Hydrocephalus

Hydrocephalus arises from the multiplication of cerebrospinal fluid in the ventricles or subarachnoid space due to increased secretion, decreased resorption of the fluid or obstruction of the liquor pathways. Usually there is oppression and reduction of the brain parenchyma. The simple multiplication of cerebrospinal fluid, which leads to the expansion of the ventricular system, but without oppression and reduction of brain tissue, is called ventriculomegaly.

Physiology of liquor pathways

CSF is secreted from the choroideus plexus (making up 80% of the CSF) – the rest is probably made up of ependyme, interstitial fluid and capillaries . From the lateral ventricles, the liquor passes through the *foramen Monroi* (*foramen intraventriculare*) into the III ventricle, from where it *continues through the aquaeductus mesencephali (Sylvii)* to the IV chamber, from which it flows through *the foramina Luschkae* (two laterally) and through *the foramen Magendi* (one in the middle line) into the subarachnoid space – into the pontocerebellar cistern.

CSF formation is approximately **15–30 ml/hour** (i.e. 0.25–0.5 ml/min), the total amount of CSF is normally **120–180 ml (the liquor is renewed every 4–6 hours)**. Resorption occurs by active transport through pacchion granulations in *sagitalis superior sinus* on convexity, absorption capacity is 25 ml/min (so it has a large reserve).

Etiology

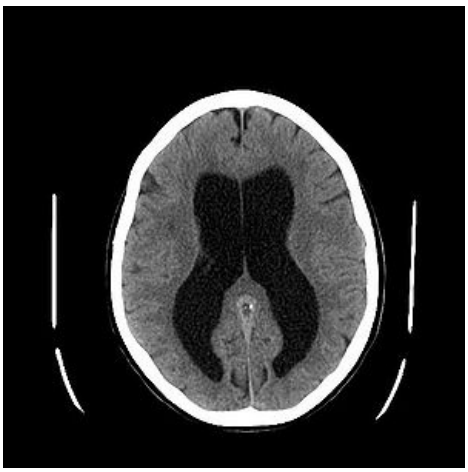
The main cause of hydrocephalus is hemorrhage in prematurity newborns, myelomenigocele or tumor, stenosis of the aqueduct. Other causes may be:

- congenital malformations – Dandy-Walker malformation, Chiari malformations,
- trauma,
- hemorrhage,
- infection,
- intracranial tumors,
- AV malformations,
- cavernous malformations,
- or postoperative complications.

Evaluation and diagnosis of hydrocephalus

The degree depends on the size of production and the rate of resorption. The size of the chambers is different.

The basis of the diagnostic means is CT. For young children, it is possible to use USG through the fontanel, if they are already closed, we choose MRI. Ventriculography and cisternography are advantageous for clarifying obstacles. As an additional examination, CSF biochemistry, isotope examination, etc. can be used.



CT of obstructive hydrocephalus, enlargement of lateral ventricles

Types of hydrocephalus

Hydrocephalus can be divided into **acute** or **chronic**. In terms of dynamics (importance for treatment) to **active** and **passive**.

According to the functional classification, it can be divided into

- obstructive
- communicating
- hypersecretory (very rare, in tumors of the choroidal plexus, papilloma or carcinoma),
- and hyporesorptive (with repeated minor bleeding from the tumor).

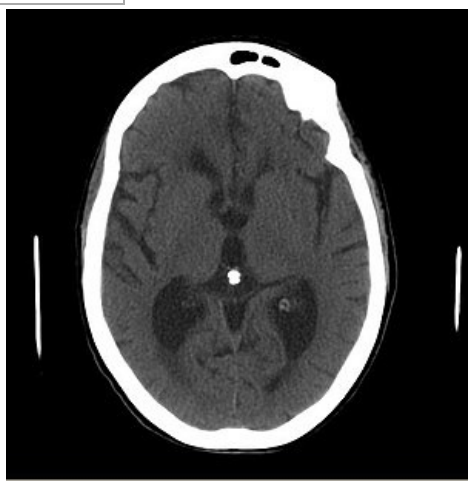
Normotensive hydrocephalus

Normotensive hydrocephalus (NPH) is a communicative hydrocephalus and is serious, one of the least diagnosed diseases due to significant competition with other neurodegenerative comorbidities. Typical is ventriculomegaly with expansion of subarachnoid spaces without obvious obstruction. Cortical atrophy or ischemic changes are often present. There is talk of a **treatable form of dementia**, because the disease itself is to some extent influenced by surgical implantation of a shunt (most often it is a ventriculoperitoneal shunt).

A typical manifestation is the so-called **Adams-Hakim triad** consisting of cognitive deficit, gait disturbance and urinary incontinence (mainly in men over 60 years of age). [source?]). The etiology is unclear (so-called idiopathic normotensive hydrocephalus), a specific cause may not be identified. In some cases, a history of meningitis, SAK, other obstruction in the form of tumors, vascular malformations, etc., or even injury (secondary normotensive hydrocephalus) may occur.

Obstructive hydrocephalus

Anatomical localization	Cause of obstruction
lateral ventricles	ventricular haemorrhage, tumors – meningioma, ependymoma (more rarely)
foramen monroi	cysts from the third ventricle
III. chamber	pituitary adenomas, craniopharyngealema
aquaeductus sylvii	congenital narrowing, atresia, haemorrhage
IV Chamber	haemorrhage, medulloblastoma (in children), ependymoma
foramen Magendi	processes in Chamber IV
magna cistern	Dandy-Walker malformation
basal cistern	acute subarachnoid hemorrhage



CT of normotensive hydrocephalus, the ventricular system is not widespread, but the expansion of the subarachnoid space is noticeable

Obstructive hydrocephalus arises from the blockade of the circulation of the liquor. In terms of the place of obstruction, it is further divided into:

- non-communicative, when the obstacle is in the ventricular system, and
- communicating, when the obstruction is in the subarachnoid spaces or venous system.

From a practical point of view, obstructive hydrocephalus arises from the obstruction of some part of the liquor pathways from the place of origin in the choroidal plexus to the place of absorption, which is mainly into the venous canals at the site of the so-called arachnoid villi.

Communicating hydrocephalus or occlusion of arachnoid villi that resorb the liquor back into the venosal sinuses is a condition in which all cerebral ventricles and subarachnoid spaces expand. This unit must be distinguished from the benign extraaxial collection in infants (the head circumference of these patients does not exceed the percentile limit of the relevant table, we often find a larger head circumference in the father or mother). Another cause of enlargement of the head circumference, which requires urgent diagnosis, is *shaken baby syndrome*. Here there is a progressive increase in the circumference of the head, imaging methods demonstrate the presence of a collection of blood.

Mickey Mouse sign

Mickey mouse sign is one of the typical CT images of obstructive hydrocephalus when both monroii foramen are closed. The image shows the balloon-like swelling of the frontal corners of the lateral chambers and the III chamber, which creates the silhouette of the Mickey Mouse.

Clinical picture

Clinical manifestations of hydrocephalus depend on the age of the child and the speed of its formation. Their recognition is important not only for primary diagnostics, but also for early recognition of failures in surgical treatment, shunt or endoscopic surgery, which can manifest itself even several years after the procedure.

Infants and children up to 2 years
: The child tends to be irritable, the main symptom is a growing head circumference (macrocephaly). It is possible to notice the thinned skin of the scalp with a shining venous drawing and, in the case of acute progression of tension of the large fontanel, spacing of the skull seams. Paresis of the VI cranial nerve and vomiting may also be present. With further progression, the deviation of the bulbs occurs caudal (the so-called "setting sun" symptom), impaired consciousness, bradycardia, hypertension and respiratory disorders. The condition requires urgent examination and neurosurgical intervention.

Older children
: Whose cranium is no longer unyielding, acute hydrocephalus is manifested by headache, vomiting, a symptom of the setting sun and impaired consciousness, followed by breathing disorders and bradycardia. Manifestations of chronic hydrocephalus in older children tend to be creeping, with morning headaches, abdominal pain with vomiting, gradual change in behavior and deterioration of school grades. Sometimes psychological-psychiatric symptomatology can be in the foreground. As a result of the difficult to recognize the onset of the disease, often at the time of diagnosis, the radiological picture is already extensive dilatation of the ventricular system and pronounced congestion with bleeding on the papilla of the optic nerve during the examination of the eye background.

Adults

Hydrocephalus is manifested by headaches and intracranial hypertension syndrome. Parinaud's syndrome (disorder of the conjugate view upwards) may be present, as well as a symptom of the setting sun (when looking down, the upper eyelid does not follow the upper edge of the iris, whites appear). As part of the examination, it is important not to forget the examination of the eye background due to papilla congestion. Subsequently, we indicate CT or MRI.

Seniors

Typically, normotensive hydrocephalus arises from impaired absorption of liquor with a triad of symptoms: dementia, incontinence and gait disturbance.

Hydrocephalus therapy

Conservative therapy

In immature children with bloody liquor, where we expect a decrease in liquor formation, diuretics (acetazolamide, furosemide) are administered. (But in recent recommendations, there is a departure from them for possible serious side effects and questionable therapeutic effect.)

Surgical therapy

Acute hydrocephalus – the method of choice is the introduction of temporary drainage;

- ventricular drainage – in obstructive hydrocephalus;
- lumbar drainage – in communicating hydrocephalus.

Chronic hydrocephalus

- hyporesorptive – the introduction of permanent drainage;
- obstructive – several options are offered:
  1. Surgical **removal of obstruction**;
  2. bypassing obstruction by creating a different **communication** between the liquor pathways (septotomy, III. ventriculostomy – endoscopic method);
  3. **shunt** – ventriculoperitoneal, ventriculoatrial, lumboperitoneal.

Links

Related articles

- Hydrocephalus (neonatology)
- CNS malformations
- Normotensive hydrocephalus
- Surgical treatment of hydrocephalus
- Central nervous system
- Neurodegenerative diseases

External links

- Hydrocephalus (English Wikipedia)

Source

- HAVRÁNEK, Jiří: *Hydrocephalus* [textbook]
- BENEŠ, Jiří. *Study materials* [online]. ©2007. [Retrieved 2010]. <http://www.jirben.wz.cz/>.

Literature used

- ZEMAN, Miroslav, et al. *Special surgery.* 2nd edition. Praha : Galén, 2004. 575 s. ISBN 80-7262-260-9.

Reference

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