Pneumococcal Meningoencephalitis as Rare Complication of Ear Infection in a 4-Month-old Girl: A Case Report

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Abstract

Streptococcus pneumoniae is a common cause of bacterial meningitis. It rarely causes more serious infections such as brain abscess, encephalitis, encephalomyelitis, or meningoencephalitis. We report a 4-month-old girl with a severe course of meningoencephalitis caused by *Streptococcus pneumoniae* as a complication of bilateral otitis media. She was treated with ceftriaxone, dexamethasone, multiple antiepileptic drugs, and neurosurgical drainage of subdural empyema. Gradual neurological improvement was observed. However, follow-up MRI revealed extensive cortical and subcortical damage with profound cerebral volume loss. This case illustrates that early recognition and timely appropriate treatment are crucial for a positive outcome.

Keywords

Case report ; children ; *Streptococcus pneumoniae* ; meningo-encephalitis ; complication of ear infection.

Introduction

Streptococcus pneumoniae is commonly found in the respiratory tract of healthy people, especially children. It is transmitted by respiratory droplets. When disease does occur, it is usually mild and the most common symptoms are acute otitis media and sinusitis. However, more severe clinical presentations such as pneumonia, bacteraemia and meningitis are not uncommon. They are associated with high mortality and morbidity. It is estimated that *Streptococcus pneumoniae* causes more than one million deaths in children worldwide each year. The development of meningoencephalitis is rare (1-7).

Case report

A 4-month-old girl with no relevant medical history and fully vaccinated up to the current age presents to the emergency department of a secondary hospital with a fever of 39°C for the past 2 days. Inspection of the left ear reveals a highly purulent otorrhoea with no possibility of inspection of the tympanic membrane. At this time, the clinical examination by the emergency physician shows a normal neurological examination. Amoxicillin is started and reassessment by the paediatrician is recommended in the next few days.

The next day, the child returns to the emergency department with post-feeding vomiting, drowsiness and sleepiness. In the emergency department, the child begins to convulse, with twitching of the left arm and leg, and gaze deviation to the left. The emergency physician administers midazolam (0.5mg/kg) intranasally as there is no intravenous access. Vital signs are stable, except for a brief desaturation to 88%, for which 5 L/min oxygen is administered by mask.

When the paediatrician arrives, the child is pale, unresponsive to stimuli and still has slight twitching of the left arm. Intravenous access is obtained and midazolam IV (0.1 mg/kg) is administered. After administration, the convulsions stop and a post-ictal state is observed.

On further examination, a clearly bombed anterior fontanel is noted, there is obvious hepatomegaly (3 cm below the rib, midclavicular diameter of 8.5 cm on ultrasound), purulent otorrhoea on the left side, but no clinical signs of mastoiditis. Prior to lumbar puncture, a CT scan of the brain is performed, showing no midline shift, two wide open fontanelles, no ischaemic areas, but signs of otitis/mastoiditis on the left side. The results of the examination of the cerebrospinal fluid (CSF), blood and urine are shown in Table 1. After taking cultures, dexamethasone, ceftriaxone and acyclovir are given intravenously and a maintenance infusion is started.

The child is admitted to the paediatric ward, but after a few hours the seizures recur, initially bilateral, then lateralised to the right with subtle twitching of the arms and legs, and now gaze deviation to the right. A new dose of IV midazolam does not stop the convulsions. Brief bradycardia (85/min) occurs once. There is also obstructive breathing which requires a jaw thrust. In consultation with a tertiary centre, a loading dose of phenobarbital is administered, which leads to resolution of the seizures. The patient is transferred to the paediatric intensive care unit (PICU) of the tertiary centre.

During her stay in the PICU, increasing seizures are observed. A new CT scan of the brain shows a left frontal empyema for which neurosurgical drainage with irrigation is performed. Despite surgery, the seizures persist, requiring a wide range of antiepileptic drugs: midazolam, valproic acid, phenobarbital, levetiracetam and finally propofol. The patient was intubated and mechanically ventilated for a total of 12 days. An interictal electroencephalogram (EEG) showed baseline activity that was unstructured for the age, notable bilateral frontocentral low-voltage, and no epileptiform changes. A brain magnetic resonance imaging (MRI) scan was performed and showed diffuse areas of oedema and diffusion restriction in the cortex of both cerebral hemispheres, most prominent in the high biparietal, right frontotemporal and left parietotemporal regions, confirming the diagnosis of pneumococcal meningoencephalitis with a severe encephalitis component (Figure 1). Ceftriaxone was administered intravenously for a total of 10 days, then changed to high-dose amoxicillin intravenously for a further 14 days (total duration of intravenous antibiotics 24 days). Oral amoxicillin was continued for 21 days (total duration of antibiotics 35 days). Dexamethasone was given for 4 days.

During the PICU stay, sedation is systematically reduced and a progressive improvement in neurological outcome is observed. After a total stay in the PICU of 15 days, the patient is able to leave the PICU and is transferred to the regular ward. She still has severe axial hypotonia and asymmetry with a right-sided disadvantage, for which intensive rehabilitation is initiated. After a further 3 weeks on the regular ward, the patient is able to leave the hospital.

On discharge from the tertiary centre, the patient was treated with levetiracetam and valproic acid. Valproic acid was discontinued because of impaired liver tests, which recovered rapidly after discontinuation of the drug.

An examination after 2.5 months of multidisciplinary rehabilitation revealed still evident but already improving hypotonia, asymmetry to the right in the upper limbs, difficulty organising postural changes, limited grasping, short attention span and difficulty with visual tracking.

A check-up one month later with the paediatric neurologist showed a very favourable evolution. The clinical neurological examination is within normal limits for the age and no significant developmental difference with peers

Table 2: Laboratory data on admission.

Laboratory test (SI units)	Result	Normal range	Antibiogram
CEREBROSPINAL FLUID			
Leukocytes (/µL)	150	< 5	
Glucose (mg/dL)	5	60 – 80	
Protein (mg/dL)	223	8 – 32	
Lactate (mmol/L)	13.8	1.1 – 2.8	
Culture	*Streptococcus pneumoniae*, serotype 19A		S: - Gentamycin high level - Cefepime - Penicillin - Amoxicillin - Linezolid - Moxifloxacin - Cefuroxime - Cefotaxime - Tetracycline - Erythromycin - Clindamycin - Meropenem - Vancomycin - Teicoplanin - Chloramphenicol - Trimethoprim/ Sulfamethoxazole I: - Levofloxacin
BLOOD			
Leukocytes (/µL)	5600	6000 – 13 200	
CRP (mg/L)	156	< 10	
Glucose (mg/dL)	129	50 – 80	
AST (U/L)	126	< 90	
ALT (U/L)	71	< 49	
Culture	Negative		
URINE			
Leukocytes (/µL)	6.16	0 – 10	
Glucose (mg/dL)	2029	0 – 33	
Culture	Negative		
CEREBROSPINAL FLUID/BLOOD			
Glucose ratio	0.03	> 0.5	

CRP, C-reactive protein; AST, aspartate-aminotransferase; ALT, alanine-transaminase; S: susceptible standard dose; I: susceptible increased exposure.

has been observed. An EEG shows no epileptiform activity. Brainstem evoked response audiometry (BERA) shows normal hearing on the right and limited hearing loss on the left, but at the time of testing the patient has otitis media with effusion on the left. A control MRI shows extensive cerebral tissue loss, a greatly dilated supratentorial ventricular system and still severe meningeal thickening (Figure 2). Treatment with levetiracetam and physiotherapy are continued.

As the patient was infected with pneumococcal serotype 19A, which is part of the Prevenar 13 vaccine, of which she has already received 2 doses, an immunity check was carried out. There is no asplenia, complement and immunoglobulins A, M and G are normal. There is a mannose-binding lectin (MBL) deficiency, but this does not seem to fully explain the severe clinical picture. Additional blood samples should be taken for further diagnosis.

Discussion

Definition and pathogenesis

Acute meningoencephalitis is a common cause of death and neurodevelopmental problems in children. The infection can be caused by a variety of agents, including viruses, bacteria, mycobacteria and protozoa, or it can be parainfectious and immune-mediated. Meningoencephalitis typically starts with symptoms such as fever, headache, stiff neck and sensitivity to light. However, as the infection progresses, additional symptoms may occur, including nausea, vomiting, altered mental status and even seizures.

Figure 1: Brain MRI (T2, axial) on admission to PICU showing diffuse oedema and diffusion restriction in the cortex of both hemispheres.

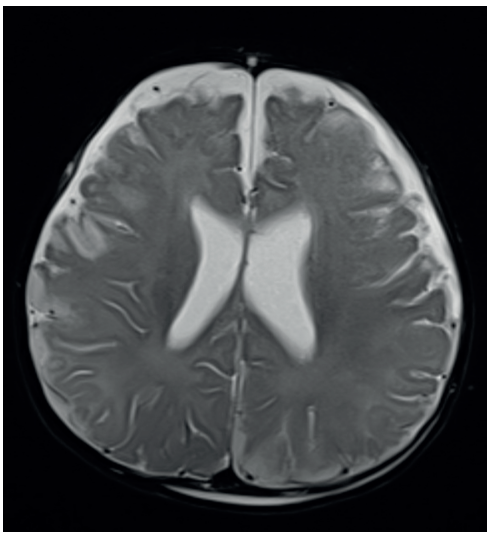
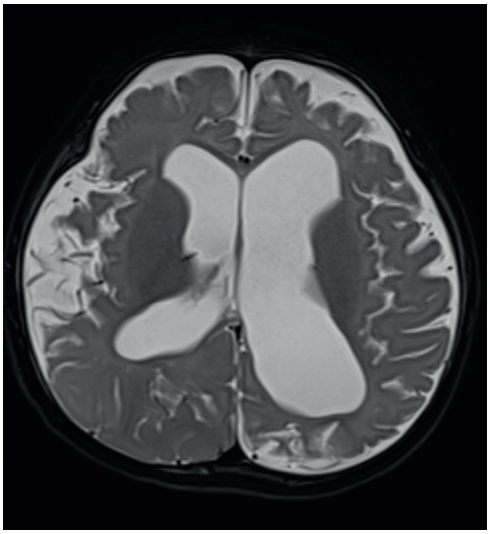


Figure 2: Control brain MRI (T2, axial) 3 months after admission to PICU showing extensive brain tissue loss, dilated supratentorial ventricular system and severe meningeal thickening.



In severe cases, individuals may develop coma or other neurological deficits (3, 6, 8). In infants, headache and photophobia are usually overlooked and neck stiffness with fontanelle bulging is often absent, making early diagnosis more challenging.

Streptococcus pneumoniae is a common inhabitant of the respiratory tract and can spread to the bloodstream and cross the blood-brain barrier, or the bacteria can reach the brain through an abnormally formed connection between the nasopharynx and the subarachnoid space, for example in mastoiditis, where the bacteria spread through the bone into the brain causing meningitis. Certain risk factors may increase the likelihood of developing pneumococcal meningoencephalitis, including young age, advanced age, a weakened immune system, chronic diseases, alcohol abuse, or recent head trauma (1-3, 6).

Clinical and biochemical findings

Diagnosis of pneumococcal meningoencephalitis involves a thorough physical examination and analysis of cerebrospinal fluid and blood cultures to identify the causative bacteria. Imaging studies such as CT or MRI of the brain may also be used to assess the extent of brain involvement. An EEG may provide additional information, typically showing a non-specific slowing of background activity. An EEG is particularly important in patients with persistent unexplained altered mental status to exclude status epilepticus (2, 3, 8).

Treatment

Prompt and appropriate treatment of pneumococcal meningoencephalitis is essential. First, the patient's airway, breathing and circulation should be assessed and stabilised if necessary. Meningoencephalitis is a life-threatening emergency that requires prompt empiric therapy. Antibiotics such as penicillin or cephalosporins are commonly used to target the bacteria. In our region, surveillance reports (data to 2022) show that *Streptococcus pneumoniae* is resistant to penicillin in 14.3% of strains that were tested and caused invasive disease. Resistance to cefotaxime is reported at 3.5% (9). Acyclovir should be started in all patients at risk of herpes simplex encephalitis. Antiepileptic drugs should be given if the patient presents with seizures, as well as in patients with a Glasgow Coma Scale (GCS) < 8 and in patients with signs of increased intracranial pressure. A few studies report the controversial role of corticosteroids, which should be considered in patients with cerebral oedema or increased intracranial pressure to reduce inflammation and improve outcomes (6, 8, 10). The timing of corticosteroid administration is important, with studies showing that it should be given early in the disease process, preferably before or with the start of antibiotics. The duration of treatment is best limited to 48 hours (11).

Prognosis

Despite advances in medical care, pneumococcal meningoencephalitis can be associated with serious complications. These can include brain damage, hearing loss, vision loss, cognitive impairment and, in severe cases, death (20%). Therefore, early recognition, prompt diagnosis and aggressive treatment are critical in the management of this condition (3). A recent study shows that children with pneumococcal meningoencephalitis are at high risk of sensorineural hearing loss. In the population studied, 30% of children had unilateral or bilateral sensorineural hearing loss (12). A few studies have shown a protective effect of corticosteroids on the outcome of sensorineural hearing loss, with one placebo-controlled, double-blind study showing a reduction from 38% (group without corticosteroids) to 14% (group with corticosteroids). However, the data are highly variable and often outdated (13, 14).

Pneumococcal meningoencephalitis can be prevented by vaccination. Vaccines against Streptococcus pneumoniae, such as pneumococcal conjugate vaccine (PCV) and pneumococcal polysaccharide vaccine (PPSV), are available and recommended for infants, children, older adults and people with certain medical conditions that increase their risk of infection. Studies examining the incidence of pneumococcal meningoencephalitis before and after the introduction of PCV vaccination in the United States show a dramatic decrease in incidence. In children under 2 years of age, the incidence fell from 10.16 cases per 100 000 children in 1998-1999 to 3.66 cases per 100 000 children in 2004-2005, a decrease of 64% (1, 15).

However, infection may occur despite vaccination, in which case underlying immunological disorders should be investigated. Primary immunodeficiencies (PID) known to underlie clinical disease caused by encapsulated bacteria such as *Streptococcus pneumoniae* include congenital asplenia, complement deficiency and antibody deficiency. In the study, 10% of children with invasive pneumococcal disease were found to have PID, and this rate increased to 26% in children over 2 years of age (16).

Conclusion

We report the case of a 4-month-old girl with meningoencephalitis caused by *Streptococcus pneumoniae* serotype 19A as a complication of an ear infection. Although this complication is rare, it is important to be aware of it because of the serious consequences it can have. Early recognition and appropriate treatment are crucial for a positive outcome. Further research is needed to determine the incidence of the complication, the role of corticosteroids, the prognosis of the infection and the possible pathways and underlying conditions leading to the infection. It is recommended that children who develop the complication undergo immunological screening to identify an underlying immunodeficiency.

Conflicts of interest:

All authors declare no conflicts of interest.

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