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A review on hydrocephalus

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ABSTRACT

Hydrocephalus is an abnormal condition that buildup of fluid in the skull within the brain and causes brain to swell. Hydrocephalus also called as water on the brain. Hydrocephalus is a condition in which excess amount of cerebrospinal fluid (CSF) gets accumulated within the fluid-containing cavities (or) ventricles of the brain. Hydrocephalus mainly occurs in children and adults over 60, but younger adults can get it. According to the Institute of Neurological Disorders and Stroke (NINDS) estimates that 1 to 2 of every 1,000 babies are born with hydrocephalus. There is about 500ml is produce of cerebrospinal fluid (CSF) at any one time, and about 125ml is absorbed. The cerebrospinal fluid (CSF) is constant circulation within the brain ventricles and its act as many circulating functioning like as; A cushion (or) buffer, providing basic mechanical protection to the brain inside the skull, Serves a vital function in the cerebral auto-regulation of cerebral blood flow and removing waste from it, Changes pressure in between cranium and spine. When excess amount of CSF accumulated in the brain due to birth defected (or) acquired later in life. It may be neutral tube defects (spina bifida, anencephaly) and also including meninges, intracranial tumors, traumatic brain injury, intra-ventricular hemorrhage and sub-arachnoid hemorrhage. Hydrocephalus are majorly divided into two types are called Communicating hydrocephalus and Non-communicating hydrocephalus. Causes of hydrocephalus are imbalance between how much produced and absorbed of cerebrospinal fluid into the bloodstream, spina bifida, a brain tumor and also infection in the brain. The symptoms of hydrocephalus are mostly depend on age like Infant, older children, middle-aged adults, young adults and significantly can vary from person to person. Testing and diagnosis of hydrocephalus can be carried out by a clinical neurological exam and also by using brain imaging techniques like Ultrasound, Magnetic resonance imaging (MRI), Computed tomography (CT), Fundoscopic examination, Spinal tap (lumbar puncture), and Intracranial pressure monitoring (ICP). Hydrocephalus is mainly treated with surgical options as; A shun (tube) & Endoscopic third ventriculostomy (ETV).

INTRODUCTION

Hydrocephalus is not a disease, hydrocephalus is a common condition in fact it's the most

common condition that we treat in pediatric neurological practice. The term hydrocephalus is derived from Greek wards "hydro" meaning water and "cephalus" meaning head. Hydrocephalus is

also known as water on the brain. Cerebrospinal fluid (CSF) is a clear, colorless body fluid that's found in the brain and spinal cord (cerebellum). It is produced by specialized ependymal cells in the choroid plexuses of the ventricles of the brain and it's absorbed in the arachnoid granulations. Due to birth defects hydrocephalus can occur, birth defects include neural tube defects, brain tumors, meningitis, etc. Hydrocephalus has many different causes. Some people are born with this condition and also some people are developing this condition during their lives [1-5].

What is Hydrocephalus?

Hydrocephalus is a physical condition wherein increases size of ventricles and sometimes causing brain damage due to excess production (or) decreases absorption of cerebrospinal fluid (CSF) which is put pressure on the brain. The balance between production and absorption of the cerebrospinal fluid critically important because of cerebrospinal fluid is produced continuously, in this condition interruption its normal flow (or) absorption these will make an over-accumulation in ventricles and creating pressure of the brain. The resulting pressure of excess CSF against the brain causes hydrocephalus [6-9].

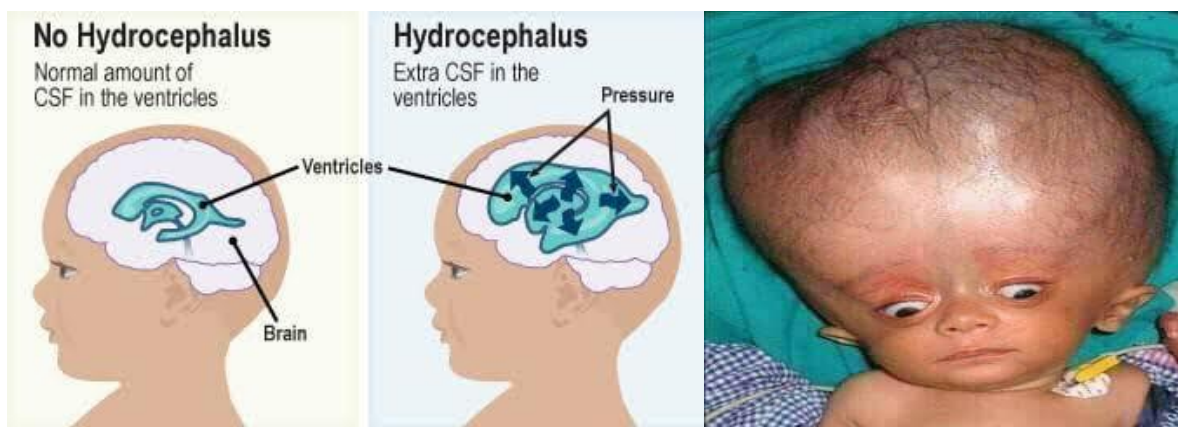


Fig 1: Structure of hydrocephalus

TYPES OF HYDROCEPHALUS

Hydrocephalus is a physical condition, not a disease. It can create by various reasons which is mentioned on above. Based upon causes hydrocephalus can be classified as following category [10-11].

Communicating hydrocephalus

Communicating hydrocephalus is also called non-obstructive hydrocephalus. Communicating hydrocephalus occurs when the cerebrospinal fluid (CSF) flows out of the chambers of the brain (ventricles) by the narrow vessels and enters into the spinal cavity, but it is not reabsorbed properly by the tissue surrounding the brain and spinal cord. Communicating hydrocephalus can divided into two types like.

Congenital hydrocephalus

It is the form of hydrocephalus that appearance at birth. Congenital hydrocephalus is caused by a complex interaction of genetic and environmental factors during fetal development. Birth defect (such as spina bifida), genetic defect and mother's infections during pregnancy (such as rubella, mumps, and syphilis) can responsible for congenital hydrocephalus. Nevertheless, congenital hydrocephalus is now diagnosed before birth through a routine ultrasound.

Acquired hydrocephalus

Acquired hydrocephalus it is the form of hydrocephalus that develops at the time of birth or at some point afterward. This type of hydrocephalus can affect individuals of all ages and may be caused by injury or disease. Bleeding (hemorrhage), brain trauma, infection (such as

cerebral abscess, bacterial meningitis) is responsible for acquired hydrocephalus. Sometime premature birth may be a risk factor for hydrocephalus.

Non-communicating hydrocephalus

Non-communicating hydrocephalus also called as obstructive hydrocephalus. Reasons behind the obstructive hydrocephalus are when the flow of cerebrospinal fluid (CSF) is blocked along one or more of the narrow vessels connecting the ventricles.

Other

Ex-vacuo hydrocephalus

It primarily affects adults and occurs when the brain is damaged due to stroke (or) traumatic injury and Alzheimer's disease that may cause the brain tissue to shrink. This type of hydrocephalus perhaps not is a health danger for some patients, in which case treatment is not required.

NORMAL PRESSURE HYDROCEPHALUS (NPH)

The normal pressure hydrocephalus (NPH) is an excessive accumulation of cerebrospinal fluid (CSF) in the brain ventricles that causes increases the size of ventricles of the brain, sometimes imbalance of intracranial pressure (ICP). cerebrospinal fluid (CSF) is a clear liquid that's produced and stored in the cavities (ventricles) in brain which circulates around the brain and spinal cord because of providing nutrients and protecting them from damage. When cerebrospinal fluid gets accumulation in ventricles because of the improper production (or) improper drain and absorbs the fluid in the brain. These conditions called "Normal Pressure Hydrocephalus" (or) NPH. The difference between Normal Pressure Hydrocephalus and another form of hydrocephalus is;

- There is excessive amount of CSF present in ventricles than the normal amount of CSF.
- It is mainly occur in the adult's person.

CAUSES OF HYDROCEPHALUS

The main reason for hydrocephalus is excessive build-up of cerebrospinal fluid in the brain ventricles which is put pressure on the brain wall. The excess cerebrospinal fluid causes due to the following reasons such as

Blockage

The cerebrospinal fluid (CSF) flows through narrow vessels from one ventricle to another ventricles (or) ventricles to spinal cord (or) ventricles to another part of brain.

Slow absorption

The cerebrospinal fluid (CSF) absorbed primarily by blood vessels in tissue near ventricles of the brain. The rate of absorption is poor due to the injury (or) cells diseases near the ventricles.

Excessive production

Generally, about 500ml is produced of cerebrospinal fluid (CSF) at any one time, and about 125ml is absorbed. If there is more produced and less absorbed from that amount can cause hydrocephalus.

Other causes

The underlying causes of hydrocephalus as following as-

- Infections during pregnancy.
- Brain cells damage.
- Brain tumors.
- Central nervous system (CNS) infection.
- Head injury.

Symptoms of Normal Pressure Hydrocephalus (NPH)

- Gait disturbance/ Difficulty in walking.
- Dementia.
- Impair bladder control/ loss of bladder control.
- Headache.
- Speech problems.
- Memory loss.
- Leg weakness.

Prevalence of Normal Pressure Hydrocephalus (NPH)

The Normal Pressure Hydrocephalus [12-15] is mainly occurs in people over the age between 60s to 70s (or) older adults.

- It is calculated that over than 700,000 people in America have NPH, but less than 20% receive a corrective diagnosis.
- Without corrective diagnostic testing.

Prevalence of Hydrocephalus

Hydrocephalus can happen at any age, but most common in infants and adults, those people belong 60 or above. According to the health India. Com, "Hydrocephalus is an extremely rare condition that affects only about one in 500 children over the world". In a recent series of The National Institute of Neurological Disorders and Stroke (NINDS) was estimated one to two of every 1,000 babies are born with hydrocephalus in US. That would make approximately 200, 000 cases each year of congenital hydrocephalus in infants around the approximately 12, 000 cases of congenital hydrocephalus each year in India. Over the last few years, the news of INDIA TODAY was published an article about 18 month old girl in India(Tripura) name Roona Begum born with unusual giant head (hydrocephalus) and died before her corrective surgery.

Symptoms of hydrocephalus

The clinical presentation of hydrocephalus is depends upon person to person (or) differ in the case of the neonate and infant compared with the older child (or) adults. In general, symptoms and signs that suggest a rise in intracranial pressure (ICP) including headache, puking (vomiting) in Infants and neonate are more susceptible and adults can experience trouble walking and memory loss [16-19].

Infants

The early symptoms in infants are following as

- Sun-setting sign (or) dorsal midbrain syndrome.
- Irritability
- Vomiting
- Seizures
- Distinct structure
- Unnatural head size

- Rapidly increases in head wall
- Slow growth
- High pitched-cry
- Todeller and Adult children

The early symptoms in todeller and adult child's are following as

- Nausea and vomiting (puking).
- Seizures.
- Loss of balance.
- Opposite of loss of appetite.
- Slow growth of muscle.
- Walking imbalance.
- Extremely desire to sleep.
- Difficulty in reminding.
- Impair bladder control/ loss of bladder control.
- Adults

The symptoms in adults are appeared as following as

- Nausea, vomiting
- Loss of appetite
- Headache
- Loss of bladder control (or) frequent urge to urinate
- Excessive sleepiness
- Trouble in concentrating
- Trouble in vision
- Trouble to make decision.

TESTING AND DIAGNOSIS

At one time a physician suspects hydrocephalus, he/she performs a thorough clinical evaluation, including

- Asking about symptoms.
- Doing a physical exam.
- Doing imaging studies such as ultrasound, CT scan, and MRI

Physical Examination

- Pressure on the mid-brain may in impairment of upward gaze this is known as dorsal midbrain syndrome and frontal bossing.
- Head circumference increase with increase in children and these children will be up an abnormally big head and excessive head growth.
- Distortions of the brainstem may results in changes in vital signs and ventricular dilation.
- The anterior fontanelle becomes distended.

Ultrasound

Ultrasound of head imaging, a head ultrasound is a safe and painless test uses sound waves in which uses high-frequency sound waves to produces images of the brain and the cerebrospinal fluid that's flows within its ventricles. When conducting this exam, an ultrasound machine emits sound waves into head and images are recorded on a computer. Its shows that black & white images of internal structure of the brain including ventricles (cavities full with fluid located deep portion of the brain) and blood vessels. Head ultrasound exam is most commonly performed on infants younger than

6 months old, whose skull bones have not completely grown, also called as soft spot. The soft spot providing a "window" allowing the ultrasound beam to freely pass into back from brain. Ultrasound machine is placed outside (soft spot) of the brain [20-21].

Computerized Tomography (CT) Scan

A CT scan of the brain is a non-invasive (doesn't require surgery) diagnostic imagine procedure that's uses a specialized X-ray technology that can produce cross-sectional and horizontal views of the brain.

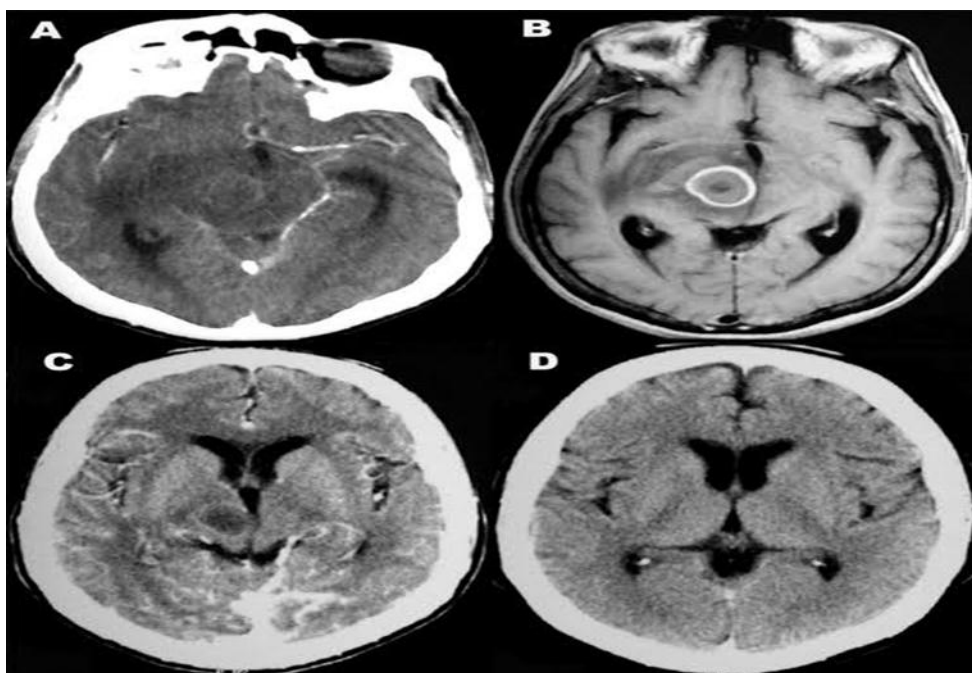


Fig:2: Brain CT scans Image

This is also called as CAT scan. The images crested by brain CT scan are provides more details than regular (or) standard. Drawbacks to CT scanning include less detailed images than an MRI, and use radiation which can increase the risk of cancer. Children and infants brain are still developing. [22-23]

Magnetic Resonance Imaging (MRI)

Magnetic Resonance Image of the brain is uses radio waves and a magnetic field to produce detailed 3D or cross-sectional images of the brain and brain stem. It is a painless, noninvasive test. This test also known as brain MRI (or) a cranial

MRI. An MRI scan is slightly different from a CT scan (or) an X-ray because it doesn't use radiation to produce image. It is noisy and requires lying still [24-26].

TREATMENT

There are generally One of two surgical treatments may be used to treat hydrocephalus. There are including;

Shunt System

The most common treatment of hydrocephalus is the placement of a device called shunt. A shunt is

tube that buildup of a long, flexible tube with a valve which is regulates the flow of fluid. The shunt are usually placed in the lateral ventricles (small opening of the brain) of the skull and passes through the brain and enters into the enlarge ventricles. Then tubing slides down the skin and it is passed into the abdominal cavity where the fluid can absorbed in a normal way.

Endoscopic third ventriculostomy

The alternative treatment which is might be appropriate for a child but not an every case that is Endoscopic Third Ventriculostomy. That is also known as ETV. In this procedure an endoscope is passed through a small opening in the skull into the ventricles of the brain and this is attached to a small video camera to have direct vision inside the brain and perform the procedure. Surgeon makes a small hole in a membrane at bottom of ventricles (or) between the ventricles to escape into the normal fluid pathway and be absorbed into the brain [27].

COMPLICATION OF TREATMENT

A shunt device maybe lead to obstruction from blood cells, tissue or bacteria can occur in any part of the shunt.

- Shunt infection is usually occur caused by a person own bacterial organism. The most common infection is Staphylococcus Epidermises which is normally seen one to three months after surgery.
- Placement of shunt system it may lead to subdural hematoma.
- The problem with placement of shunt is that they can require a number of operations.
- Sometimes throughout the child life to keep them functioning properly.
- Being dependent on a device that requires maintenance can be real problems. Neurological damage such as decreases function, movement (or) sensation.
- Headache, vomiting and lethargy.

Prognosis

- Simple aqueduct stenosis treated early, prognosis of normal IQ and neurologic function is good.

- The prognosis for individuals diagnosed with hydrocephalus is difficult to predict. Hydrocephalus depends on the cause, the extent of symptoms and the timeliness of diagnosis and treatment.
- Repeated episodes of raised intracranial pressure (ICP) and ventriculitis, results in low IQ and neurological function. Neurological and intellectual disabilities depend on
- Presence of other brain anomalies and requirements for a shunt.
- Associated conditions: Interventricular Hemorrhage (IVH), infection and thickness of the brain and corpus callosum, etc. maybe play a large role than the hydrocephalus alone.

Management

- The diuretics furosemide and acetazolamide, dose of 1mg/kg/day decreases the CSF production.
- Oral glycerol has also been used for the similar purpose.
- The most effective is surgical drainage - but it is helpful treat the symptoms. Ventricular Peritoneal (V-P) shunt (or) Ventriculoatrial (V-A) shunt but most commonly used VP shunt.
- The antibiotics use for the treatment of shunt infections such as septicaemia, ventriculitis, and meningitis (or) given as a prophylactic treatment. Maintain intake-output chart of the baby and for the older children offer small frequent feedings of light food [28-30].

CONCLUSION

Hydrocephalus is a very vast topic and each situation is very different and although it's simply defined as the build-up of too much fluid in brain. Not all the child born with hydrocephalus. It is actually a very deceptively and very complex disorder. There is usually no way to tell the child born with hydrocephalus. If child has hydrocephalus it's very important to discuss your neurosurgeon very closely to figure out what the best treatment is going forward again careful consideration of the causes of the hydrocephalus is very important. Oftentimes neurosurgeons will ask you what is the reason why your child has

hydrocephalus (or) what is the initial cause the hydrocephalus is. It is really important to remember that to convey that because that can influence the management of your child. Ultimately I strongly believe that becoming well informed in the disease

process the treatment option will allow you to make good decision in conjunction with your pediatric neurosurgeon and ultimately affect the prognosis and outcome of your child with hydrocephalus.

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