

# Diagnosis and Treatment of Central Nervous System Infections in the Emergency Department



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## KEYWORDS

- Meningitis • Encephalitis • Brain abscess • Emergency department • Diagnosis • Treatment

## KEY POINTS

- The classic triad of fever, neck stiffness, and altered mental status is present in only a minority of patients with meningitis.
- Kernig's and Brudzinski's signs are poorly sensitive but relatively specific physical examination maneuvers for identifying meningitis.
- Imaging tests and lumbar puncture should not delay initiation of empiric antibiotic therapy in patients suspected to have bacterial meningitis.
- Although certain cerebrospinal fluid (CSF) profiles are highly suggestive of viral or bacterial meningitis infection, emergency physicians should not be not falsely reassured by a benign CSF fluid profile supporting a viral cause.
- Encephalitis should be considered in any patient presenting with new-onset seizure or focal neurologic deficit accompanied by fever, headache, altered mental status, or behavioral changes.

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Disclosures: The authors report no conflicts of interest in this work. S.Y. Liang is the recipient of a KM1 Comparative Effectiveness Research Career Development Award (KM1CA156708-01) and received support through the Clinical and Translational Science Award (CTSA) program (UL1RR024992) of the National Center for Advancing Translational Sciences (NCATS) as well as the Barnes-Jewish Patient Safety & Quality Career Development Program, which is funded by the Foundation for Barnes-Jewish Hospital.

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Emerg Med Clin N Am 34 (2016) 917–942  
<http://dx.doi.org/10.1016/j.emc.2016.06.013>

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## INTRODUCTION

A key clinical responsibility of the emergency physician is to consider the “worst case scenario” for a given chief complaint. When it comes to infections of the central nervous system (CNS), the greatest challenge is identifying patients that have a rare life-threatening diagnosis amid the multitude of patients presenting with nonspecific symptoms. Alone or in combination, fever, headache, altered mental status, and behavior changes encompass a broad differential diagnosis. A diagnosis not considered is a diagnosis never made. In this vein, this review discusses the clinical signs and symptoms that should lead emergency physicians to consider CNS infection, paying particular attention to the sensitivity and specificity of different clinical findings at the bedside. Subsequently, the diagnostic workup and management of patients for whom there is high clinical suspicion for CNS infection is discussed.

## MENINGITIS

The term “meningitis” applies broadly to inflammation of the meninges. While meningitis can arise from a wide variety of pathologies, infectious and non-infectious, for the purpose of this review we specifically refer to acute infections of the meninges of bacterial, viral, or fungal origin. Bacterial meningitis occurs when organisms gain access to the subarachnoid space either through bacteremia (usually from an upper airway source), contiguous spread from dental or sinus infections, traumatic or congenital communications with the exterior, or a neurosurgical procedure.<sup>1</sup> The severe inflammation associated with bacterial meningitis results in edema of the brain and meninges, and eventually increased intracranial pressure once the compensatory mechanisms for cerebrospinal fluid (CSF) displacement have been overwhelmed.<sup>1</sup> Bacterial meningitis is associated with significant morbidity with mortality rates ranging from 13 to 27%.<sup>2</sup>

In contrast to bacterial infection, meningitis caused by viral infection is usually less severe. The most common causes are enteroviruses (eg, Coxsackie A and B, echovirus). Herpes simplex virus (HSV, types 1 and 2), cytomegalovirus (CMV), Epstein-Barr virus (EBV), varicella zoster virus (VZV), mumps virus, and human immunodeficiency virus (HIV) may also cause viral meningitis.<sup>3</sup> Fungal meningitis is usually secondary to systemic mycoses (eg, *Cryptococcus neoformans*, *Coccidioides immitis*, *Histoplasma capsulatum*) originating elsewhere in the body, usually from a pulmonary focus of infection in an immunocompromised patient.<sup>4</sup> Rare fungal infections have also been associated with contaminated glucocorticoid injections to treat chronic pain.<sup>5</sup>

Meningitis is a poster child for the success of childhood vaccination in reducing the incidence of many life-threatening infectious diseases. Before the introduction of an effective vaccine in 1988, *Haemophilus influenzae type B* (Hib) was the leading cause of bacterial meningitis in the United States. After the recommendation that all infants receive the Hib vaccination starting at age 2 months, the incidence of Hib meningitis among children less than 5 years of age declined by greater than 99%.<sup>6</sup> Similarly, the advent of the pneumococcal seven-valent conjugate vaccine and the meningococcal conjugate vaccine significantly decreased the incidence and mortality of pneumococcal and meningococcal meningitis in the United States.<sup>7</sup> Meningitis due to nosocomial pathogens, including Gram-negative bacteria and *Staphylococcus*, have now surpassed *Neisseria meningitidis* and *H influenzae* in incidence.<sup>7</sup> With changing pathogen demographics, the average age of a patient with meningitis has increased from 15 months of age in 1986 to 35 years in the present day.<sup>8</sup>

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