



Received: 10-09-2026
Accepted: 20-10-2026

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Ultrasonography (USG) Imaging of Neonatal Periventricular Leukomalacia- Role of Serial USG Cranium Imaging: A Case Study

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Abstract

Periventricular leukomalacia (PVL) is a common CNS complication in preterm infants.

It is otherwise known as neonatal White matter injury.

After periventricular haemorrhage, PVL is the second most common CNS complication in preterm neonates.

USG of cranium is a bedside examination & is fast, therefore ideal for premature infants. It is radiation free & can be repeated as required. The cause of PVL is ischemia but infection & vasculitis play an additional role. It occurs in premature infants born at less than 32 weeks gestation and less than 1500gm birth weight. In these neonates serial cranial USG is the standard of care as it is widely available, inexpensive & non-invasive. The modality is good for

assessment in early stages of PVL & results are good predictors in sub acute and chronic stages.

Detection of PVL is important as premature infants with PVL develop cerebral palsy, intellectual impairment or visual disturbances. At most half of infants with PVL develop cerebral palsy. USG scans often shows cystic periventricular leukomalacia within 14 days after injury. So, serial USG cranial scans with high resolution probe after 2 weeks of life is required to find out all cases of PVL.

It is classified into four grades. In term infants it may also be seen in small percentage of cases. MRI is important in acute as well as subacute and chronic phases.

Keywords: USG Cranium, PVL, Preterm Neonate, Term Neonate, Serial USG

Introduction

Periventricular leukomalacia (PVL) is the second most common CNS complication in preterm neonates. It is otherwise known as neonatal white matter injury, also known as hypoxic-ischemic encephalopathy of the preterm. It occurs commonly in premature infants born at less than 32 weeks of gestation and less than 1500 g birth weight.

USG of the cranium is a bedside examination and is fast, non-invasive, radiation free procedure and is widely available and inexpensive. In PVL cases, serial cranial USG is the standard of care. It is good for assessment in the early stages of PVL and the results predict about the subacute and chronic stages. PVL is classified into four grades. MRI is important in acute as well as subacute and chronic phases.

Ischemia was thought to be the single cause of PVL, but other causes such as infection and vasculitis also found to be involved. In significant percentage of surviving premature infants with PVL, cerebral palsy, intellectual impairment, and visual disturbances found. It is rare in term infants. It may be found in 27.9% term infants (in specific cardiac cases). In our case, PVL found in a term infant with no Cardiac disease.

Case Report

Our patient, a term male neonate was admitted to our hospital on 25/07/2025 from a private hospital, where seizures and respiratory distress was initially managed. The neonate admitted to our neonatology unit was single, term, appropriate for gestation age, vaginal delivery and it was suspected obstructed labour. The child has delayed/no cry after birth which is not clear from birth history.

The neonate has perinatal asphyxia HIE II & neonatal seizures. The neonate was having poor activity, had sutural diastasis & had full anterior fontanelle.

Immediately oxygen, antiepileptics, and antibiotics started due to elevated CRP and the screening for sepsis positive. Despite therapy, seizures persisted and were not associated with autonomic disturbances, leading to stepwise escalation of antiepileptic

with additional drugs. Over course of admission, frequency and duration of seizures gradually reduced and antiepileptics were tapered.

Lumbar puncture done with no significant result.

CRP was elevated with normal ketones & mildly elevated ammonia. Serum lactate also elevated. TSH was normal.

Serial USG cranium done with high resolution probe atleast four times since admission of the neonate to the day of discharge which revealed grade IV periventricular leukomalacia (white matter injury). Lot of cystic changes in frontoparietal and occipital region with septation noted. Subcortical cysts also extensively seen (Fig 1-5). Thalamus was mildly echogenic & corpus callosum thin posteriorly, with no other findings of partial agenesis of corpus callosum. Therefore advised MRI brain once the infant becomes stable and on the day of discharge of patient, the same USG cranium findings were there.



Fig 1: Grade IV PVL with lot of cystic areas and septations



Fig 2: Grade IV PVL in frontal lobe

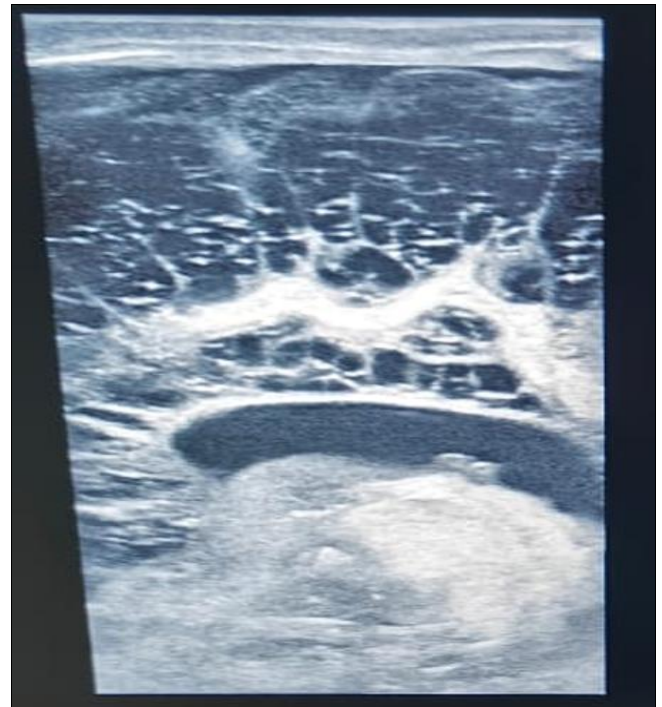


Fig 3: Grade IV PVL



Fig 4: Grade IV PVL

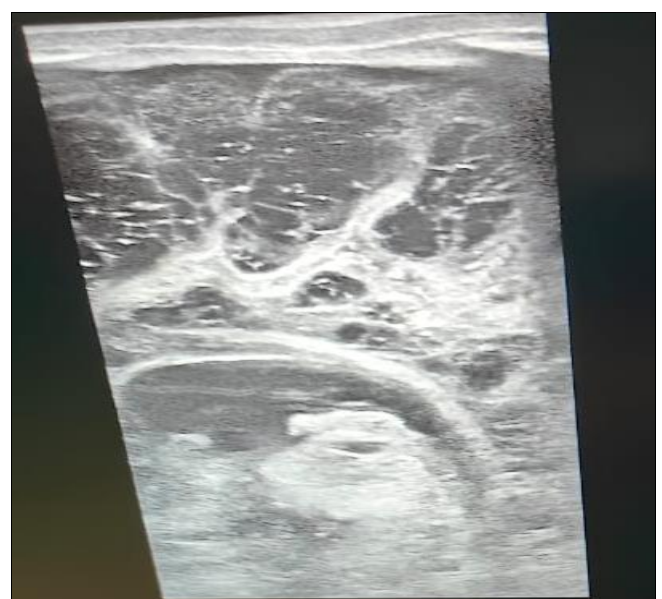


Fig 5: Grade IV PVL involving frontoparietal lobes

Discussion

USG findings are well correlated with the neurologic outcome. The presence of cysts on sonograms indicates that the disease is severe and the prognosis is poor, with adverse neurologic outcomes. The development of cysts, as shown on sonograms, is also correlated with volume loss on MRIs and a poor neurologic outcome ^[1].

Ultrasonography can make differentiation of the normal periventricular halo and homogeneous periventricular flares difficult, but MRIs do not show notable changes in homogeneous flares ^[3, 4, 5].

Although DiPietro *et al.* noted that irregular, inhomogeneous flares indicate hemorrhagic periventricular leukomalacia, hemorrhagic or non-hemorrhagic PVL are difficult to predict on the basis of its ultrasonographic appearance.

A modified ultrasonographic grading system ^[2] is as mentioned below:

Grade IA – Includes transient flares involving periventricular densities less than one week old.

Grade IB – Includes homogeneous periventricular densities more than one week old.

Grade II – Includes inhomogeneous periventricular densities more than one week old.

Grade III – Includes periventricular densities evolving into small cysts.

Grade IV – Defined as periventricular densities evolving into extensive cysts.

Grade V – Involves densities in the periventricular and subcortical region with extensive and evolving periventricular and subcortical cysts.

USG scanning with a high-resolution probe (≥ 7.5 MHz) after 2 weeks of life is required to identify all cases of periventricular leukomalacia. Scanning at the term equivalent age allows the assessment of brain development and identification of permanent residual injury of white matter and grey matter ^[6, 7, 8, 9].

Although PVL is more common in preterm infants, it is also seen in term infants as in our case. Clinical characteristics and long-term neurodevelopmental outcomes between premature infants and term infants with leukomalacia have been described in Europe (PMC, August 2023) ^[10].

Levine *et al.* indicated that cranial USG performed at 40 weeks provides the best predictor of neurologic outcome. Almost all patients with bilateral frontal, parietal, and occipital white matter lesions develop cerebral palsy.

Conclusion

In preterm infants PVL is commonly noted though it can occur in term infants. USG Cranium is the best modality for bedside investigation which is fast, non-invasive, widely available, and radiation free. Serial USG cranium done for these patients, it not only diagnose the disease condition but also grade it. It occurs commonly in premature infants born at less than 32 weeks of gestation and with less than 1500 g birth weight. MRI is also may be required and is helpful for predicting the neurological outcome. PVL (Grade IV) is mostly seen in fullterm neonates as opposed to PVL grades I–III which is a disease of the preterm neonate.

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