



## New Therapeutic Options from Current Antimicrobial Armamentarium

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The usage of some antimicrobial agents developed decades ago declined because of the development of newer agents with broader bactericidal activity in vitro and improved safety profile. Other antimicrobial agents are used commonly to treat conditions, such as acne, but are not commonly considered as therapeutic alternatives for the treatment of serious infections. Because of the global spread of resistant microorganisms, new therapeutic options for these and other antimicrobial agents must be reconsidered.

Minocycline is used commonly for the treatment of acne. In our laboratory, more than 90% of strains of coagulase-negative *Staphylococci* and *S. aureus* are susceptible in vitro to minocycline. Minocycline is inhibitory in vitro against many strains of vancomycin-resistant Enterococci. Minocycline was effective therapy for methicillin-resistant *Staphylococcus aureus* experimental endocarditis in one study. The combination of chloramphenicol and minocycline or quinupristin/dalfopristin and minocycline, respectively, was effective therapy of a patient with vancomycin-resistant enterococcal endocarditis. The activity of minocycline against *Staphylococci* suggests that this drug may be useful for chronic suppressive therapy for prosthetic joint infections caused by *Staphylococci*. Minocycline has also been effective for the management of noninfectious diseases, such as rheumatoid arthritis and hypoxic ischemic brain damage.

Rifampin is widely used for the treatment of tuberculosis and is used in combination with other antimicrobial agents to treat staphylococcal prosthetic valve endocarditis. Rifampin is highly active in vitro against most strains of *Pneumococci*, including penicillin-resistant strains. In the treatment of pneumococcal experimental meningitis, rifampin-based regimens were the most effective therapy for this experimental infection. Rifampin is also useful for the eradication of meningococcal carrier state.

Bacitracin was introduced during the 1950s but is too toxic for parenteral use. Bacitracin may be an effective alternative to oral vancomycin for *Clostridium difficile* colitis. Many patients are unable to tolerate orally administered metronidazole. In these patients, the use of Bacitracin may be preferable to the use of vancomycin because of the potential for emergence of vancomycin-resistant *Enterococci*. Bacitracin was also effective therapy for giardiasis and may be an alternative to the use of metronidazole.

Colistin was introduced during the late 1950s. Colistin is effective in vitro against many gram-negative bacilli, including *Pseudomonas* and *Acinetobacter*. However, colistin has significant associated nephrotoxicity. With the introduction of gentamicin and other agents effective against gram-negative bacilli, the use of parenteral colistin essentially stopped. However, some strains of *Pseudomonas*, in particular *Acinetobacter baumannii*, are resistant to all other antimicrobial agents, except colistin. Colistin has been used for the treatment of patients with cystic

fibrosis and in one case resulted in cure of *Acinetobacter baumannii* meningitis.

Streptomycin was the first aminoglycoside introduced and has been available since the 1940s. Streptomycin is still used widely for the treatment of infections caused by multidrug resistant strains of *Mycobacterium tuberculosis*. The usage of streptomycin for the treatment of enterococcal infections declined following the introduction of gentamicin. However, the emergence of gentamicin-resistant strains of *Enterococci* led to a reinterest in streptomycin use. Approximately one-third of gentamicin-resistant strains of *Enterococci* which cause enterococcal endocarditis are susceptible to streptomycin. Accordingly, there has been an increased usage of streptomycin for the treatment of gentamicin-resistant enterococcal endocarditis.

Novobiocin was introduced during the late 1950s as an oral regimen for treatment of gram-positive coccal infections. However, undesirable side effects, in particular rash, resulted in minimal usage of novobiocin during the past 35 years. Novobiocin in combination with rifampin, doxycycline, or ciprofloxacin has been effective therapy in some cases of infection caused by vancomycin-resistant *Enterococci* or methicillin-resistant *S. aureus*.