

**LEUKOCYTES IN ACUTE INFLAMMATION : BRONCHOPNEUMONIA  
DESCRIBING AND INTERPRETING PATHOLOGICAL CHANGES IN TISSUES**

**ANSWERS**

- (i) Neutrophils are formed in the bone marrow. Some reach the lumen of the bronchus via the blood vessels, mostly post-capillary venules, in the sub-mucosal zone of the bronchial wall. Others have migrated from the capillaries of the alveolar walls into the alveoli, forming the pneumonic neutrophilic exudate, and a small proportion of these may be coughed up or forced upwards into the bronchus.
- (ii) The time for which the main leukocytes involved in acute inflammation remain in the blood depends on the cell type. Broadly the times are as follows:  
A. Neutrophils: 7-10 hour half-life in the circulation.  
B. Monocytes: approx. 1 day half-life in the circulation (long-lived as macrophages in tissues, with a half-life measured in months).  
Most leukocytes are recruited to sites of injury or where there is a stimulus produced by an immune response to an exogenous agent such as micro-organisms, parasites, or allergens such as pollen. There they are involved in inflammatory reactions by phagocytosing micro-organisms and killing them. After exhaustion of their supply of killing enzymes and membrane (for phagocytosis), they die mostly by necrosis and some by apoptosis (unused neutrophils also die by apoptosis) and are phagocytosed by macrophages. Macrophages (derived from the circulating monocytes) may re-enter the circulation, possibly via lymphatics. Thereafter, they would be removed along with other effete (i.e. old, worn out) or damaged blood cells by phagocytic cells in liver and spleen.
- (iii) Had the tissue not been harvested, the leukocytes would have undergone necrosis or apoptosis (see (ii) above).
- (iv) Neutrophil activation results in the production and release of reactive oxygen species (ROS) and catabolic enzymes, the evolved purpose of which is to inactivate micro-organisms. These substances may, however, also damage normal tissue - a so-called bystander effect.
- (v) The viral infection of the bronchial epithelium will have led to epithelial cell injury and death, allowing entry of bacteria into the bronchial walls and alveolar walls, causing the bacterial bronchopneumonia.
- (1) Destruction of bronchial mucosal epithelium.
- (2) Further destruction of bronchial mucosal epithelium, with release of bacterial toxins; production of mediators of inflammation, e.g. histamine.
- (3) Fibrinous exudate and haemorrhage, resulting from vasodilatation & increased permeability of alveolar capillaries, enter the alveoli, bronchioles and bronchi [**vascular response**].
- (4) Leukocytes, largely neutrophils, enter alveoli and bronchioles [**cellular response**].
- (5) Exudate (neutrophils & fibrin) in alveoli impairs gas exchange.
- (6) Cytokines, IL-1, IL-6, TNF- $\alpha$ , IFN- $\gamma$  are released by leukocytes, circulate and trigger the hypothalamus to reset the body thermostat to 1-4 $^{\circ}$ C higher.

- (7) Reduced blood oxygen and increased blood carbon dioxide concentrations stimulate respiratory centres.