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A CASE REPORT OF SUSPECTED RARE ANOMALY AQUEDUCTAL STENOSIS BY WEB CAUSING HYDROCEPHALUS OBSTRUCTIVE IN PEDIATRIC

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ABSTRACT

The aqueductal web is a rare congenital anomaly where a thin membrane obstructs the aqueduct of Sylvius, disrupting cerebrospinal fluid (CSF) flow and leading to obstructive hydrocephalus. This condition can be challenging to diagnosis, particularly in settings with limited access to advanced imaging. This report discusses a six-month-old male infant presenting with progressive head enlargement, vomiting, and irritability. A head CT scan revealed dilated lateral and third ventricles suggestive of obstructive hydrocephalus, likely caused by an aqueductal web. Due to limited access to MRI and endoscopic third ventriculostomy (ETV) facilities in the local healthcare setting, a ventriculoperitoneal (VP) shunt was chosen as the treatment. The patient underwent VP shunt placement, which successfully diverted excess CSF, reduced intracranial pressure, and improved clinical symptoms. Postoperative management included prophylactic antibiotics, with no significant complications observed apart from a localized hematoma. Early diagnosis and appropriate management of obstructive hydrocephalus due to the aqueductal web are essential to prevent long-term neurological damage. While MRI remains the gold standard for detailed diagnosis, CT remains crucial with limited resources. VP shun remains a reliable intervention in such settings, with good clinical outcomes when managed appropriately.

KEYWORDS

Aqueductal web, Obstructive hydrocephalus, Cerebrospinal ventriculoperitoneal shunt, Pediatric neurosurgery

INTRODUCTION

The brain is the most complex structure in the central nervous system, responsible for vital functions such as motor, sensory, cognitive, and emotional activities. Within the human brain is a network of cavity structures known as the ventricular system, which includes the lateral, third, and fourth ventricles interconnected by foramina1. These ventricles are filled with a clear and transparent fluid called cerebrospinal fluid (CSF), which plays several critical roles, including the removal of metabolic waste from the brain, maintaining a homeostatic environment, and regulating intracranial pressure (Telano and Baker, 2025).

Hydrocephalus can occur due to obstruction of CSF flow. The small size of the aqueductus Sylvii can lead to significant blockage, resulting in increased ventricular volume as fluid accumulates within the brain's ventricles. This condition can be congenital or acquired, either extrinsically or intrinsically. As a congenital disorder, it is rare, with an estimated incidence of approximately 1 in 5,000 births. One potential cause of obstruction is the presence of anatomical structures such as membranes or tissues blocking the CSF pathway within the aqueductus Sylvii (Farb and Rovira, et al., 2020).

Neuroimaging techniques, including ultrasonography and magnetic resonance imaging (MRI), are crucial for diagnosing obstructive hydrocephalus and identifying its causes, as these methods provide detailed characteristics and their relationship with surrounding brain structures. In this study, we report a case of suspected aqueductus Sylvii obstruction caused by an aqueductal web, diagnosed through a head CT scan in a seven-month-old patient, regarding management in developing countries such as Indonesia, the use of MRI flow studies and the implementation of ETV cannot yet be established as standard practice due to limited resources.

MATERIALS AND METHODS

This study applies a descriptive case report approach. Clinical evaluation began with anamnesis obtained from the patient's parents regarding the main complaints of progressive head enlargement, vomiting, and irritability, followed by detailed physical and neurological examinations. Further assessment was conducted using a head computed tomography (CT) scan to identify ventricular dilatation and possible cerebrospinal fluid obstruction. Based on the clinical and radiological findings, the patient was diagnosed with suspected obstructive hydrocephalus secondary to aqueductal stenosis caused by an aqueductal web. Therapeutic management was performed through ventriculoperitoneal (VP) shunt placement. The clinical course, postoperative outcome, and radiological findings were subsequently reviewed in relation to current literature to evaluate diagnostic considerations and management outcomes in resource-limited settings.

RESULTS

A six-month-old male infant, the second of two siblings, weighing 12.9 kg, was brought to the emergency department with symptoms of progressive head enlargement over the past four months, accompanied by nausea and vomiting five times and fever for four days. The infant had developed normally until the age of two months, after which his mother noticed rapid and abnormal head enlargement. There was no significant history of trauma or infection. However, the infant was delivered via cesarean section at 39–40 weeks of gestation due to oligohydramnios and aspiration, which had been identified through ultrasonography at 32 weeks of pregnancy. The mother admitted to frequently missing antenatal visits during the pregnancy. Preoperative VP shunt shows in Figure 1, with the front view (1A) and side view (1B).

Physical examination revealed an irritable infant who cried without apparent cause, with a good level of consciousness (GCS 15) and vital signs within normal limits. On localized head examination, the infant's head appeared enlarged, with a bulging anterior fontanel, dilated peripheral veins, a head circumference of 78 cm, and positive sunsetting of the eyes sign. A computed tomography (CT) scan of the head confirmed obstructive hydrocephalus at the level of the aqueductus cerebri, which was suspected to be caused by an aqueductal web (shows in Figure 2).

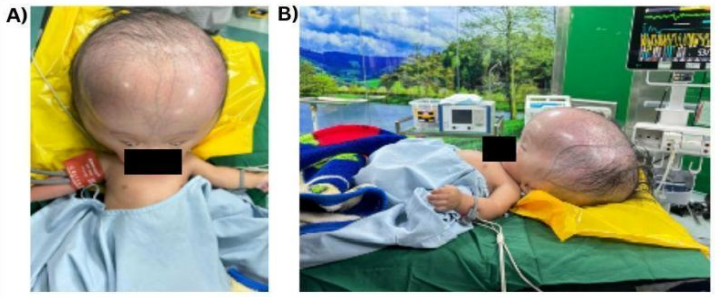

Figure 1. Preoperative VP shunt in a six-month-old male infant. A) front view; B) side view.

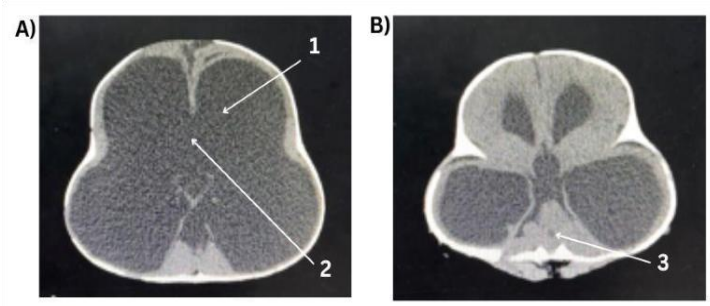

Figure 2. Preoperative CT scan with axial section. A) dilation of the lateral ventricle (1), dilation of the third ventricle (2); B) patient aqueductus Sylvii (3).

Based on the anamnesis results, physical examination, and radiological findings, the patient was scheduled to undergo a VP shunt placement procedure. This procedure was performed under general anesthesia, involving the placement of a VP shun to divert excess CSF from the brain's ventricles to the peritoneal cavity, aiming to reduce intracranial pressure (Figure 3).

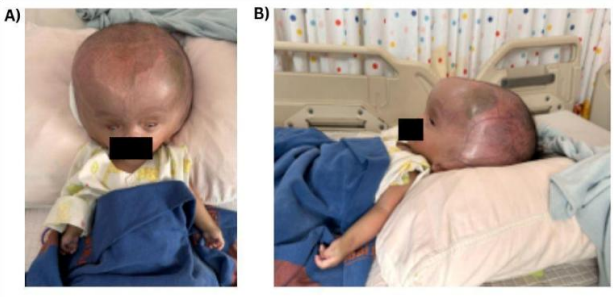

Figure 3. Postoperative VP shunt in a six-month-old male infant. A) front view, and B) side view.

After the surgery, the patient was instructed to position the head at a 30-degree elevation and was given intravenous paracetamol 3x150 mg and ceftriaxone 2x600 mg as prophylaxis in case of postoperative VP shunt infection. The patient's postoperative neurological condition appeared stable, with reduced irritability and vomiting, and the infant's development showed progress. No significant postoperative complications were observed, except for a hematoma in the tomporoparietal region.

DISCUSSION

Hydrocephalus is a neurological condition characterized by abnormal (CSF) accumulation within the brain's ventricles. This accumulation leads to ventricular dilation, brain tissue damage, and various symptomatic manifestations. Hydrocephalus can be classified into communicating and non-communicating (obstructive) types based on its pathophysiology. Infections, hemorrhages, congenital stenosis (both idiopathic and genetic), pineal region tumors, and cerebral vascular malformations are causes of obstructive hydrocephalus. However, stenosis or obstruction of the aqueductus Sylvii is the most common cause of obstructive hydrocephalus (Masarwy et al., 2024).

An aqueductal web is a rare structural abnormality in the brain where a membrane or thin tissue blocks the aqueductus Sylvii. This narrow channel connects the third and fourth ventricles in the brain's ventricular system (Osman, 2025). This channel is crucial for CSF flow, which protects the brain and spinal cord. The cerebral aqueduct is a narrow 15 mm conduit that allows (CSF) to flow between the third and fourth ventricles (Rubino and Hogg, 2025).

The aqueductal web is clinically significant due to its potential association with other neurological anomalies, including hydrocephalus. It typically consists of ependymal cells and fibrillary neuroglia and can cause disruptions in CSF flow. This obstruction is localized and may have subtle anatomical differences compared to general stenosis. The obstruction can lead to CSF buildup in the ventricles (obstructive hydrocephalus). Its prevalence is difficult to determine because its severity varies, and it is often asymptomatic. Hydrocephalus usually manifests with symptoms early on, but compensatory mechanisms may delay symptoms until adulthood, making it frequently unnoticed (Masarwy et al., 2024).

CSF is produced by the choroid plexus in the brain's ventricles, particularly in the lateral ventricles. From the lateral ventricles, CSF flows into the third ventricle through the Monro foramen. It then flows into the fourth ventricle via the Sylvian aqueduct. After reaching the fourth ventricle, CSF exits the brain through three main pathways: the Luschka foramen (two lateral openings) and the Magendie foramen (the central opening) into the subarachnoid space surrounding the brain and spinal cord. In the subarachnoid space, CSF circulates the brain and spinal cord, protecting and nourishing the central nervous system. CSF is then absorbed into the bloodstream through the arachnoid villi in the superior sagittal sinus. This absorption allows continuous CSF circulation, maintaining fluid balance in the brain and spinal cord and regulating intracranial pressure (Zhang et al., 2024). Classical theory of CSF circulation shows in Figure 4.

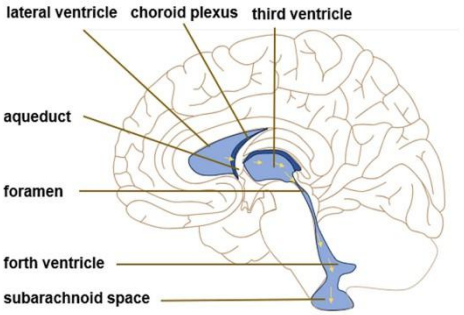

Figure 4. Classical theory of CSF circulation. CSF is absorbed from the third and fourth ventricles into the subarachnoid space through the secretion of the CP pathways. The yellow arrows indicate the direction of CSF flow (Zhang et al., 2024).

CT scan and MRI imaging are often the primary choices in the diagnostic process and therapy monitoring. MRI is generally selected as the gold standard due to its advantage in avoiding radiation exposure, making it a safer method, especially for patients with long-term needs. However, the limited availability of MRI equipment often presents a challenge in clinical practice (Schabi et al., 2022). Figure 5 shows a preoperative sagittal CT scan of the patient.

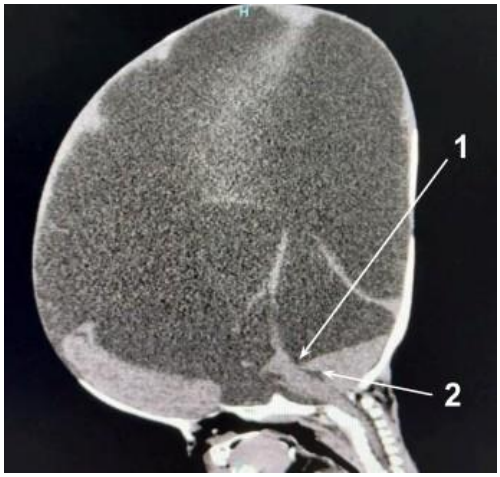

Figure 5. Preoperative sagittal CT scan of the patient. 1) the aqueductus Sylvii is narrowed; 2) the size of the fourth ventricle appears normal.

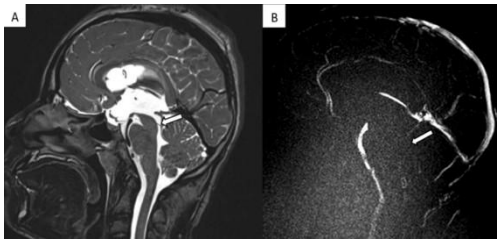

Figure 6. A) Sagittal T2 TSE image demonstrating aqueductal web; B) Sagittal phase contrast, MAG sequence, showing the absence of flow across cerebral aqueduct and fourth ventricle. Flow related signals at the level of the foramen magnum may be muted due to upstream obstruction (Masarwy et al., 2024).

Obstructive hydrocephalus suspected to be caused by an aqueductal web requires an accurate diagnosis to determine the appropriate therapy. Diagnosis via high-resolution imaging is necessary for definitive management. MRI is the modality of choice for assessing aqueductal obstruction, and sagittal

T2 sequences are suitable for revealing the presence of an aqueductal web (Figure 6). MRI provides detailed visualization of brain structures, depicting stenosis or obstruction in the Sylvian aqueduct due to the aqueductal web. For this reason, MRI is essential for diagnosing and planning surgical interventions (Masarwy et al., 2024).

CSF diversion is the primary treatment for obstructive hydrocephalus caused by the aqueductal web. Neurosurgical options include endoscopic aqueductoplasty (EAP), endoscopic third ventriculostomy (ETV), and ventriculoperitoneal shunt (VPS). Endoscopic aqueductoplasty (EAP) can restore CSF flow in obstructive hydrocephalus due to aqueductal stenosis but requires careful patient selection and long-term follow-up due to the risk of restenosis. Endoscopic third ventriculostomy (ETV) is generally preferred for patients over 10 years old with aqueductal stenosis, as it bypasses the obstruction and has fewer complications and lower mortality compared to ventriculoperitoneal shunting (VPS), based on meta-analysis findings (Masarwy et al., 2024; Badran et al., 2025).

Phase-contrast CSF flow imaging and accurate, fast imaging with steady-state precession (TrueFISP) sequence represent complementary MRI sequences that can be helpful in the evaluation of CSF flow obstructions. TrueFISP allows for cinematic imaging of tissue pulsatility and fluid dephasing. In an obstructed cerebral aqueduct, relative increases in lateral and third ventricular pressures cause outward-convex bowing of the floor of the third ventricle and the lamina terminalis (Figure 7) (Masarwy et al., 2024; Ichikawa et al., 2017).

In Indonesia, the implementation of ETV cannot yet be established as a standard practice due to limited resources. So, for this case, the VP shunt procedure is chosen to manage excess CSF and reduce intracranial pressure. If VP Shunt is successful, shunting from the lateral ventricles can help normalize the size of the ventricles. Postoperatively, there are potential complications, including the risk of postoperative infection (Fowler et al., 2025; Javeed et al., 2023).

CONCLUSIONS

Aqueductal web is a rare but important cause of obstructive hydrocephalus, particularly in infants. Early clinical recognition and accurate neuroimaging, ideally using MRI, are essential for diagnosis and surgical planning. In resources-limited settings, where MRI and ETV are not readily available, CT scans and VP shunts remain effective and practical tools for management. Timely intervention can lead to significant improvement in clinical symptoms and overall prognosis.

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