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INFECTIOUS DISEASES BOARD REVIEW MANUAL

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The *Hospital Physician Infectious Diseases Board Review Manual* is a study guide for fellows and practicing physicians preparing for board examinations in infectious disease. Each quarterly manual reviews a topic essential to current practice in the subspecialty of infectious diseases.

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Acute Bacterial Meningitis

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Acute Bacterial Meningitis

Todd B. Ellerin, MD, and Allan R. Tunkel, MD, PhD

INTRODUCTION

Acute bacterial meningitis is a medical emergency that demands a high level of clinical suspicion by health care providers. At the time of the first American account of epidemic meningococcemia and meningitis in 1806, this illness was almost uniformly fatal. The introduction of intrathecal antimeningococcal antiserum in 1913 improved survival, but side effects such as serum sickness limited its utility. It was not until the advent of sulfonamide antibiotics in 1941 that mortality from this disease could be impacted. Despite the efficacy of sulfonamides in patients with meningococcal meningitis, however, this class of antibiotics was less effective against other meningeal pathogens.¹ Despite further diagnostic and therapeutic advances, particularly the discovery of penicillins and the introduction of mechanical ventilation, bacterial meningitis remains a major cause of morbidity and mortality. Modern case series of adults with bacterial meningitis demonstrate overall case-fatality rates and severe neurologic sequelae of approximately 25%, although there is some variability depending upon the microorganism causing meningitis.

This article will review the epidemiology, pathogenesis, clinical manifestations, treatment, and prevention of bacterial meningitis. Recent trends and controversies, including the rising incidence of penicillin-resistant pneumococci, use of corticosteroids for adjunctive treatment, and reduction in the incidence of *Haemophilus influenzae* meningitis through vaccination, will be emphasized.

EPIDEMIOLOGY

Bacterial meningitis is an important disease in developed as well as developing countries worldwide. A U.S. surveillance study of 27 states from 1978 to 1981 concluded that the overall annual attack rate for bacterial meningitis was 3 cases per 100,000 population.² At that time, the most common isolated organisms were *H. influenzae*, *Neisseria meningitidis*, and *Streptococcus pneumoniae*, comprising more than 80% of the cases. More re-

cent surveillance performed in 1995 demonstrated that the incidence of bacterial meningitis had decreased significantly, owing to the dramatic decline in *H. influenzae* meningitis resulting from introduction and widespread use of the *H. influenzae* type b conjugate vaccines (incidence of 2.9 cases/100,000 population in 1986 compared to 0.2 cases/100,000 population in 1995).^{3,4} The prevention of *H. influenzae* meningitis through vaccination is one of the most important U.S. public health successes.

Age is an important factor in defining the pathogens responsible for community-acquired bacterial meningitis (Table 1). In adults, the majority of cases are caused by *S. pneumoniae*, *N. meningitidis*, and *Listeria monocytogenes*. Overall, case-fatality rates for bacterial meningitis vary according to individual studies but may approximate 25%. Risk factors that increase mortality include age over 60 years, presence of obtundation on admission, and seizures within the first 24 hours of presentation.

Nosocomial meningitis is an uncommon entity, generally found in patients who have undergone neurosurgery, and is associated with a distinct microbiologic profile that includes gram-positive organisms such as coagulase-negative staphylococci and *Staphylococcus aureus* in addition to gram-negative bacilli such as *Escherichia coli* and *Klebsiella pneumoniae*. A comprehensive review of bacterial meningitis at the Massachusetts General Hospital from 1962 through 1988 determined that in this tertiary care medical center, 40% of cases were nosocomial, with 38% of these cases caused by gram-negative bacilli. The overall case-fatality rate in this study was 35%.⁵

An important epidemiologic trend in bacterial meningitis is the increase in antibiotic-resistant *S. pneumoniae*. The emergence of penicillin-resistant pneumococcus was originally described in 1967, and, more recently, widespread resistance of this organism to multiple antibiotics has been observed. An Atlanta survey in 1994 demonstrated that one quarter of pneumococcal isolates were resistant to penicillin (7% had a minimum inhibitory concentration [MIC] > 2 µg/mL) and 9% were resistant to third-generation cephalosporins.⁶ Recent surveillance of 8 states by the Centers for Disease Control and Prevention demonstrated that 24% of invasive pneumococcal strains