

extend as far as the temporomandibular joint and mastoid process. A small minority of patients have systemic symptoms. Patients in whom the diagnosis is made late may present with cranial nerve palsies or even with cavernous venous sinus thrombosis. The ESR is invariably elevated (≥ 100 mm/h). The diagnosis is made on clinical grounds in severe cases; however, the “gold standard” is a positive technetium-99 bone scan in a patient with otitis externa due to *P. aeruginosa*. In diabetic patients, a positive bone scan constitutes presumptive evidence for this diagnosis and should prompt biopsy or empirical therapy.

TREATMENT EAR INFECTIONS

(Table 189-2) Given the infection of the ear cartilage, sometimes with mastoid or petrous ridge involvement, patients with malignant (necrotizing) otitis externa are treated as for osteomyelitis.

Urinary Tract Infections UTIs due to *P. aeruginosa* generally occur as a complication of a foreign body in the urinary tract, an obstruction in the genitourinary system, or urinary tract instrumentation or surgery. However, UTIs caused by *P. aeruginosa* have been described in pediatric outpatients without stones or evident obstruction.

TREATMENT URINARY TRACT INFECTIONS

(Table 189-2) Most *P. aeruginosa* UTIs are considered complicated infections that must be treated longer than uncomplicated cystitis. In general, a 7- to 10-day course of treatment suffices, with up to 2 weeks of therapy in cases of pyelonephritis. Urinary catheters, stents, or stones should be removed to prevent relapse, which is common and may be due not to resistance but rather to factors such as a foreign body that has been left in place or an ongoing obstruction.

Skin and Soft Tissue Infections Besides pyoderma gangrenosum in neutropenic patients, folliculitis and other papular or vesicular lesions due to *P. aeruginosa* have been extensively described and are collectively referred to as *dermatitis*. Multiple outbreaks have been linked to whirlpools, spas, and swimming pools. To prevent such outbreaks, the growth of *P. aeruginosa* in the home and in recreational environments must be controlled by proper chlorination of water. Most cases of hot-tub folliculitis are self-limited, requiring only the avoidance of exposure to the contaminated source of water.



Toe-web infections occur especially often in the tropics, and the “green nail syndrome” is caused by *P. aeruginosa* paronychia, which results from frequent submersion of the hands in water. In the latter entity, the green discoloration results from diffusion of pyocyanin into the nail bed. *P. aeruginosa* remains a prominent cause of burn wound infections in some parts of the world. The management of these infections is best left to specialists in burn wound care.



Infections in Febrile Neutropenic Patients In febrile neutropenia, *P. aeruginosa* has historically been the organism against which empirical coverage is always essential. Although in Western countries these infections are now less common, their importance has not diminished because of persistently high mortality rates. In other parts of the world as well, *P. aeruginosa* continues to be a significant problem in febrile neutropenia, causing a larger proportion of infections in febrile neutropenic patients than any other single organism. For example, *P. aeruginosa* was responsible for 28% of documented infections in 499 febrile neutropenic patients in one study from the Indian subcontinent and for 31% of such infections in another. In a large study of infections in leukemia patients from Japan, *P. aeruginosa* was the most frequently documented cause of bacterial infection. In studies performed in North America, northern Europe, and Australia, the incidence of *P. aeruginosa* bacteremia in febrile neutropenia was quite variable. In a review of 97 reports published in 1987–1994, the incidence was reported to be 1–2.5% among febrile neutropenic patients given empirical therapy and 5–12% among

microbiologically documented infections. The most common clinical syndromes encountered were bacteremia, pneumonia, and soft tissue infections manifesting mainly as ecthyma gangrenosum.

TREATMENT INFECTIONS IN FEBRILE NEUTROPENIC PATIENTS

(Table 189-2) Compared with rates three decades ago, improved rates of response to antibiotic therapy have been reported in many studies. A study of 127 patients demonstrated a reduction in the mortality rate from 71% to 25% with the introduction of ceftazidime and imipenem. Because neutrophils—the normal host defenses against this organism—are absent in febrile neutropenic patients, maximal doses of antipseudomonal β -lactam antibiotics should be used for the management of *P. aeruginosa* bacteremia in this setting.

Infections in Patients with AIDS Both community- and hospital-acquired *P. aeruginosa* infections were documented in patients with AIDS before the advent of antiretroviral therapy. Since the introduction of protease inhibitors, *P. aeruginosa* infections in AIDS patients have been seen less frequently but still occur, particularly in the form of sinusitis. The clinical presentation of *Pseudomonas* infection (especially pneumonia and bacteremia) in AIDS patients is remarkable in that, although the illness may appear not to be severe, the infection may nonetheless be fatal. Patients with bacteremia may have only a low-grade fever and may present with ecthyma gangrenosum. Pneumonia, with or without bacteremia, is perhaps the most common type of *P. aeruginosa* infection in AIDS patients. Patients with AIDS and *P. aeruginosa* pneumonia exhibit the classic clinical signs and symptoms of pneumonia, such as fever, productive cough, and chest pain. The infection may be lobar or multilobar and shows no predisposition for any particular location. The most striking feature is the high frequency of cavitory disease.

TREATMENT INFECTIONS IN PATIENTS WITH AIDS

Therapy for any of these conditions in AIDS patients is no different from that in other patients. However, relapse is the rule unless the patient's CD4+ T cell count rises to $>50/\mu\text{L}$ or suppressive antibiotic therapy is given. In attempts to achieve cures and prevent relapses, therapy tends to be more prolonged than in the case of an immunocompetent patient.



Multidrug-Resistant Infections (Table 189-2) *P. aeruginosa* has a notorious propensity to develop antibiotic resistance. During three decades, the impact of resistance was minimized by the rapid development of potent antipseudomonal agents. However, the situation has recently changed, with the worldwide selection of strains carrying determinants that mediate resistance to β -lactams, fluoroquinolones, and aminoglycosides. This situation has been compounded by the lack of development of new classes of antipseudomonal drugs for nearly two decades. Physicians now resort to drugs such as colistin and polymyxin, which were discarded decades ago. These alternative approaches to the management of multiresistant *P. aeruginosa* infections were first used some time ago in CF patients, who receive colistin (polymyxin E) IV and by aerosol despite its renal toxicity. Colistin is rapidly becoming the last-resort agent of choice, even in non-CF patients infected with multiresistant *P. aeruginosa*.

The clinical outcome of multidrug-resistant *P. aeruginosa* infections treated with colistin is difficult to judge from case reports, especially given the many drugs used in the complicated management of these patients. Although earlier reports described marginal efficacy and serious nephrotoxicity and neurotoxicity, recent reports have been more encouraging. Because colistin shows synergy with other antimicrobial agents *in vitro*, it may be possible to reduce the dosage—and thus the toxicity—of this drug when it is combined with drugs such as rifampin