PEDIATRIC PRIMARY INTRAVENTRICULAR HEMORRHAGE: A CASE REPORT OF ISOLATED 4TH VENTRICLE HEMORRHAGE IN A 10-YEAR-OLD BOY

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KEY CLINICAL MESSAGE:

Primary Intraventricular Hemorrhage (PIVH) is a rare condition in pediatric patients, presenting with headache, vomiting, and altered mental status. Surgical interventions, such as External Ventricular Drain (EVD) placement, followed by ventriculoperitoneal shunting, show promising outcomes. Further research is needed to enhance understanding and optimize management strategies for pediatric PIVH.

ABSTRACT:

This case report describes a 10-year-old boy with isolated PIVH in the fourth ventricle, shedding light on its clinical presentation and management challenges. The patient presented with headache, vomiting, and altered sensorium, and was subsequently diagnosed with obstructive hydrocephalus due to intraventricular bleeding. Emergency External Ventricular Drain (EVD) insertion was performed, followed by ventriculoperitoneal shunt placement, resulting in a favorable outcome. The etiology of PIVH in children differs from that in adults, with arteriovenous malformations, Moya Moya disease, and aneurysms being commonly implicated causes. Management strategies for pediatric PIVH are challenging due to limited research, but EVD placement and surgical interventions have shown promise.

KEYWORDS: Pediatric Intraventricular hemorrhage, Pediatric Neurosurgery, External Ventricular Drain, Ventriculoperitoneal Shunt

INTRODUCTION:

Primary Intraventricular Hemorrhage (PIVH) refers to bleeding that occurs specifically within the ventricular system of the brain, without any involvement or bleeding within the surrounding brain tissue. It is a rare occurrence comprising approximately 3.1% of non-traumatic central nervous system hemorrhages [1]. While there is some literature on the etiology, clinical features, and management of PIVH in adults, the understanding of this condition in the pediatric population is limited, posing challenges in identifying its characteristics and developing specific management protocols. Available reports suggest that arteriovenous malformations, Moya Moya disease, and aneurysms are among the commonly implicated causes in pediatric cases [2]. Surgery, particularly the use of an External Ventricular Drain (EVD) to alleviate intracranial pressure in case of acute hydrocephalus, remains the primary approach documented in the literature [2]. Due to the significant risks of mortality and neurological impairment associated with primary intraventricular hemorrhage (PIVH), it is imperative to thoroughly report and discuss the key features of this condition in the pediatric population. In this context, we present a rare case of isolated PIVH in the fourth ventricle observed in a 10-year-old boy.

CASE REPORT:

A 10-year-old child presented with a one-day history of headache and vomiting, followed by altered sensorium. He was not taking any medications and had no history of trauma. There was no history of perinatal complications, all vaccinations were administered on schedule, with timely achievement of developmental milestones. Upon initial examination, the patient did not exhibit fever, rash, or meningeal symptoms. He was hemodynamically stable, had a clear airway, and was breathing normally; his Glasgow coma scale was E3V2M3, both pupils were equally reactive to light with a size of 4mm, and no papilledema or neck stiffness. However, following admission, the patient's Glasgow Coma Scale score deteriorated to E1V1M3 with pupils reacting to light bilaterally equally, necessitating intubation and elective ventilation.

The results of various medical tests, including complete blood count, measurements of urea and electrolyte measures, C-reactive protein levels, glucose levels, liver function tests, and clotting profiles, were within normal ranges. Initial brain scan using computed tomography (CT) revealed a recent bleeding episode in

the fourth ventricle with obstructive hydrocephalus. No bleeding was observed within the brain tissue itself or in the subarachnoid space. The magnetic resonance imaging (MRI) brain confirmed the findings and magnetic resonance angiography (MRA) revealed no vascular abnormality (**Figure 1A-F**).

Emergency External Ventricular Drain (EVD) insertion was performed following which his GCS improved to E3VtM5. After 6 hours, he was extubated and the next day his GCS was E4V5M6. On day 6, his external ventricular drain was changed to ventriculoperitoneal shunt. The post-procedure period was uneventful, and a repeat CT scan done showed resolving hematoma inside the fourth ventricle. At the time of discharge, the patient was symptomatically better, neurologic status improved and GCS E4V5M6, without any neurologic deficit to the patient. Post discharge, the child was closely monitored and was asymptomatic. A repeat CT taken after 60 days showed complete resolution of hematoma and a CT brain with angiogram done after 2 months (**Figure 2A and 2B**) ruled out any vascular anomalies.

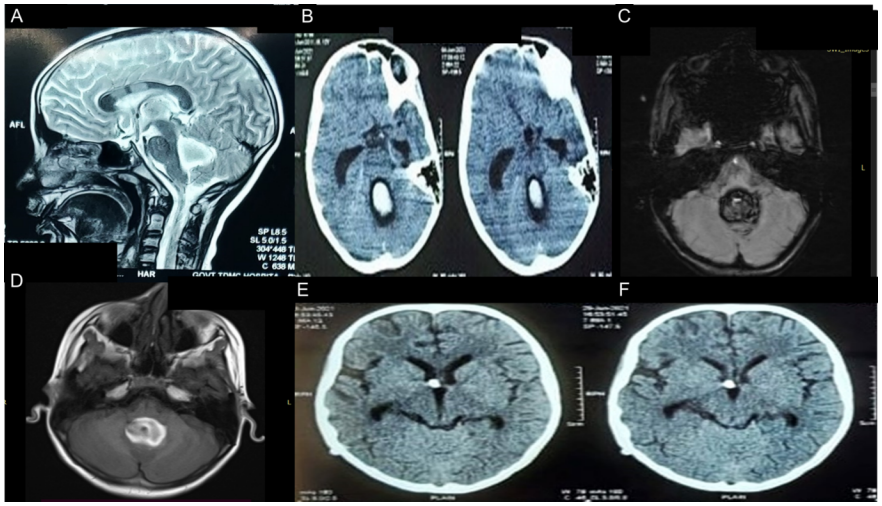

Figure 1A: MRI showing isolated hemorrhage in the 4^{th} ventricle. **1B:** CT scan showing a hyperdense area of blood density noted within 4th ventricle, likely Intraventricular hemorrhage. Upstream dilatation of bilateral lateral and 3rd Ventricle is noted, possibly due to obstructive hydrocephalus.**1C:** Susceptibility Weighted Image showing blooming foci in the 4th Ventricle. **1D:** T1 weighted image showing hyperintense area within 4th Ventricle. **1E, F:** CT scan taken after VP shunt showing EVD tube in situ with tip in the right lateral ventricle. Mild hydrocephalus (reduced) seen.

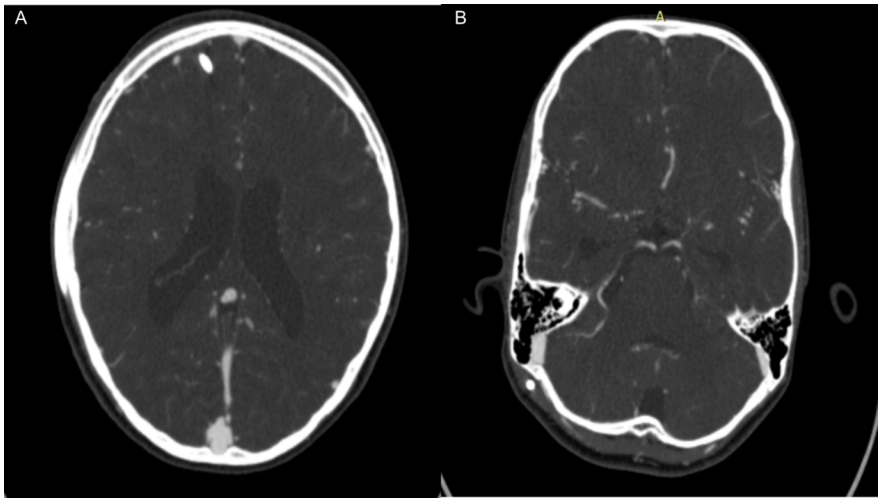

Figure 2A and 2B: CT angiogram taken after resolution of bleed 2 months after discharge

DISCUSSION:

Primary intraventricular hemorrhage (PIVH) is an uncommon condition characterized by bleeding within the ventricles of the brain, lacking any parenchymal or subarachnoid bleeding. While there is a growing body of research on PIVH in adults, the understanding of this condition in the pediatric population remains limited. This case report presents a 10-year-old child with PIVH, shedding light on the clinical presentation and management challenges.

This scarcity of studies has made it difficult to consistently identify characteristic features of PIVH in children. Headache has consistently been reported as the most frequent presenting symptom in patients, followed by vomiting and loss of consciousness [2.3]. In contrast, a study by Weinstein et al. found altered mental status to be the most commonly reported presenting symptom, followed by headache and nausea [1]. These findings align with our case, where the child initially presented with headache and vomiting, and altered sensorium. In adult populations, hypertension has been identified as the most common etiology for PIVH [1,4]. However, the etiology of PIVH in children differs from that in adults. Vascular malformations, such as arteriovenous malformations (AVMs), Moya Moya disease, and aneurysms, can lead to intraventricular hemorrhage in children [2]. Other potential etiologic factors include coagulopathies, choroid plexus tumors and cysts, and arteritis. It is crucial to consider these underlying causes when evaluating pediatric patients with PIVH.

Management strategies for primary intraventricular hemorrhage (PIVH) in pediatric patients pose significant challenges, as there is limited research specific to this population. In the case presented, an external ventricular drain (EVD) was inserted to alleviate obstructive hydrocephalus. EVD is a commonly employed method for draining cerebrospinal fluid and reducing intracranial pressure in PIVH cases. However, it is worth noting that EVD alone may be insufficient, as blood clots often occlude the drain [5]. In a study by Guo et al., surgical intervention was the predominant treatment modality, with 83.3% of patients undergoing surgical procedures, while the remaining received conservative treatment [2]. The management of PIVH with obstructive hydrocephalus involves the placement of an external ventricular drain (EVD) and is the preferred method of treatment [2]. In cases involving arteriovenous malformations (AVMs), various surgical interventions, such as resection, endovascular embolization, or stereotactic radiation, were employed [2]. PPIVH patients diagnosed with aneurysms were subjected to a combined treatment approach involving the placement of an external ventricular drain (EVD) and subsequent endovascular embolization [2]. Notably, ventriculoperitoneal shunting was not employed as part of the management strategy for any of the pediatric patients in this study [2].

Certain prognostic factors play a significant role in determining the outcome of PIVH. In particular, the initial level of consciousness, presence of early hydrocephalus, and timely diagnosis of intracranial aneurysms can adversely affect patient outcomes. These factors may lead to severe neurological deficits and increased mortality rates. Further research is needed to identify additional prognostic indicators specific to pediatric PIVH cases, allowing for improved risk stratification and tailored management approaches.

While the presented case report highlights the successful management and favorable outcome in the reported patient, it is important to acknowledge the limitations of this study. One significant limitation is the limited comparative analysis, which is also due to the limited availability of literature on PPIVH. This prevents a comprehensive understanding of the condition and its management options. Future studies should aim to address this gap by conducting larger-scale investigations and drawing comparisons with similar cases in the literature.

CONCLUSION:

PIVH in pediatric patients remains a challenging condition due to its rarity and limited research on this specific population. This case report adds to the existing knowledge on pediatric primary intraventricular hemorrhage (PIVH) by providing insights into the clinical presentation, management approach, and favorable outcome in a pediatric patient, highlighting the potential efficacy of a combined strategy involving external ventricular drain (EVD) placement and subsequent ventriculoperitoneal shunting. However, further research is warranted to better understand the etiology, prognostic factors, and optimal management strategies for pediatric PIVH, enabling improved outcomes for affected children.

DECLARATIONS:

LIST OF ABBREVIATIONS:

PIVH - Primary Intraventricular Hemorrhage

EVD - External Ventricular Drain

CT - Computed Tomography

MRI – Magnetic Resonance Imaging

MRA - Magnetic Resonance Angiography

AVMs - Arteriovenous Malformations

CONFLICTS OF INTEREST:

None declared.

AUTHOR CONTRIBUTION:

All the authors contributed equally in drafting, editing, revising and finalizing the case report.

ETHICAL APPROVAL:

The ethical approval was not required for the case report as per the country's guidelines.

CONSENT:

Written informed consent was obtained from the patient to publish this report.

DATA AVAILABILITY STATEMENT:

The data that support the findings of this article are available from the corresponding author upon reasonable request.

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