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The Importance of Nasal Hygiene in Children

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Good nasal hygiene, that is the maintenance of a clean and moist nasal cavity, is an important defense mechanism for adequate function of the respiratory system, especially in children. Nasal breathing is the only physiological breathing for humans, although they can also survive breathing only through the mouth. At birth, the child already breathes through the nose, and most do not know how breathe through the mouth. Nasal breathing has therefore been considered as mandatory. Throughout its development, the child will continue to use this respiratory pattern until adult life. It has also to be taken into consideration that a child's nose – especially that of infants – is much narrower than the nose of an adult. Cold, pollutants, and allergic processes can easily obstruct the small nose.
Mechanical or functional obstruction of upper airways leads the child to modify her respiratory nasal pattern, replacing it with oral breathing. This alteration in the trajectory of the air prevents the respiratory system from performing its classical functions of smell, filtration, heating and humidification of air, and also interferes in the inter-relation with other structures such as the paranasal cavities, lacrimal ducts, middle ear, and adenoids. If the obstacle to breathing is temporary, the child can recover without the occurrence of physical alterations. If the mechanical or functional nasal obstruction is more prolonged, alterations of the facial skeleton can occur.
Normal respiratory function through the nasal pathway is also primordial for adequate development of facial growth and of structures of the stomatognathic system, and for development of adequate oral muscular functional patterns. And all this contributes to better facial aesthetics and also good quality of life. Efficient breathing is essential for a child to have a satisfactory quality of life. To achieve efficient breathing it is necessary that all structures involved in the physiological mechanism of this breathing work in harmony, and especially so the epithelial layers that line these structures and are in close contact with inspired air.
The mucosa that covers the nasal fossae is formed by ciliated columnar pseudo-stratified epithelium which has four cellular types: (a) basal cells that can differentiate themselves into other cells: (b) ciliated columnar cells that have between 50 to 200 cilia; (c) non-ciliated columnar cells with structures (microvilli) that help in humidification of air, warming, and filtration; and (d) goblet cells that produce a thick layer of mucus, mainly when stimulated by

irritants and pollutants. The upper layer of the epithelium is covered by mucus, a thin liquid layer containing water, glucoproteins, immunoglobulins (lysosomes, lactoferrins) and ions.

Mucus is the first line of defense of the airways against inhaled allergens, bacteria, and pollutants. [1-3] The mucociliary layer actively participates in respiratory homeostasis using a series of protective mechanisms including ciliary function, secretion of mucus, and release of inflammatory mediators in response to noxious environmental stimuli.[4] In this way, foreign particles are retained in the mucus and ciliary action pushes the whole layer of mucus towards the nasopharynx, where it is swallowed, providing physiologic cleaning of the nasal cavity. [3-5] Physiologic cleaning of airways depends on the mucociliary layer, which depends on the mucus layer, and these depend on mucociliary appendices.

When there is alteration in this transporting mechanism, the result can be an inflammatory process affecting the whole nasosinusal mucosa. Inflammation stimulates the conversion of ciliary cells into goblet cells, thickening the mucus, and as a consequence its removal becomes more difficult and bacterial growth is facilitated.[1] The inflammatory process interferes with mucociliary clearance, as besides thicker nasosinusal secretion the frequency of the ciliary sweeping movement drops to less than 300 per minute, and under normal conditions it is higher than 700 movements per minute.[1] Unfavorable environmental conditions are also responsible for alterations in mucociliary balance, resulting in nasal congestion and release of histamines.[6]

Thus healthy respiratory mucosa is essential in order for the respiratory pathways to play their role, which justifies the use of external resources such as sprays, washing, and irrigation in the nasal cavity to promote and/or facilitate nasal hygiene. Good nasal hygiene, as well as good oral hygiene, is very important for both children and adults. Adequate nasal cleaning can prevent respiratory diseases and help in the treatment of viral or bacterial infections (influenza, common colds, rhinosinusitis acute or chronic, rhinitis either allergic or not, non-specific nasal symptoms including posterior nasal dripping), and in the post-operative care of patients who have undergone rhinologic surgeries. In some circumstances, correct nasal hygiene can allow for a reduction in the duration of use of certain drugs.[3,5]

Mode of action of nasal hygiene

The precise mode of action of nasal hygiene is still controversial, in spite of its having been used for a long time, initially without scientific evidences and more recently as proven by various researchers. There are many theories to justify nasal hygiene, especially in liquefaction of mucus and interference in ciliary movement, favoring mucociliary clearance and the patency of ostia of the sinuses. Nasal hygiene with saline solutions seems to facilitate the transport of mucus towards the nasopharynx, possibly by direct physical action. Crusts associated with several conditions (pollution, post-operative conditions) can be softened and displaced by nasal hygiene and thicker secretions can become less viscous, favoring their elimination.[5]

On the other hand, it is known that nasal mucus contains inflammatory mediators such as histamines, prostaglandins, leukotrienes and interleukins

(lL). More recently, defensin antimicrobial peptides have been isolated, and their concentrations seem to increase with inflammatory processes.[7] Although the action of some of these mediators is not well understood, it is accepted that one of the mechanisms of action of nasal hygiene can be the removal of these inflammatory mediators, thus protecting the nasal mucosa.[8]

Boek and colleagues (1999)[9] reported that the increase in ciliary movements seems to effectively influence mucociliary clearance, and several authors consider that nasal hygiene with saline favors the frequency of ciliary movements, facilitating mucociliary clearance.

Tabary and coworkers (2001)[2] demonstrated in an *in vitro* study that the use of saline reduces the production of IL-8 by activated human respiratory epithelial cells, which is potentially useful in decreasing the inflammatory response of mucosa of the airways. To summarize, good hygiene in the nasal cavities provides for removal of excessive mucus and, of particles and irritants that can cause allergies, and also removal of organisms (bacteria and viruses), reducing inflammation and favoring normal function in nasal mucosa.

Indications for nasal hygiene in children

In children, nasal hygiene can and should be performed in a natural, physiological way, at any time of day. It should normally be used twice a day – in the morning and at bedtime, at least. Increased frequency does not seem to bring additional benefits, unless the child is exposed to a very polluted environment or to air with low relative humidity (air conditioning, closed environments), or to a process that involves the nasosinusal mucosa. Under these conditions it is necessary to humidify the nose by using isotonic saline solutions which help to reach homeostasis in the mucociliary system and nasal mucosa.[6]

Nasal hygiene plays an important role as a procedure complementing underlying therapy in any condition where there are alterations in the upper airways. Nasal hygiene can and should be used before using any medication administered as a nasal spray (steroids, decongestants), as it is thought that this hygiene will lead to increased efficacy of the drug given next.[5] In general nasal hygiene is indicated in the prevention and treatment of acute or chronic rhinosinusitis, rhinitis (allergic or not), processes of influenza, and post-operative care. Nasal hygiene is often mentioned only briefly in publications related to sinus symptoms, and even guidelines and statements of consensus have only short references to nasal hygiene. However, nasal hygiene should be considered as a coadjuvant therapeutic measure, as well as an important procedure in managing complaints and conditions that affect the nasosinusal system.

The use of nasal hygiene with saline has been advocated to complement therapy for rhinosinusitis that uses antibiotics, decongestants and corticosteroids, because of its ability to favor mucociliary clearance and reduce congestion of the mucosa, improving the drainage and patency of ostia of the sinuses.[3,10-13] As a complementary therapy, nasal hygiene seems to reduce required duration of use of antibiotics and corticosteroids, as was reported by Seppey and Krayenbuhl (1998)[13] and by Rabago and colleagues (2002).[14] In allergic rhinitis, cleansing is also recommended to make the mucus more fluid and remove mucosal irritants,

improving airflow through the nose and nasal cavity. It has also been reported that nasal hygiene with saline reduces the concentration of nasal histamines and decreases the nasal concentration of leukotrienes.[6,8]

In atrophic rhinitis, a condition that is difficult to treat, regular and active nasal hygiene favors its effective management. [15,16,24] In influenzal processes and common colds the efficacy of nasal hygiene is controversial in regard to its interaction with symptomatic drugs used, although some studies have shown benefits with the use of isotonic saline solutions, especially because they do not cause nasal irritation such as occurs with hypertonic solutions.[17] Nasal hygiene with saline has an important indication in post-operative care of patients who have had surgeries involving rhinosinuses. It helps to soften and remove the nasal crusts associated with surgery, favoring epithelial regeneration.[18,19]

Indications for nasal hygiene

- Removal of excessive mucus caused by influenza, common colds, allergic or inflammatory processes, or nasal congestion.
- Prevention of viral or bacterial infections in the paranasal cavities, creating an unfavorable environment for the organisms.
- Cleaning of nasal mucosa, removing dust and environmental pollutants, preventing the formation of crusts, and favoring mucociliary clearance.
- Cleaning the nostrils and nasal cavity, removing irritating agents and other allergens.
- Humidifying dried nasal mucosa.
- Favoring the action of topical drugs
- Improve breathing in general.

Types of nasal hygiene

The nasal administration of solutions can be accomplished by using positive-pressure systems (flasks, syringes, irrigators), negative-pressure systems (sprays, droppers, aerosols), or nebulizers. One method of nasal irrigation, practiced for many years and originating in India, uses a pot with a spout (like a teapot) – the neti pot. It is introduced into one of the nostrils, releasing the solution that is then eliminated through the other nostril. Many yogis practice their morning ablutions and adopt daily nasal cleaning, using the neti pot. Although are many varieties of this piece of equipment, the procedure is very difficult (almost impossible) to perform in children. In general, nasal douches use devices that are bulb-like and require digital pressure, and they are difficult to use in children.

There are electronic devices that emit a jet of solution directly into the nasal cavity, using an adapter for the nose. Since the introduction of compressible plastic flasks for nebulization (sprays), that “spread” the solution directly on the nasal mucosa and, in a way, have replaced irrigation devices and douches, topical delivery systems for nasal solutions are improving. In the same way as droppers, the disadvantage of these systems for nasal nebulization is related to the variation in volume delivered, possible contamination and, most of all, inefficiency in providing adequate coverage of the nasal mucosa.

Systems for nasal administration of solutions work as mechanical pumps, where

energy is applied to a closed chamber filled with the liquid formulation or suspension. As it is not possible to compress the liquid, the weakest part of the closed chamber will be displaced and will release the formulation. The applied energy breaks the formulation into very small particles (microparticles), releasing a fine mist over most of the mucosa of the nasal cavity, preventing its propagation to the lower airways, preventing the feeling of suffocation referred with use of nasal drops, irrigation, or douches. Other relevant parameters obtained with the use of these mechanisms for nasal sprays are the accuracy and consistency of doses delivered, with release in a reproducible manner of adequate doses for efficient therapy.

Although different types of pump-valves with dosimeters are now available on the market, they basically work in very similar ways. One of the problems related to traditional valves, however, is that they allow penetration of air into the flask, which can include organisms, interfering with solutions without preservatives. To provide a definitive solution to the problem reported with the previous mechanisms, a filter was added to the pump, positioned in such a way that air penetrating into the system has to pass through this antimicrobial barrier. In this way, the solution has protection against organisms and, at the same time, the barrier assures that there will be no risk of toxicity for the user.

Some studies have shown that the release of saline by negative-pressure systems such as nasal sprays that use a pump with a dosimeter is as efficient as or more efficient than nasal irrigation, nebulization, and passive instillation.[20-22] Scheithauer and colleagues (2006)[23] reported that nasal sprays seem to be superior to manual irrigation for hygiene and for care of wounds after nasosinusal surgeries.

How to perform nasal hygiene in children

When indicated, nasal hygiene in children can and should be performed at any time of day. In general, it is necessary to remove secretions beforehand. In younger children (infants) or in those who do not know how to blow their nose, a stick with cotton on the tip should be used to remove secretions from the anterior portion of the nose (vestibule). Older children should softly blow the nose, even when there is nasal obstruction, to avoid sending secretions into the middle ear or paranasal cavities.

The best way to perform physiologic nasal hygiene is to use isotonic saline solutions, that is those with concentrations of sodium chloride in their formulations (osmolarity) that are similar to that of our bodily secretions. After softly blowing the nose, one nostril at a time, use a nasal spray with a dosimeter to deliver the saline solution to each nostril. Carefully place the tip of the spray at the opening of one nostril towards the external wall, not the septum. Close the other nostril by pressing it with a finger and move the head forward and activate the spray, pressing it downwards with the forefinger and middle finger, using the thumb to support the bottom of the vial. In this way, the jet will be directed to a deeper portion of the nose. Repeat the whole process in the other nostril.

The use of preservatives

With the new systems for release of nasal solutions, sprays with closed dosimeters, the use of preservatives to prevent microbial contamination of solutions seems to be unnecessary. On the other hand, the use of benzalkonium chloride, the main preservative used since 1930, may be related to the inhibition of ciliary movements (ciliostasis), a reduction in mucociliary transport, and dysfunction of neutrophils, delaying the cleaning process of the nasal epithelium. [34,35]

Isotonic or hypertonic saline solution?

Controversy on the use of isotonic or hypertonic saline solutions seems to be related to their action on mucociliary clearance, although some studies have shown favorable effects from both isotonic and hypertonic solutions. In an *in vitro* study using nasal epithelial cells, Min and coworkers (2001)[25] concluded that isotonic or hypotonic saline solutions do not reduce ciliary movement, but hypertonic solutions (3% or 7%) caused ciliostasis and epithelial damage. Kim and colleagues (2005)[26] also concluded that isotonic saline solutions are more like physiological fluids and do not affect cell morphology in the nasal epithelium.

Nuutinen and coworkers (1986)[16] reported that physiologically balanced saline solutions are beneficial when used in the humidification of atrophic nasal mucosa or mucosa that is somehow dried, and also in the cleaning of nasal crusts, acting as adjuvant therapy in the treatment of allergic rhinitis. Keojampa and colleagues (2004)[27] suggest that the use of saline solutions delivered by sprays improves mucociliary clearance, and that they are thus beneficial under normal conditions and in rhinitis and rhinosinusitis.

Nasal hygiene using isotonic saline solutions has been efficient when used in the treatment of acute and chronic sinusitis in children, facilitating nasal drainage and cleaning the airways by removing any posterior nasal secretion.[28-33] Hypertonic saline solutions seem to have a favorable action on mucociliary clearance, but in some cases may cause painful or burning sensations reported with their use.[30]

Conclusion

Hygiene of the nasal cavity in children results in removal of excessive mucus, particles, and irritants that can cause allergies, and also of organisms (bacteria and viruses), reducing inflammation and favoring normal function in nasal mucosa. Maintaining a healthy respiratory mucosa is essential in order for the respiratory pathways to play their role, and justifies the use of saline solutions delivered by sprays with dosimeter valves. These have been shown to be superior to other types of nasal cleaning (irrigation, douches, nasal drops, and so on). Adequate nasal cleaning can prevent respiratory diseases and help in treatment of viral and bacterial infections (influenza, common colds, rhinosinusitis acute or chronic, rhinitis either allergic or not, non-specific nasal symptoms including posterior nasal dripping), and in the post-operative care of patients who have undergone rhinologic surgeries. It may also help reduce the duration of administration required for certain topical drugs

To summarize, nasal hygiene in children can:

- Remove thick (viscous) and persistent mucus, reducing nasal congestion.
- Clean the sinus cavities, remove allergens, irritants, and contaminants.
- Improve dryness by humidifying the nasal mucosa.
- As a coadjuvant, treat acute or chronic viral or bacterial rhinosinusitis.
- Improve the efficacy of treatments for allergic rhinitis.
- Prevent the lengthening of bouts of influenza and common colds.
- Reduce coughing and other symptoms caused by posterior nasal dripping.
- Improve breathing and the health of the stomatognathic system.
- In general, favor homeostasis of paranasal cavities.

Additional benefits can be observed such as:

- Improved smell and taste.
- Help with cleaning of lacrimal ducts
- Deeper and more relaxed breathing

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