POSTNATAL MORPHOFUNCTIONAL DEVELOPMENT OF THE BRONCHIAL TREE IN CHILDREN DURING THE FIRST THREE YEARS OF LIFE

B.M.Xatamova,
M.A.Ergashov
Tashkent State Medical University

Abstract *The early childhood period, spanning from age 1 to 3, represents a transformative phase in human respiratory development. This study details the postnatal ontogenetic progression of the lungs and bronchi, focusing on airway dimensions, histological maturation, and clinical implications. As the child transitions from infancy to a more active lifestyle, the bronchial tree undergoes significant structural remodeling to accommodate increased metabolic demands.*

1. Anatomical and Morphometric Dynamics

During the first three years of life, the lungs do not merely grow in size; they undergo complex architectural changes.

- **Lumen Expansion:** The internal diameter of the main and lobar bronchi increases by approximately **1.5 to 2 times** compared to the neonatal period. Despite this growth, the peripheral airways (bronchioles) remain disproportionately narrow, which is a major factor in respiratory resistance.
- **Tracheal Development:** The trachea doubles its length by the age of 3, and its bifurcation (carina) gradually shifts downward to the level of the 4th or 5th thoracic vertebra.
- **Branching Pattern:** While the number of bronchial generations is mostly established prenatally, the distal parts of the tree undergo significant expansion through the addition of new alveolar ducts and sacs.

2. Histological Maturation of the Bronchial Wall

The cellular composition of the bronchi at ages 1–3 is characterized by high metabolic activity:

- **Cartilaginous Framework:** The bronchial rings are highly compliant and rich in water content. Between the ages of 1 and 3, the process of chondrification (hardening of cartilage) accelerates, providing the structural stability needed to prevent airway collapse during forced expiration.
- **Smooth Muscle and Elastic Fibers:** The muscularis mucosae becomes more defined. However, the elastic fiber network is still underdeveloped compared to adults. This lack of "elastic recoil" means that the airways are more likely to trap air (hyperinflation) during infections.

- **Glandular Activity:** The density of submucosal glands is significantly higher in toddlers than in adults. This results in hypersecretion of mucus in response to minor irritants, often leading to obstructive syndromes

3. Physiological Integration and Gas Exchange

The functional capacity of the lungs during early childhood is optimized to support rapid physical growth:

- **Alveolarization:** It is estimated that nearly **80–90%** of the adult number of alveoli are formed by the age of 3. This massive increase in surface area facilitates efficient gas exchange.
- **Vital Capacity:** Although the total lung capacity increases, the functional residual capacity (FRC) is relatively low, meaning toddlers have less "oxygen reserve" during periods of apnea or respiratory distress.

4. Clinical Correlations

Understanding these ontogenetic indicators is vital for pediatric practice:

1. **Airway Resistance:** Resistance in the small airways of a 2-year-old is nearly **4 times higher** than that of an adult, making them highly susceptible to wheezing.
2. **Reactive Airway Disease:** The relative hyper-responsiveness of the bronchial smooth muscle at this age explains the high prevalence of viral-induced asthma-like symptoms.

Conclusion

The period of 1–3 years is a "window of vulnerability" and rapid development. The postnatal ontogenesis of the bronchi during these years is marked by a transition from a compliant, mucus-prone system to a more stable and efficient respiratory apparatus. Monitoring these growth indicators is essential for early intervention in chronic pediatric respiratory conditions.

Expanded References

1. **Burri, P. H.** (2006). *Structural aspects of postnatal lung development - alveolar formation and growth.* Biological Neonate, 89(4), 313-322.
2. **Hislop, A. A.** (2005). *Developmental biology of the pulmonary vasculature.* Paediatric Respiratory Reviews, 6(1), 35-43.
3. **Maden, M.** (2004). *Retinoids and airway/alveolar development.* Paediatric Respiratory Reviews, 5, S259-S264.
4. **Pinkerton, K. E., & Joad, J. P.** (2000). *The mammalian respiratory system and critical windows of exposure for children's health.* Environmental Health Perspectives, 108(suppl 3), 457-462.
5. **Taverne, Y. J., et al.** (2015). *The comparative anatomy and physiology of the lung: Focus on the bronchial tree.* Journal of Anatomy, 227(3), 245-258.