

Respiratory immunity to infectious disease

Respiratory defence mechanisms are complex, integrating responses that include mechanical barriers (ciliated epithelium, sneezing, coughing, mucus...), the chemical poisons, neutrophils and macrophages (white cells) of the innate immune system, and the development of highly specific antibody and lymphocyte responses by the adaptative immune system.

Figures 1 and 2 show the areas that are the frontline for defences.

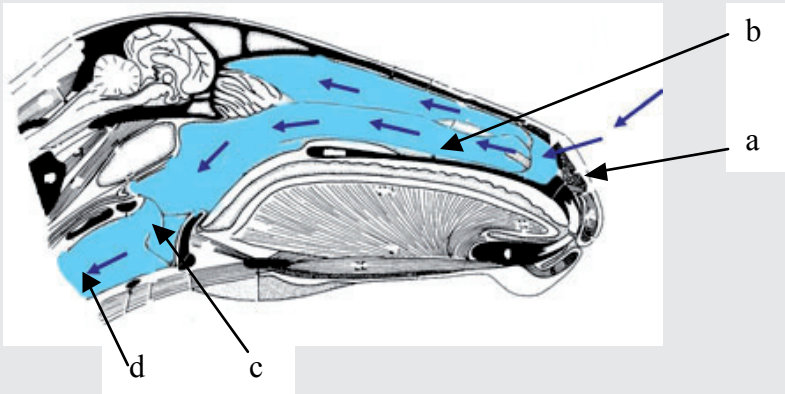


Figure 1 : Air moving outside the body passes first through the upper respiratory system including the nostrils (a), the nasal passages (b) and larynx (c) and then into the trachea (d).

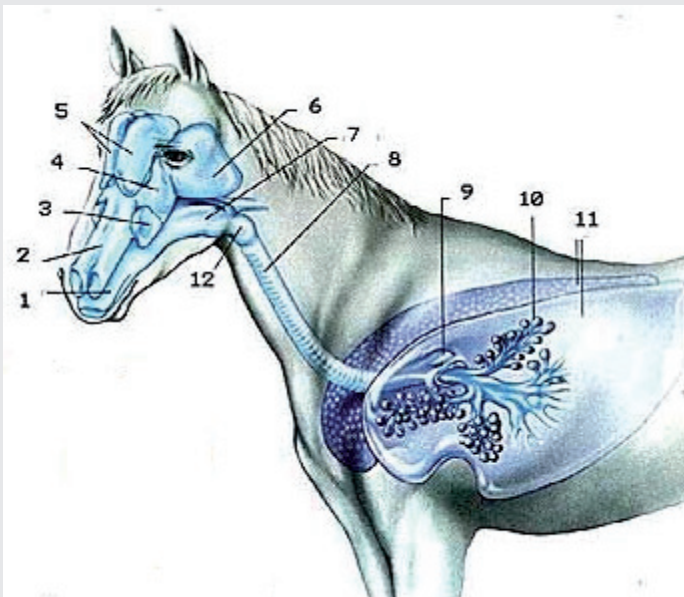


Figure 2 : Features of the horse's respiratory system

1. Buccal cavity
2. Nasal Cavity (open to pharynx)
3. Inferior maxillary sinus
4. Superior maxillary sinus
5. Frontal sinuses
6. Guttural pouch
7. Pharynx
8. Trachea
9. Bronchus
10. Alveolus
11. Lungs
12. Larynx

The mechanical defence mechanisms of the respiratory tract are:

- The nasal, oropharyngeal and sinus ciliated epithelium and sneezing, and the mucus production (fig.2: 2, 3, 4, 5, 7, 12)
- The mucociliary clearance and impaction on bronchial branching and coughing (fig. 2: 8, 9, 10, 11)

Nonetheless, local and systemic immunity protections begin as soon as the upper respiratory tract (secretion of immunoglobulins and white cells in mucus and respiratory tissues) until the lung parenchyma. Now, let's look more in details to understand what happened at a smaller scale.

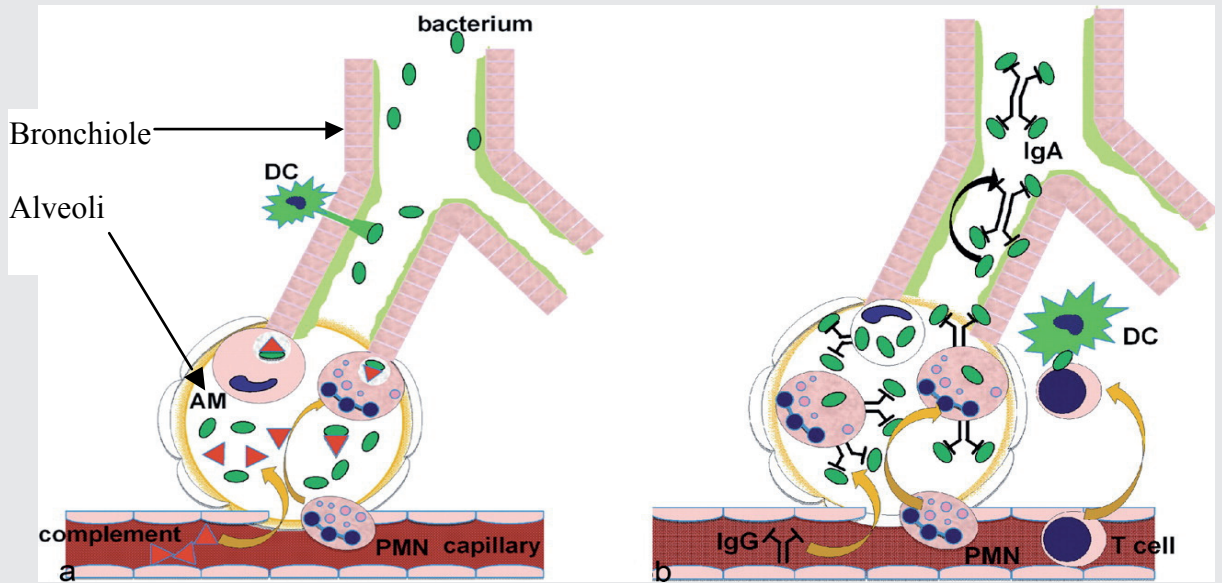


Figure 3 : The innate and adaptive immune response in the lung. Different types of specialized white cells are involved: DC, dendritic cell; PMN, polymorphonuclear leukocyte; AM, alveolar macrophage.

On the left side of the figure 3 (a), in the naïve lung exposed to virus or bacteria, the innate defences include the mucociliary escalator, surfactant and other secreted proteins, and alveolar macrophages and neutrophils recruited from the blood. Inflammation facilitates the entry of complement into alveoli and airways, where complement activation provides molecules to enhance uptake of bacteria/virus by phagocytes. Subepithelial dendritic cells (DCs) sample bacteria/virus, process antigens, and travel to draining lymph nodes to initiate the adaptive response.

On the right side of the figure 3 (b), on reexposure to the bacteria/virus, the lung of the immune host responds with an amplified and more focused response. Immunoglobulin A (IgA), secreted by plasma cells into the lumen of the conducting airways, can block binding of the microbe to the epithelium. IgG in the alveolus come to fix themselves onto bacteria for enhanced uptake by phagocytes. Th1 cells recruited to alveoli and the interstitium, following presentation of antigen by resident lung DCs, can secrete interferon γ to activate alveolar macrophages and recruit monocytes.

Vétoquinol



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