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Physiology and Pathophysiology during Airway Resistance at Pulmonary Intensive Care Unit

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COMMENTARY

The lungs are a complex organ that serves as the body's gas exchange centre, inhaling and expelling about 7 to 8 mL of air every minute while exchanging oxygen for carbon dioxide. The frictional forces of the airways, which oppose airflow, cause airway resistance, which is an important metric of lung function. At physiologic levels, turbulent airflow is caused by airway resistance in the trachea, whereas airway resistance in the bronchi and bronchioles allows for more laminar airflow, in which air travels easily to the distal regions of the lungs. When airway resistance is high, as it is in some pulmonary disorders, air can become trapped in the lungs, reducing gas exchange and, in extreme cases, leading to respiratory failure. The Hagen-Poiseuille equation is mainly responsible for the standard airway resistance encountered in normal breathing's laminar flow:

$$R = \frac{8hl}{\pi r}$$

Given this equation, it is evident that the radius is the most critical element in airway resistance, and that modest changes in radius can result in considerable airway resistance changes. When the radius of the tube is doubled, for example, the resistance drops by a factor of 16. The bronchi with the smallest radius are the medium-sized bronchi. Using the theory stated above, it seems obvious that because the medium-sized bronchi have the shortest radius collectively, they would also have the highest airway resistance. Using the same logic, we may deduce that the terminal bronchioles have the lowest resistance because they have the largest radius collectively. Airway smooth muscle, which lines all of our conducting airways save the trachea, where airway smooth muscle is restricted to the anterior wall, can drastically modify airway radius. The sympathetic nervous system relaxes the smooth muscle of the airway. Bronchodilation and decreased airway resistance are induced by stimulating beta-2 receptors in airway smooth muscle. When the parasympathetic nervous system is aroused, it innervates the smooth muscle of the airway, causing it to contract. The airway lumen is reduced by this contraction of airway smooth muscle, increasing airway resistance.

Traditionally, lung development is divided into three stages: embryonic, foetal, and postnatal. At 4 to 7 weeks after conception, the main airways form. The bronchial tree develops between 5 and 17 weeks, while the most distant airways form between 16 and 26 weeks throughout the foetal era. The lung resembles a tubular gland at the commencement of bronchial tree construction. Outgrowth and branching of the terminal bud occur from 4 to 7 weeks, resulting in bronchial buds, which will subsequently become bronchi. The bifurcation of the bronchial buds leads to the creation of bronchioles. This branching continues, and the first 20 generations of airways are visible by around 26 weeks. Around week, foetal respiratory movements begin. Asthma is one of the disorders that emphasises the necessity of normal airway resistance. Asthma arises when the conducting airways, particularly the bronchi and bronchioles, become inflamed over time. Constriction and hypertrophy of the airway smooth muscle, increased mucus production, and thickening of the lamina reticularis are all symptoms of chronic inflammation (a layer of connective tissue that surrounds the airways). Because these maladaptive changes to the airways result in narrowing or even complete occlusion of the airway lumen, which leads to an increase in airway resistance that prevents air from exiting the lungs, asthma is classified as an obstructive lung disease. Many of the signs and symptoms a patient will encounter during an asthma exacerbation are caused by increased airway resistance, including wheezing, dyspnea, chest tightness, and air trapping. The failure to produce enough expiratory pressure to overcome the airway resistance of the more proximal bronchi and bronchioles causes air to be trapped in the distal portions of the lungs. Because this

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airway resistance cannot be overcome, air becomes trapped in the lungs' distal portions.

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CONFLICT OF INTEREST

The author has nothing to disclose and also state no conflict of interest in the submission of this manuscript.