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CASE REPORT

NEURODEVELOPMENTAL REHABILITATION IN AN INFANT WITH COMMUNICATING HYDROCEPHALUS AND PERIVENTRICULAR LEUKOMALACIA: A CASE REPORT

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ABSTRACT:

Background: Hydrocephalus is a neurological condition caused by excess accumulation of cerebrospinal fluid (CSF) in the brain's ventricles, often leading to increased intracranial pressure and developmental delays.

Case Presentation: This case report presents a preterm, low birth weight male infant diagnosed with communicating hydrocephalus, accompanied by a porencephalic cyst and periventricular leukomalacia. Clinical findings included seizures, macrocephaly, absent primitive reflexes, and global developmental delay. A ventriculoperitoneal (VP) shunt was placed to divert CSF and control intracranial pressure.

Intervention: Physiotherapy interventions focused on neurodevelopmental therapy, sensory integration, trunk control, fine and gross motor training, and parental education. Post-intervention, the infant showed improvements in motor skills, postural control, and balance.

Results: Post-intervention, the infant demonstrated notable improvements in motor performance, postural control, and balance. GMFM scores improved from 59% to 69%, while PBS scores increased from 2/56 to 15/56.

Conclusion: This case highlights the importance of early diagnosis and a multidisciplinary rehabilitation approach to improve neurodevelopmental outcomes in high-risk infants with hydrocephalus and associated brain injuries.

Keywords: Communicating hydrocephalus, ventriculoperitoneal shunt, physiotherapy, developmental delay, preterm infant, neurodevelopmental therapy

INTRODUCTION:

Hydrocephalus is a neurological condition characterized by an abnormal accumulation of cerebrospinal fluid (CSF) within the brain ventricles, leading to elevated intracranial pressure and subsequent neurological deficits[1]. It is broadly categorized into communicating (non-obstructive) and non-communicating (obstructive) types, depending on whether the flow of CSF between the ventricles and the subarachnoid space is impaired[2].

Communicating hydrocephalus occurs when CSF flows freely through the ventricular system but absorption at the arachnoid villi is impaired, resulting in ventricular dilation without a physical obstruction[3] Common causes include intraventricular hemorrhage, infections, or idiopathic mechanisms.

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In infants, especially those born preterm, communicating hydrocephalus is often associated with brain injuries such as periventricular leukomalacia (PVL) and porencephalic cysts, which can further complicate the clinical picture [4].

Clinical manifestations in infants typically include progressive macrocephaly, bulging fontanelles, irritability, vomiting, and developmental delays[1]. Early diagnosis and management are essential to prevent long-term neurological impairment. Surgical intervention via ventriculoperitoneal (VP) shunting remains the standard of care to alleviate raised intracranial pressure and prevent further damage[2]. However, surgical treatment alone does not fully address the neurodevelopmental consequences, necessitating early rehabilitative intervention and family-centered care.

This case report presents a preterm infant with communicating hydrocephalus, PVL, and a porencephalic cyst. It highlights the combined approach of surgical and physiotherapeutic management and discusses the impact of early intervention on the child's functional outcomes.

Case Examination:

1. Head circumference measurements pre- and post-VP shunt for your case report:

Parameter	Measurement
Head Circumference at birth	32 cm
Head Circumference Before VP Shunt	36 cm
Head Circumference After VP Shunt	33 cm

2.Prmitive Reflex:

Reflex	Normal Age / Description	Finding in Case
Moro Reflex	Startle response; birth to 4–6 months	Absent
Parachute Reflex	Protective extension when falling; appears ~8–9 months	Absent
Rooting Reflex	Turns head toward touch on cheek; birth to 4 months	Absent
Sucking Reflex	Sucking motion when roof of mouth stimulated; birth to 4 months	Present
Grasp Reflex (Palmar)	Grasps object placed in palm; birth to 5–6 months	Absent
Plantar Grasp Reflex	Toes curl when sole stimulated; birth to 9–12 months	Absent
Babinski Reflex	Toes fan on sole stimulation; birth to 12 months	Present
Asymmetrical Tonic Neck Reflex (ATNR)	Fencer position when head turned; birth to 4–6 months	Present
Symmetrical Tonic Neck Reflex (STNR)	Flexion of head causes arm/leg movement; birth to 6–8 months	Absent
Stepping / Walking Reflex	Infant makes stepping motions when held upright; birth to 2 months	Absent
Galant Reflex	Trunk curves toward stimulus along spine; birth to 2 months	Absent
Extensor Tone	Spontaneous extension of limbs; typical in newborns	Present

3. Developmental Milestones:

Domian	Normal Developmental Milestones	Finding In Case
Gross Motor	1. hold head steady by 3-4 months 2. rolls over by 4-6 months 3. sits without support by 7 – 8 months	1. poor head control 2. unable to roll over 3. unable to sit indepentaly
Fine Motor	1. grasps object by 3 – 4 months 2. transfers object hand to hand by 6-8 months	1.weak grasp reflex 2. poor hand eye coordination
Language	1. coos and smiles responsively by 2-3 months 2. babbles consonant sounds by 6 months	1. poor vocalization 2. minimal babbling
Social	1. smiles socially by 2 months 2. recognizes caregiver by 4-6 months	1. limited social smile 2. poor interaction with care giver

4.Tone Examination:

Limb	Right	Left
Upper limbs	Flaccid	Flaccid
Lower limbs	Flaccid	Flaccid

CLINICAL DIAGNOSIS:

Table 1: MRI Brain Findings – Pre and Post VP Shunting

Parameter	Pre-VP Shunt Findings	Post-VP Shunt Findings
Ventricular Size	Moderately dilated (communicating hydrocephalus)	Reduced ventricular dilation
Porencephalic Cyst	Large cyst in right frontal lobe	Size of cyst slightly reduced
Periventricular Leukomalacia	Present (white matter injury)	No new lesion seen
Signs of Raised ICP	Presents (compressed sulci and effected cisterns)	Resolved after shunting, sulci and cisterns re-expanded
Periventricular Edema	Presents	Reduced periventricular signal intensity

PHYSIOTHERAPY INTERVENTION

Table 2: Interventions

Sr.	Goals	Intervention	Activities	Duration	Rational
1	Parental Education	counseling and demonstration	educate on correct handling, positioning, and stimulation at home	daily guidance during each therapy session	ensures carryover and consistency at home
2	Facilitation of muscle tone	➢ sensory integration ➢ neurodevelopmental therapy ➢ rood's approach ➢ joint compression	➢ gentle proprioceptive input to limbs and trunk ➢ rhythmic rotation ➢ tactile brushing	➢ 2-3 sets ×10 reps (each limb),2-3times/day	improves tone and prepares muscles for functional activity
3	Trunk control	➢ ball exercises ➢ hydrotherapy ➢ trunk rotation	➢ supported sitting or prone on therapy ball ➢ gentle rocking ➢ back extension facilitation	➢ 3set× 8-10 reps,1-2 times/day	strengthens core muscles, improves postural alignment
4	Gross motor development	weight-bearing and balance exercises	➢ quadruped position training ➢ weight shifts side to side ➢ crawling imitation	➢ 3set×5-10 reps (short play interval)	encourages postural stability and mobility milestones
5	Fine motor development	➢ reaching and grasping activities ➢ play therapy	➢ reach for toys in various directions ➢ grasp-release play using textured toys	➢ 3-4sets×10-15 reps, daily	improves co-ordination, objects manipulation, and attention
6	Oro motor stimulation	➢ oral sensory stimulation	➢ soft brush or finger stimulation on lips, gums, and cheeks	➢ 3-5minutes/session,2-3times/day	enhances oral awareness, sucking, and swallowing coordination
7	Follow-up and monitoring	➢ regular assessment and goal adjustment	➢ track developmental milestone weekly ➢ adjust therapy intensity as per progress	➢ weekly review	ensures progressive developmental gains

Figure: 1 Slow Rolling

Figure 2: Segmental Approach (Sitting)

Figure 3: Quadruped Position

Figure 4: Half Kneeling Position

OUTCOME MEASURES:

Table 3: Pre and Post Intervention

Outcome measure	Pre intervention	Post intervention
Groos motor functional measure	59%	69%
Pediatric balance scale	2/56	15/56
Gross motor function classification system	Level I	Level II
Tone examination	Flaccid	Normal
Hammersmith infant neurological examination	30	72

Discussion:

Communicating hydrocephalus is marked by impaired CSF absorption despite a patent ventricular system, resulting in ventricular dilation and increased intracranial pressure[3]. This condition is particularly prevalent among preterm infants, who are at heightened risk for perinatal brain injuries, including intraventricular hemorrhage and PVL[6].

In the present case, a preterm male infant exhibited progressive macrocephaly, seizure activity, and developmental delays. MRI revealed moderate communicating hydrocephalus, a right frontal porencephalic cyst, and PVL. These findings reflect both destructive lesions (such as cyst formation) and developmental disturbances (white matter injury), which are commonly observed in preterm neonates with neurologic compromise[6].

PVL is an ischemic injury to the periventricular white matter that interferes with corticospinal tract development and is a significant risk factor for motor impairments and cerebral palsy[6,8]. The porencephalic cyst indicates focal cortical damage, which can impact higher-order motor and cognitive functions depending on its location and size[4].

Neurological examination revealed multiple abnormal reflexes, including persistent Babinski and asymmetrical tonic neck reflexes (ATNR), as well as hypotonia. These clinical signs suggest impaired maturation of the central nervous system and disruption of descending motor pathways[5]. Global developmental delays were also noted, affecting gross and fine motor skills, language, and social interaction—consistent with the widespread nature of the underlying brain injury.

Surgical treatment with VP shunting normalized intracranial pressure and head circumference, with imaging confirming resolution of ventricular dilation. However, the persistence of neurodevelopmental deficits post-surgery underscores the importance of comprehensive rehabilitation strategies [2].

A multidisciplinary physiotherapy approach was adopted, focusing on neurodevelopmental therapy (NDT), sensory integration, trunk and core strengthening, gross and fine motor facilitation, and oro-motor stimulation. Parental education and home-based therapy were emphasized to ensure continuity and maximize functional gains, aligning with current early intervention models [7].

Marked improvements were observed in several outcome measures. GMFM scores improved from 59% to 69%, PBS scores increased from 2/56 to 15/56, and HINE scores rose from 30 to 72. Muscle tone normalized, and although the Gross Motor Function Classification System (GMFCS) shifted from Level I to Level II, this was likely due to increasing motor demands with age rather than a decline in function[3,8].

These results support the hypothesis that early, targeted physiotherapy can enhance neuroplasticity and functional outcomes, even in the presence of structural brain injuries. Importantly, caregiver involvement played a critical role in facilitating therapy and improving outcomes, highlighting the significance of family-centered care.

In conclusion, this case illustrates the multifaceted approach required in managing preterm infants with communicating hydrocephalus and associated brain injuries. While surgical intervention is essential for managing intracranial pressure, long-term outcomes depend heavily on individualized, early rehabilitation and ongoing multidiscipli-nary support. The prognosis remains guarded due to coexisting lesions such as PVL and poren-cephalic cysts, necessitating careful monitoring and adaptive intervention strategies throughout early childhood development.

Conclusion:

This case illustrates the complexity of managing communicating hydrocephalus in a preterm infant with additional brain injuries. While the prognosis remains guarded due to PVL and a porencephalic cyst, the documented improvements in gross motor function and postural control highlight the benefits of early intervention and family involvement. Continued follow-up and tailored therapy are essential to support the child's evolving developmental needs.

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