, and impaired school productivity and social functioning. Moreover, the chronic inflammatory process caused by allergic rhinitis favors the development of comorbidities, increases the incidence of ear problems such as acute otitis media and otitis media with effusion, and aggravates physiological adenoid and tonsil hypertrophy in the first years of life. Finally, allergic rhinitis is strictly related to the development of asthma, and its prevention and treatment is strongly recommended. Treatment combines educating the patients and their parents, immunotherapy and drug administration. However, even the best approach does not relieve the symptoms of a number of patients, and alternative therapies are particularly needed for children because the fear of adverse events frequently reduces parental compliance to the prescribed drugs, and immunotherapy is less easy to administer than in adults.

We studied whether children with seasonal AR secondary to grass pollen sensitization could benefit from nasal irrigation by assessing the effects of normal and hypertonic saline on nasal signs and symptoms, on middle ear effusion and on adenoidal hypertrophy. In a prospective investigator-blinded study randomized children aged 5-9 years with documented seasonal grass pollen-related allergic rhinitis to normal saline or hypertonic saline nasal irrigation or no treatment. Nasal symptoms (rhinorrhea, itching, sneezing, nasal obstruction), turbinates swelling, and adenoidal hypertrophy and middle ear effusion were assessed at baseline and four weeks later. Two hundred twenty children completed the study according to the protocol (normal saline: 80; hypertonic saline: 80; no treatment: 60). After four weeks, the

proportion of children treated with hypertonic saline with reduced nasal symptoms and turbinates swelling was highly significant (p <0.0001 for all the studied items), whereas only the proportion of those suffering from rhinorrhea and sneezing was significantly reduced in the group treated with normal saline (p= 0.0002 and 0.002, respectively). There was no significant change in the controls (**Table 1**).

Table 1. Nasal score at baseline and after 4 weeks according to treatment group.

	Normal saline (n =80)	Hypertonic saline (n= 80)	Controls (n= 80)	*P* value
NASAL SCORE, mean ± SD Baseline At 4 weeks *p* value	3.43 ± 0.6 2.55 ± 0.7 < 0.001*	3.4 ± 0.5 1.3 ± 0.7 < 0.001*	3.56 ± 0.8 3.1 ± 0.7 0.4*	0.5 § < 0.01§

* Wilcoxon signed rank sum test for within group difference; § Kruskal-Wallis for between groups difference

The proportion of children with bilateral otitis media with effusion and moderate to severe adenoidal hypertrophy was significantly reduced in the children treated with hypertonic saline (p <0.0001 and p = 0.0001, respectively), whereas there was no significant change in the other two groups. The duration of oral antihistamines was significantly lower in the children receiving hypertonic saline than in those treated with normal saline or in controls.

The positive effect of nasal irrigation with hypertonic saline on the clinical course of seasonal allergic rhinitis and the need for drug administration to control its signs and symptoms has been previously demonstrated in children by Garavello *et al*. who studied children with allergic rhinitis due to Parietaria and demonstrated a significant benefit from the use of hypertonic solution (**Figure 1**).

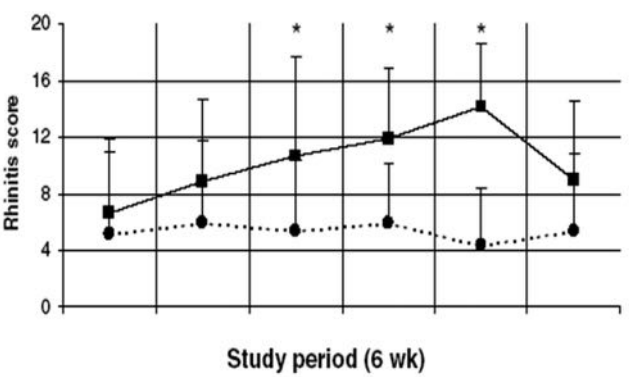

Figure 1. Mean ± SD of the rhinitis score during the 6- week period of the pollen season for patients treatd with nasal irrigation (dotted line) and controls (solid line).

However, our findings extend our knowledge of the possible impact of nasal irrigation in children with seasonal grass pollen-related allergic rhinitis. They come from the first comparative study carried out in children, and suggest that

hypertonic solutions are more effective than isotonic solutions. This is *per se* important because nasal irrigations are widely used, and no definite data concerning the real effects of solutions of different saline content on children were previously available. Furthermore, our findings indicate that, when performed with an appropriate solution, nasal irrigation can not only be clinically and therapeutically beneficial, but can lead to a significant reduction in at least some of conditions frequently associated with allergic rhinitis (such as middle ear effusion and adenoid hypertrophy), which usually have a considerable impact on the clinical history and quality of life of affected children.

The children who used the hypertonic solution needed significantly less antihistamine treatment to control the signs and symptoms of seasonal AR rhinitis than all of the other patients. Although limited in duration, the pharmacological treatment of seasonal allergic rhinitis is significantly more expensive than nasal irrigation, and the use of drugs can be followed by adverse events, which suggests that hypertonic saline nasal irrigations may be globally beneficial as an adjunctive treatment for seasonal allergic rhinitis due to grass pollen sensitization. This view is further supported by the reduction in the proportion of children with bilateral middle ear effusion and the severity of the adenoid hypertrophy observed in our study because otitis media with effusion has been associated with delayed speech development, and adenoid hypertrophy can lead to a greater incidence of upper respiratory infections, as well as mouth breathing and snoring at night with possible obstructive sleep apnea. The possibility of reducing these risks in children with allergic rhinitis by means of a simple, inexpensive and well tolerated method is particularly important in clinical practice.

Using our procedure, hypertonic saline is effective, inexpensive, safe, well tolerated and easily accepted by children with seasonal grass pollen-related allergic rhinitis and their parents.

Survey of attitudes and prescribing habits of primary care pediatricians working in northern Italy

It is agreed that nasal saline irrigation (NSI) is safe and well tolerated because there were no severe adverse events and only a minority of children has to discontinue the treatment because of poor tolerance. The procedure is quite inexpensive and reduces the use of prescription and over-the-counter medications, and therefore have a substantial impact not only on medical costs, but also on antibiotic pressure and the associated antibiotic resistance.

On the basis of these findings, a number of experts have identified nasal saline irrigation as an appropriate adjunctive treatment for many pediatric upper respiratory tract diseases, and some scientific societies have included it in their treatment guidelines for rhinosinusitis (U.S. and Italy) and acute otitis media (Italy). However, it is not clear how or how extensively nasal saline irrigation is used in everyday practice, particularly in the community and in younger children. The only available data, which were collected some years ago from family physicians by Rabago in Wisconsin, indicate that NSI is frequently prescribed for a variety of upper respiratory conditions, but administered using various dosing schedules and types of solution, some of which are different from those suggested in the studies that

have found the practice effective, safe and well tolerated. No study has assessed the awareness or clinical use of nasal saline irrigation among practising pediatricians, and so nothing is known about the extent of their awareness of the procedure, how they use it and for what conditions, its clinical successfulness or otherwise, or the physician characteristics that might influence their practice patterns.

We evaluated the use of NSI in pre-school children by primary care pediatricians working in Italy. Nine hundred randomly selected National Health Service primary care pediatricians with an e-mail address were sent an e-mail asking whether they were willing to respond to a questionnaire regarding the use of nasal saline irrigation. The 870 who answered positively were sent an anonymous questionnaire by post and e-mail that had 17 multiple-choice items.

Completed questionnaires were received from 860 of the 870 primary care pediatricians (98.8%). NSI was used by almost all the respondents (99.3%), although with significant differences in frequency (**Figure 2**).

It was considered both a prophylactic and a therapeutic measure by most of the respondents (60.3%), who prescribed it every day for healthy children and more frequently when they were ill (**Figure 3**).

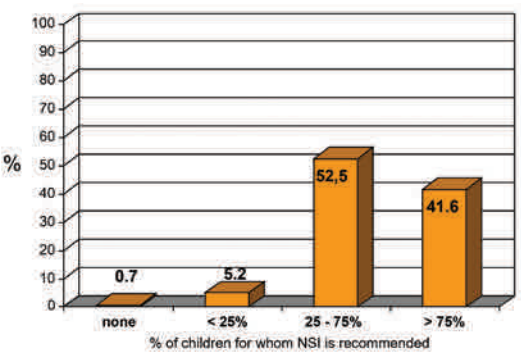

Figure 2. Proportion of patients to whom the respondents declare to recommend nasal irrigation.

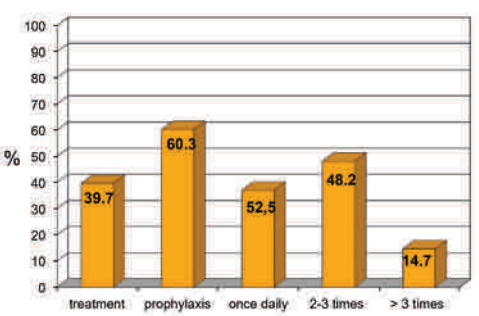

Figure 3. Reason for using nasal saline irrigation and frequency of administration.

The widespread therapeutic use of NSI was not surprising given the frequency of these diseases in younger children, their very high tendency to recur, the positive opinion of the pediatricians concerning the effectiveness of NSI, and the results of the published pediatric studies.

On the contrary, its prophylactic use was quite unexpected because NSI has never been evaluated in randomised, double-blind and placebo-controlled studies. Slapak *et al* treated children aged 6-10 years with uncomplicated cold or influenza with nasal saline and standard therapy or nasal saline alone for three months.

Nasal symptoms during acute illness resolved more rapidly in the children treated with nasal saline alone, who also experienced less frequent recurrences of rhinitis.

Some of the presumed mechanisms of action of nasal saline irrigation may explain why our primary care pediatricians think it effective as preventive measure. In addition to

cleaning the nasal cavities and removing antigens and local inflammatory mediators such as histamine and prostaglandins, it is thought that nasal irrigation may improve mucus clearance by enhancing ciliary beat frequency, thus reducing the risk of bacterial super-infections and enhancing mucosal healing. This may be more beneficial during the winter (when respiratory infections are more frequent) because of the co-existence of conditions related to impaired respiratory epithelial ciliary activity, such as low temperatures, air pollution, inspired air humidity and dehydration.

Most of the primary care pediatricians (87%) indicated an isotonic solution as the preferred solution, and the most frequently recommended administration devices were a nasal spray (67.7%) and bulb syringe (20.6%) (**Figure 4**)

The most appropriate method of administration is still subject to debate. A review published in 2010 found that high-volume, positive-pressure devices led to better fluid distribution throughout the sinuses than low-volume applications such as nebulisers or sprays, or low-pressure devices such as the Net pot (**Figure 5**) . However, it only considered adult studies, and there are no published data comparing bulb syringes and sprays in children, particularly very young subjects. There is therefore a need for pediatric studies but, in meantime, it can be suggested that NSI should be started using a bulb syringe because of the larger amount of solution it delivers, and that its use may be continued if the child tolerates it without any problem.

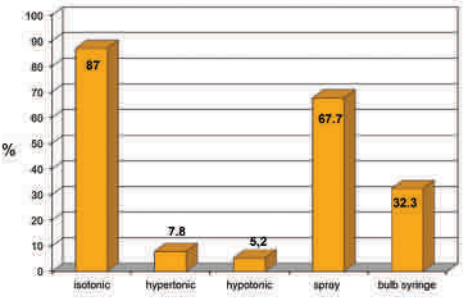

Figure 4. Preferred type of solution and method of administration.

Most of the respondents use isotonic saline for a NSI, and only about 8% use hypertonic saline. This does not seem to be in line with the literature because a number of *in vitro* and clinical studies, including pediatric studies, have found that hypertonic saline is more effective than isotonic in reducing the signs and symptoms of upper respiratory diseases. However, the effect of hypertonic saline has only been tested in ill patients, and the better results may be explained by its greater activity in improving mucociliary clearance. Frthermore, it has not been demonstrated that hypertonic saline is better in the case of prophylaxis, and it is worth remembering that it may be a little less tolerated because it can cause uncomfortable burning or stinging sensations, even if rarely.Both solutions are able to clear microorganisms, allergens and other pollutants from the nasopharynx and can protect children against respiratory diseases. Once again, further studies are needed, but it can be suggested that normal saline should be used for prophylaxis and hypertonic saline for therapy.

Figure 5. Net Pot

Recommended readings

1. Brozek JL, Bousquet J, Baena-Cagnani CE, Bonini S, Canonica GW, Casale TB, et al. Global Allergy and Asthma European Network; Grading of Recommendations Assessment, Development and Evaluation Working Group. Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines: 2010 revision. J Allergy Clin Immunol. 2010; 126: 466-476.
2. Brown CL, Graham SM. Nasal irrigations: good or bad? Curr Opin Otolaryngol Head Neck Surg 2004; 12: 9-13.
3. Dunn JD, Dion GR, McMains KC: Efficacy of nasal irrigations and nebulizations for nasal symptom relief. Curr Opin Otolaryngol Head Neck Surg 2013, 21:248-251.
4. Garavello W, Romagnoli M, Sordo L, Gaini RM, Di Berardino C, Angrisano A. Hypersaline nasal irrigation in children with symptomatic seasonal allergic rhinitis: a randomized study. Pediatr Allergy Immunol 2003; 14: 140-143.
5. Hauptman G, Ryan MW.The effect of saline solutions on nasal patency and mucociliary clearance in rhinosinusitis patients.Otolaryngol Head Neck Surg. 2007;137:815-21.
6. Hermelingmeier KE, Weber RK, Hellmich M, Heubach CP, Mösges R: Nasal irrigation as an adjunctive treatment in allergic rhinitis: a systematic review and meta-analysis. Am J Rhinol Allergy 2012, 26:e119-125.
7. Hong SD, Kim JH, Kim HY, Jang MS, Dhong HJ, Chung SK: Compliance and efficacy of saline irrigation in pediatric chronic rhinosinusitis. Auris Nasus Larynx 2014; 41:46-49.
8. Jeffe JS, Bhushan B, Schroeder JW Jr: Nasal saline irrigation in children: a study of compliance and tolerance. Int J Pediatr Otorhinolaryngol 2012; 76:409-413.
9. Kassel JC, King D, Spurling GK. Saline nasal irrigation for acute upper respiratory tract infections. Cochrane Database Syst Rev. 2010 Mar 17;(3):CD006821.
10. Li H, Sha Q, Zuo K, Jiang H, Cheng L, Shi J, Xu G. Nasal saline irrigation facilitates control of allergic rhinitis by topical steroid in children.ORL J Otorhinolaryngol Relat Spec. 2009;71:50-55.
11. Marchisio P, Varricchio A, Baggi E, et al. Hypertonic saline is more effective than normal saline in seasonal allergic rhinitis in children. Int J Immunopathol Pharmacol 2012; 25:721-730.
12. Pham V, Sykes K, Wei J: Long-term outcome of once daily nasal irrigation for the treatment of pediatric chronic rhinosinusitis. Laryngoscope 2014; 124: 1000-1007.
13. Rabago D, Zgierska A. Saline nasal irrigation for upper respiratory conditions Am Fam Physician. 2009;80:1117-1119.
14. ScaddingGK, Durhnam SR, Mirakian R et al. BSACI guidelines for the management of allergic and non-allergic rhinitis. Clin Exp Allergy 2008; 38: 19-42
15. Shaikh N, Wald ER, Pi M. Decongestants, antihistamines and nasal irrigation for acute sinusitis in children. Cochrane Database Syst Rev. 2010 Dec 8;(12):CD007909.
16. Shoseyov D, Bibi H, Shai P, Shoseyov N, Shazberg G, Hurvitz H. Treatment with hypertonic saline versus normal saline nasal wash of pediatric chronic sinusitis. J Allergy Clin Immunol 1998; 101:602-605
17. Sih T, Mion O. Allergic rhinitis in the child and associated comorbidities. Pediatr Allergy Immunol 2010: 21: e107–e113
18. Slapak I, Skoupá J, Strnad P, Horník P: Efficacy of isotonic nasal wash (seawater) in the treatment and prevention of rhinitis in children. Arch Otolaryngol Head Neck Surg 2008, 134:67-74.
19. Talbot AR, Herr TM, Parsons DS. Mucociliary clearance and buffered hypertonic saline solution. Laryngoscope 1997; 107:500-503
20. Thomas M, Yawn BP, Price D, Lund V, Mullol J, Fokkens W; European Position Paper on Rhinosinusitis and Nasal Polyps Group. EPOS Primary Care Guidelines: European Position Paper on the Primary Care Diagnosis and Management of Rhinosinusitis and Nasal Polyps 2007 - a summary. Prim Care Respir J. 2008;17:79-89.
21. Wald ER, Applegate KE, Bordley C, Darrow DH, Glode MP, Marcy SM, Nelson CE, Rosenfeld RM, Shaikh N, Smith MJ, Williams PV, Weinberg ST, American Academy of Pediatrics: Clinical practice guideline for the diagnosis and management of acute bacterial sinusitis in children aged 1 to 18 years. Pediatrics 2013, 132:e262-280.