Case Report

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Paediatrics Section

Ventriculoperitoneal Shunting and Endoscopic Adhesiolysis of Multiloculated Obstructive Hydrocephalus in an Extreme Preterm: A Case Report

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ABSTRACT

Multiloculated obstructive hydrocephalus is a complication of infection in early life, especially in preterms. In cases of obstructive hydrocephalus with loculated fluid pockets, procedures like Ventriculo-Peritoneal (VP) shunting can target 1-2 loculi, subsequently leading to occlusion of Cerebrospinal Fluid (CSF) even after shunting, resulting in obstruction of the shunt. Incomplete treatment leads to a progressive increase in head circumference and subsequent developmental delay. Obstructive hydrocephalus in infancy poses a significant neurosurgical challenge, particularly in cases with multiloculated compartments or congenital anomalies such as aqueductal stenosis. An extreme preterm infant born at 27 weeks presented with progressive head enlargement and was diagnosed with obstructive hydrocephalus at three months of age. The child underwent right VP shunt placement, followed by a contralateral shunt after 14 months due to further obstruction. Despite this, she presented again with signs of raised intracranial pressure, and imaging revealed multiloculated hydrocephalus with midline shift. Endoscopic adhesiolysis and septostomy with fenestration were subsequently performed, resulting in clinical improvement. This case emphasises the importance of neuroendoscopy as a minimally invasive and effective alternative in selected cases of shunt malfunction, avoiding repeated shunt revisions and associated complications. This case report presents a challenging scenario of recurrent obstructive hydrocephalus in an ex-preterm infant, initially managed with VP shunt placement but ultimately requiring endoscopic adhesiolysis and septostomy due to multiple intraventricular septations and compartmentalised hydrocephalus.

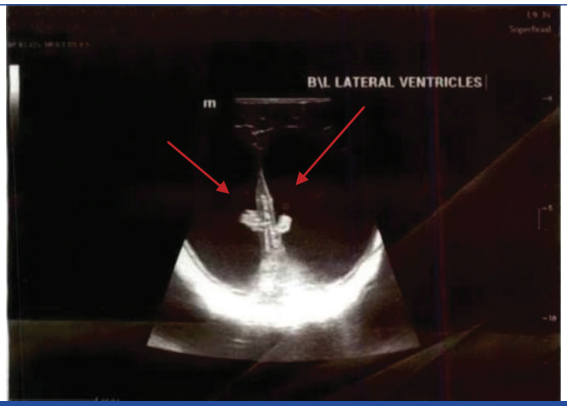
Keywords: Cerebrospinal fluid diversion, Intraventricular septation, Neuroendoscopy, Paediatric neurosurgery, Post-infectious sequelae

CASE REPORT

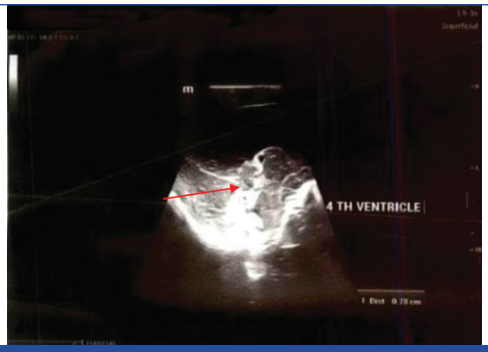
A female infant, born at 27 weeks of gestation, weighing 735 gms via Lower Segment Caesarean Section (LSCS) due to Preterm Premature Rupture of Membranes (PPROM), was admitted to the Neonatal Intensive Care Unit (NICU) with extreme prematurity and respiratory distress. She required ventilatory support and NICU care for 2.5 months. Her early course was complicated by respiratory distress, apneic spells, and anaemia of prematurity, after which she was discharged in stable condition. There was no prior history of central nervous system infection or haemorrhage. The mother (G2P1) had PPROM at 27 weeks but had no antenatal comorbidities such as diabetes, hypertension, or infection, and the previous sibling was healthy with no similar illness or congenital anomaly.

At 3 months of age, the infant was re-admitted with complaints of progressive increase in head size for the past month, accompanied by vomiting for one week. Examination revealed a lethargic but responsive infant with a bulging anterior fontanelle, "sunset sign," and signs of raised Intracranial Pressure (ICP). Vitals were stable except for mild tachycardia {Heart Rate (HR) 138/min}. No focal neurological deficits were noted. The child was admitted for further evaluation, and relevant investigations were sent for assessment.

Baseline investigations were within the normal range and CSF culture revealed no growth. CSF cell count was 138 cells/mm^3, which indicated the possibility of future infections. Ultrasonography (USG) cranium was suggestive of post-meningitic hydrocephalus likely due to aqueductal stenosis [Table/Fig-1,2]. The differential diagnoses considered were post-meningitic hydrocephalus, congenital aqueductal stenosis, and post-haemorrhagic hydrocephalus. Post-haemorrhagic and active infective causes were ruled out by sterile CSF culture, normal imaging, and absence of intraventricular bleed, confirming post-meningitic obstructive hydrocephalus due to aqueductal stenosis.



[Table/Fig-1]: Dilated bilateral lateral ventricles.

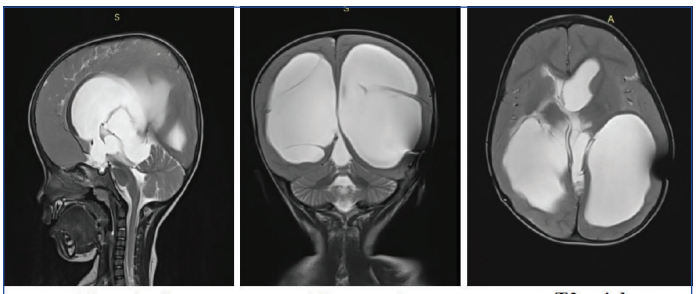


[Table/Fig-2]: Axial USG image showing dilated bilateral lateral ventricles and a normal 4th ventricle, likely aqueductal stenosis.

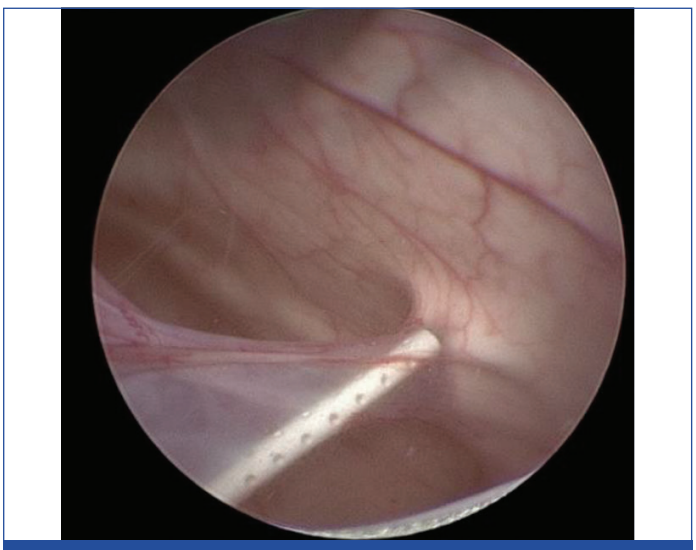
Pre-anaesthetic evaluation showed normal systemic and laboratory parameters, and the child was optimised and classified as ASA Grade III for general anaesthesia [1]. Surgery was planned and the child underwent right parietal burr-hole craniostomy with placement of a low-pressure Chhabra VP shunt, directed anteriorly toward the foramen of Monro. The peritoneal catheter was tunneled subcutaneously and placed over the liver. CSF flow was confirmed intraoperatively. The child tolerated the procedure well and was discharged on postoperative day 10 with regular follow-up advised.

After approximately 14 months post-first surgery, the child presented with features suggestive of raised ICP and VP shunt obstruction. Left-sided VP shunt insertion was performed, following which the child was doing well.

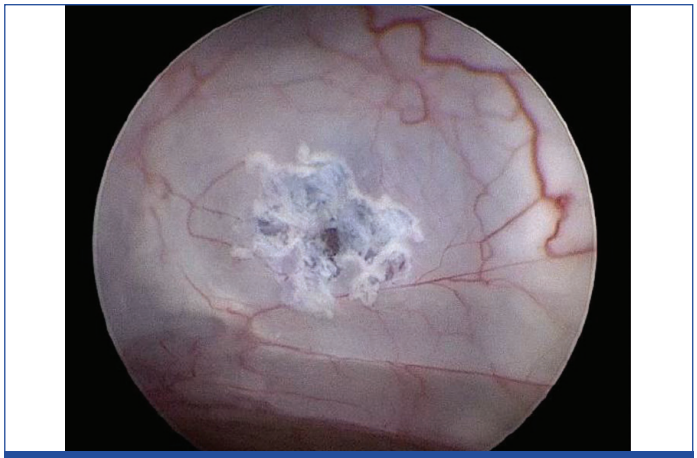
After 9 months at approximately 2 years of age, the child again presented with signs of raised ICP. Magnetic Resonance Imaging (MRI) brain revealed gross obstructive hydrocephalus with multiple internal intraventricular septations and midline shift, consistent with multiloculated hydrocephalus [Table/Fig-3]. Based on radiological findings and clinical deterioration, the child was planned for and underwent endoscopic adhesiolysis with septostomy and fenestration instead of shunt revision [Table/Fig-4,5]. Under general anaesthesia, a rigid neuroendoscope was introduced through a frontal burr hole into the lateral ventricle. Multiple intraventricular adhesions and septations were identified and carefully lysed using a monopolar probe and Fogarty catheter. Fenestrations were created to re-establish CSF communication between the loculi, ensuring unobstructed flow before achieving meticulous haemostasis and closure. After the endoscopic adhesiolysis and septostomy, the child showed steady neurological improvement and was discharged on postoperative day 5 in stable condition. She improved postoperatively and no shunt reversal surgery was required. The child is presently on regular follow-up and is clinically stable with mild motor and language delay. However, steady improvement has been noted on subsequent developmental assessments.



[Table/Fig-3]: T2 axial, coronal and sagittal image shows gross degree dilation of the bilateral lateral and third ventricles with mass effect on adjacent brain parenchyma, suggestive of obstructive hydrocephalus.



[Table/Fig-4]: Adhesions of the shunt tip seen intraoperatively.



[Table/Fig-5]: Showing septotomy done intraoperatively.

At the last follow-up, conducted two years after the endoscopic procedure, the child remained clinically stable with normal head growth and no evidence of raised intracranial pressure or shunt malfunction. Neurological examination showed mild but improving developmental delay with satisfactory motor and cognitive milestones for age. The child remains clinically stable and paediatric neuroimaging requires sedation; hence, no follow-up Computed Tomography (CT) or MRI has been performed. The patient continues under regular neurosurgical and developmental follow-up, with favourable long-term outcomes expected.

DISCUSSION

Hydrocephalus in infants, particularly when secondary to congenital or post-infectious etiologies, remains one of the most challenging entities in paediatric neurosurgery [2]. Traditional management through VP shunting has offered symptomatic relief but is frequently associated with long-term complications, including obstruction, infection, over-drainage, and repeated revisions [3]. Recent literature emphasises that complex or multiloculated hydrocephalus requires a paradigm shift from mere diversion to anatomical correction of intraventricular communication [4].

Thomale UW (2021) proposed an integrated model of hydrocephalus management emphasising the importance of understanding CSF dynamics and ventricular anatomy to guide surgical planning [5]. The author highlighted that multiloculated hydrocephalus represents a pathophysiologically distinct entity, in which fibrous septations create non-communicating compartments, rendering standard shunting inadequate for complete decompression. This observation aligns closely with the present case, wherein, despite a functioning VP shunt, persistent ventriculomegaly and midline shift necessitated further intervention [5].

Amen MM et al., (2023) conducted a comparative analysis of surgical outcomes in post-infectious hydrocephalus with multiple intraventricular septations and concluded that neuroendoscopic adhesiolysis with septostomy achieved superior results over repeat shunt insertions [6]. Their study demonstrated that endoscopic techniques restore physiological CSF pathways, reducing the need for multiple shunts and subsequent revisions. Similarly, in the present case, endoscopic fenestration successfully re-established intraventricular communication and alleviated symptoms without further shunt placement [6].

Tully HM and Dobyns WB (2014) elaborated on the etiologic classification of infantile hydrocephalus, identifying aqueductal stenosis and post-haemorrhagic or infectious causes as the most frequent culprits [7]. They emphasised that anatomical alterations following these insults often necessitate individualised management strategies. The current case, involving aqueductal stenosis evolving into multiloculated hydrocephalus, exemplifies the clinical transition described in their review and reinforces the necessity of etiology-specific approaches rather than uniform shunting protocols [7].

Alojan A et al., (2021) presented a case series evaluating outcomes of endoscopic adhesiolysis in post-infectious multiloculated hydrocephalus, demonstrating that targeted endoscopic fenestration achieved substantial ventricular decompression, with a reduced need for multiple shunts [8]. Their results parallel the present experience, where neuroendoscopic management provided durable clinical improvement following shunt obstruction and multiple compartmental loculations on imaging [8].

The global consensus reported in the Hydrocephalus 2019 meeting abstracts by Zwimpfer TJ (2019) further substantiates this shift in neurosurgical practice [9]. International data reflect a progressive move toward endoscopic management as either a primary or adjunctive procedure for complex ventricular pathologies, particularly in infants with multiloculated or post-infectious forms. Endoscopy not only improves anatomical restoration but also mitigates long-term shunt dependency and enhances neurodevelopmental outcomes [9].

When compared across these studies, the key difference lies in therapeutic philosophy: VP shunting focuses on bypassing CSF obstruction, while endoscopic techniques address the root cause, ventricular compartmentalisation [10]. The literature consistently indicates that repeated shunt revisions without addressing septations are unlikely to yield sustainable outcomes. Instead, neuroendoscopic adhesiolysis with septostomy offers superior control of intracranial pressure, decreased revision rates, and improved quality of life [7,9].

In the present case, neuroendoscopic fenestration following recurrent shunt failure resulted in clinical stabilisation and radiologic improvement without requiring additional shunts, consistent with findings from Amen (2023) and Alojan (2021) [6,8]. Thus, this comparative evaluation reinforces that endoscopy, when feasible and performed by experienced hands, represents a more definitive and individualised approach in the management of multiloculated infant hydrocephalus than repeated VP shunt interventions.

CONCLUSION(S)

This case highlights the challenges of managing recurrent hydrocephalus in a preterm infant. Despite bilateral VP shunt placement, the patient developed multiloculated hydrocephalus requiring further intervention. Endoscopic adhesiolysis with septostomy should be considered a safe and effective treatment in managing shunt adhesions instead of shunt reversal, as seen in this case where obstruction was managed endoscopically and shunt is well functioning even after 2 years of surgery . Neuroendoscopy offers a minimally invasive alternative to repeated shunt revisions in selected cases.

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