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Vancomycin in the Treatment of Pediatric Staphylococcal Infections

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Vancomycin, an inhibitor of cell wall synthesis, is produced by the bacterium *Streptococcus orientalis* and is effective primarily against gram-positive organisms [1]. Vancomycin has become an important antibiotic for use in both the adult and pediatric populations, in particular, in the fight against methicillin-resistant *Staphylococcus aureus* (MRSA), and increased use of the antibiotic has been documented in some hospitals with a high prevalence of MRSA. Development of resistance to vancomycin is also a real possibility, and strains of vancomycin-resistant enterococcus (VRE) have been identified in culture.

Vancomycin inhibits transglycolase and thereby eliminates peptidoglycan prolongation, causing the cell to become weak and susceptible to lysis. The alteration of the peptidoglycan structure in the cell wall results in a higher affinity bonding with vancomycin and, thus, loss of cell activity. A glycopeptide, vancomycin is bactericidal for actively dividing bacteria only and kills more slowly than many other antibiotics, such as penicillins.

Administration of vancomycin to treat bloodstream infections requires intravenous delivery. In fact, because vancomycin has poor gastrointestinal absorption, the only infection it can effectively treat orally is *Clostridium difficile*. All other infections must be treated by parenteral administration. Pharmacokinetic studies of vancomycin show that approximately 90 percent of the drug is removed from the body by renal excretion. In patients whose creatinine clearance becomes a problem, accumulation of vancomycin is marked. Because the drug is not removed by hemodialysis, and there is risk of nephrotoxicity, a pharmacist-based clinical service with expertise in pharmacokinetics and dosing should be consulted in its use.

The most common adverse reactions to vancomycin are short-lived and minor, but real toxicities do occur in the clinical setting. Perhaps the most well-known reaction is “red man syndrome.” Often thought to be related to anaphylaxis, this reaction is actually caused by histamine release in the patient, and can be eliminated by pretreating the patient with diphenhydramine and by prolonging the infusion duration.

The pediatric population presents significant clinical challenges to both the physician and pharmacist. At LeBonheur Children’s Medical Center in Memphis, Tennessee, a pharmacist-based clinical pharmacokinetic service is called to interact with and

advise physician colleagues in the proper dosing regimens when vancomycin and other antimicrobial agents are prescribed for inpatients with the potential for toxicity.

Pharmacokinetics and physiology are constantly evolving as the child grows, particularly in the first few months of life. To date, pharmacokinetic data exists in detail for adults, but more studies are needed for different pediatric populations. The pediatric pharmacist must consider body composition and percentage of fat and total body water relative to adults, since changes in development bring changes in absorption and body composition. Moreover, glomerular filtration rate (GFR) is lower in newborns than in toddlers and adolescents.

In summary, clinicians face real challenges when using medications in pediatric patients, particularly when use of medication and its excretion is dependent on ever-changing physiologic responses in growing children. It is our recommendation that, in this special population, multiple experts be consulted in the utilization of nephrotoxic parenteral medications to minimize the potential injury to the growing kidneys and the growing child.

References

1. For more detail about this antibiotic and its uses, see Katzung B. *Basic and Clinical Pharmacology*. 9th ed. New York: McGraw-Hill; 2001: 734-753; 995-1006.

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