

Hydrocephalus

1) Definition or Meaning

Hydrocephalus is a condition due to the interference with the circulation or absorption of cerebrospinal fluid with a corresponding increase of fluid in the intracranial cavity and resulting in increased intracranial pressure.

2) Incidence and Prevalence.

- The incidence of congenital hydrocephalus is precisely not known.
- The incidence of the acquired hydrocephalus is 1 in 1000 children.

3) Anatomy and Physiology

Cerebrospinal Fluid

Cerebrospinal fluid is a clear, colorless liquid that protects the brain and spinal cord against chemical and physical injuries. It also carries oxygen, glucose, and other needed chemical from the blood to neurons and neuroglia. CSF continuously circulates through cavities in the brain and spinal cord and around the brain and spinal cord in the subarachnoid space.

Formation of CSF in the Ventricles

CSF is filled in the cavities within the brain called ventricles. A lateral ventricle is allocated in each hemisphere of the cerebrum. Anteriorly, the lateral ventricles are separated by a thin membrane, the septum pellucidum. The third ventricle is narrow cavity along the midline superior to the hypothalamus and between the right and left halves of the thalamus. The fourth ventricle lies between the brain stem and the cerebellum.

The site of CSF production is the choroid plexuses which are networks of capillaries in the walls of the ventricles. The capillaries are covered by ependymal cells that form cerebrospinal fluid from blood plasma by filtration and secretion.

The total volume of CSF is 80 to 150ml in an adult. CSF contains glucose, proteins, lactic acid, urea, cations (Sodium, Potassium, Calcium and Magnesium) and anions (chloride and Bicarbonate); it also contains some white blood cells.

Cerebro-Spinal Fluid Circulation

The fluids flows from the lateral ventricles through the foramen of Monro to the third ventricle, where it combines with fluid secreted into the third ventricle. From there CSF flows through the aqueduct of Sylvius into the fourth ventricle, where more fluid is formed; it then leaves the fourth ventricle by way of the lateral foramen of Luschka and the midline foramen of Magendie into the cistern magna. From there CSF flow to the cerebral and cerebellar subarachnoid spaces, where it is absorbed. A large portion is absorbed through the arachanoid villi, but the sinuses, veins, brain substance and dura also participate in absorption.

Functions of CSF

- 1. Mechanical Protection:** CSF serves as a shock-absorbing medium that protects the delicate tissue of the brain and spinal cord from jolts that would otherwise cause them to hit the bony walls of the cranial and vertebral cavities. The fluid also buoys the brain so that it “floats” in the cranial cavity.
- 2. Chemical Protection:** CSF provides an optimal chemical environment for accurate neuronal signaling. Even slight changes in the ionic composition of CSF with in the brain can seriously disrupt production of action potentials and postsynaptic potentials.
- 3. Circulation:** CSF is a medium for exchange of nutrients and waste products between the blood and nervous tissue.

4) Etiology and Causes.

The etiology may be,

- Increased production (Obstructive Hydrocephalus) Eg. Choroid plexus papilloma.
- Obstruction of the flow (Communication Hydrocephalus) Eg. Inflammatory adhesions, developmental obstructive lesions.
- Interference with the absorption Eg. Cavernous sinus thrombosis.

Types of Hydrocephalus

Hydrocephalus can be clinically classified as,

1. Congenital Hydrocephalus:

- ***Arnold-Chiari Malformation:*** It is characterized displacement of brain stem and cerebellum through foremen magnum into the upper cervical part of spine.
- ***Dandy-Walker Anomaly:*** It is a congenital condition characterized by membranes block at the fourth ventricle.

2. Acquired Hydrocephalus:

- Inflammatory conditions like Meningitis, encephalitis in first few months of life.
- Traumatic causes like birth trauma, head injury and intracranial hemorrhage.
- Neoplastic lesions like tuberculoma and gliomas.

5) Patho-physiology

In non-communicating hydrocephalus there is a blockage between the ventricular and subarachnoid systems, resulting in an interference with the circulation of CSF and lack of access to the subarachnoid spaces. In communicating hydrocephalus there is normal communication between the ventricles and the spinal subarachnoid space. There is an inference with the absorption of CSF.

The fluid that is not absorbed in the subarachnoid space accumulates, compressing the brain and distending the cranial cavity. There is an excess of spinal fluid outside the brain resulting in flattening and atrophy of convolutions of the brain.

6) Clinical Features.

Congenital hydrocephalus is present right at birth or becomes apparent in the first few month of life.

Acquired hydrocephalus develops later, in association with or as a sequel to the causative factor.

Clinical features includes,

- Large head
- Wide and bulging fontanel with open sutures.
- Protruding forehead
- Dilated and prominent scalp vein
- Scalp appears thin and shiny.
- The sun-set sign.
- Cracked Pot sound (Macewen Sign): A resonant sound heard due to separated sutures.
- Cry becomes thrill with increase in ICP

When there is no progression in the head size it is termed as Arrested Hydrocephalus. This type requires surgical intervention.

Hydrocephalus occurring in the late childhood is not accompanied by big head. Instead there occurs manifestation of raised intracranial pressure such as Papilledema, spasticity, ataxia and urinary incontinence.

7) Diagnostic Evaluation.

Diagnostic techniques include,

- Extensive radiological studies of the skull
- Ventriculography
- Pneumoencephalography.
- CT, MRI and Ultrasound are most reliable.

8) Complications

Complications include Brain Herniation.

9) Prognosis.

Following appropriate medical and Neurosurgical treatment about 70% of patients with infantile hydrocephalus live beyond the first year of life. Around 60% of these are likely to have motor and intellectual handicap.

Without treatment, mortality is as high as 50% to 60%

10) Management

a) Medical Management.

Medical treatment aimed at reducing the raised intracranial pressure with hypertonic solutions, acetazolamide, Frusemide and other diuretics.

b) Surgical Management.

Surgical management includes Choroid Plexectomy and various shunting procedure like ventricular-pleural shunt, ventriculo-peritoneal shunt and ventriculo-cardial shunt (into right atrium).

Sepsis of the shunt usually staphylococcus epidermidis is common complication of shunting with pulmonary hypertension and corpulmonale.

c) Nursing Management.

Nursing Management mainly includes,

- Daily check of Head Circumference.
- Provide supine position with head elevated 30 degree
- Providing the calm and quiet environment.
- Monitor for vital signs.
- Monitor Intra cranial pressure.
- Check for the pupillary reaction.
- Avoid excessive straining and crying.
- Assessing for the behavioral changes in the child.
- Administer prescribed diuretics.

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