



Unveiling the Evolving Airway: Anatomic Transformations Impacting the Elderly Population

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ABSTRACT

Various anatomical, physiopathological, and cognitive alterations occur in the elderly population, impacting different aspects of the respiratory system. Anatomically, modifications manifest across multiple regions, ranging from the oral cavity to the larynx. Airway changes commonly include tooth decay, oropharyngeal tumours, and significant limitations in neck mobility. Additionally, muscle atrophy around the lips and tooth loss contribute to these alterations. Pulmonary conditions prevalent among the elderly, such as obstructive sleep apnea and chronic obstructive pulmonary disease (COPD), further heighten the likelihood of oxygen desaturation events. Overall, the progressive deterioration of the airway, coupled with physiological and cognitive changes, renders the elderly more susceptible to respiratory complications

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INTRODUCTION

Ageing is a complex and inevitable process characterized by a gradual decline in functional reserve and overall physiological function across various organisms. It is a heterogeneous phenomenon, exhibiting substantial variations among individuals and even within different organs within the same individual. While ageing itself is not a disease, it significantly increases the susceptibility to developing various health conditions, often with a higher risk associated as one advances in age[1]. Tissue composition undergoes biochemical changes, and physiological capacity progressively decreases, impairing the ability to maintain homeostasis and adapt to stressors. Moreover, after reaching maturity, the mortality rate rises exponentially with age. Understanding the anatomical changes that occur in the respiratory system of the elderly population is of paramount importance in comprehending the impact of ageing on respiratory health [2].

ANATOMIC CHANGES

The nose, a vital respiratory organ, plays a pivotal role in our ability to breathe from the moment of birth. It serves as a conduit for more than 12,000 litres of air per day and as a natural filter, ensuring that the air we inhale is warmed, humidified, and purified before reaching our lungs. Additionally, the nose helps maintain positive end-expiratory pressure, keeping the lungs expanded and serving the crucial function of olfaction.

The function of the nose can be influenced by both its anatomical structures and the process of ageing. As we age, noticeable changes such as drooping of the nose and sagging of the nasal tip may occur. These alterations can be attributed to changes in the nasal cartilages, loss of midfacial support, and decreased tensile strength in ageing skin. The nose is particularly susceptible to age-related changes due to its constant exposure to sunlight and environmental factors.

The skin undergoes several transformations with age, including thinning of the epidermis and dermis, reduced melanocyte activity, and decreased strength in the skin surrounding the nose. The natural tension lines of the skin become more pronounced, potentially affecting the external nasal valve. Additionally, the surface area of the nasal septal cartilage diminishes, particularly in the region below the nasal bones and along the dorsum of the nose.

Despite these changes, the resistance to nasal airflow in the normal geriatric population does not seem to be significantly affected by ageing. However, alterations in nasal cartilage, skin, and muscle integrity, as

well as the regression of teeth and alveolar structure, may impact airflow in older individuals[4]. Age-related factors can contribute to alar collapse and dynamic closure of the external nasal valve, as well as alter the angle of the internal nasal valve, potentially disrupting the natural flow of air through the nose [3].

In conclusion, the nose serves multiple vital functions, including respiration, air conditioning, and olfaction. While ageing may not directly impact the resistance to nasal airflow in healthy older individuals, it can affect the nasal structures, skin, and muscles, potentially influencing the flow of air into the ageing nose. Understanding these age-related changes is important for comprehending the complexities of nasal airflow in the elderly population.

ORAL CAVITY

The lips, often overlooked by the elderly, are particularly susceptible to lacerations due to increased dryness and fragility [3]. As individuals age, the cutis (skin) of the lips becomes thinner, and collagen fibres start to separate⁷. This thinning of the lips aligns with the overall tendency of the epidermis and dermis to lose thickness with age. Furthermore, there is a noticeable atrophy of the orbicularis oris muscle, which can result in a mild drooping near the corners of the mouth[7].

Age-related dental problems are prevalent among the elderly, including periodontal disease and tooth decay [3]. As individuals age, there is a decline in the production of saliva, resulting in xerostomia, commonly known as a dry mouth. Saliva plays a crucial role in providing protective minerals to the teeth and inhibiting bacterial growth, so reduced saliva production contributes to dental decay. Approximately two-thirds of the elderly population have experienced tooth decay, with almost a quarter having untreated cavities[9]. Tooth loss is also common as gums tend to recede with age, exposing the tooth roots and increasing the likelihood of cavities. These cavities can lead to infections and eventual tooth loss if left untreated.

Moreover, tongue pressure, which is the force exerted by the tongue on the hard palate, significantly decreases with age, indicating muscle fatigue, particularly in the infrahyoid and suprahyoid muscles [3]. This reduction in tongue pressure can impact swallowing abilities.

In summary, the lips in the elderly undergo changes such as increased dryness, thinning of the cutis, and loss of collagen fibres. Dental problems, including tooth decay and periodontal disease, are prevalent due to reduced saliva production and gum recession[8]. Tongue pressure decreases with age, potentially affecting swallowing function [3].

PHARYNGEAL/ LARYNGEAL

Oropharyngeal cancer is frequently observed in elderly patients, particularly in regions such as the base of the tongue and tonsils. These tumours can manifest as masses in the neck, leading to a reduced range of motion in the neck and a decreased distance between the thyroid notch and the tip of the jaw when the head is extended [3,11]. The occurrence of obstructive sleep apnea (OSA) in the elderly can be attributed to pharyngeal changes. Furthermore, ageing independently contributes to the accumulation of parapharyngeal fat, which increases the likelihood of OSA, regardless of body mass index (BMI) [12].

Additionally, the elderly population experiences a decline in the genioglossus negative-pressure reflex. Since the genioglossus muscle plays a crucial role in maintaining upper airway dilation and preserving pharyngeal patency, any impairment in this muscle or reflex elevates the risk of airway obstruction and pharyngeal collapse [3]. Ageing also decreases the number of collagen and elastin fibres in the hyoepiglottic ligament, rendering the epiglottis floppier and more challenging to move anteriorly. Abnormalities associated with epiglottis are more prevalent in the elderly compared to other age groups, including delayed functioning, limited movement, or even a lack of downward movement. Additionally, tumours in the elderly can cause thickening of the epiglottis, rendering it almost immobile. These factors collectively impede the effective protection of the airway by the epiglottis.

NECK

The ageing process brings about various changes in the neck, including the development of conditions such as rheumatoid arthritis, myelopathy, and thyroid masses, all of which impact neck rotation and range of motion. Rheumatoid arthritis primarily affects the second and third cervical vertebrae, leading to ligament destruction, inflammation, synovial membrane swelling, and atlantoaxial subluxation, which hinders rotation. Arthritis often accompanies the formation of osteophytes, which can potentially cause neurological symptoms by compressing spinal nerves.

As individuals age, intervertebral discs gradually lose their supportive capacity and shrink, reducing the distance between vertebrae. This disc shortening places stress on the vertebral cartilage, resulting in a narrowing of the spinal canal. The narrowed space puts pressure on the spinal cord, leading to a condition known as cervical spondylotic myelopathy [3]. Symptoms of this condition include neck stiffness and pain that may radiate to the arms and shoulders.

The incidence of goitres, and enlargement of the thyroid gland, increases in the elderly population. If goitres grow large enough, they can lead to thyroid failure. Elderly patients with hypothyroidism are at a higher risk of experiencing myxoedema coma, a severe complication triggered by certain medications, hospitalization, stress, or other illnesses.

Hyperthyroid conditions, such as Graves' disease and toxic multinodular goitre, are also common among the elderly. These conditions can result in various complications, including osteoporosis, nausea, vomiting, supraventricular arrhythmias, other heart conditions, as well as mood disorders such as depression and mania[6].

DISCUSSION AND CONCLUSION

The ageing process brings about notable structural and functional alterations in the airway, which can contribute to the development of difficult airways in the elderly [10]. Specifically, age-related changes in the nasal cavity, oral cavity, pharyngeal/laryngeal region, and neck can significantly impact airway management. These anatomical changes associated with ageing align with the predictors of a difficult airway.

The nasal cavity undergoes various transformations as individuals age, including changes in nasal cartilage, skin thickness, and the surface area of the nasal septal cartilage. In the oral cavity, the lips become thinner and more fragile, while dental problems such as periodontal disease, tooth decay, and tooth loss become more prevalent [5]. The pharyngeal/laryngeal region may experience the development of oropharyngeal tumours and rheumatoid arthritis, leading to difficulties in neck mobility and rotation. Additionally, the neck can exhibit structural changes such as osteophyte formation, disc shrinkage, and goitre enlargement.

Understanding these age-related anatomical alterations is crucial for identifying and managing difficult airways in the geriatric population. By prospectively examining the hallmarks and implications of these anatomical changes, future studies can provide valuable insights into the specific challenges associated with airway management in the elderly.

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