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Commentary

Toxicity Effect on Respiratory System

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DESCRIPTION

Airborne particles can cause pathological alterations in the respiratory system when inhaled. As a result, histopathological changes in the upper respiratory tract, trachea, and/or lungs are frequently assessed in toxicological investigations on the effects of inhalable particles and fibers. In traditional pathological examinations, histological lesions are scored in order to gain "quantitative" information and an estimate of the severity of the lesion. Inhaling hazardous particles can cause health problems as well as pathological alterations in the respiratory system. Inhaled noxious particles frequently cause a pulmonary inflammatory response, which can lead to the development of sub-chronic or chronic lung disorders such as pneumonitis, silicosis, asbestosis, Chronic Obstructive Pulmonary Disease (COPD), emphysema, asthma, fibrosis, or cancer. Particle and fiber-induced pathology has different features and severity depending on exposure length and concentration, as well as particle properties such chemical composition, size, structure, and surface composition.

Inhalation exposure to chemicals can have an impact on lung tissues and distant organs once chemicals enter the body by inhalation. Indeed, inhalation toxicology refers to the route of exposure, whereas respiratory tract toxicology relates to target-organ toxicity, or toxicant-induced abnormalities in the respiratory tract. Lung tissue can be damaged directly or indirectly by organic compound metabolic products. Many hazardous inhalants, on the other hand, have the most significant impact of increasing the oxidative load on the lungs.

The degree of pulmonary inflammation and tissue damage may be determined using pulmonary histopathology, and other inflammatory markers, such as cellular or structural alterations, can be assessed with stereology. The inflow of pro-inflammatory cells like neutrophils and macrophages, as well as cellular growth and death, are all possible biological alterations. Severe inflammation causes epithelial or endothelial cell destruction, as well as edoema fluid exudation into the peri-bronchovascular or alveolar septal interstitium and the alveolar lumen. The number of inflammatory/proliferating/apoptotic cells, the amount of pulmonary edoema, or the surface area of injured epithelium/endothelium are all stereological measures that may be used to quantify pulmonary inflammation.

The pattern of toxicant toxicity is determined by the locations of toxicant deposition in the respiratory system. The solubility of a gas in water is a key element in determining how deeply it penetrates the lungs. Because highly soluble gases like SO_2 do not permeate much farther than the nose, they are quite safe for animals. Ozone and NO_2, which are relatively insoluble gases, penetrate deeply into the lungs and reach the tiniest airways and alveoli, where they can cause hazardous reactions. CO and H2S, which are insoluble gases, effectively travel through the respiratory tract and thus are absorbed by the pulmonary blood supply, which then distributes them throughout the body.

Inflammatory cell infiltration, alveolar epithelial cell damage, fibroblast hyperplasia, collagen deposition, and scar formation are all symptoms of pulmonary fibrosis. Quantitative histopathology at light and electron microscopic levels can be used to examine lung fibrosis: For example, the amount of nonfunctional parenchyma (collapsed or previously remodeled) *vs.* ventilated parenchyma may be determined at the light microscopic level, as can the volume of parenchymal collagen stained with picrosirius red. The thickening of the air-blood barrier, as well as the volume of different septal compartments such as collagen, extracellular matrix, and fibroblasts, may be examined at the electron microscopic level.

Histopathology of the lungs can be used to determine the intensity and mechanism of action of noxious particles and fibers, as well as other inhalative toxicants. As a corollary, histopathology of the lungs is a significant tool in toxicity research and risk assessment. Stereology allows for the efficient and impartial quantification of histopathological lesions, allowing for the construction of dose response curves and the estimation of effect levels based on lesions and pathologies.

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