Operational Topic

An updated and timely review of the procedures for decontaminating the nasal passages is presented.

Decontaminating the Nasal Passages

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Abstract: *Nasal decontamination may be indicated when the anterior nasal passages are contaminated with highly radioactive material or radioactive material with either irritating or toxic properties. Nasal irrigation (wash, rinse, douche, lavage) is an established technique used for other conditions and can be applied in these cases. This paper discusses the rationale and use of nasal irrigation and how to perform the technique. Health Phys. 84(Supplement 2):S80–S82; 2003*

Key words: *operational topic; decontamination; radioactivity, removal of; exposure, radiation*

INTRODUCTION

Our noses efficiently warm, humidify, and clean the air we breathe. As a consequence, when we are in an area of airborne contamination without respiratory protection, the nostrils and inner surfaces of the nose can become contaminated as particulates are inhaled from the air. The interior of the nose can be contaminated in other ways, such as when accidents involve liquids splashing onto the face or when an individual falls into liquid, powdered, or pulverized materials. Unlike the mouth, the nares are always open.

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The decision to decontaminate the nasal fossae depends on the chemical and physical nature of the contaminant, the relative amount present, and the condition and choice of the contaminated individual. The primary reason for cleansing the nose after accidental inhalation of highly radioactive material is to reduce the amount of radioactive material swallowed and the subsequent dose. However, cleansing might also be indicated to prevent harm to tissue, such as might occur following inhalation of aerosols or particulates containing radioactive material having irritating or toxic properties.

Nature provides us with remarkably efficient ways to prevent the entrance of foreign material into the respiratory system and to deal with any particulates gaining entrance. This protection of the respiratory system comes at the expense of the gastrointestinal system. Depending on the nature of the contaminant, the amount present, and the potential for harm to tissues or even to the individual, other cleansing methods might be needed.

Nature's way of cleansing

Air passing through the nose is cleansed in several ways: 1) air is partially filtered by the hairs located at the entrance to the nostrils; 2) turbulent precipitation occurs as particulates in air hit the septum, turbinates, and pharyngeal wall; are trapped in the thin layer of mucus that covers the mucous membranes lining the nasal passages and are swept into the pharynx to be swallowed; 3) some material deposited in the nose is carried by phagocytes to nasal associated lymphoid tissue (Eyles et al. 2001); and 4) sneezing can be caused by inhaled air that contains irritating foreign matter. Sneezing is a reflex that propels particulates and mucus out through the nose and mouth at very high velocities. In some cases, inhaled irritants also cause a marked, rapid increase in production of mucus of low viscosity, some of which flows out of the nostrils while the remainder is swallowed. Since irritants in air can also irritate the eyes, nasal cleansing is augmented by tears flowing from the eye through the nasolacrimal duct to the inner nose.

Turbulent precipitation associated with ciliary transport is the most efficient cleansing action of the nasal passages, with few particles larger than 4–6 microns ever entering the lungs through the nose (Guyton 1976). The tiny, hair-like cilia of the epithelial cells that make up the mucous membrane lining the nasal cavity have been shown to transport material from the nasal fossae in healthy humans with a velocity of 4.28 ± 1.38 mm min^{-1} (Sun et al. 2002). It is worth noting, however, that transport time can be adversely affected by aging (Ho et al. 2001), allergy,

or disease (Sun et al. 2002), and variations in anatomy (Jang et al. 2002). In addition, research has shown that clearance time for each nostril varies with the nasal cycle, since each side of the nose alternates through phases of congestion and decongestion (Soane et al. 2001).

McLean et al. (1984), using aerosolized technetium 99m pertechnetate on four volunteers, found that clearance occurred in phases: a relatively rapid initial phase believed due to mucociliary clearance, and a prolonged late phase with a slower disappearance of material from the far anterior region of the nose. This supports information in NCRP 65 indicating that particles deposited near the mucocutaneous junction will remain for 60 min or longer, while those deposited 2–3 cm above the junction will be cleared and swallowed in 10–20 min (NCRP 1979). Clearance time for the anterior nares is significant, since research has shown that the anterior nasal segment is the main area of intranasal particle deposition (Keck et al. 2001). Fortunately, it is also the area most accessible for decontamination.

Removing contaminants from the nose

Nasal cleansing can be self-administered at the worksite, or it can be done in a clinic or hospital, depending on the presence or absence of injuries or other medical problems. *If respiratory distress occurs with inhalation of materials, prompt emergency medical care is essential and may be lifesaving.* A physician should be consulted any time there is a possibility of internal contamination so that treatment decisions can be made in a timely manner. Prompt collection of nasal swab samples can confirm the presence of contaminants, but a negative swab cannot rule out the possibility of inhalation of radioactive material.

Nose blowing

Blowing the nose has been advocated by some as a way of cleansing the nasal passages. Research has demonstrated, however, that as much as 1 mL of viscous fluid can be blown into the maxillary sinus with a single nose blow (Gwaltney et al. 2000). Blowing the nose also causes large and rapid pressure changes in the Eustachian tubes that connect the nasal cavity with the middle ears (Sakikawa et al. 1995). Mucinous material (and anything trapped in the mucus) can be blown into the Eustachian tubes and possibly even into the middle ear. A nasal wash, followed by a gentle nose blow, might be a better option.

Nasal wash by "snuffling"

The simplest and quickest way an individual can reduce the amount of foreign material in the anterior nose is by "snuffling." Snuffling (also known as "sniffing") is a lavage method that can be performed almost any place water is available. Ideally, this lavage is done by bending over a sink, filling both hands with warm water, sniffing the water into the nose, allowing it to run out, and repeating the wash several times. NCRP 65 points out that, "often when a patient showers he snuffles water into his nose and blows it out forcefully, a maneuver that may wash out most of the contamination." (NRCP 1979) This lavage procedure is commonly prescribed after paranasal sinus surgery (Keerl et al. 1997) using saline solution or hypertonic saline solution instead of water. One major disadvantage associated with snuffling is that some individuals find it difficult to purposefully inhale with their noses immersed in water. In addition, it is not a cleansing method that can be used by the young, injured, ill, or those otherwise unable to perform self-care.

Nasal irrigation (also known as nasal wash, douche, or lavage)

Nasal irrigations have been used for centuries and continue to be commonly prescribed following sinus or nasal surgery and for conditions such as rhinosinusitis and allergic rhinitis (Keerl et al. 1997; Tomooka et al. 2000). Irrigation of the nasal passages can be accomplished in several ways, all using commonly available equipment. The washing solution can be water, saline, hypertonic saline, or Ringer's lactate solution. Otolaryngologists have found that the hypertonic saline (Talbot et al. 1997; Homer et al. 1999) and Ringer's lactate solution seem to maintain and improve mucociliary transit times (Unal et al. 2001). As a procedure done twice daily for a treatment period of several weeks, choice of solution is important. However, for the purpose of emergency decontamination, the use of ordinary water or saline is perfectly acceptable. Since it is desirable that the patients not swallow contaminated fluid, the posture of the individual undergoing any procedure for nasal irrigation should be such that any irrigation fluid flows out the nares.

A simple way to irrigate the nasal fossae involves use of a bulb syringe (such as those used for infants). The bulb should be filled with warm saline or water. With the patient sitting or standing with head bent over a sink or basin, the solution is squeezed gently into one nostril and the return solution allowed to drain from nostrils into the emesis basin or sink. The procedure should be repeated with the other nostril. This type of nasal wash is commonly used for collection of secretions for sampling, to remove mucus crusts and secretions, and has even been used in the removal of nasal foreign objects in children.

When nasal swabs (and accident history) indicate that the level of nasal contamination or the nature of the contaminant is especially troublesome, a more thorough nasal irrigation, performed by health professionals, might be indicated. Nasal irrigation can be readily ac-

complished using IV saline or Ringer's lactate solution with a nasal catheter fit over the end of the IV tubing. Preferably, the patient should be in a sitting position and leaning forward over a sink or basin. The irrigation solution should be positioned about 12 inches above the individual's head. A plastic drape, taped directly under the nares, is recommended to prevent transfer of contamination to mouth and skin of the lower face. The patient should be instructed to breathe through the mouth, and to not speak or swallow during the introduction of the solution. The catheter can be inserted into one nostril (1–2 cm) and the solution should be allowed to flow with gravity to wash the interior of the nose. With the patient leaning forward, solution will drain out of one or both nostrils. This should then be repeated, with solution inserted into the other nostril. If necessary, large amounts of fluid (i.e., 1 L per nostril) can thoroughly flush the nasal fossae. The efficacy of the procedure can be checked by comparing the amount of radioactivity in an aliquot of solution from the initial washing with the final washing.

Although some otolaryngologists have demonstrated that self-administered nasal irrigation using a Water Pik™ with a commercially available adapter is effective (Tomooka et al. 2000), use of such a pressurized device for removal of contaminants is not recommended unless done by medical personnel.

Washing the nares of injured patients

Nasal swabs collected shortly after an incident can provide evidence that contamination is present. Nasal swabs can also serve to remove contamination from the anterior nose of patients who are not critically injured but who are otherwise unable to help themselves. Large swabs are preferable for decontamination, but small swabs are adequate. A swab should be moistened with saline, inserted into the nostril, gently swirled around once, and then removed. A clean swab should be used in a similar manner for the other nostril. These wipes can be repeated (with clean swabs) so that the outer 2 cm of each nostril has been swabbed. The health physicist can monitor the procedure by checking contamination levels on the swabs. A finding of contaminants on the swabs indicates that transferable contaminants are effectively being removed.

CONCLUSION

Despite good radiation protection practices and safety precautions, accidents sometimes occur. Nasal samples should be promptly collected after an incident to assess the possibility of inhalation of radioactive material. After samples are collected, and *assuming there are no injuries*, it does no harm, and probably is beneficial (both in terms of dose reduction and psychology), to include nasal lavage with other decontamination procedures. Snuffling can be easily accomplished at a worksite and is an effective, easy, and acceptable nasal wash procedure. Other procedures might be selected for patients undergoing medical care. At the discretion of the health professional, and based on the patient's condition and information (or lack thereof) regarding the nature of the contaminant, a washing procedure may or may not be prescribed.

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