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Multiloculated hydrocephalus developing secondary to ventriculitis and their management. Two paediatric cases

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Abstract

Background: Inflammatory ventricular processes such as meningitis, severe intraventricular haemorrhage, or ventriculitis may result in multiloculated hydrocephalus. It is a significant condition associated with high morbidity and mortality. Loculated hydrocephalus is a condition characterised by distinct, noncommunicating compartments within the ventricular system due to different etiologies.

Observation(s): Two pediatric cases, aged 0 and 5 years, with refractory ventriculitis complicated by multiloculated hydrocephalus were presented; intraventricular antibiotics were used to treat the ventriculitis, and external and closed shunt systems were used to resolve the multiloculated hydrocephalus.

Conclusion: Complex cases often complicate surgical management. Various surgical methods have been proposed for treatment, but multiloculated hydrocephalus is a complex and difficult condition to manage. To achieve success in the treatment of multiloculated hydrocephalus, there will always be a need for surgeons who are persistent and know what they are doing.

Keywords
multiloculated hydrocephalus, ventriculitis, intraventricular antibiotic therapy, triventricular hydrocephalus, treatment-resistant ventriculitis

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Introduction

Postinflammatory cystic hydrocephalus is a rare and unfortunately difficult clinical condition that is extremely resistant to treatment. It is usually associated with inflammatory ventricular processes such as meningitis, severe intraventricular hemorrhages or ventriculitis. Ventriculoperitoneal shunt and subsequent infection are also among the causes. neurosurgery and it is an important situation that is associated with high morbidity and mortality (1,2). It has been variously called "multiloculated hydrocephalus", "multiloculated ventricles", "ventricular compartmentalization", "septated ventricles" or "polycystic brain disease". Its simpler forms have been called "squeezed" or "isolated" ventricles. These simpler forms, such as unilateral isolation of the lateral ventricle, can be resolved more quickly and easily by physicians. However, more complex cases often defy the dedicated treatment of a persistent surgeon (3).

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Loculated hydrocephalus is a condition characterized by different, non-communicating compartments within the ventricular system due to different etiologies. Intraventricular septations or obstructions between the site of CSF production and the tip of the ventricular catheter can represent a barrier to the CSF flow and can result in an accumulation of fluid in the excluded compartments (4). Etiology may vary in children; the most important ones are intraventricular hemorrhage (IVH) occurring in the neonatal period or neonatal infections.Various classifications have been made according to the anatomical appearance and the location of obstruction of the cysts. The classification accepted worldwide is that of Spennato et al which distinguishes four types of loculated hydrocephalus (2).

Various surgical methods have been proposed for treatment, but multiloculated hydrocephalus is a complex and difficult condition to manage. No treatment modality has been evaluated as superior to another. All aim to improve the quality of life of the patients, reduce the number of future surgical procedures, and ensure the effectiveness of the shunt systems. Ventriculoperitoneal (VP) shunt is the most commonly used method, although in appropriate patients the endoscopic approach may also be a good option.

These latter conditions are rarely discussed in important texts or reviews on hydrocephalus and its treatment and complications. Here, we report two pediatric cases of refractory ventriculitis complicated by multiloculated hydrocephalus; in these cases, intraventricular antibiotics were used to treat the ventriculitis and external and closed VP shunt systems were used to resolve the multiloculated hydrocephalus.

CASE REPORT

Case one

In January 2025, a male baby was born by normal vaginal delivery at 32 weeks, weighing 2050 grams, and was intubated by ambulance at the first minute of birth due to a heart rate below 60/mn. The heart rate increased to 100, but oxygen saturation did not exceed 80%. The newborn was taken to intensive care. Two doses of surfactant were administered with the diagnosis of premature asphyxia and treatment was continued. When neurosurgery consultation was requested, triventricular hydrocephalus was observed in the patient's brain tomography. Ventriculoperitoneal shunt (medium pressure-12mm) surgery was performed. The patient, who was treated with Ampicillin-Amikacin in postoperative follow-ups, received antibiotics directed to the causative agent due to the development of neonatal meningitis and the shunt tip was monitored as an external ventricular drain, and the reservoir was removed.

The patient continued her treatment with multiple antibiotics due to the development of ventriculitis. Control brain computed tomography (CT) revealed multiloculated hydrocephalus. Cerebrospinal fluid (CSF) sampling was repeated at intervals. Antibiotic therapy was continued. Contrast-enhanced brain magnetic resonance imaging (MRI) was performed in consultation with pediatric infectious diseases. Empyema regressed, ventriculitis regressed, but mild contrast hemorrhage was present. Sequelae were hemorrhagic encephalomalacia areas.

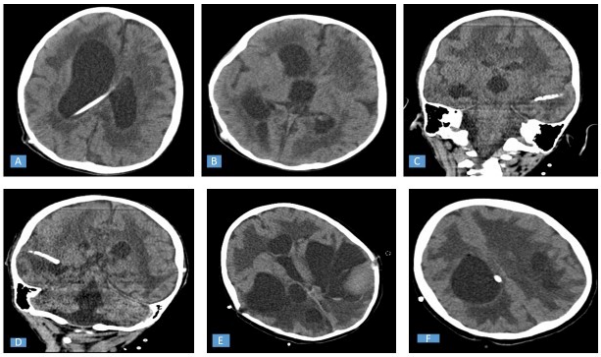

Figure 1 A: The 5-year-old male patient's infected VP shunt catheter is observed in the ventricle on the axial brain CT image. B: The patient's infected VP shunt catheter was removed, and her trihydrocephalus persists. C: Coronal brain CT showing external catheter placed in the left temporal ventricle D: Coronal brain CT showing external catheter placed in the right temporal ventricle. E: Demonstration of multiloculated hydrocephalus on axial brain CT. F: Showing external catheter tip on axial brain CT.

Based on the imaging data and the lack of response to previous antibiotic therapy, we consulted pediatric infectious diseases specialists to facilitate the management of hydrocephalus and decided to add intraventricular antibiotics to counteract refractory ventriculitis. In April 2025, the patient responded adequately to treatment and was scheduled for elective surgery due to continued elevation of

microprotein in the cerebrospinal fluid. He was discharged from the pediatric ward in good condition and with adequate oral nutrition. VP shunt surgery was performed on May 13, 2025. The patient's general condition is good and he continues to be followed up in the outpatient clinic with an effective shunt.

Case two

A 5-year-old male patient with known Leukodystrophy (genetically proven: arr (X,Y)x1, (1-22)x2) and triventricular hydrocephalus underwent surgery after it was determined that the previously applied ventriculoperitoneal shunt was infected. An external drainage system was placed in the *bilateral right and left temporal horns* and the old shunt system was removed. The CSF was observed to be turbid and draining at high pressure. In the following days, ventriculitis became complicated and antibiotic therapy was continued. CSF cultures isolated clustered gram-positive cocci and pediatric infectious diseases recommended continued treatment with antibiotic therapy. In the control CT taken in February 2025, the configurations of both lateral ventricles were distorted and contained cystic dilatations.

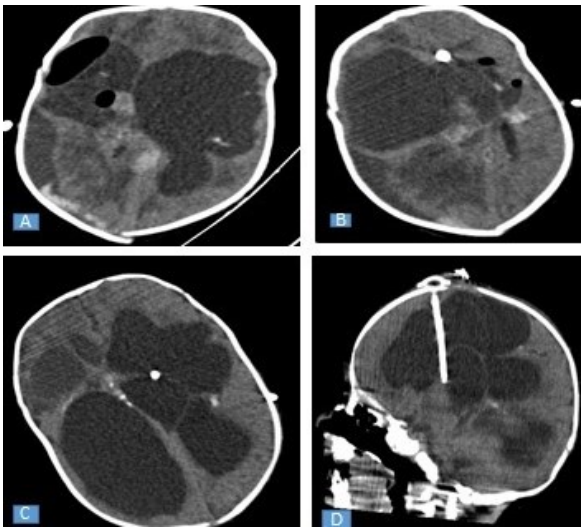

Figure 2. A:Demonstration of multiloculated hydrocephalus of 0-aged male baby on axial brain CT.B,C: Axial brain CT showing external catheter placed in the lateral ventricle and cyst. D: Electively placed VP shunt catheter is observed on sagittal brain CT.

There were proencephalic cystic appearances in the neighborhood of both lateral ventricles. The patient was diagnosed with multiloculated hydrocephalus and ventriculitis, and while his antibiotic therapy continued, his external ventricular drainage was changed 4 more times. In the control CT dated April 2025, there were cystic appearances in both cerebral and cerebellar hemispheres, the largest of which reached approximately 52 mm in diameter. During the following 3 weeks, the patient showed multiple intraventricular septations, which made hydrocephalus management difficult and led to the simultaneous use of two external ventricular drainages.

Continuous antibiotic treatment was also applied to treat the ventriculitis, which was constantly changed according to the cause. However, due to widespread fibrosis, we could not connect the entire ventricular system via external drainage to establish communication with the entire ventricular system. The patient is still receiving treatment and his general condition is poor, he is being kept alive with supportive treatment. Since the ventriculitis continues and the CSF is dirty, surgical treatment has not yet been indicated and a closed system has not been converted. As of May 2025, the patient is still being followed up in the pediatric clinic with an external ventricular drainage system.

Discussion

In neurosurgery, intraventricular antibiotics are beneficial for adults and children with refractory ventriculitis (5) However, this treatment requires further investigation as there is no consensus on its use (6). In the case of ventriculitis, multiloculated hydrocephalus makes it impossible for systemic or intraventricular antibiotics to circulate freely due to the formation of septate spaces, and the infection becomes chronic. Therefore, it is essential to communicate all septate spaces to treat the infection and hydrocephalus with a minimum number of ventricular systems (7).

Multiloculated hydrocephalus. we have presented to our readers the management of two pediatric cases with high morbidity and mortality, accompanied by multiloculated hydrocephalus and ventriculitis. The diseases were difficult to manage, mostly resistant to conventional medical treatment, and required the collaboration of pediatric and neurosurgery clinics. Both cases illustrate the difficulty of managing multiloculated hydrocephalus

secondary to ventriculitis and achieving a successful outcome.

Valdivia et al. in their two pediatric cases, they indicated that the best option was endoscopic ventricular septostomy (8). This approach avoids the excessive morbidity and mortality risks of multiple ventricular catheter placement, such as increased risk of infection and the possibility of multiple reinterventions due to catheter occlusions (5,6-8,9). It is currently one of the first options for the treatment of septate hydrocephalus to minimize morbidity and the number of ventricular catheters required.

In patients with treatment-resistant ventriculitis, if systemic antibiotics cannot be used as a suppository, intraventricular antibiotics are also an alternative modality. There are also recent studies reporting the efficacy and safety of intraventricular antibiotics in newborns. Therefore, we consulted the pediatric infectious diseases department and decided to administer intraventricular antibiotics to two of our patients. The 5-year-old patient is still struggling with ventriculitis, and the newborn was discharged with an elective reoperation planned.

Conclusion

Although multiloculated hydrocephalus secondary to ventriculitis is a difficult medical condition to manage and treat, we must surgically drain the septate cystic spaces and relieve the brain under pressure. Both conventional shunt and endoscopic methods provide success for those experienced in this disease. With the support of our pediatric clinics, it is not very difficult to achieve a cure. We will probably make a good contribution with our literature experience.

ANTIBIOTIC REGIMEN OF CASE ONE	***Specific antibiotic***	***Treatment duration***
First	Amikacin sulphate	*6 days*
Second	Ampicillin	*6 days*
Third	Fluconazole	*22 days*
Fourth	Vancomycine	*15 days*
Fifth	Meropenem	*30 days*
Sixth	iv immunoglobulin	*10 days*
Seventh	Amikacin sulphate (iv-intraventricular)	*28 days*
Eighth	Meropenem	*28 days*
Ninth	Vancomycine	*21 days*
Tenth	iv immunoglobulin	*10 days*
ANTIBIOTIC REGIMEN OF CASE TWO	Vancomycine + Meropenem	*40 days*
First	Amphotericin B	*10 days*
Second	Amikacin sulphate (iv-intraventricular)	*18 days*
Third	*Colistimethate sodium*	*20 days*
Fourth	Amphotericin B	*10 days*
Fifth	Cefepime hydrochloride	*15 days*
Sixth	Teicoplanin	*15 days*
Seventh	Amikacin sulphate	*16 days*
Eighth	Vancomycine	*15 days*
Ninth	Cefepime hydrochloride	*5 days*
Tenth	Piperacillin / Tazobactam	*10 days*
Eleventh	Cefotaxime	*7 days*
Twelfth	Ceftriaxone	*30 days*
Thirteenth	Vancomycine	*continues*
Fourteenth		

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