II. NEONATOLOGY

HYDROCEPHALY AT INFANTS AND CHILDREN

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Abstract

The paperwork discusses about anatomy, physiology, classification, etiology, physiopathology, clinical aspects, paraclinical investigations, differential diagnosis, evolution, prognostic, therapeutical aspects of hydrocephaly.

Keywords: hydrocephaly.

By hydrocephaly of the infants we understand an increase in the volume of the skull due to an increase of the quantity CSF (cerebrospinal fluid) and its being accumulated, under pressure, in the preformed anatomical intraskulled cavities, which has for consequence an expansion of these liquid cavities because of the cerebral substance. As the quantity of CSF in the intracerebral spaces increases under pressure, so does the volume of the skull, while the global volume of the cerebral parenchyma decreases.

The hydrocephaly of the child involves an active increase of the quantity of CSF in the cerebral ventricles, under pressure without the increase of the skull perimeter, already finalized.

As far as the mechanism of production is concerned, we have to differentiate between the active hydrocephaly described above, and the passive hydrocephaly which follows the reduction of the cerebral parenchyma by cerebral atrophy, during which the CSF, being under normal pressure comes to fill in the empty space (ex vacuo). In the case of passive hydrocephaly, the skull has normal dimension.

The anatomy of liquid spaces

The anatomic spaces that normally contain the CSF, in the liquid spaces, include two compartments:

1-The spaces derived from the primitive neural tube, disposed inside the CNS (central nervous system), contains the cerebral ventricles (at the level of the encephalon) continued by the ependymal canal (at the level of the spinal cord).

At the level of the encephalon, there are the four ventricles: the lateral ventricles (2) (telencephalic), the third ventricle (diencephalic) and the fourth ventricle (rhombencephalic). These ventricles communicates with one another through the Monro foramen (which ties the lateral ventricles to the third ventricle) and through the Sylvius aqueduct (which links the third and the fourth ventricle).

The cerebral ventricles are lined with the ependym (nevroglic membrane) except the choroid plexus.

The ependymal canal (the central canal of the spinal cord) crosses longitudinally the spinal cord at the level of the grey comissure.

2-Subarachnoidian spaces form between arachnoid and pia matter. Subarachnoidian intracranial space communicates with intrarahidian space by cisternae systems (cisterna magna, cisterna pontomedullaris).

The connection between these two compartments (liquidian spaces derived from the primitive neural tube and subarachnoidian space) is done at the fourth ventricle level, through three foramens:

- Magendie foramen (connects fourth ventricle and cisterna magna);
- Luschka foramens (two) (that achieves the connection with cisterna pontomedullaris).

Physiology of CSF

The amount of CSF at infants is 40-60 ml, and after five years old reach 100ml.

The production of CSF was considering belonging to the choroids plexus of the ventricles, but new studies shows that nervous tissue has a role in CSF production.

There is two types of CSF circulation:

- longitudinal circulation – the CSF outflow is directed from choroids plexus toward arachnoid granulations (main place of CSF resorbtion);
- transversal circulation (transependymar and transspinal) - there is a continuous exchange between spaces filled with CSF and extracellular space of nervous system.

CSF resorbtion is an active process, which is in a dynamic balance with the active process of secretion of CSF. The main place of CSF resorbtion is Pacchioni's arachnoid granulation which allowed the passing of CSF outflow from subarachnoid space into the venous and lymphatic systems. Anothers resorbtion are as are: capilaro - venous system of leptomeninges, perivascular and perineural slits. Resorbtion of CSF is controlled by the endocranian venous pressure.

The classification of hydrocephaly

The old classification used to divide hydrocephalies in to: congenital and gained.

Nowadays there are different classifications according to the etiology, morphology, clinical aspect, evolution etc.

The most used classification are:

1-Dandy's classification (1918) based on physiopathological criterion:

- the obstructive hydrocephaly: caused by a blocking of the circulation ways of CSF.
- the communicating hydrocephaly: caused by hypersecretion or hyporesorbtion of the CSF (the circulation ways are free).

2-Matson's classification (1963) based on clinical criterions and therapeutic importance:

- progressive hydrocephaly: with progressive signs but without proofs of irreversible cerebral lesions;
- extremely progressive hydrocephaly: with longtime persisting hydrocephaly and with irreversible cerebral lesions, having yet therapeutic importance;
- stabilized hydrocephaly when a cease of evolution exists, but which needs periodical control because it can often became progressive again;

3-Lazorthes's classification (1954):

- active hydrocephaly: when there is a disorder or a blockage of the CSF circulation (corresponding to Dandy's obstructive hydrocephaly);
- functional hydrocephaly: there is a disproportion between the CSF production and resorbtion (corresponding to Dandy's communicating hydrocephaly);
- passive hydrocephaly: following the reduction of the cerebral parenchyma through cerebral atrophy (it doesn't belong to the infant's and child's hydrocephaly).

4-Carnier's classification (1969):

- communicating hydrocephaly;
- noncommunicating hydrocephaly.

Etiopathogenesis

There are a lot of factors responsible for the formation of the hydrocephaly, which can be grouped in this way:

1. Congenital malformation. The hydrocephaly through congenital malformation can manifest itself at birth, but not obligatory, sometime it can be discovered after a few months from the birth.

During the intrauterine development there is a stage/phase of physiological hydrocephaly during the first 5 months, initially obstructive (through the unpermeabilisation of the Magendie and Luschka foramens) then communicating (through the permeabilisation of the same foramens) which normally up to the fifth month sets off. So, some forms of hydrocephaly do not represent a new phase, but the pathological persistence of a stage which is normal for the fetal life.

The hydrocephaly may be produced by the following congenital malformation:

a. Disgenesis of the Sylvius's aqueduct produces through obstructive mechanisms a triventricular hydrocephaly accompanied by important cerebral lesions.
b. The Dandy-Walker syndrome or the atresia of the Magendie and Lushka holes accompanied by agenesis of inferior vermis; realizes a quadriventricular hydrocephaly with an enormous pseudocystical dilatation of the IV th ventricle.
c. The Arnold - Chiary malformation is characterized by the descent (herniation) of the cerebellum and the bulb in the medullary cervical duct produces the hydrocephaly as a result of the deformation which exists at the level of the IV th ventricle.
d. Spina bifida, the mielomeningoceles and the meningoencephaloceles are very frequently associated with the hydrocephaly (70-80 %). The belief that the surgical cure creates a liquids maladjusted followed by hydrocephaly is not true. It was proved through preoperative and postoperative ventriculography (Lorber 1961) that the hydrocephaly is present before the operation, and postoperative the hydrocephaly does not appear to those to whom the ventricular system was normal before the operation. It appears that the bag of the mielomeningocele acts as auxiliary to the normal mechanism of pulsate absorbtion of the spinal sheath; the ablation can produce a partial loss of this mechanism and can contribute to a ventricular dilatation. It has been noticed the frequent association of the mielomeningecele with cranio-vertebral junctions malformation and with the Arnold-Chiari malformation.
e. Other malformations: congenital arachnoidal cysts, bones malformations localized at the level of the cranio - vertebral junctions (the basilar impression, the platybasia) or generalized (achondroplasia, Hurler's polydistrophy).

2. Intracranial expansive processes

a. The cerebral tumors are rare at the infant and at the child. They may produce hydrocephaly especially by an obstructive mechanism, affecting directly the flow of CSF: tumors of the IV ventricle, tumors of the posterior cranial fossa, tumors of the brain stem, and tumors of the pineal area. The papillomas of the choroidal plexus by the hypersecretion of CSF produce the communicating hydrocephaly.
b. Cerebral abscesses;
c. Subdural overflows.

3. Meningo-cerebral inflammatory processes

They include infectious processes, which generate a hydrocephaly of bacterial, viral or parasitic origin.

a. Ependymitis (in case of inflammation, the ependyma produces an increased quantity of CSF);
b. In ependyitis the hydrocephaly may be:
   - communicative, if the inflammation is limited to the lateral ventricles;
   - obstructive, if the inflammation expands secondary to the aqueduct.
c. The meningitis produce obstructive hydrocephaly by the formation of adherences which prevent the CSF circulation;
d. The toxoplasmic encephalitis produces an obstructive hydrocephaly, the presence of the classical triad of the

congenital toxoplasmosis (hydrocephaly + intracranialcalcifications + corioretinitis) allows the suspicion of the toxoplasma as etiology of the hydrocephaly.

4. The hemorrhage of the meninx produces obstructive hydrocephaly by fibrous lying which causes fibroadhesive leptomeningitis, especially at the base and at the fissures of the cerebral hemisphere, accompanied by the blocking of the resorbtion.

Small quantities of blood can be found in the CSF at almost all new-born babies, with more severe bleeding in the case of prematurity ones. In the developing of a hydrocephaly, only severs bleeding in the CSF comes into consideration. After subarachnoidian hemorrhage, the meninx fibrosis appears, especially if the blood had persisted for at least 10 days; this is the reason why the lumbar puncture are necessary and efficient in order to evacuate the blood and to prevent the installation of hydrocephaly.

5. Vascular disorders:

- thrombosis of the superior longitudinal sinus;
- malformation of the great Galen's cerebral vein;

In both cases, the hydrocephaly is obstructive because of the diminution of the CSF resorbtion causing by stasis and hypertension in venous sinuous.

6. CSF hypersecretion

- hypersecretative papillomas of the choroids plexus;
- -A hypervitaminosis and hypovitaminosis(they are benign and do not need treatment).

7. Hydrocephaly with normal pressure (HPN) - is rare in the case of children. The clinical signs consist of: mental retardation, equilibrium and behavioral disorder, personality changes, disorder of the sphincters. In all cases, the intraventricular pressure is not high; but drainage with automatic valve with low pressure is a must for diminishing the quantity of intracranial CSF which may become active as a result of cranio-cerebral trauma, sunstroke, etc.

8. Hydrocephaly of indeterminate origin – it must be insisted both anamnestic and paraclinical investigations in order to detected the cause of this hydrocephalyes.

Physiopathology

Generally, in the pathogenesis of hydrocephaly the following three factors may occur:

a) CSF hyperproduction usually accompanies the evolution of a papilloma of the choroids plexus this is a rare possibility;

b) Insufficiency of CSF resorbtion.

In occur separately, this two factors did not cause progressive hydrocephaly.

c) An obstruction in CSF circulation can produce a chronic obstructive hydrocephaly by unbalance in secretion and absorbtion of CSF. Experimentally was establish that absorbtion diminish with almost 80%in first hours after obstruction and remain low for 10-15 days. Concomitant CSF secretion decrease progressively and it will begin balance with absorbtion from 21-th day. This unbalance, determine a rise of ventricular volume. Initially cerebral substance remain unimpaired, but because of repeated episodes of high intracranian pressure lesion of cerebral structure appear.

An increase in ventricular volume determine a diminish in reserve functional space of CSF resorbtion by compression of subarachnoidal space, cisterns and venous system. All this factors contribute to hydrocephaly development. Exceedingly ventricular dilatation cause stretching of corticospinales nervous tracts, cerebellum compression and appearance of associated clinical signs.

Clinical aspect

1. A large neurocranium is the main sign. Because of enlargement of neurocranium, viscerocranium appears small in comparison.
2. Bulging and large anterior fontanel is a result of high intracranian pressure. A persistent bilging anterior fontanel is a proof of hydrocephaly even if perimeter is normal.
3. Dilatation of scalp's veins, which is very well visible at frontoparietal region.
4. The eyeballs are orientated downwards, with pupilla partial covered by eyelid.
5. The palpation find: cranian suture are dehiscent, anterior fontanel is large (8-10 cm or more), bulging.
6. The percution of the heed demonstrate a " broken pot " (Macewin sign)
7. Mental and motor retardation.
8. Psychico-motor agitation (because of CSF's high pressure)
9. In advances stages there are present: slow spontaneous movements; spasticity of inferior limbs, than superior limbs; bilateral Babinski sign; strabismus; modification of retina, even optic atrophy with absence of pupillary reflexes and blindness; disorders of consciousness state that may advances to coma.

Clinical aspects in child's hydrocephaly is same as infant's with exception of: increase of cranian perimeter, bulging anterior fontanella and dehiscents of cranian sutures.

Diagnosis – is easy in advanced hydrocephaly, when all clinical sign are present, but is difficult in incipient stages, when paraclinical investigation is needed to confirm the diagnosis.

Paraclinical investigation

1. The diagrams of head circumference increasing and anterior fontanella closing (periodic measurement every two weeks). The normal increasing rhythm of head circumference is: 2 cm by month in the first three months; 1cm /months between 4-6 month; 1cm every two months in next to months.
2. Transfontanellar ultrasound shows ventricles dimension and cerebral parenchyma status.
3. Head-radiograph shows a cranium with balloon shape and disproportion between neurocranium, which is very big, and viscerocranium .The anterior fontanel is very large. The radiograph transparence of the cranium is high, with invisible sutures. If a subsequent X-ray

shows a most evident sutures there is a proof of stabilization of hydrocephaly.In case of intracranian expansive process (tumors, subdural hematoma, abscesses,etc) there is a little increase of cranium volume and sutures of cranium are dehiscent, which is the main sign. In case of intracranian calcifications we must consider toxoplasmosis, choroids plexus, papilloma with calcifications or craniopharingioma.

4. CT-scan is the main investigation in hydrocephaly. This method identifies periventricular edema ("perilucency") which proves CSF accumulation in parenchyma of the cerebrum. This edema indicates a serious damage of the parenchyma and in this case is this case is requiring an emergency CSF drainage. CT scan provides informers about stadialization of hydrocephaly. Evans index represents ratio between extreme interventricular distance and interparietal distance on horizontal section and is below 0,3 normally.

There are four stages of hydrocephaly:

- stage I (minor hydrocephalus): Evans index = 0,26–0,40
- stage II (medium hydrocephalus): Evans index = 0,41–0,60
- stage III (severe hydrocephalus): Evans index = 0,61-0,90
- stage IV (extreme hydrocephalus): Evans index = 0,91–1,00

5. MRI– is not obligatory if CT-scan was done. MRI advantage are major in discover of concomitant malformations which product obstructive hydrocephaly.
6. CSF examen

Two elements is important for hydrocephaly: total proteins of CSF and cytology of CSF which may indicates an inflammatory, tumoral or hemorrhagic etiology. A high level of proteins contraindicates the interventions for ventricular drainage.

7. Pneumoaencephalography and ventriculography may be useful for estimate of: CSF cavities morphology, level of obstruction of CSF flow and to guide in surgical interventions.
8. Radioactives isotopes may provide dates about CSF flow, speed of circulation and CSF resorbtion.
9. Cerebral angiography discovers vascular malformations.

Differential diagnosis

1. Congenital macrocephaly: usually have familial caracter; is nonpathologic, nevolutive and ventricles dimensions are normal.
2. Florid rickets: the cranium is large but squarer shape, anterior fontanel is normal and time evolution makes the difference CT scan is useful.
3. Subdural overflow with macrocephaly necessitates CT scan and eventually MRI to make the diagnosis.
4. Congenital arachnoid cysts in infants can manifest with increase in cranian dimension.
5. CT scan identify the diagnosis.Hydranencephaly – there is no cerebral substance at the level of temporal, parietal lobes, on convex surface of temporal and occipital lobes which means the territory of distribution of medium and anterior cerebral arteries (hydranencephaly is cause by an occlusion of internal carotid arteries).Only brain stem exist and survival is due this nervous structure. There is no indication to surgical intervention.
6. Hydranencephaly must differentiate from extreme severe hydrocephaly (stage IV), when ventricles are in maximum distension but cerebral parenchyma exists between ependym and leptomeninx.

Evolution

There are four stages that coincide with CT scan stages:

- stage I: head circumference is normal, ventriculomegaly exists, CSF pressure is increase and there is no cerebral atrophy

This stage may remain stationary or may progress.

Management in this stage consist in clinical, ETF and CT scan follow-up

- stages II and III: there appears the distension of the osteomembranous space as a compensation of the increase of the CSF pressure, with a clinical aspects typical of hydrocephaly and starting to diminish the cerebral mantle. These stages may be stabilized spontaneously or may evolve to stage IV. Therapeutic indication: CSF drainage proceeding
- stage IV: a stop appears in the growth of the nervous tissue and the one already existing is subjected to more and more rapid destruction . The cerebral mantle is reduced progressively and becomes papyraceous. I n this stage the spread hypertonicity is always present. Therapeutic indication: CSF drainage proceeding depending on the clinical neurological and ophtalmological state and on the modification noticed on the CT scan or MRI.

Some hydrocephalies get stabilized suddenly – the stabilized hydrocephaly non-progressive. This type of hydrocephaly may decompensate in some situations (cranio-cerebral traumatism, effort, sunstroke, intercurrent illness, lumbar puncture, and the pneumoencephalography) and become evolutionary with serious phenomena of intracranian hypertension. So to the compensated hydrocephalies the lumbar puncture and the pneumoencephalography are dangerous leading very easily to the decompensation of the stabilized hydrocephaly.

The evolution at infant and children with acute hydrocephaly (stage IV) is towards death in the first 6-12 months by cardio-respiratory insufficiency due to the compressed of the brain stem (of the bulb) by CSF through intracranian hypertension.

The evolution of those who treated their hydrocephaly surgically (stages II -III) is easily favorable in the case of a good functionality of the drainage system. Through the reduction of the CSF pressure on the cerebral parenchyma, there is an obvious improvement of all the SNC functions. The postoperative results must be observed in time neurologically, ophtalmologically, psychiatrically and by repeated CT scan.

Prognostic

The vital prognostic of the progressive (active) hydrocephaly is reserved, being more favorable to the cases, which suffered a surgical treatment than to those that didn't.

The vital prognostic depends on: repeated intercurent affections; infections of the CNS, septicaemic condition, other severe infections (bronchopneumonia, acute endocarditis, etc.); prematurity; severe cranio-cerebral traumatism; other organic or metabolic affections; the evolutive stage of the hydrocephaly (stage IV has a severe vital prognostic).

The functional prognostic (intellectual, cognitive functions, IQ, neurological focal deficit, the affectation of the cranial nerves) of the active, evolutive hidrocephaly depends on: the time elapsed from the beginning to the diagnosis, the cranial hypertension syndrome, the destruction of the cerebral parenchyma, the affectation of the visual function, the evolution stage of the hydrocephaly, the time elapsed up to the surgical intervention, the correct surgical intervention adapted to the stage of the hydrocephaly. The exact evaluation of the functional prognostic of the treated hydrocephalics may be performed only after 10-15 years from the application of the CSF drainage.

Treatment

I. The active, evolutive hydrocephaly is only treated surgically, the medical treatments (lumbar or ventricular punctures) being insufficient or having a limited, temporary effect.

An essential principle of the surgical indications is that the time elapsed from the beginning to the treating of the hydrocephaly be as short as possible.

The immediate purpose of the surgical treatment is: to remove the causes of the hydrocephaly and to stop its evolution; and, as a secondary purpose: to ensure a functional future for the child, family, and society.

The major contraindications of the surgical treatment are:

1. signs of severe neurological damage :blindness, hemiplegia, coma;
2. concomitant congenital malformations of the CNS or of the other organs;
3. hyperalbuminorahia > 1g/l (a uni-shunt drainage can be applied where the automatic valve is not obturated);
4. the cerebral mantle <1 cm thick (stage IV);
5. the cranial perimeter exceed 60 cm ;
6. an accentuated dystrophy or a bad general mood;
7. when the hydrocephaly is not plainly evolutive;
8. internal hydrocephaly without tension;
9. serious infections of the nervous system (menyngoencephalitis, ventriculitis – bacterial or bacillar)or general (bronchopneumonia, sepsis state, endocarditis).

Of all these , an absolute contraindication is only the serious infection that can lead to generalization of the infection .the other contraindications are given by the weak postoperative results to witch we can expect , and concern especially the future of the child .

Surgical treatment concerns the reduction of the intaventricular pressure of the CSF which is realized through three types of procedures:

A. Procedures to decrease the CSF secretion: resection or coagulation of the choroids plexus in the lateral ventricles. There were not satisfactory results, they were accompanied by increased mortality and morbidity.
B. Intracranial drainage procedures of the ventricular CSF:
   1. The perforation of the superoptic lame for ventriclestomia III.
   2. Posterior ventriclecisternostomia type Torkildsen (1939
   3. Endoscopic ventriclecisternostomia.
   4. The posterior endoscopic ventriclestomia of the ventricle III, with the opening of the Sylvius aqueduct: it has major efficiency, minimal complications, so it is recommended in conditions of neuroimagistic and actual endoscopy.
C. Extracranial drainage procedures of the CSF ventricular with the automatic valves: there are numerous possible variants: lomboperitoneal drainage, ventriclecardiac drainage, ventricleperitoneal drainage.

1. Lomboperitoneal drainage has been imagined in the communicant hydrocephalies for the deversation of CSF directly in the peritoneum on a much shorter path (Chuma and collab. 1993). The main complications are mechanical: hyperlordosis, scoliosis, the hernia of cerebellous amigdales (tonsils).
2. Ventriclecardiac (VC) drainage is a physiologic drainage, CSF in excess arriving directly to its destination medium (venous blood). Automatic drainage valves are used, type Holter-Codman, Hakim, Pudenz, Denver, Neurone, Heyer-Schulte, Chabra, etc., with a high-medium-low pressure dial or even with a much larger dial; these valves assure protection against the blood flow and also against the fast ventricular decompression.

The surgical procedure includes the application of three elements:

-intraventricular catheter with measurement of the intraventricular pressure;

-automatic valve adapted to the catheter, with a pressure dial perfectly adaptable to the intraventricular pressure;

-intra-atrial catheter (adapted by the facial vena, via the internal jugular vena, in the right atrium) connected to the automatic valve.

The advantages of the VC drainage consist in: simple surgical technique, minimal surgical trauma, good adaptability at infants, good tolerance, there are not water and electrolytes losses, it can be controlled radiologically, the surgical reintervention is relatively simple.

The complications of the VC drainage are mechanical and infectious. The mechanical complications are: the blocking of the tubules and of the valve, the tubes

(the catheters) becomes too short as the child grows, the presence of the air in the valve or in the tubes hinders the CSF circulation, the disconnection of the tubes.

The infectious complications are major: infections of the nervous system (meningitis, ventriculitis), cardiopulmonary infections (bacterial endocarditis, bronchopneumonia), infections at distance (shunt glomerular nefritis), and sepsis state. Due to these redoubtable infectious complications, in the last 20 years they passed gradually to the VC drainage

3. The venticuloperitoneal drainage (VP) supposes the CSF ventricular drainage in the peritoneal cavity through a system of tubes (silicone catheters) and automatic valves.

The surgical procedure includes the application of four elements:

1. intraventricular catheter with measurement of the intraventricular pressure;
2. automatic valve with pressure dial adaptable to the intraventricular pressure, connected to the ventricular and to the distal catheter;
3. intermediary piece (connector) for the possibility of the effectuation of a MRI anytime;
4. intraperitoneal catheter of about 30 cm, allowing the sliding of the later along with the child's growing.

The advantages of the VP drainage are: the possibility of applying surgical techniques in the first week of life even the possibility of quick revising in case of mechanical complications, the infectious complications are much more reduced than in the VC drainage and with more efficient therapeutically possibilities.

The complications in VP drainage are frequent, being dominated by the mechanical ones.

The mechanical complications are: the disconnection of the tubes, the moving off of the tubes from the peritoneum, the moving off of the tubes from the cerebral ventricle (all possible with the child's growing), disconnections at the connector's level or between the tubes and the automatic valve. For the correct evaluation of the VP drainages and of the mechanical complications are imposed X-ray examinations, CT-scan abdominal and transfontanellar ultrasounds. For the mechanical complications we have two possible drainage tube revisions until puberty (Hirsch, 1992).

The infectious complications are more reduced than in the case of VC drainage and they consist of: infections of the nervous system (meningitis, ventriculitis), abdominal infections (peritonitis, septic abdominal cysts). The treatment protocol of the infectious complications is very strict and complex: the drainage system must be totally replaced, a temporary passage to the external CSF, the restoring of the VP drainage on the opposite side after having obtained 3 sterile CSF samples (Khanna &Co.,1995).

Other frequent complications of the VP drainages enclose: bilateral subdural overflowing, the premature closing of the cranial sutures, "slit-ventricle syndrome" (small ventricles on the median line), and "over-drainage" syndrome. The correction of these complications is made through: the checking of the intracranial pressure and the adjusting of the valves; Orbis-Sigma automatic valves with adjustable pressure according to the CSF pressure; Sophysa automatic valves with exterior adjustable pressure, with magnet.

The evaluation of the cases operated is obligatory for: the appreciation of the function of the VP drainage system, the decompression of the cerebral parenchyma, the functionality of the nervous system (IQ). The protocol of evaluation is structured in this way:

1. in the first 3 post operator years :

-neurological, neuropsychiatric, ophthalmologic control at 2 months;

-CT-cerebral scan and the abdominal ultrasound at 3 months;

2. in the next 3 post operator years:

-neurological, neuropsychiatric and ophthalmologic control at 6 months;

-CT-cerebral scan and abdominal ultrasound at 4 months;

3. after 6 post operator years:

- neurological, neuropsychical and ophthalmologic control at 1 year;
- CT-cerebral scan and abdominal ultrasound at 1 year;

Any neuropsychical, ophthalmologic clinical modification must immediately be evaluated correctly and completed by a CT-scan examination. Also the post operator control (inclusively CT-scan) is obligatory in the case of possible decompositions of the hydrocephalic through: sunstrokes, undercurrent infections, TCC, abdominal surgery.

II The obstructive symptomatic hydrocephalic –benefit only by surgical treatment.

A. In these cases we must orientate firstly towards an ethiopathogenic surgical treatment that could solve the cause of obstruction.

In cerebral tumors, cerebral abscesses, subdural overflows it will be an attempt to their ablation.

In the arachnoidita of posterior cerebral fosses or the Arnold-Chiari malformation the intervention directly on these lesions has a temporary character because the arachnoidian adherences recovered very fast.

In the stenos of aqueduct some authors propose the matter of repermeabilization of the aqueduct.

Because all these surgical interventions cause a great mortality, the ethiopathogenical treatment addresses to a limited number of hydrocephalus.

B. Internal drainage of CSF: only in case of obstructive (noncomunicating) hydrocephaly and is vital for decrease of intracranian pressure cause by tumoral process. Can be used the "uni-shunt drainage "procedure (the absence of automatic valve) (Ciurea & co.1998). The major complications of this drainage is extradural hematoma or subdural overflow by over-drainage (control CT scan is necessary).

C. External drainage of CSF by a standard system with assessment of intraventricular pressure and CSF gathering. This system function for 48-72 hours and then must occur surgical intervention for obstructive

hydrocephaly (maintain more than 72 hours may produce infections).

Results

Statistics about results of operates hydrocephalies vary and depending specially on duration of postoperative follow-up and less on valve type. Results depending very much on surgical indications which is made on time and correctly. Long term results evaluation is made on the basis of mental and motor development criterions.

On an average, statistics with postoperative follow-up more than 8 years shows this results: excellent 20-25% of cases, good 40-50%, poor 20-25%, deaths 5-10 %, postoperative complications 25-35%.

In conclusion, functional outcome depend more on cerebral parenchyma damages than dimensions of hydrocephaly.

Conclusions

In last decades more progress in hydrocephaly's treatment was done, but wasn't found an ideal cure. The most used surgical procedure is ventriculoperitoneal drainage.

At present, since neuroimagistics and endoscopy development,endoscopic posterior third ventricle venticulosomy with Sylvius aqueduct opening is performing with very good results .

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