

Carbapenems in Pediatric Infectious Disease Management

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Description

Carbapenems are a class of beta-lactam antibiotics renowned for their broad-spectrum activity and resilience against many beta-lactamase enzymes. Their efficacy against Gram-positive, Gram-negative, and anaerobic bacteria has made them critical tools in treating severe infections, especially in pediatric patients where timely and effective therapy is essential. This article describes into the clinical role of carbapenems in managing pediatric infectious diseases, highlighting their benefits, challenges, and the need for prudent use to mitigate resistance.

Clinical applications of carbapenems in pediatric care

Carbapenems, such as meropenem, imipenem-cilastatin, ertapenem and doripenem, are frequently used in pediatric settings to treat severe or resistant bacterial infections. These drugs are often employed when first-line antibiotics fail or when multidrug-resistant organisms are suspected. Their broad-spectrum activity makes them particularly valuable in addressing life-threatening infections, such as sepsis, meningitis, and pneumonia. Pediatric sepsis remains a leading cause of morbidity and mortality, necessitating rapid and effective antimicrobial therapy. Carbapenems are a cornerstone in treating sepsis caused by resistant Gram-negative bacteria, including *Enterobacteriaceae* producing Extended-Spectrum Beta-Lactamases (ESBLs). Meropenem is often preferred due to its efficacy and safety profile in children. Bacterial meningitis, especially caused by *Streptococcus pneumoniae* and *Neisseria meningitidis*, poses significant risks to children. Carbapenems, particularly meropenem, are effective against penicillin and cephalosporin-resistant strains, offering a potent alternative when resistance is encountered. Additionally, meropenem's favorable central nervous system penetration makes it suitable for treating central nervous system infections. Infections like Hospital-Acquired Pneumonia (HAP) and Ventilator-Associated Pneumonia (VAP) often involve multidrug-resistant pathogens. Carbapenems are essential for addressing these infections, especially in critically ill pediatric patients. Pediatric patients with appendicitis, peritonitis, or other complicated intra-abdominal infections benefit from carbapenems due to their robust activity against polymicrobial flora, including anaerobes. While carbapenems are highly effective, their use in pediatrics requires careful dosing and monitoring. Children have distinct pharmacokinetics and pharmacodynamics

compared to adults, necessitating precise adjustments to avoid toxicity or subtherapeutic levels. For instance, meropenem is approved for use in neonates and infants due to its established safety and efficacy, but close attention is needed to prevent adverse effects like seizures, which are rare but more likely in patients with renal impairment.

Challenges and considerations in pediatric carbapenem therapy

The utility of carbapenems in pediatric infectious disease management is undeniable, but their widespread use is not without challenges. Resistance, adverse effects, and stewardship concerns warrant careful consideration. The rise of Carbapenem-Resistant *Enterobacteriaceae* (CRE) is a significant global health concern. CRE infections are challenging to treat, leaving few therapeutic options. In pediatrics, where vulnerable populations often have limited treatment alternatives, this resistance crisis underscores the need for judicious carbapenem use. Resistance mechanisms, such as carbapenemase production, efflux pumps, and porin mutations, highlight the adaptability of bacteria in circumventing these potent drugs. While generally well-tolerated, carbapenems can cause side effects, including gastrointestinal disturbances, rash, and, in rare cases, neurotoxicity. Pediatric patients, particularly neonates and those with renal dysfunction, are at higher risk for adverse outcomes, such as seizures, due to altered drug metabolism and clearance. To curb resistance, antimicrobial stewardship programs emphasize the appropriate use of carbapenems. In pediatric settings, this includes reserving these antibiotics for confirmed or strongly suspected multidrug-resistant infections. De-escalation switching from carbapenems to narrower-spectrum antibiotics once pathogen susceptibilities are known is a key strategy in preserving their efficacy. Despite their widespread use, data on carbapenem safety and efficacy in certain pediatric subgroups, such as premature neonates or those with complex comorbidities, remain limited. Further research is essential to optimize dosing regimens and understand long-term impacts. Carbapenems play a pivotal role in managing severe and multidrug-resistant infections in pediatric patients. Their broad-spectrum activity and effectiveness against resistant pathogens make them indispensable in conditions such as sepsis, meningitis, and complicated intra-abdominal infections. However, the

emergence of resistance, potential side effects, and the need for antimicrobial stewardship highlight the complexities of their use. In pediatric care, balancing the life-saving potential of carbapenems with the responsibility to prevent resistance is critical. Physicians must rely on evidence-based guidelines, local resistance patterns, and precise dosing to ensure optimal outcomes. Ongoing research and global efforts to develop new

antibiotics and resistance mitigation strategies are essential to safeguard these vital drugs for future generations. By adopting a judicious and informed approach, healthcare providers can continue to leverage the benefits of carbapenems while minimizing risks and preserving their utility in pediatric infectious disease management.