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HYPEROXIA IN PEDIATRIC CRITICAL CARE

Ketevan Gabriadze, Robert Makharashvili, Tamari Goginashvili

Givi Zhvania Pediatric University Clinic of TSMU, Tbilisi, Georgia

Background: Supplemental oxygen is a lifesaving and critical intervention in pediatric emergency and intensive care. However, excessive or inappropriate administration can induce hyperoxia and hyperoxemia. This overexposure triggers the overproduction of reactive oxygen species (ROS), causing severe oxygen toxicity and direct parenchymal lung injury. Pediatric patients requiring mechanical ventilation with a fraction of inspired oxygen (FiO_2) greater than 0.60 for prolonged durations (exceeding 24 hours) face the highest clinical risk. Furthermore, this risk is significantly exacerbated by prior exposure to certain sensitizing drugs or radiation.

Objectives: This study/review aims to evaluate the clinical impact and mechanisms of oxygen toxicity in pediatric populations, identify critical risk factors, and outline effective monitoring strategies to optimize safe oxygen delivery.

Methods: A comprehensive literature review and clinical analysis were conducted, examining the pathophysiology of hyperoxia-induced cellular damage. The analysis focused on the duration of exposure, target arterial oxygen tension (PaO_2), and the susceptibility of lung parenchyma to oxidative stress, particularly in patients undergoing mechanical ventilation.

Results: The evidence demonstrates that hyperoxia produces direct cellular injury through increased production of reactive oxygen intermediates (ROIs). Prolonged exposure to FiO_2>0.60 for over 24 hours is strongly associated with cellular and tissue damage. Additionally, certain medications (such as bleomycin and amiodarone) or radiation exposure sensitize the lungs, causing toxicity to occur at much lower FiO_2 levels.

Conclusions: Oxygen toxicity remains a significant but highly preventable complication in pediatric critical care. Standardized titration protocols and careful monitoring of oxygen saturation are crucial to prevent oxidative damage. When clinically indicated, oxygen must not be withheld, but its delivery should be strictly optimized to safeguard vulnerable patients.

Keywords: Oxygen toxicity, Hyperoxia, Pediatric intensive care, Reactive oxygen species, Mechanical ventilation.