

## **HYDROCEPHALUS**

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**Abstract:** This article describes the history, classification, diagnosis, and causes of hydrocephalus. It also talks about specific features of hydrocephalus treatment.

**Key words:** Hydrocephalus, occlusive hydrocephalus, aresorptive hydrocephalus, Bypass operation, craniotomy , Dandy-Walker syndrome, "setting sun" symptom .

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**Hydrocephalus** ( other Greek. rdōr "water"+ kephalē "head"), *cerebral droplet-of the brain* in the ventricular system as a result of the difficulty of the cerebral fluid to pass from the place of its secretion ( cerebral ventricles ) to the place of absorption ( subarachnoid space ) in the blood circulation system - *occlusive hydrocephalus* or as a result of absorption disorders - *aresorptive hydrocephalus* .

Hydrocephalus was rarely described in ancient medical literature, although its presence and symptoms were well known. Hippocrates, the father of medicine , is considered the first physician to attempt to document the treatment of hydrocephalus. He recommended trepanation to treat epilepsy , blindness, and possibly hydrocephalus. The Greeks reportedly treated hydrocephalus by wrapping a shell around the patient's head and inserting it into trepanation holes.

Evacuation of superficial intracranial fluid in children with hydrocephalus was first described in detail by Ibn Sina . Due to the poor understanding of the pathophysiology of hydrocephalus, early attempts at therapy were sporadic and usually failed. Many practitioners relied on conservative therapy. Attempts at treatment include many medications, laxatives such as rhubarb , calomel , and oil, as well as various diuretics , head wraps, blood transfusions, and craniotomy .

The most characteristic feature of hydrocephalus in newborns is that it precedes the growth of the head circumference, which leads to a visually identifiable hydrocephalic shape of the skull, with a significant increase in size (one of the types of macrocephaly). A sign of hydrocephalus is a swollen, tense fontanel, frequent head tilting back, lower eyelids. Round pulsating protrusions may appear in places where the bones of the skull do not fuse normally . Strabismus and nystagmus often appear. There is high excitability due to headache, the child eats poorly, often cries, vomits, is lethargic. Sometimes vision and hearing loss can be observed.

Hydrocephalus in adults is characterized by headache, especially in the morning, headache, nausea and vomiting at the height of dizziness; the size of the head is not increased. In skull radiographs the destruction of the Turkish saddle , the increase in finger drop was noted. Magnetic resonance imaging and computer tomography are the most informative and reveal sharply enlarged ventricles of the brain.

Hydrocephalus is an increase in cerebrospinal fluid in the cerebrospinal fluid. Hydrocephalus accompanies many congenital and acquired neurological diseases. Clinically, it is characterized by increased intracranial pressure (headache, nausea, pressure in the eyes), signs of compression of brain structures (vestibular ataxia, visual disturbances, mental disorders, epi-attacks) and the disease that caused it. is manifested by specific symptoms. Diagnosis of hydrocephalus includes cranial radiography, ophthalmological studies, Echo-eg (in babies - neurosonography), brain MRI or CT. Surgical treatment of hydrocephalus allows you to correct congenital abnormalities of the cerebrospinal fluid, remove intracranial formations that disrupt the cerebrospinal fluid, and establish the outflow of the cerebrospinal fluid from the skull cavity.

Neurosurgeons have more than 180 causes that can lead to the development of hydrocephalus. It can be congenital (when a child is born with an excess amount of cerebrospinal fluid in the head) or it can occur due to other problems:

- traumatic (develops after trauma, for example, childbirth, cerebral hemorrhage),
- inflammation (develops after neuroinfections), - tumor (tumor blocks the outflow of cerebrospinal fluid or increases its secretion),
- blood vascular (due to vascular diseases of the brain),
- idiopathic (when the cause is not clear).

In the risk zone are premature babies and children with excisional spinal cord hernia (because the spinal cord is connected to the head, hydrocephalus often manifests itself as a joint disease). Often, hydrocephalus is detected before three months of age, in boys it develops more often than in girls.

According to the etiological principle, congenital and acquired hydrocephalus are distinguished. According to the mechanism of occurrence, hydrocephalus is divided into open and closed form.

- **Open hydrocephalus** is associated with excessive accumulation of cerebrospinal fluid or impaired absorption by normal cerebrospinal fluid.
- **Closed hydrocephalus** is caused by a violation of the outflow of cerebrospinal fluid due to compression, partial or complete obstruction of any part of the cerebrospinal fluid system.

Depending on where the excessive accumulation of cerebrospinal fluid occurs, internal and external hydrocephalus are distinguished. Internal hydrocephalus is accompanied by the accumulation of cerebrospinal fluid in the ventricles of the brain. External hydrocephalus is characterized by an abundance of cerebrospinal fluid in the subarachnoid and subdural space.

According to the characteristics of the course, hydrocephalus is classified as acute, subacute and chronic. Acute hydrocephalus is characterized by rapid development, in which decompensation occurs a few days after the initial symptoms of the disease. Subacute hydrocephalus develops within one month, and chronic hydrocephalus develops over six months.

The division of hydrocephalus into stabilized (compensated) and progressive (growing) is of great clinical importance.

- **Stabilized hydrocephalus** does not progress and usually persists with normal cerebrospinal fluid pressure.

- **Progressive hydrocephalus** is characterized by an increase in symptoms, is accompanied by an increase in the pressure of the cerebrospinal fluid, does not respond well to conservative therapy, and leads to atrophy of brain tissue.

Causes of hydrocephalus include:

#### 1. **Congenital hydrocephalus :**

- malformation of the cerebrospinal fluid (atresia of the openings of Majandi and Lushka)
- defects in the structure of the lower cavity
- stenosis of the sylvian aqueduct, Dandy-Walker syndrome, etc.)
- craniovertebral anomalies (chiari anomaly , congenital basilar impression )
- intrauterine infections (toxoplasmosis, congenital syphilis , cytomegaly , rubella), birth trauma .

#### 2. **Acquired hydrocephalus :**

- inflammatory processes in the brain and its membranes ( encephalitis , arachnoiditis , meningitis)
- brain damage
- vascular disorders (ventricle bleeding, hemorrhagic stroke or intracerebral hematomas with blood entering the ventricles).
- Colloidal cyst of the III ventricle and intracerebral tumors ( astrocytomas , germinomas , ganglioneuromas , etc.) against the background of sprouting of ventricles and compression of cerebrospinal fluid. In this case, the normal circulation of the cerebrospinal fluid and its exit from the skull cavity are disturbed.

The atrophic (replacement) form of hydrocephalus, which occurs as a result of post-traumatic death or age-related atrophy of brain tissue, is distinguished. In this case, the cerebrospinal fluid fills the space created in the skull as a result of the decrease in brain volume. Atrophic hydrocephalus in the elderly can develop against the background of cerebral blood supply disorders with atherosclerosis , hypertension , diabetic macroangiopathy .

An increase in intracranial pressure is not observed in children due to the great elasticity of the bones of the skull, in which hydrocephalus is accompanied by an increase in the volume of the skull. In newborns and young children, hydrocephalus is characterized by the size of the head, swelling of the vessels of the scalp, lack of tension and pulsation of the large fontanelle, swelling of the optic nerve discs.

The "setting sun" symptom is often noted - restriction of upward movement of the eyelids. Divergence of skull sutures can be observed. Touching the skull is accompanied by a characteristic sound ("a cracked pot" symptom). In children of the first year of life, hydrocephalus causes a delay in development. Later, they hold their heads, roll over, sit and walk.

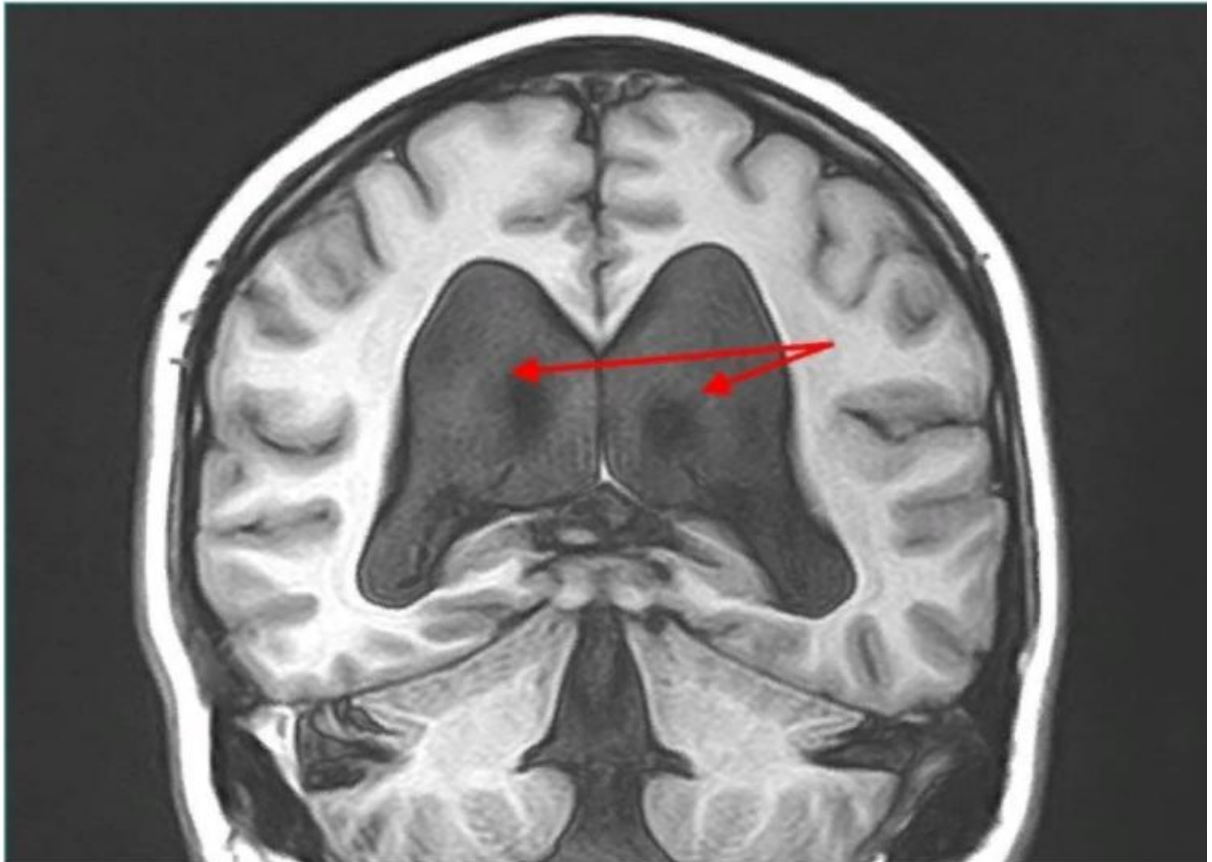
Children with pronounced hydrocephalus are characterized by a spherical shape of the head, very large dimensions, deep-set eyes, open ears and thinning of the scalp. Decreased vision, increased muscle tone in the lower extremities, cranial nerve disorders can be observed. Unlike adults, hydrocephalus in childhood is often accompanied by intellectual deficiency rather than emotional-volitional disorders.

Children with hydrocephalus are usually inactive and obese . They are indifferent, not proactive, they do not have the love of their peers that is characteristic of their relatives. A decrease in the level of hydrocephalus often leads to an increase in the child's intellectual ability and activity.

In adolescence, hydrocephalus often occurs acutely against the background of an infectious disease, mental or physical injury. At the same time, it is accompanied by severe headache, repeated vomiting, bradycardia . Loss of consciousness, sometimes convulsive attacks are possible. In some cases, episodic psychoses with hallucinatory or delusional syndromes are observed.

Clinical signs of hydrocephalus are usually so characteristic that they allow a neurologist to suspect its presence when examining the patient for the first time. Additional tests are performed to determine the degree and form of hydrocephalus, as well as to determine the underlying disease:

- **X -rays.** X-rays of the skull reveal thinning of the bones of the skull and divergence of the sutures between them; There is a sign of "finger drops" on the inner surface of the skull vault. Due to stenosis of the cerebral water supply, hydrocephalus is accompanied by a decrease in the volume of the posterior cranial fossa on X-rays of the skull. Hydrocephalus in Dandy-Walker syndrome, on the contrary, is characterized by an increase in the volume of the posterior cranial fossa in craniograms. When closing one of the interventricular messages, hydrocephalus is manifested by the asymmetry of the skull visible on the craniogram.
- **Computer or MR tomography .** Tomographic diagnostic methods make it possible to determine the nature of hydrocephalus, to identify the site of blockage of cerebrospinal fluid or an existing congenital anomaly, to determine the underlying disease (tumor, cyst, hematoma, etc.). With hydrocephalus, the use of an MRI of the brain is the most informative. If vascular diseases are suspected, MRA of cerebral vessels is indicated.
- **Ecography .** Among the ultrasound diagnostic methods for hydrocephalus , echoencephalography is used, which allows to determine the level of increased intracranial pressure. In children of the first year of life, ultrasound examination of the brain through an open fontanel can be performed using ultrasonography .
- **Consultation with an ophthalmologist .** Assessment of optical disorders and condition of optic nerve discs is carried out by an ophthalmologist. As a rule, the list of ophthalmic examinations for hydrocephalus includes ophthalmoscopy , determination of visual acuity and perimetry .
- **Lumbar puncture .** If there are no contraindications, a lumbar puncture can be performed to determine the underlying disease, followed by examination of the cerebrospinal fluid. Congenital hydrocephalus of infectious etiology requires PCR diagnosis to determine the type of infection that caused it.



*MRI of the brain. Obvious expansion of the lateral ventricles of an occlusive nature.*

The choice of hydrocephalus treatment method depends on its etiology. Conservative therapy is often carried out with hydrocephalus acquired due to inflammatory diseases, tBI, bleeding in the ventricles. The main disease is treated, and diuretics (acetazolamide, furosemide) are prescribed to reduce the level of hydrocephalus and increase intracranial pressure.

Congenital hydrocephalus usually requires surgery to correct the underlying malformation. If hydrocephalus is associated with the presence of a volumetric process in the brain, it is also treated surgically. According to the instructions, intracranial hematoma is removed, operations to remove tumors, opening or complete removal of a brain abscess, separation of adhesions with arachnoiditis, etc.

In cases where it is impossible to eliminate the cause of hydrocephalus, shunt operations are used:

- cystoperitoneal bypass surgery
- Endoscopic ventriculocisternostomy of the bottom of the III ventricle
- ventriculoperitoneal bypass surgery
- Lumboperitoneal bypass operation
- external ventricular drainage

They are aimed at creating additional pathways for the outflow of cerebrospinal fluid from the skull cavity. If it is not possible to restore the normal circulation of the cerebrospinal fluid during

the operation, bypass operations can be performed as an addition to the surgical treatment of the main disease.

Since the 1950s, the standard treatment for any form of hydrocephalus has been shunt surgery to restore fluid flow . After craniotomy, one end of the shunt ends with an X-ray contrast catheter and is passed into the dilated ventricle. The spacer made of silicone, the longest part is placed under the skin. The distal end with a catheter opens into the abdominal or thoracic cavity to provide drainage. The shunt is equipped with a pump that automatically regulates the pressure of the cerebrospinal fluid. Since the mid-80s, endoscopic operations have taken an important place in the treatment of hydrocephalus.

occlusive hydrocephalus with bypass surgery is very effective, but according to various sources, complications in this operation account for 40-60% of cases. In this case, depending on the reason that caused the dysfunction, the whole shunt or its parts should be replaced. Experience shows that complications that often require revision of the shunt occur six months to a year after surgery. Most of the patients who underwent a shunt operation have to undergo several surgical procedures during their lifetime. In any case, it is necessary to wait for at least two or more inspections - after all, the child is growing. After shunt operations , the patient becomes dependent on the shunt, which means that his future life depends on the work of the shunt.

### **Complications of bypass operations**

In the ventricles of the brain occlusion (clogging).

- the shunt, cerebral ventricles, meninges .
- Mechanical damage to the shunt.
- Hyperdening (a rapid outflow of cerebrospinal fluid from the ventricles) is often accompanied by the rupture of convexity vessels and the formation of hematomas .
- Hypo-training (slow exit from the ventricles) - in this case, the operation is ineffective.
- of epileptic syndrome , pressure ulcers of abdominal organs, etc.

### **External drainage operations**

See also: ventricular puncture

This method of external removal of cerebrospinal fluid from the ventricles of the brain, used as a measure of desperation , is accompanied by the most complications, especially the increased risk of infection.

### **Endoscopic treatment of hydrocephalus**

Currently, endoscopic treatment of hydrocephalus is a priority in world neurosurgery practice. Types of surgical endoscopic interventions for hydrocephalus:

- Endoscopic ventriculocisternostomy of the bottom of the III ventricle,
- Aqueductoplasty,
- ventriculocystocisternostomy,
- septostomy,
- endoscopic removal of intraventricular brain tumor,
- of the shunt system .

The remaining types of surgical interventions are not yet widely used in clinical practice .

### **Endoscopic ventriculocisternostomy of the bottom of the III ventricle**

This operation is widely used and accounts for about 80% of neuroendoscopic operations for hydrocephalus. The purpose of surgery is to remove fluid from the ventricular system (III ventricle) of the brain is to create exit routes to the brain cisterns , through which liquid reabsorption (absorption) occurs, like a healthy person.

Instructions for operation:

- primary operation for occlusive hydrocephalus with the degree of occlusion from the back and distal third ventricle ;
- shunt operations with removal of previously installed shunt system (instead of "revision of shunt system" operation);
- post-traumatic hydrocephalus;
- mixed hydrocephalus (internal and external);
- elective surgery to remove the shunt system to achieve shunt independence;

Advantages of the operation compared to classic shunts:

- surgery restores physiological (like a healthy person) cerebrospinal fluid from the ventricular system of the brain to the basal cisterns;
- there is no implantation of a foreign body (shunt system) in the body, and related problems (infection, malfunction, need for revision ) are excluded ;
- the risk of hyperdraining and related complications ( subdural hematomas , hydromas , etc.) is significantly lower;
- less surgical trauma;
- more cost-effective for surgical treatment facilities;
- improve the quality of life.

Surgical intervention is actually the only way to fight the disease. Drug methods can slow the progression of the disease in most cases, but do not eliminate the root cause of the disease. If the operation is successful, almost complete recovery is possible with a return to normal.

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