

# INTRACRANIAL HYPERTENSION DUE TO DISORDERS IN THE CEREBOSPINAL FLUID DYNAMICS - REVIEW

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The intracranial hypertension due to disorders in the cerebrospinal fluid dynamics is the intracranial pressure increase caused by disorders of the cerebrospinal fluid circulation from at the moment of its formation at the level of the choroid plexuses and until its passage in the venous circulation. The dynamic disorders of the cerebrospinal fluid are: circulation disorders of the cerebrospinal fluid from formation to the resorption place and disorders of the cerebrospinal fluid passage in the venous drainage system (resorption). The obstructive hydrocephalus is caused by a partial or complete obstruction of the ventricular system or by a blockage of the CSF flow. Intracranial hypertension due to resorption disorders or of a meningeal cause is the intracranial pressure increase caused by the reduction in the cerebrospinal fluid resorption due to various causes, which directly affect the resorption mechanisms.

**Keywords:** cerebrospinal fluid dynamics

## INTRODUCTION

The intracranial hypertension due to disorders in the cerebrospinal fluid dynamics is the intracranial pressure increase caused by disorders of the cerebrospinal fluid circulation from at the moment of its formation at the level of the choroid plexuses and until its passage in the venous circulation. [1, 3, 11, 17, 18]

The dynamic disorders of the cerebrospinal fluid are:

- circulation disorders of the cerebrospinal fluid from formation to the resorption place and
- disorders of the cerebrospinal fluid passage in the venous drainage system (resorption).

The circulation disorders of the cerebrospinal fluid are caused by an obstacle along the fluid route (ventricular system, magna cistern, basal cisterns) due to an obstruction by a ventricular or paraventricular tumor, an intra-ventricular hemorrhage or an

obstruction due to various causes of the Sylvian aqueduct. The segments of the ventricular systems, which are superjacent to the obstruction, increase their volume, creating an obstructive internal hydrocephalus.

The resorption disorders of the cerebrospinal fluid occur due to the injury of the anatomic structures or due to disorders of the physiological mechanisms that assure the cerebrospinal fluid passage in the drainage venous system. These phenomena occur in acute meningitis, in sub-arachnoid hemorrhage, in meningeal carcinomatosis, in chronic sarcoidosis meningitis, etc. Most frequently there is a thickening of the leptomeninges blocking the Pachioni arachnoid corpuscles and decreasing the cerebrospinal fluid absorption. The cerebrospinal fluid accumulates in the ventricular system and a communicating hydrocephalus occurs, with a periventricular hydrocephalic brain

edema and with a generally sub-acute intracranial hypertension syndrome, designated as meningeal intracranial hypertension. The clinical presentation and the type of intracranial pressure increase resemble the intracranial hypertension syndrome met in the obstruction cases of cerebrospinal fluid circulation. [17,18]

**DISORDERS IN CEREBROSPINAL FLUID FLOW AND OBSTRUCTIVE HYDROCEPHALUS**

The obstructive hydrocephalus is caused by a partial or complete obstruction of the ventricular system or by a blockage of the CSF flow. [1, 2, 4, 5, 8]

The ventricular blockage is achieved by:

- stenosis of Sylvian aqueduct – malformation, tumor, by intra-ventricular hemorrhage or inflammatory secondary stenosis.
- expansive intra-ventricular processes of 3rd ventricle or 4th ventricle that block the circulation of the cerebrospinal fluid.
- extrinsic blockage of the ventricular system due to paraventricular lesions. These may be expansive intracranial processes of cranium base, of posterior cerebral fosse, of median line (sellar, parasellar, etc.), which, through local compression and cerebral movement, cause the ventricular obstruction (the 3rd ventricle, Sylvian aqueduct or the 4th ventricle).

- the obstruction of the communications with the sub-arachnoid cisterns – Magendie foramen, Luschka foramens; or the blockage of the basal sub-arachnoid space secondary to the sub-arachnoid hemorrhage or of an inflammatory origin. [9, 10, 12, 13]

Therefore, there is a rapid increase in the intracranial pressure, which exceeds the normal limit values of 20 mm Hg. The increased intracranial pressure reduces the auto-regulation of the cerebral circulation.

There are significant ICP differences between the cerebrospinal compartments, which leads to the occurrence of cerebral herniation phenomena.

**CLINICAL PRESENTATION**

The symptoms of hydrocephalus vary according to the illness age, the hydrocephalus progression type and the individual characteristics. The evolution of the ICH syndrome is rapid, and, if the appropriate therapy is not applied, the decompensated intracranial hypertension may occur

The usual signs in infants and young children are as follows: increase in the cranium dimensions, swelling of the anterior fontanelle, somnolence, vomiting, irritability, "sunset" glance.

Comparison between the two forms of ICH by disorders of the cerebrospinal fluid dynamics:

ICH by dynamics disorders of the cerebrospinal fluid	
obstruction of the cerebrospinal fluid flow disorders of resorbtion CSF ( meningeal ICH)	
Known etiology: obstruction of the cerebrospinal fluid circulation	Known etiology: meningeal inflammation, etc.
Obstructive hydrocephalus with periventricular or generalized edema	Communicating hydrocephalus with periventricular or generalized edema
Rapid ICP increase	Moderate ICP increase
Critical ICP value ≈ 20 mm Hg	Critical ICP value ≈ 20 mm Hg
ICP differences between the cerebrospinal compartments	no ICP differences between the cerebrospinal compartments
The increased ICP decreases the auto-regulation of the cerebral circulation	The inflammatory vasculitis may affect the auto-regulation of the cerebral circulation
Short action duration of the increased ICP	Varied duration of the pressure – time fluctuation
Complete evolution towards decompensated ICH	Etiology dependent evolution, usually towards a complete or incomplete ICH syndrome
Neurosurgical treatment: etiologic or ventricular drainage	Symptomatic and/or etiologic treatment; sometimes a ventricular drainage in acute hydrocephalus

In older children and adults, the symptomatology includes: cephalgia preceded by vomiting, diplopia, "sunset" glance, development delay, disorders of walking, coordination, sphincter disorders, psychic disorders: of personality, of memory, irritability, etc.

In the case of the acute hydrocephalus, there is an escalation of the previous symptoms, or they are rapidly installed from the beginning: cephalgia, vomiting, walking and equilibrium disorders, visual disorders.

### HYDROCEPHALUS DIAGNOSIS

It is based on the clinical data and the paraclinical explorations: echography in infants and young children, cerebral computer tomography, nuclear magnetic resonance and intracranial pressure monitoring. [14, 15, 16, 17]

### TREATMENT

The purpose of the treatment is to reestablish the balance between the production and the absorption of the cerebrospinal fluid and the removal or avoidance of the causes that lead to a blockage of the cerebrospinal fluid circulation. [21, 22, 25, 28, 30, 31]

Depending on the etiology and pathogenic mechanism, the following treatment is applied:

- the medical treatment that may diminish the production of the cerebrospinal fluid – acetazolamide,
- the etiologic neurosurgical treatment of the compressive lesion,
- the neurosurgical treatment of the cerebrospinal fluid drainage:
  - a ventricular-peritoneal shunt is set up,
  - the endoscopic ventriculostomy is applied for the 3rd ventricle,
  - repeated, lumbar draining punctures are used. [21, 22, 24, 25]

### INTRACRANIAL HYPERTENSION DUE TO RESORPTION DISORDERS

Intracranial hypertension due to resorption disorders or of a meningeal cause is the intracranial pressure increase caused by the reduction in the cerebrospinal fluid resorption due to various causes,

which directly affect the resorption mechanisms. [2, 6, 10, 17]

The diminished resorption of the cerebrospinal fluid can be caused by disorders of the cerebrospinal fluid resorption due to disorders of the membrane transfer mechanisms in the venous drainage system or to lesions of the anatomic structures that secure this transfer.

The pressure gradient changes from the drainage venous system by the venous sanguine pressure increase in the malformations of the Galien's vein (in children) or the longitudinal sinus thrombosis or the syndrome of the superior cavus vein, etc., reduce the cerebrospinal fluid resorption with the occurrence of the ICH syndrome, but the responsible pathogenic mechanism includes this form in the intracranial hypertension of vascular etiology.

The anatomic structures that ensure the drainage of the cerebrospinal fluid in the venous sinuses may be interested in acute meningitis, in sub-arachnoid hemorrhage of traumatism, aneurisms, etc, in meningeal carcinomatosis, in chronic sarcoidosis meningitis, etc. Most frequently, there is a thickening of the leptomeninges by blocking Pachioni arachnoid corpuscles and by decreasing the absorption of the cerebrospinal fluid. The cerebrospinal fluid is accumulated in the ventricular system and a communicating hydrocephalus is produced, with a periventricular hydrocephalic brain edema and with a generally sub-acute intracranial hypertension syndrome, which is designated as the meningeal intracranial hypertension. [19, 20, 26, 27, 32]

The intracranial pressure increase is moderate and there are differences between the cerebrospinal compartments. Due to the meningeal inflammation, there may be an inflammatory vasculitis, which affects the superficial cerebral circulation in various degrees.

The clinical presentation and the type of intracranial pressure increase are similar to the intracranial hypertension syndrome in cases of obstructed circulation of the cerebrospinal fluid. The evolution depends on etiology, and it is usually headed towards a complete or incomplete ICH syndrome, usually with no occurrence of decompensation phenomena.

The treatment is symptomatic and/or etiologic depending on identifying etiology and of the pathogenic mechanisms; a ventricular drainage is rarely needed in order to prevent an acute hydrocephalus. [21, 23, 26, 29].

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