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RESEARCH ARTICLE

CASE STUDY ON CONCEPT MAPPING IN NURSING FOR A CHILD WITH HYDROCEPHALUS AND MYELOMENINGOCELE

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Abstract

Hydrocephalus, an imbalance between cerebrospinal fluid (CSF) production and absorption, results in ventricular dilation and increased intracranial pressure (ICP). This case study presents a 7-month-old male diagnosed with hydrocephalus post-myelomeningocele correction surgery.The child was admitted with fever,irritability, and poor feeding, alongside an increased head circumference (50 cm) and weakness in the left limbs.Despite medical management with antibiotics,antiepileptics,and antipyretics,the child showed poor prognosis due to contraindications for ventriculoperitoneal shunting.The nursing management emphasized continuous monitoring of vital signs, head circumference, and seizure prevention. This case underscores the importance of early detection and intervention in managing hydrocephalus and associated neural tube defects. Prompt nursing care, along with multidisciplinary medical intervention, plays a crucial role in the prognosis of pediatric patients with hydrocephalus.

Introduction:-

Myelomeningocele (MMC), the most severe form of spina bifida, is characterized by the protrusion of the spinal cord and meninges through a gap in the vertebral arches. MMC occurs between 0.2 to 2 times per 1000 live births and can cause a range of detrimental clinical symptoms, such as Chiari II malformation, genitourinary dysfunction, sensory and hydrocephalus, and motor abnormalities [1]From the Greek terms hydro, which means water, and cephalus, which means head, derives the term hydrocephalus. An abnormal buildup of cerebrospinal fluid (CSF) within the brain's ventricles causes hydrocephalus. The choroid plexus and ventricles both create cerebral spinal fluid. It enters the bloodstream after passing via the brain's ventricular system. This fluid, which surrounds the brain and spinal cord and serves as a cushion against damage, is constantly circulating and serves a variety of purposes. It transports waste materials out of the surrounding tissues and includes nutrients and proteins that the brain needs to grow and function normally. When there is an imbalance between the volume of CSF produced and the pace of absorption, hydrocephalus develops. The ventricles widen and the internal pressure of the head rises as the CSF

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accumulates.Out of every 1000 newborns, one or two have hydrocephalus. In wealthier countries, rates might be higher [2]. Children over the age of two are more likely to exhibit the signs and symptoms of intracranial hypertension in comparison to neonates with growing microcephaly. Because of barrier to bulk CSF flow, models that include aberrant cerebral pulsations, brain compliance, and recently discovered water transport channels are replacing the traditional concept of hydrocephalus.

Hydrocephalus can result from various factors. Aqueduct stenosis and other genes that control brain development and growth have been linked to congenital hydrocephalus. Hydrocephalus can be caused by pathological processes that impair cerebral venous compliance, subarachnoid space function, or ventricular outflow. It is believed that a number of factors affect the pathogenesis of hydrocephalus in children with myelomeningocele. Among other CNS illnesses, there are aqueduct stenosis, aberrant venous drainage, Chiari type II malformation, and open Myelomeningocele. Every anomaly affects the development of hydrocephalus. The reported incidence of MMC-related hydrocephalus varies from 57% to 86% once the MMC defect heals postnatally [3].

Research Gap and Significance:-

Limited focus on nursing-specific interventions, when compared to most existing literature on myelomeningocele and hydrocephalus in children, emphasizes medical and surgical management. Without integrated frameworks connecting evaluation, interventions, and anticipated results, nursing care is delivered in a fragmented manner. In clinical case reporting for uncommon and complicated conditions like myelomeningocele-associated hydrocephalus, concept maps are underutilized while being widely used in nursing education.A case study method bridges the gap between theoretical nursing care plans and practical implementation by enabling a thorough examination of the infant's complicated demands.Nurses can better grasp care goals by creating a concept map, which offers a visual, organized, and comprehensive picture of nursing diagnoses, interventions, and outcomes.This method enhances students' and practicing nurses' clinical reasoning, critical thinking, and decision-making skills. By providing a reproducible model for treating comparable neurodevelopmental disorders in pediatric care, it adds to the body of nursing literature.

Cases Report:-

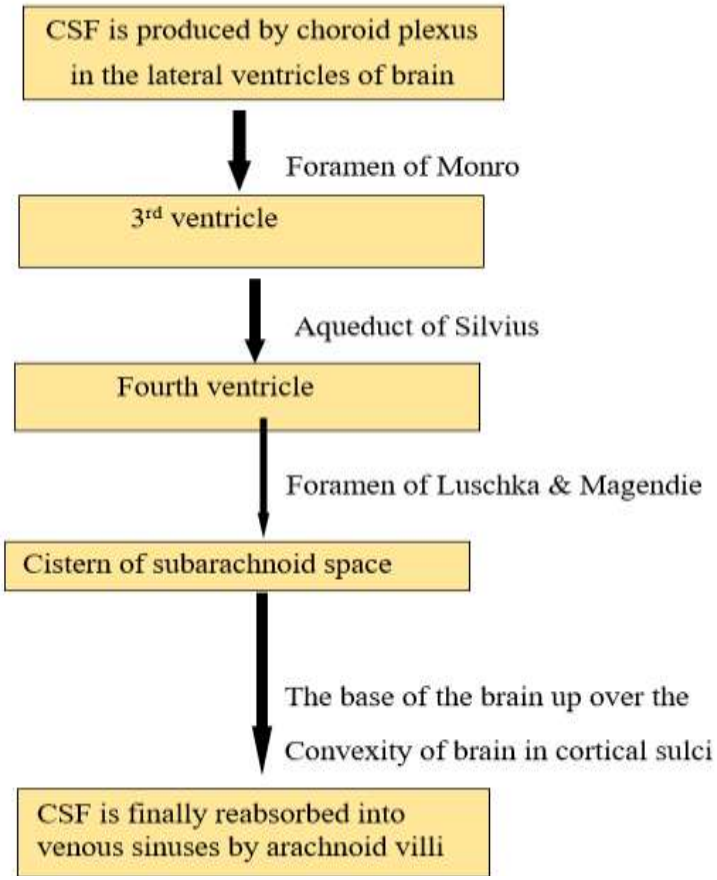
A seven-month-old baby a known case of hydrocephalus since 2 months of birth was admitted with complaints of high-grade fever for one week not resolving on medications, poor feeding, and irritable cry for one week. Other associated features include increased head circumference (50cm), poor sucking reflexes, and weakness over the left side of the limbs He also had a past medical history of Myelomeningocele with Tethered cord (Chiari Malformation) and a history of hydrocephalus from 2 months of age after the correction surgery of Myelomeningocele from another hospital.This is the 3rd child in the family and has delivered through normal vaginal delivery at term. Neonatal history record shows that the child cried immediately after birth and the child was shifted to NICU due to the presence of Myelomeningocele.

Data on birth history from the case file reveals the infant's lower back displayed a noticeable outpouching upon delivery. Vital signs were stable. At birth, the APGAR score was 8 at 1 minute and 8 at 5 minutes. 48 cm in length, 2900 grams at birth, and 33 cm around the head. During the physical examination, a 3 cm soft mass in the thoracolumbar region that was covered by skin stood out.A soft mass covering the lumbar spine with unbroken skin was visible during an ultrasound of the child's spinal canal. Ventricular tapping was done to reduce ICP. Blood culture shows E. coli. Prompt treatment and ideal nursing care were provided. The child showed a poor prognosis even with all treatments.

Causes of hydrocephalus:-

It is imperative to understand the normal pathway of cerebrospinal fluid circulation, which can lead to hydrocephalus.

Figure 1. The normal pathway of CSF and imbalance leads to Hydrocephalus



Cerebrospinal fluid (CSF) circulation is essential for preserving healthy intracranial dynamics. The choroid plexus in the lateral ventricles produces CSF, which then enters the third ventricle through the foramen of Monro and then enters the fourth ventricle by the aqueduct of Sylvius. After leaving through the Luschka and Magendie foramina, it enters the subarachnoid space's cisterns and travels around the brain and spinal cord before being reabsorbed into the venous sinuses through the arachnoid villi. Hydrocephalus is caused by the pathological buildup of CSF that occurs when this channel is blocked, production and absorption are out of balance, or circulation is compromised. Understanding this physiological mechanism is fundamental for nursing care and clinical decision-making in infants with conditions such as myelomeningocele-associated hydrocephalus.

Congenital hydrocephalus:-

Aqueduct stenosis frequently causes aqueduct obstruction, which stops the passage of cerebrospinal fluid (CSF) and accounts for 70% of cases. Other frequent impediments are the foramina of Magendie and Luschka, as well as the foramen of Monro. CSF blockage is also linked to some congenital conditions, including Dandy-Walker syndrome and Arnold-Chiari syndrome. Additionally, spina bifida may be a part of Arnold-Chiari syndrome, where parts of the brainstem and cerebellum herniate into the cervical spinal canal, further obstructing CSF flow. Congenital midline tumors may also hinder the circulation of CSF, and intrauterine infections such as CMV or toxoplasmosis can cause inflammatory responses that result in comparable obstructions. CSF obstruction can also be caused by trauma, such as intraventricular hemorrhage or cerebral bleeding.

Acquired hydrocephalus:-

Impaired flow can result from infections that block cerebrospinal fluid (CSF) routes, such as pyogenic meningitis and tubercular meningitis. Another frequent reason for obstruction is sequelae from post-intraventricular hemorrhage. Furthermore, tumors of the posterior fossa, including astrocytomas and medulloblastomas, may potentially obstruct CSF circulation. Similar to this, intracranial bleeding—which frequently results from ruptured

aneurysms or arteriovenous malformations—can obstruct normal CSF transport and cause serious neurological problems.

Table 1. Classification of hydrocephalus with a case

Book picture	Child picture
1. Communicating/ non obstructive The ventricular system in communicating hydrocephalus has adequate CSF flow, but interference outside the ventricles reduces the amount of CSF absorbed by the subarachnoid villi. **2.** Non-communicating / obstructive This kind interferes with the circulation and absorption of CSF due to blockage in the CSF flow inside the ventricles and subarachnoid space. Children are more likely to have this type.	The child has non-communicating/ obstructive Hydrocephalus. His CT shows stenosis of the Aqueduct of Sylvius

Table 2. Comparison of Clinical features of hydrocephalus with Case.

Book picture	Child picture
• Enlargement of the skull • Suture become widely separated. • Delayed closure of anterior fontanelle • Tense bulging fontanelle • The pounding of the skull produces a hollow or empty sound (MacEwen's sign). • There could be a noticeable sclera above the iris and a broad bridge connecting the eyes (sun-setting sign). • A baby with neurological issues may exhibit fussiness, restlessness, irritability, apathy, or a changed or decreased state of consciousness along with a slow papillary response to light, posturing, and lower limb stiffness. • Physical or mental retardation	• Enlarged skull(50cm) • Widely separated suture. • Tensed bulged fontanelle. • Crack pot sound is heard on percussion of head (MacEwen's sign present) • Sunset eyes • Restless • Irritable • Drowsy and weakness of left side and lower extremities • Feeding difficulty (very poor sucking reflex and the child was on Ryles tube feeding. • Delayed growth and development (Absence of social smile, complete head lag, not able to be in prone position and not able to sit with support.)

Table 3. Diagnostic evaluation/ investigation comparision with case

Book picture	Child picture
The diagnosis of hydrocephalus is made on the following basis: • Quick expansion of the skull together with additional criteria points that point to elevated ICP. • An MRI and CT scan are performed to confirm the diagnosis, and the results show any structural defects, if any, as well as ventricular enlargement or dilation. • Other radiological studies included USG or echo encephalography, done exclusively in neonates because of open fontanelle. • Disproportionate large lateral and 3rd ventricle may be seen in X-ray of skull may show a large skull.	• Physical examination reveals inactive and irritable child and weakness of left limb. • Growth and development assessment reveals a very delayed milestones and markedly increased head circumference. • Vitalsigns:Temperature:103-degree F • CT brain plain - Stenosis of Aqueduct of Sylvius • Liver function test: Normal. • Complete blood count (elevated ESR 30mm/hr. Heamoglobin8.5gm/dl • Culture and sensitivity of CSF shows presence of E-coli. • Urine routine: Turbid urine.

Table No. 4 Medical and surgical management with case

Book picture	Child picture
Management of hydrocephalus directed towards: • Relief of hydrocephalus or reducing ICP • Prevention and management of complications • Managing problems caused by the pathology. **Medical management** • Use of osmotic diuretics: Acetazolamide and Frusemide to reduce the rate of CSF production. These medications provide temporary relief. **Surgical management** • Removal of any space occupying lesion and insertion of shunt. **Complication** • Seizure • Meningitis • Impaired growth and development Kinking and disposition of shunt tube and infection	• Manual ventricular taping was done. • Antibiotics: Inj. Ceftriaxone (250 mg OD), Inj. Meropenem (250 mg OD), Inj. Piptaz, (250 mg OD) • Antipyretic agents.Syp Vamol 1ml 6th hourly and sypMeftal P1 ml if temperature goes beyond 101 degree Fahrenheit Syrup . • Child was also on anticonvulsant agent, syp. Valparin No surgery was done as child developed infection. Child developed increase intracranial pressure and episode of seizure.

Nursing assessment and management:

Nursing assessment:

A nurse can assess several critical clinical manifestations, including hyperthermia, enlarged head, increased intracranial pressure (ICP), and MacEwen's sign. Other key signs may include poor feeding, delayed growth and development, and disturbed sensory perception. Additionally, an irritable cry and a heightened risk for seizures are significant indicators to monitor closely, as they may signal underlying neurological concerns requiring prompt intervention.

Nursing care plan and interventions:

Ineffective cerebral tissue perfusion related to increased intracranial pressure as evidenced by drowsiness.

Interventions:

A nurse should begin by assessing the child's general condition, including vital parameters and neurological status, to establish a baseline. Observing for any signs of increased intracranial pressure, such as drowsiness, is essential for early detection of complications. Additionally, it is important to monitor for increasing restlessness, moaning, and abnormal gaiting behaviors that may indicate distress or neurological impairment. Creating a calm and peaceful environment further supports the child's comfort and can help in managing symptoms effectively.

Hyperthermia related to infectious process as evidenced by elevated body temperature abovenormal range, hot and flush skin:

Interventions:

The nurse should start by assessing the child's body temperature and other vital parameters, along with monitoring for signs of dehydration. Providing a tepid sponge can help regulate body temperature, while ensuring adequate fluid intake, as tolerated, supports hydration and overall recovery. Administering medications as prescribed by the doctor is also essential to manage symptoms and facilitate the child's healing process.

Acute pain related to increased intracranial pressure secondary to inflammation of meninges as evidenced by irritability:

Interventions:

The nurse should assess the child's general condition and monitor neurological status closely. It is advisable to prevent unnecessary stimulation and restrict visitors to reduce overstimulation and minimize stress. Positioning the child carefully is crucial, especially elevating the head if there are signs of increased intracranial pressure (ICP). Measuring the head circumference daily provides valuable insights into any changes in cranial pressure. Additionally, administering anti-seizure prophylaxis as the physician prescribes can help manage the risk of seizures and enhance the child's overall safety and comfort.

Disturbed sensory perception related to hydrocephalus as evidenced by reduced activity levels, poor response to painful stimuli:
Interventions:
The nurse should carefully assess the child's general condition, observing closely for any signs of increased intracranial pressure (ICP). Regularly changing the child's position is important for comfort and to prevent complications. Maintaining a calm and quiet environment, along with reducing the number of visitors, helps minimize stimulation and supports the child's recovery process.

Imbalanced nutrition less than body requirement related to poor sucking reflex as evidenced by child on Ryles tube feeding:
Interventions:
The nurse should closely observe the child's nutritional status and watch for any signs of dehydration. Offering small, frequent meals can improve intake and comfort while serving foods that the child enjoys encourages better nutrition. Providing high-calorie, protein-rich foods is also essential to support the child's growth, energy, and overall health.

Delayed growth and development related to hydrocephalus as evidenced by poor head control at 7 months of his age:
Interventions:
The nurse should assess the child's growth and development through detailed history collection and physical examination. To support developmental needs, providing improvised play articles and engaging the child in therapeutic play can be beneficial. Additionally, ensuring a nutritious diet is essential to promote the child's physical and cognitive growth effectively.

Parental anxiety related to a child with a life threating disease condition:
Interventions:
The nurse should assess the educational background of the parents and evaluate their level of anxiety, allowing for a tailored approach to support and communication. Encouraging parents to express their concerns can help alleviate stress, and involving the mother in the child's care fosters bonding and confidence in the caregiving process. Providing psychological support is crucial, as is explaining the child's condition and its prognosis in understandable terms, which can help parents feel more informed and reassured about the path ahead.

Deficit knowledge of parents related to the outcome of the disease condition:
Interventions:
Parents should be assessed for their understanding of the child's condition and provided with clear explanations. They should be actively involved in the child's care and advised to take precautions to prevent falls. Additionally, they should be instructed to report any fever to the healthcare provider.

Risk for injury related to seizure episodes:
Interventions:
The child's general condition should be assessed, and signs of seizures monitored. The environment should be cleared of any potential hazards, and the mother should be educated on seizure care. A calm and quiet environment should be maintained, and stimulation minimized. Additionally, the child should be observed for signs of increased intracranial pressure.

Discussion:-

It is apparent that the onset of hydrocephalus and the closure of the myelomeningocele are related chronologically, it is unclear if this association is causal or whether the closure of the neural sac just accelerates and precipitates the onset of the condition. Only 15%–25% of children with myelomeningocele have hydrocephalus visible in immediate postnatal imaging [4].nevertheless, hydrocephalus manifests in a considerable number of the other children within the first few weeks of life following the closure of the defect.Loss of CSF causes the hindbrain hernia and the accompanying hydrocephalus to worsen prior to and during surgical correction of the myelomeningocele in the first few days of life. Due to a combination of increased intracranial pressure from the ventriculomegaly and acute bulbar dysfunction from compression of the brain stem in the foramen magnum, this might result in abrupt neurological impairment. After ventricular shunting, the neurological condition often becomes better [5].

When compared to historical controls who got "traditional" treatment, the incidence of hydrocephalus was significantly lower in a small subset of infants who underwent intrauterine surgery for myelomeningocele, going from 91% to 59% [6]. Patients with Chiari II malformation with myelomeningocele have varying degrees of aqueduct stenosis. Aqueduct stenosis aids in the aetiology of hydrocephalus; however, the remaining CSF channels are deviant and deformed.

Hydrocephalus has the potential to cause brain atrophy, which results in a bad prognosis because of compression, and it may also be linked to severe mental impairment. Because birth asphyxia is linked to multi-organ impairment, mental evaluation along with other systems should often be closely followed. However, this can be avoided at a modern medical facility by detecting uterine hydrocephalus through CT and US scans.

Prenatal myelomeningocele repair was found to minimize hindbrain herniation and the need for cerebrospinal fluid shunting at the 12-month in the management of Myelomeningocele. Additionally, compared to children who underwent postnatal myelomeningocele surgery, prenatal repair infants at 30 months of age displayed improved motor function [7].For the present case, Myelomeningocele was detected during antenatal period followed by appropriate surgical management.

Child developed hydrocephalus after the myelomeningocele repair which was done at the age of 40 days after birth. Increased head circumference, which was unnoticed by the mother in the early days, worsened the condition of the child. The child underwent manual ventricular tapping twice to reduce the increased ICP. The child's condition can be improved only by a ventriculo-peritoneal shunt, which was contraindicated in this case due to elevated WBC count, constant increase in temperature and development of seizure.

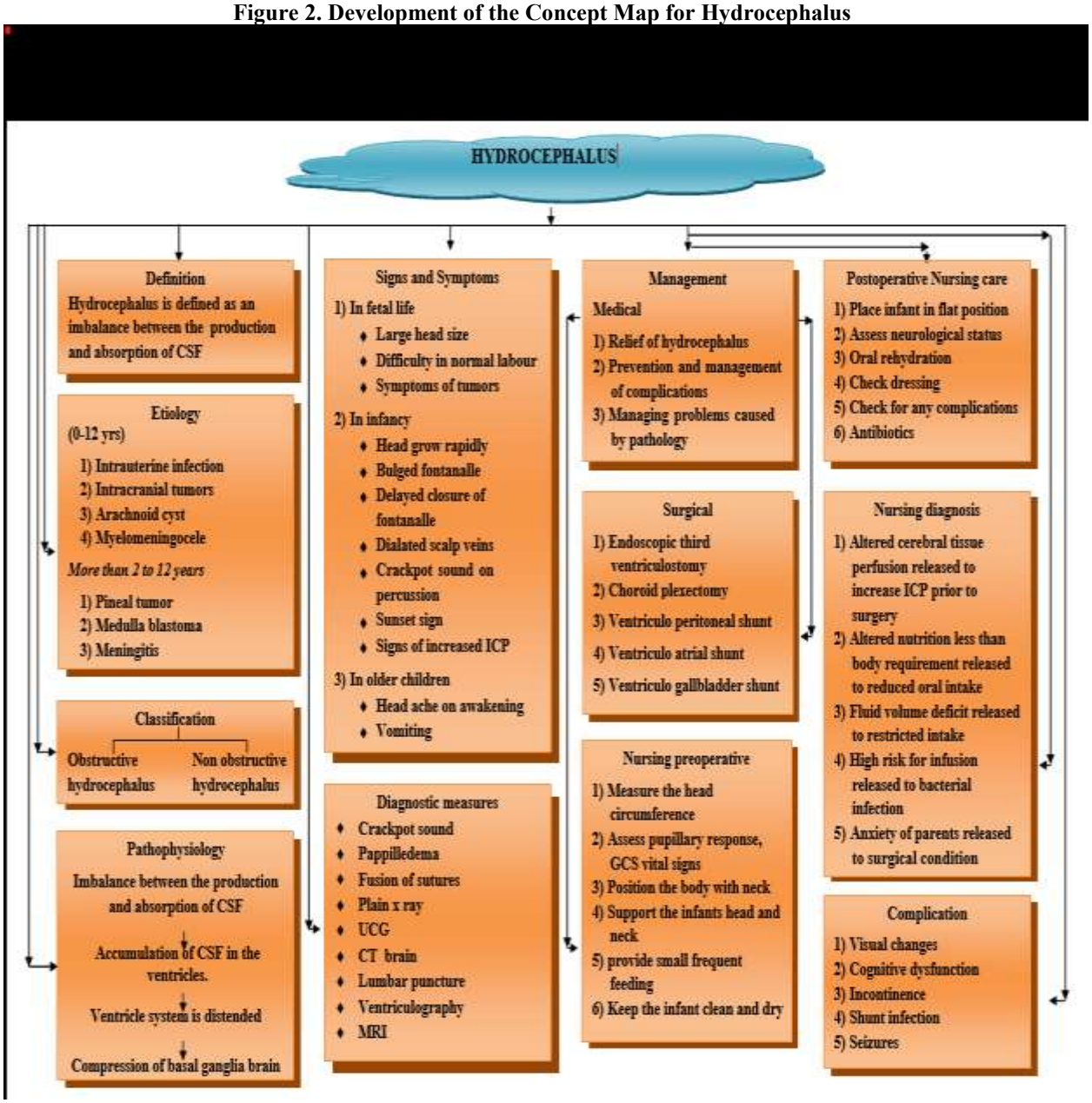
Pediatricians and neurosurgeons tried to treat this condition with the help of conservative management, i.e., (antibiotics, antiepileptic agents&antipyretics).A comprehensive nursing care was provided, which included vital signs monitoring, especially temperature elevation, intake and output were strictly maintained, and head circumference was recorded every 2 hourly. Adequate explanation and prognosis of the condition of the child was informed to the parents. Child had poor prognosis in spite of adequate medical and nursing management.

Development of a Concept Map for a Child with Hydrocephalus:-

The development of a concept map for hydrocephalus provides a structured framework to understand the complexity of the condition and guide comprehensive nursing care. Hydrocephalus, an imbalance between the production and absorption of cerebrospinal fluid (CSF), can result from either congenital or acquired causes, including myelomeningocele, tumors, arachnoid cysts, and intrauterine infections.

Classification, pathogenesis, clinical manifestations across developmental phases, diagnostic procedures, and management techniques are all highlighted in the concept map. It highlights the role of nurses in preoperative, postoperative, and long-term care, including monitoring neurological health, preventing problems, and supporting families, by combining medical, surgical, and nursing views. For infants and children with hydrocephalus, concept mapping is a useful technique for enhancing clinical reasoning, prioritizing care, and implementing evidence-based practices.

Figure 2. Development of the Concept Map for Hydrocephalus



Implications for Nursing Practice:-

- The development of a concept map for hydrocephalus helps nurses in a systematic way to assess, plan, implement, and evaluate care for children with hydrocephalus with myelomeningocele.
- It offers nurses by visually organizing the pathophysiology, signs and symptoms, diagnostic measures, and medical cum nursing interventions.
- It also enables nurses to prioritize critical care needs such as monitoring intracranial pressure, preventing infection, and supporting optimal growth and development.
- Concept mapping enhances clinical reasoning, reduces fragmentation in care delivery, and supports evidence-based nursing practice for improved child outcomes.

Implications for Nursing Education:-

- Concept maps provide an innovative pedagogical tool to strengthen critical thinking and problem-solving skills among nursing students.

- Learners are encouraged to integrate theoretical knowledge of anatomy, physiology, and pathology with practical aspects of clinical care.
- Concept mapping encourages collaborative learning, as students can work together to identify connections between assessment findings, nursing diagnoses, interventions, and outcomes.
- It also bridges the gap between classroom learning and bedside practice.

Conclusion:-

Regular prenatal screening can identify meningomyelocele, an open neural tube defect. As a result, early intervention is recommended to minimize problems and enhance the infant's prognosis. For prevention, it is advised to follow a varied diet, fortify foods, and take supplements before conception. Low-risk women just need to take 0.4 mg of folic acid, whereas high-risk women, such as those who have a history of impacted pregnancies, should take 4 mg. Folic acid supplements have been shown to be able to prevent neural tube abnormalities in pregnancies through a number of randomized clinical trials [8].Ideally, taking supplements of folic acid should be started at least one month prior to conception and continued until the completion of neurulation in the twelfth week of gestation.When taking folate supplements, it's crucial to make sure getting enough vitamin B12 [9]. Pregnant women should abstain from certain medications, including phenytoin, carbamazepine, and valproic acid, as these might induce meningomyelocele.Treatment for hydrocephalus can have different long-term impacts on kids. Upcoming advancements in brain imaging, technology, and pathology should lead to more effective treatments for illness [10].

Conflict of Interest:-

The authors declare that they have no competing interests.

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