Occupational Rhinitis and Other Work-Related Upper Respiratory Tract Conditions

Yu A. Zhao, MD, MS, Dennis Shusterman, MD, MPH*

KEYWORDS

• Occupational rhinitis • Occupational asthma • Sinusitis • Sinonasal cancer • Olfactory dysfunction • Vocal cord dysfunction • Sensory irritation • Allergy

KEY POINTS

- The upper airway serves as an air conditioner, filter, and sensory monitor.
- Irritants and allergens can impact the upper airway.
- According to the "unified airway" hypothesis, the development of occupational allergic rhinitis may herald the onset of occupational asthma, and airway irritant exposures may also contribute to both conditions.
- Other occupational upper airway conditions include sinusitis, nasal erosions, sinonasal cancer, olfactory dysfunction, and vocal cord dysfunction.

INTRODUCTION

The upper airway acts as a sentinel for the respiratory tract, alerting individuals to the physical and chemical qualities of inspired air. It also acts as a filter and air conditioner, and plays an important role in communication. Common occupational upper airway conditions include rhinitis, sinusitis, laryngitis, and vocal cord dysfunction (VCD). Less common are nasal erosions, sinonasal neoplasms, and chemically induced olfactory dysfunction. Etiologic agents range from those specific to occupational settings (eg, chromic acid in the case of nasal erosions) to more ubiquitous environmental agents, such as office dust, cold air, or second-hand tobacco smoke. The epidemiology, pathophysiology, diagnosis, and treatment of occupational upper airway conditions, in particular occupational rhinitis, are reviewed in this article.

ANATOMY OF THE UPPER AIRWAY

The upper airway refers to the airway above the vocal folds, including nasal cavities, nasopharynx, oropharynx, and hypopharynx. Along with the oral cavity, the oropharynx and hypopharynx (and glottis) are sometimes referred to as the "aerodigestive tract."[1] The cofunctionalities of breathing and swallowing dictate that the area be heavily innervated and endowed with a variety of reflex responses.

Anatomically, the lateral walls of the nasal cavity are invested with turbinates or concha (literally, "shells"), the functional consequence of which is to increase the surface area of contact between the mucosa and inspired air. The histology of the nasal cavity has evolved to meet the functional requirements of heat and humidity transfer; biochemical metabolism of inhaled substances; and mucociliary transport of particulate matter to the

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Division of Occupational and Environmental Medicine, University of California, San Francisco, Campus Box 0843, San Francisco, CA 94143, USA
* Corresponding author. Upper Airway Biology Laboratory, 1301 South 46th Street, Building 112, Richmond, CA 94804.
E-mail address: dshusterman@sfghoem.ucsf.edu

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oropharynx (from which it is either swallowed or expectorated). Posterior to the resilient squamous and transitional epithelium of the anterior nares lies a pseudostratified columnar epithelium consisting of ciliated columnar, goblet, and basal cells, and submucous glands.[2]

PHYSIOLOGIC FUNCTIONS

Air Conditioning, Filtration, and Scrubbing

The nose serves as the main portal of entry for the respiratory tract, filtering, scrubbing, physically conditioning inspired air; signaling the quality of the surrounding atmosphere; and playing a role in communication (hearing and phonation). Under most climatic conditions, inspired air is heated and humidified in the upper airway, thereby reducing any thermal or osmotic stress on the tracheobronchial tree.[3]

Filtration of large particles is accomplished mechanically (by nasal vibrissae) and by the process of impaction (whereby particles collide with the turbinates, and are subsequently cleared by the mucociliary apparatus).[4] Finer particles, however, are more likely to evade this clearance system and reach the lower respiratory tract (**Fig. 1**). In the case of inhaled droplets carrying infectious agents, the mucosa produces specific and nonspecific defenses, the former including secretory IgA and the latter including lactoferrin and lysozyme.[5]

Water-soluble irritants, including such gases and vapors as ammonia, organic acids, aldehydes, and chlorine, readily dissolve in mucous membrane water, providing for immediate sensory impact and mass removal.[6] This effect (scrubbing) protects the lower respiratory tract during nasal breathing and incidentally reinforces the sensations of eye, nose, and throat irritation, which can serve as a warning to reduce exposure (**Fig. 2**).

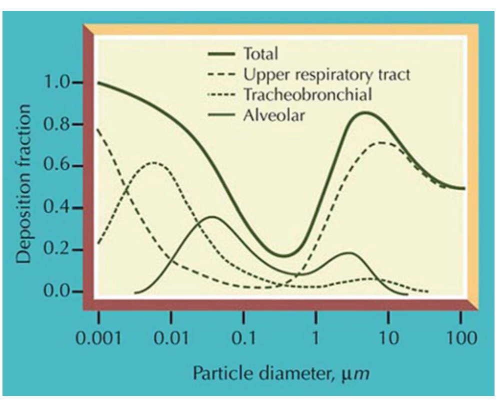

Fig. 1. Fractional deposition of particles in the upper respiratory tract, tracheobronchial tree, and alveolar region of the lung as a function of particle size. (*From* Shusterman D. Toxicology of nasal irritants. Curr Allergy Asthma Rep 2003;3(3):258–65; with permission.)

In contrast to the lower airway, patency in the upper airway is controlled through vascular engorgement rather than smooth muscle tone. Underlying this vasoactivity is an elaborate network of arterioles, capacitance vessels, and arteriovenous shunts located beneath the mucosal surface.[7] Controlling nasal patency (and secretory responses) is a variety of endogenous mediators derived from immune effector cells and mucosal nerves.[8,9]

Sensation and Reflexes

The sentinel function of the nose is achieved through the sense of smell and nasal irritant perception (chemesthesis). These senses are mediated by cranial nerve I (olfactory nerve) and cranial nerve V (trigeminal nerve), respectively (**Fig. 3**). Just as the appreciation of flavor involves a seamless combination of taste and smell, the appreciation of inhaled compounds involves smell and trigeminal stimulation. It is not unusual for an individual to describe "a pungent odor," and in the process integrate information from two separate cranial nerves.[10]

Peripherally, the terminal branches of the trigeminal nerve include small diameter nociceptive neurons (C- and Aδ-fibers) invested with a variety of nociceptive (pain-perceiving) ion channels.[11] The C-fiber population also elaborates vasoactive neuropeptides, which in turn can be released as part of nociceptive reflexes.[12] Similar neurophysiology applies to the glossopharyngeal and vagal nerves (cranial nerves IX and X), which convey the sense of irritation for the hypopharynx and larynx. A recent development has been the identification of specialized receptor cells (solitary chemoreceptors cells) in the human nose, carrying transduction mechanisms for bitter taste and selected airborne irritants, further linking chemical exposures to airway inflammation.[13]

Reflexes in the upper airway include sneezing, secretion, and nasal obstruction. Upper respiratory tract nerves also participate in the laryngeal adductor reflex, cough, and bronchospasm.[14] Along with cold, dry air, chemical irritants can trigger upper respiratory tract symptoms that are virtually indistinguishable from those of allergic rhinitis, leading to inevitable diagnostic confusion (see later).

PATHOPHYSIOLOGY

Irritation

Upper airway irritation can be defined variously as stimulation of nociceptors (resulting in sensations