Encephalitis in Children

Description/Etiology

Encephalitis is an acute inflammation of the brain tissue that can be accompanied by meningeal, spinal cord, or peripheral nerve involvement. Encephalitis is usually caused by a virus, but can also result from bacterial, fungal, or parasitic infection. The disease course is extremely variable, ranging in severity from mild to life-threatening.

Most cases of viral encephalitis are due to either direct invasion of the brain by the virus or to a postinfectious viral-mediated inflammatory response in the brain, which can be relapsing in some patients. Viral causes of encephalitis include herpes simplex virus (HSV), cytomegalovirus (CMV), influenza virus, varicella-zoster virus (VZV; the virus responsible for chickenpox and shingles), and Epstein-Barr virus (EBV; which causes infectious mononucleosis). Epidemics of encephalitis are caused by arboviruses (e.g., Western and Eastern equine encephalitis viruses, West Nile virus, St. Louis encephalitis virus, La Crosse virus) transmitted by mosquitoes and ticks. Rabies and monkeypox viruses, which are transmitted through animal bites, can also lead to encephalitis. Bacterial and parasitic infections that can cause encephalitis include Lyme disease, tuberculosis, and toxoplasmosis. (See Quick Lesson About ... Encephalitis: an Overview.)

The clinical presentation of encephalitis can vary depending on the causal agent, degree of parenchymal involvement, and age of the patient. Children with encephalitis exhibit behavioral abnormalities (e.g., confusion), and infants can have a bulging fontanel (i.e., soft spot on the head due to membranous intervals at the margins of the cranial bones). The acute phase of encephalitis in children is often fully treatable with prompt diagnosis; untreated children can develop severe symptoms that can lead to permanent cognitive and neurologic deficits. Most children diagnosed with encephalitis are hospitalized, treated aggressively, and monitored closely to prevent inflammation from causing further swelling and damage of the brain.

Although encephalitis can be difficult to treat because the viruses that cause it are often nonresponsive to medications, the milder forms of encephalitis (e.g., those caused by HSV-1 or VZV) are usually manageable with supportive care (e.g., supplemental oxygen, fluid and nutrition support, bed rest, pain management) and pharmacologic treatment with analgesics and other agents. Age, infective organism, and residual neurologic sequela impact the prognosis for the child with encephalitis. There is a direct correlation between the extent of brain injury and neurologic outcome; however, following encephalitis, children tend to recover better than adults with a similar degree of illness.

Facts and Figures

The incidence of viral encephalitis is highest among young children and older adults (i.e., > 65 years). The estimated incidence of neonatal HSV infection in the United States is 2–3 per 10,000 neonates per year; of these, ~ 30% develop encephalitis.

Risk Factors

Risk factors for viral encephalitis include severe influenza, measles, chickenpox, rubella (German measles or 3-day measles), mumps, mononucleosis, herpes complex, bacterial infection in the brain, and glandular fever. Other risk factors include a weakened immune system (e.g., due to HIV infection), age of patient (very young, older), living in or traveling...
to areas where mosquito-borne viruses thrive, high level of outdoor activity, and the season of the year (during warmer weather when fleas and ticks are plentiful). The risk for exposure to viral encephalitis increases as people inhabit previously undeveloped, rural areas where the causative viruses are found.

**Signs and Symptoms/Clinical Presentation**

› Physical indicators: poor appetite, nausea or vomiting, mild to severe fever, lethargy, headaches, seizures, hemiparesis (i.e., paralysis of one side of the body), unsteady gait, photophobia (i.e., abnormal sensitivity to light), swollen lymph nodes, flu-like symptoms, and apnea  
› Cognitive indicators: mild disorientation, poor responsiveness, confusion, difficulty with speech, loss of motor skills, irritability, behavioral problems, decreased short-term memory, coma

**Assessment**

› Patient History
  • Ask about medical and viral exposure history to assess for risk factors

› Laboratory Tests That May Be Ordered
  • Serum glucose levels can be abnormally low or high in encephalitis  
  • Serologic or polymerase chain reaction (PCR) testing can identify the causative microorganism  
  • Cytologic analysis of cerebrospinal fluid (CSF; obtained via lumbar puncture [LP]) can reveal pleocytosis (up to 2,000 cells/mm$^3$), which continues to rise on repeat LPs, normal or mildly depressed glucose, and increased protein; direct examination of CSF can identify bacteria or parasites, and CSF culture can identify virus, bacteria, or fungus  
  • Histologic examination of biopsied brain tissue might be needed to confirm diagnosis

› Other Diagnostic Tests/Studies
  • High-resolution ultrasonography (US) can detect congenital malformation, tumor or periventricular hemorrhage  
  • CT scan and MRI can detect excessive intracranial pressure (ICP); MRI results for herpes simplex encephalitis differ between neonates and older children: neonatal imaging shows hypointense abnormalities, and images in older children show a hemorrhagic process  
  • EEG can show abnormalities in brain waves, or indicate a head injury, tumor, infection, seizure activity, and/or degenerative disease  
  • Lumbar puncture shows increased CSF pressure in encephalitis

**Treatment Goals**

› Provide Symptomatic Relief, Reduce Risk for Complications, and Educate
  • Monitor vital signs, assess all physiologic systems (especially for signs of increased ICP [e.g., seizures, lethargy] and neurologic dysfunction), and review laboratory/diagnostic study results; immediately report abnormalities and provide prescribed treatment  
  – Maintain airway patency and provide supplemental oxygen or airway support, as ordered  
  – Assess fall risk and maintain patient safety (e.g., airway, circulation, and prevention of injury); institute seizure and infection control precautions per facility protocols  
  • Assess for pain/other discomfort; provide analgesia, antibiotics or antivirals (e.g., acyclovir, vidarabine), aspirin or acetaminophen, corticosteroids, anticonvulsants, osmotic diuretics, and supportive care (e.g., fluids, nutrition, repositioning), as ordered  
  • Request referral to an infectious disease clinician if one is not already part of the treatment team, and to a pulmonology and/or neurology clinician, as appropriate  
  • Encourage family member visitation, participation in care, and rooming-in, as appropriate  
  • Following the acute phase, request referral to physical, occupational, and/or speech therapy, as appropriate  
  • Assess patient/family member anxiety level and coping ability; educate and encourage discussion about encephalitis pathophysiology, risk factors, potential complications, treatment risks and benefits, prevention strategies, and individualized prognosis

**Food for Thought**

› CT scan results may not show abnormalities early in the course of encephalitis  
› Although corticosteroids are commonly prescribed to decrease inflammation in encephalitis, no large-scale, randomized, controlled trials have been conducted to confirm their efficacy
The exact incidence of increased ICP in children with encephalitis is unknown, and it is unclear which patients would benefit from ICP monitoring. Investigators recommend intracranial monitoring for children with encephalitis and a Glasgow Coma Scale (GCS) of < 8 (Simon et al., 2013).

### Red Flags

- Parents should seek immediate medical attention for flu-like symptoms in a child during a known outbreak of encephalitis.
- Influenza-associated encephalopathy/encephalitis infection, although uncommon in children, is a serious condition with neurologic sequela and a high mortality rate (Wang et al., 2010).
- In rare cases, a child can develop encephalitis after receiving the MMR (measles, mumps, and rubella) vaccine.
- Goals of therapy in children with encephalitis include preventing secondary brain injury, including seizures, fever, increased ICP, airway compromise or hypoventilation caused by a depressed mental status, and hypotension caused by systemic inflammatory response or autonomic instability.
- An LP is usually performed emergently but should be deferred until the child’s airway, gas exchange, and circulation have been stabilized and/or if there is clinical indication of increased ICP.

### What Do I Need to Tell the Patient/Patient’s Family?

- Educate about prevention strategies, including preventing mosquito bites by staying inside between dusk and dawn, wearing long pants and long-sleeved shirts, and spraying clothing and exposed skin with insect repellant.
- Emphasize the importance of continued medical surveillance and seeking immediate medical attention for new or worsening signs and symptoms.
- For more information, refer to the Encephalitis Society at http://www.encephalitis.info.

### References