Beyond the Shunt: A Challenging Case of Congenital Hydrocephalus Complicated by Recurrent Meningitis

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ABSTRACT

Background: Hydrocephalus is a neurological condition characterized by the abnormal accumulation of cerebrospinal fluid (CSF) within the ventricles of the brain. This can lead to increased intracranial pressure and may result in cognitive or physical disabilities, as well as developmental delays.

Case Presentation: This case report describes a 9-month-old female infant with congenital hydrocephalus who was born via cesarean section. A ventriculoperitoneal (VP) shunt was placed at 3 months of age. Three days after the shunt-placement surgery, the infant developed meningitis and subsequently developed a second episode of meningitis 15 days after undergoing a second surgery.

Conclusion: This case highlights the challenges of managing congenital hydrocephalus complicated by recurrent meningitis and CSF drainage failure. Repeated infections and surgical interventions were accompanied by neurological deterioration and feeding difficulties. The clinical course underscores the importance of prompt evaluation for infection and shunt malfunction, alongside vigilant postoperative monitoring. Multidisciplinary care, nutritional support, caregiver education, and long-term developmental follow-up remain central to ongoing management.

Key words: Hydrocephalus; Meningitis; Ventriculoperitoneal shunt; Cerebrospinal fluid; Congenital hydrocephalus

Background

Congenital Hydrocephalus impacts 1 to 3 out of every 1000 babies born globally. In this case a MRI and CT scan were performed, and she was diagnosed with congenital hydrocephalus. She underwent surgery and a ventriculoperitoneal (VP) shunt was placed, and in total she has had 4 surgical procedures performed. The patient also developed meningitis after the shunt placement. An external ventricular drain was also placed in order to reduce cranial pressure, the patient also developed meningitis post-op. Meningitis is one of the most common neurological complications of hydrocephalus.

Patient Presentation and Investigations

The 2-month-old patient, the infant, was brought to the hospital with diarrhea, high fever and seizures.

She was given medication for her diarrhea and after careful evaluation and interpretation of her CT scan and MRI, was diagnosed with congenital hydrocephalus. She was admitted into the hospital when she was 3 months old and underwent surgery for the placement of a ventriculoperitoneal (VP) shunt. The surgery was performed 15 days after diagnosis, and the patient had meningitis 3 days post surgery. Overall, the infant underwent 4 surgical procedures and developed meningitis after 2 of them. An external ventricular drain was also placed however it became blocked. When the patient was being breastfed, she was consuming almost 7 ounces of milk and is now on an NG-bolus tube. After the illness the patient became lethargic, had stomach pain and edema in the hands and feet.

Complications and Diagnostic Approach

The accumulation of CSF due to hydrocephalus resulted in an increase in the patient's head size. The patient's external ventricular drain (EVD) also failed, and there was a recurring pattern of meningitis following surgical interventions. The lack of improvement despite multiple interventions and limited clinical progress raised concerns about a persistent underlying infection.

The diagnosis of hydrocephalus was supported by the patient's history of seizures, vomiting, lethargy, and fever, along with MRI and CT findings obtained at 2 months of age. Further evidence included the placement of a ventriculoperitoneal (VP) shunt, subsequent EVD failure, and the need for multiple neurosurgical procedures. Recurrent infections with MRSA and Pseudomonas aeruginosa, along with repeated episodes of meningitis following shunt placement, suggested possible shunt obstruction and impaired CSF circulation, contributing to increased intracranial pressure. The patient's poor developmental status and difficulty with feeding further suggested significant neurological compromise.

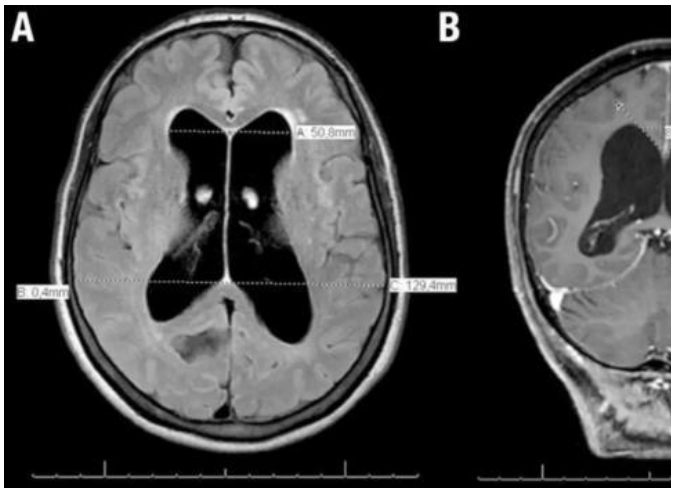


Figure 1. Neuroimaging features of hydrocephalus (source illustration as supplied; image attribution: reference 9).

1. Meningitis 2. Ventriculitis 3. Sepsis

4. Epilepsy secondary to CNS pathology

This CSF analysis from the 9 months old female reveals:

1. Elevated WBC (35cells/mm³) with lymphocytic predominance: Suggestive of viral or tuberculous meningitis rather than bacterial etiology. 2. Markedly raised CSF protein (1694mg/dl): which is a significant prognostic indicator associated with severe CNS inflammation or blood- brain barrier disruption. 3. Normal CSF glucose (50mg/dl): indicates absence of hypoglycorrhachia which reduces the likelihood of pyrogenic bacterial meningitis. 4. Negative gram stain and AFB stain: no direct microorganisms' identification; clinical and serological correlation recommended.

• 1st Surgery: Shunt placed at 3 months of age.

• Shunt Revision (2nd): Following first meningitis episode, 15 days post-surgery.

• Shunt Revision (3rd): After recurrence of meningitis (~15 days post 2nd surgery).

• 4th Surgery: Current/planned admission.

Vancomycin was initiated after the diagnosis of MRSA and Pseudomonas aeruginosa and remains ongoing. Before admission to Dr. Akbar Niazi Teaching Hospital (ANTH), a local doctor prescribed Linezolid and Panadol for fever management.

Recurrent Seizures: Seizures occurred on 22nd and 23rd January.

Post-Illness Systemic Changes: Post illness patient became lethargic with edema in hands/feet, stomach pain, and constipation.

Feeding Difficulty: Patient is now on bolus tube feeding (140ml) and not taking oral feeds.

Developmental Regression: Patient was developmentally normal after birth, but became lethargic and less responsive after the illness and repeated infections.

Discussion

Hydrocephalus is classically considered a failure of cerebrospinal fluid (CSF) homeostasis that results in the active expansion of the cerebral ventricles. Infants with

hydrocephalus can present with a progressive increase in head circumference, whereas older children often present with signs and symptoms of raised intracranial pressure. [1] Hydrocephalus accounts for approximately 0.9–1.5 cases per 1,000 live births. Early diagnosis is essential, as prolonged raised intracranial pressure can result in irreversible brain damage.

The causes of hydrocephalus vary from genetic factors and developmental abnormalities to infections. Some forms are associated with recessive genetic conditions. When both parents carry a recessive gene for a particular condition, such as in cases of consanguineous marriages, there is a 25% chance that the child will inherit two copies of the recessive gene and develop the condition. [2] Spina bifida, a neural tube defect, can also disrupt the normal flow of CSF and lead to its accumulation, resulting in hydrocephalus.

Hydrocephalus is also a common complication of tuberculous meningitis (TBM), particularly in young

individuals. It is usually a late complication of TBM and develops due to inflammation and obstruction of normal CSF flow. [3] It typically presents with signs of raised intracranial pressure, which can be evaluated through appropriate neuroimaging.

Hydrocephalus is commonly managed with ventriculoperitoneal shunt (VPS) placement. Although effective, VPS carries risks such as malfunction, infection, and migration. [4] A VPS is a surgically implanted tube that drains excess CSF from the brain into the abdominal cavity, where it can be absorbed into the body's circulation. Studies have shown that VPS blockage may occur in approximately 30–40% of cases within the first year, with blockage and infection being particularly important complications in infants and neonates. [4]

External ventricular drain (EVD) placement is also a common neurosurgical procedure used to reduce intracranial pressure in emergency situations and can usually be performed with relatively little surgical time. Correct placement of the drain, together with proper management and monitoring, is essential. Any problem with the placement or management of an EVD can lead to serious complications. [4] In our patient, meningitis developed three days after shunt placement, highlighting some of the significant challenges and complications associated with the management of hydrocephalus.

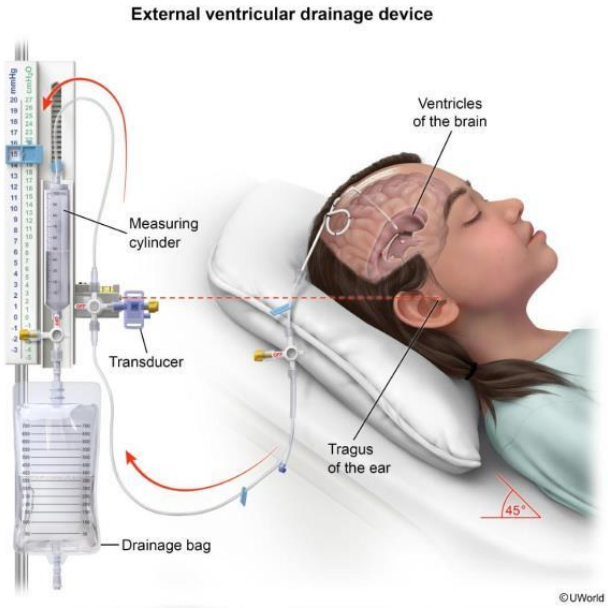


Figure 2. External ventricular drain (EVD) system (source illustration as supplied; attribution: reference 10).

Although the standard treatment of hydrocephalus is CSF shunting, there are certain circumstances in which medical treatment, either alone or in combination with shunting, has been suggested as an alternative. Drugs most frequently used include carbonic anhydrase inhibitors, loop diuretics, osmotic agents, and fibrinolytic therapy. Acetazolamide appears to be the most suitable drug, either alone or in combination with furosemide. At present, osmotic agents are no longer routinely used in the treatment of hydrocephalus. Fibrinolytic therapy administered directly into the ventricular system may not eliminate the need for shunt placement but may assist in the management of hydrocephalus by preventing or reducing catheter obstruction and accelerating clot resolution. [4]

This case study illustrates the clinical presentation and challenging course of a 9-month-old female infant with hydrocephalus. She presented with a febrile illness, vomiting, cyanosis, and seizures, indicating deterioration in her neurological status and requiring urgent medical evaluation. CT and MRI studies

performed early in infancy confirmed the diagnosis. Following diagnosis, the infant underwent surgical treatment with shunt placement.

Despite these interventions, the infant developed multiple complications, including meningitis, recurrent infections, and obstruction of the external ventricular drain (EVD), resulting in multiple hospital admissions and repeat surgeries. This case highlights some of the challenges associated with hydrocephalus in infancy, particularly the risk of recurrent infections and prolonged recovery associated with the condition.

Developmental changes, including lethargy, abnormal bowel patterns, edema, abdominal pain, and feeding difficulties, negatively affected the infant's overall health status. This case emphasizes the importance of early diagnosis, continued surveillance, timely surgical management, infection-control measures, and supportive nursing care in the management of hydrocephalus. Multidisciplinary care and long-term follow-up are vital for improving treatment outcomes and reducing complications in children with hydrocephalus. Family education, nutritional support, and close monitoring for signs of infection or shunt malfunction are also important components of ongoing care.

Hydrocephalus in infants can result from a combination of environmental and genetic factors. When a child develops hydrocephalus, the underlying cause can sometimes be determined through clinical history and radiological imaging. However, in many

cases of infantile hydrocephalus, it is not possible to identify the primary cause. In some instances, the condition may be related to an intrauterine microhemorrhage or prenatal viral infection, which can be difficult to identify and may remain undiagnosed. 8

This case also illustrates some of the challenges faced in providing pediatric neurosurgical care, particularly in resource-limited environments. One of the primary messages of this case is the importance of ensuring that infants with clinical evidence of raised intracranial

pressure are diagnosed early, undergo appropriate advanced imaging, and receive a thorough infection work-up. Delays or inaccuracies in any of these processes may adversely affect long-term neurological outcomes.[8]

DECLARATIONS

Ethics approval: Ethical approval for this case report was obtained from the Institutional Review and Ethics Board (IREB), Islamabad Medical and Dental College (IMDC), under approval number **307/IMDC/IREB-2026.**

Consent, and Confidentiality: Informed consent was obtained from the patient for publication of the case report and any accompanying clinical information or images, as applicable. Patient confidentiality and privacy were maintained throughout the preparation of this report.

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Conflict of Interest: The authors declare no conflict of interest.

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