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MANAGEMENT OF MENINGITIS IN CRITICALLY ILL CHILDREN

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Abstract:

Introduction: *Central nervous system (CNS) infections are medical emergencies that require immediate diagnosis, initiation of treatment, and admittance to an intensive care unit (ICU) is quite often. Neisseria meningitides is one of the fatal infectious diseases in childhood worldwide. Most critically ill children are best managed in a specialist pediatric intensive care unit. Immediate resuscitation and stabilization are more important for the patient's outcome than specialist pediatric intervention.*

Aim of the Study: *Aim of the study is to understand the management of children in bacterial and viral meningitis and critical care.*

Methodology: *The review is a comprehensive research of PUBMED & CROSSREF from the year 1992 to 2011.*

Conclusion: *Despite the decreased incidence of meningitis in children due to vaccination and other preventive measures, meningitis still remains to be linked with high neurological morbidity and mortality in children. Rapid administration of antibiotics and steroids improves clinical outcomes in some etiologies. CT scan is indicated but should not delay antibiotic therapy in case of history of central nervous system disease, immunocompromised state, papilledema, or focal neurological deficits. Viral and Bacterial meningitis is often difficult to differentiate; therefore, clinical models such as the Bacterial Meningitis Score and biomarkers such as serum CRP, procalcitonin, and CSF lactate can be useful in differentiating bacterial from viral meningitis. Further studies should continue to explore the utility of multiplex PCR and metagenomic next-generation sequencing (mNGS) in the evaluation of patients with suspected acute bacterial meningitis.*

Keywords: meningitis, intensive unit care,

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INTRODUCTION:

Meningitis is a rare but serious pediatric emergency presentation in which the membranes surrounding the brain and spinal cord become inflamed. Both viral and bacterial etiology is well known, and other variety of different microorganisms can cause meningitis.[1]

Bacterial Meningitis

The mortality rate is higher from bacterial meningitis. It ranges from being 2% in children to 20% in neonates. Two-third of the survivors experience transient or permanent neurological sequelae. The mean average age of children is less than five years of age in 90% of cases. The bacterial infection in infants up to three months of age is acquired during birth via secretions of the intestinal and genital tract from the mother that gets aspirated by the infant; this transmission is known as vertical transmission. Various microorganisms are involved, such as Group B streptococci (subtype III), Listeria monocytogenes (serotype IVb), and gram-negative enteric bacilli (Escherichia coli, Klebsiella, and Enterobacter. [2]

However, with older children, the incidence of meningitis is lower, with an approximate incidence of 1 per 5,900 febrile children at the age of 2 to 24 months. The common cause of bacterial meningitis in older infants and children is due to encapsulated bacteria (that have colonized the nasopharynx) disseminates in the bloodstream and the most common pathogens in children aged over three months are Neisseria meningitides and Streptococcus pneumoniae. The incidence of bacterial meningitis infections has dropped in Australia with the launch of the Hib and pneumococcal vaccines at the National Immunisation Program. [3,4]

Viral meningitis

Once bacterial meningitis is excluded, viral meningitis is usually diagnosed, and the most common causative pathogen are enterovirus, coxsackievirus, and Parechovirus (being common in infants less than three months of age). Herpes simplex virus meningitis without encephalitis is not commonly seen in children and, when present, usually has an excellent outcome without the administration of antiviral therapy. HSV with encephalitis is known to be a devastating form of herpes infection in neonates and is a major reason of morbidity and mortality if not treated appropriately. [2]

Risk Factors for Meningitis [2,3]

- Presence Bacterial meningitis case within close contact.
- Contact with HSV or enterovirus infection.
- Recent overseas travel
- Maternal GBS colonization
- Immunocompromised patients
- Recent history of penetrating head injury or neurosurgical procedure
- VP shunt
- Cochlear implant

Management

The assessment is the first step which requires a thorough history and clinical examination to identify children with meningitis promptly and enable appropriate management. Distinguishing between viral and bacterial meningitis is also essential and often difficult. Given the significance of early antibiotic therapy, it is best to assume that cause is bacterial in origin until proven otherwise, especially in the case of children less than five years.[2]

Examination:

Fever, neck stiffness, and headache are the classic triad of meningitis. However, it is not found in more than 50% of cases in older children and adolescents. Older children may present with other symptoms such as rash, upper or lower respiratory tract symptoms, myalgia, and abdominal pain, and any combination of these. Symptoms are even more nonspecific in preverbal children where the classical triad are more common in viral meningitis while neurological complications (including seizures and coma) are rare. A high index of suspicion for meningitis includes all sick, febrile, or hypothermic neonates (with or without the features described), all children aged less than two years presenting with fever and convulsions. [5]

Investigations

The definitive diagnosis of meningitis is made on the analysis of cerebrospinal fluid (CSF) obtained via lumbar puncture (LP). When an LP is contraindicated or clinically unsafe, investigations such as blood cultures and PCR testing on blood may be useful to diagnose meningococcal, pneumococcal, or Hib infection. [1,2,6]

Table 1: Investigations [1,2,6]

Blood	
Full blood count	Neutrophilia suggestive of bacterial infection
Serum glucose	Often low; allows interpretation of CSF glucose
Electrolytes, urea, and creatinine	To assess for complications and fluid management
Coagulation studies	To assess for complications
Blood cultures	Positive in 40–90% depending on the organism
Inflammatory markers	Elevation suggestive of bacterial infection; procalcitonin of more value; neither can establish nor exclude the diagnosis
CRP, procalcitonin	
CSF:	
Protein and glucose	
Microscopy, culture, and sensitivities	Gram stain: *S. pneumoniae*—gram +ve cocci *N. menigitidis*—gram −ve cocci *H. influenzae*—gram −ve rod
Latex agglutination[1]	Rapid; not 100% specific or diagnostic
PCR[2]	Rapid; good sensitivity, techniques improving
Lactate	Routine use is not currently recommended
Imaging: Computed tomography of the head	Indicated for focal neurology, signs of increased intracranial pressure (ICP), deteriorating neurological function, previous neurosurgical procedures, or immunocompromised May show evidence of hydrocephalus, abscess, subdural empyema, or infarction A normal scan does not entirely exclude the risk of raised ICP
Other: PCR on blood or urine	Useful if CSF is not obtainable

Management for critical children includes the following criteria: [5,7,8]

- Suspected sepsis
- Suspected raised ICP
- Shock
- Recent seizure

Physiological triggers based on age

Table 2: RR- Respiratory rate, HR- Heart rate, SpO2- Oxygen saturation [5,7,8]

< 1 years old	1-4 years	5-11 years	>12 years
• RR >50 • HR 170 • sBP • SpO2 <93% in oxygen or <85% in air	• RR >40 • HR 160 • sBP •SpO2 <93% in oxygen or <85% in air	• RR >40 • HR 150 • sBP • SpO2 <93% in oxygen or <85% in air	• RR >30 • HR 130 • sBP • SpO2 <93% in oxygen or <85% in air

For immediate onsite management in critically ill children, including airway management, next are most senior resources available onsite at the time, which may include: pediatric critical care, critical care, anesthetics, pediatrics, senior Medical Officer (or similar).

Antibiotic-therapy:

Early use of appropriate antibiotics IV has been shown to improve outcomes. Empiric antibiotic therapy regimens are selected, working against most likely pathogens for the selected age group of the child. The child is admitted, and empiric antibiotic therapy is continued until culture results are negative or an organism and its sensitivity pattern are identified. In many countries, the incidence of multi-resistant Streptococcus pneumoniae is at its peak, and many are also resistant to the third-generation cephalosporins. For children with gram-positive cocci in CSF (depending on age and illness severity) and in critically ill children with suspected Streptococcus pneumoniae, Vancomycin is the drug of choice with empiric antibiotics. [7,8]

Antivirals

Aciclovir is not a drug of choice in children with meningitis, but it is recommended for all suspected encephalitis cases in children and may be considered in other children if a viral etiology is suspected. [7,8]

Corticosteroids

In all cases of suspected bacterial meningitis in over three months of age, Corticosteroids should be considered, with administration ideally just prior to or immediately after the first antibiotic IV dose. Corticosteroids are known to improve patient outcomes in acute bacterial meningitis by modulating the response to inflammatory mediators. This inflammatory response is initiated in response to the lysis of bacterial cell walls after the first dose of antibiotic. [8,9]

Fluid management

Careful fluid management and electrolyte balance are crucial in the management of meningitis as there is a high risk of developing hyponatremia along with enhanced ADH secretion. Fluid restriction is not recommended in the first 48 hours. It reduces the incidence of cerebral edema in children with bacterial meningitis. For infection control, standard precautions and droplet precautions should be upheld during the care of a child with suspected or confirmed acute bacterial meningitis. Personal protective equipment must be used when undertaking any procedure where there is a risk of exposure to blood or body fluids.[1,2,9]

CONCLUSION:

Bacterial and viral meningitis is one of the leading cerebral infections among children causing various morbidity and high mortality rate. Critically ill children in acute cases of meningitis are often tricky to manage; however, with the prompt investigation and early management, the outcome seems promising. Further advances and vaccination have decreased the cases of meningitis among children.

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