Ferret Respiratory System: Clinical Anatomy, Physiology, and Disease

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ANATOMY

The upper and lower respiratory tracts of ferrets have several similarities to humans, and therefore have been used as a research model for respiratory function. The upper respiratory tract of the ferret is complex and starts with the nose and nasal cavity (**Fig. 1**). From here, air moves from the choana into the opening of the larynx, the rima glottis, and then into the trachea. The skin of the nose is unfurred and often pigmented.

The nasal cavity of mammals is considered to have a primary olfactory function, except in primates, including man. This olfactory sense requires a complex nasal cavity that provides optimal temperature and humidity for detecting the chemicals that produce the concept of odor. This part of the respiratory tract also conditions air for normal function of the lower respiratory tract. Ferrets, like most mammals other than primates, are obligatory nose breathers because of the close apposition of the epiglottis to the soft palate. The distance from the nostrils to the nasopharynx is proportional to the size of the head and the length of the snout. This larger olfactory-to-respiratory area ratio is associated with ferrets and other macrosomatic species.[1]

The nasal cavity is divided into right and left nasal passages and has dorsal and ventral nasal conchae that have numerous folds to increase the surface area of the

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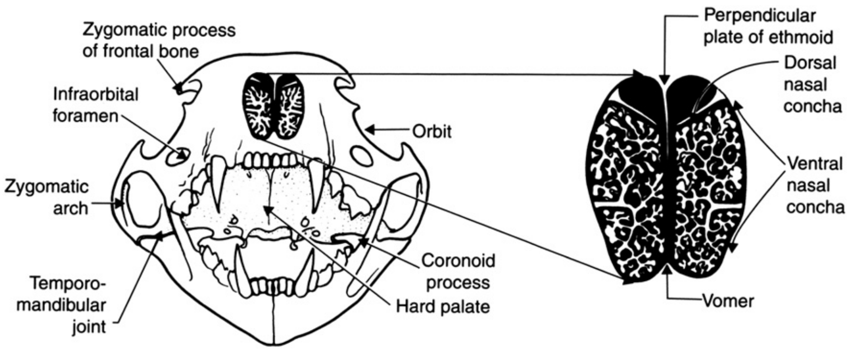

Fig. 1. Ferret skull (rostral view). (*Courtesy of* Howard E. Evans, PhD, Ithaca, NY; with permission.)

epithelium. The maxilloturbinates are composed of a double scroll-like structure that is branched. Histologically, the cranial end of the upper respiratory tract is keratinized squamous epithelium, and then in the area of olfaction it is stratified cuboidal to columnar. Some goblet cells may be present, but this epithelium is characterized as being nonciliated. Goblet cells and ciliated epithelium are characterized more caudally in the nasal cavity.[1]

The nasal cavity is designed to modify the air so that it is appropriate for inhalation into the lung surface. The bends and liner velocities in the airstream and turbulence in air flow are important for the passage of inhaled materials. These quick changes are designed to drop particulate matter out of the airstream to purify the air reaching the lungs. The final fate of particulates is influenced by the mucociliary clearance system and the permeability of secretions, including blood flow.

The hard palate continues as the flexible soft palate that sits over the opening of the larynx (**Fig. 2**). This opening is covered by the epiglottis, which rests above it. This arrangement allows air to move from the nasal cavity directly into the larynx. The larynx of the ferret is similar to that of the human larynx. It closes the airway to raise intra-abdominal pressure along with keeping ingesta from being aspirated into the respiratory tree, and acts as an aid for vocalization. During the normal breathing cycle, the vocal cords remain relaxed. The larynx is innervated by the cranial and caudal laryngeal nerves that are branches of the vagus.

The trachea extends from the larynx to the bifurcation of the primary bronchi, which divides at T5–6. The length of the trachea to this bifurcation is two to three times that of the dog or cat. There is a reduced problem passing an endotracheal tube into just one primary bronchus due to its length. Securing the endotracheal tube can be challenging because ferrets have a small mandible and maxilla. One author often secures the endotracheal tube with ties to the forelegs.

The trachea is composed of C-shaped hyaline cartilages that are connected by smooth muscle. The mucosal surface of the trachea is composed of ciliated and non-ciliated cells with mucus glands. Submucosal glands are present, and are closer in number to a human than a dog. These mucosal and submucosal glands are stimulated by nerves, acetylcholine, and histamine. Secretions can be blocked with atropine, glycopyrolate, and antihistamines.

The thoracic cavity is cone-shaped (**Fig. 3**). The rib cage consists of 14 ribs with 9 sternebrae, with the last several ribs not meeting the distal end of the sternum. The thoracic cage is divided into cranial, middle, and caudal mediastinal cavities.