

# INTRACRANIAL PRESSURE MONITORING STUDY IN SEVERE TRAUMATIC BRAIN INJURY AND POST-TRAUMATIC HYDROCEPHALUS

DR. ȘT.M. IENCEAN<sup>1</sup>, PROF. DR. N. IANOVICI<sup>2</sup>, PROF. DR. A.V. CIUREA<sup>3</sup>

<sup>1</sup>Neurosurgery, Hospital "Prof Dr N Oblu" Iasi

<sup>2</sup>University of Medicine and Pharmacy "Gr.T. Popa", Hospital "Prof. Dr. N. Oblu" Iasi

<sup>3</sup>University of Medicine and Pharmacy "Carol Davila", Emergency Clinic Hospital "Bagdasar-Arseni" Bucharest

**Objective.** To evaluate patients who developed hydrocephalus following a severe traumatic brain injury in connection with the monitoring of intracranial pressure (ICP) during the acute stage of brain trauma. **Methods.** There were studied 25 patients with severe head injuries and GCS score of 7 to 4, age between 20 and 60 years, who underwent ICP monitoring and cerebral perfusion pressure (CPP) monitoring. Sixteen surviving patients were followed for 12 months and the development of the post-traumatic hydrocephalus was found at five patients. **Conclusions.** The analysis of the data of this study shows some observations: Mortality in severe traumatic brain injuries is correlated with a low GCS score, high ICP values and arterial hypotension. The favourable outcome is in connection with a high initial GCS score, a decrease of ICP and normal values of cerebral perfusion pressure. There were five cases of moderate post-traumatic hydrocephalus and these cases of hydrocephalus have stabilized and did not need a surgical intervention.

**Keywords:** post-traumatic hydrocephalus, intracranial pressure, traumatic brain injury

Post-traumatic hydrocephalus (PTH) is a frequent and serious complication that follows a traumatic brain injury (TBI) (1, 3, 4, 9). The onset of PTH may vary from 2 weeks to years after TBI and the incidence varies greatly from study to study: 0.7 - 50%, variation results from underdiagnosis and atypical presentation. Mazzini et al, 2003, found that 50% of patients with postacute phase severe TBI had post-traumatic hydrocephalus, but that only 11% required surgery (8).

Post-traumatic hydrocephalus may present as normal pressure hydrocephalus (NPH) or syndrome of increased intracranial pressure. Post-traumatic hydrocephalus needs to be distinguished from cerebral atrophy (ie, hydrocephalus ex vacuo) and ventricular enlargement caused by a failure of brain development. This study proposes to evaluate the monitoring of intracranial pressure (ICP) and cerebral perfusion

pressure (CPP) in the treatment of patients with severe traumatic brain injury (TBI) in connection with the post traumatic hydrocephalus. The patients were followed 12 months post TBI.

## METHODS

There were studied 25 patients with severe head injuries and GCS score of 7 to 4, age between 20 and 60 years, who underwent ICP monitoring and cerebral perfusion pressure (CPP) monitoring (minute-by-minute collection system). A subgroup of 11 patients underwent surgery for intracranial hematomas and another subgroup of 14 patients did not need any surgery.

ICP monitoring started from the moment of surgery or just after determining the diagnosis by computed tomography (CT), through ventricular catheterism in connection with a Spiegelberg-type monitor.

## RESULTS

The group of operated patients included 7 patients with acute intracranial hematoma:

- 4 cases with GCS score of 6 to 4 and ICP remained elevated for 12 hours to 3 days despite of treatments for lowering of ICP and with poor results.

- 3 cases with GCS score of 7 and 6; ICP decreased gradually in 6 hours to 2 days, with favourable outcome. One patient had a pre-existing hydrocephalus (probably a stabilized hydrocephalus) without important clinical symptomatology after the surgery.

Four patients with chronic subdural hematoma (GCS = 7 – 6), where ICP decreased gradually in the first 3 to 6 hours after surgery, with a good outcome. There was a moderate ventricular enlargement at one patient after 4 months, but without clinical decompensation and he did not need a surgical treatment.

The group of patients without surgery: 5 cases with GCS 5 to 4, and constant high ICP values, difficult to correct, with bad outcome; 9 cases with GCS of 7 to 5, with high values of ICP which decreased gradually under medical treatment, with a favourable evolution. Three patients had an unimportant or moderate ventricular enlargement after 3 to 6 months, with minor clinical symptomatology and favourable evolution after medical treatment. (Fig. 1 a, b, c)

## DISCUSSION

In a study of 1979, Jensen and Jensen presented a clinical analysis of 160 patients: the patients were studied either by: quantitative isotope ventriculography (QIV) or by lumbar isotope cisternography (LIC) and 30 % of them developed post-traumatic hydrocephalus. Clinical signs were independent of the ICP and of the type of hydrocephalus and the treatment was surgical shunting (6).

Later Beyerl and Black (1984) shown that post-traumatic hydrocephalus is a treatable complication of TBI, PTH should be treated if lumbar CSF pressure > 180 mm H<sub>2</sub>O and typical symptoms of NPH are present (2).

In 1996 Marmarou, Foda et al. found that 44% of head injury survivors may develop ventriculomegaly and posttraumatic hydrocephalus was diagnosed in 20% of survivors and their outcome was significantly worse (7).

The studies of last years (Tian and Xu, 2007; Jiao and Liu, 2007) have found that risk factors for posttraumatic hydrocephalus are increasing age, low GCS score on admission and intraventricular hemorrhage and severe traumatic subarachnoid hemorrhage; the posttraumatic hydrocephalus have appeared in 11.96 % cases. They said that continuous lumbar drainage of CSF can greatly reduce PTH (5, 10).

The number of cases in our study is of 25 patients, but there were only severe TBI and they had a low GCS score (< 7). The post-traumatic hydrocephalus was found at five patients at sixteen surviving patients followed for 12 months.

There were five cases of moderate post-traumatic hydrocephalus and these cases of hydrocephalus have stabilized and did not need a surgical intervention. One patient had a pre-existing hydrocephalus (a stabilized hydrocephalus) without important clinical symptomatology. Therefore there were four moderate post-traumatic hydrocephalus after severe traumatic brain injuries. The hydrocephalus patients had minor clinical symptomatology and favourable evolution after medical treatment and they did not need a surgical treatment.

## CONCLUSIONS

1. In the present study there were five cases of moderate hydrocephalus: one case of pre-existing hydrocephalus with an acute intracranial haematoma; one case after a chronic subdural haematoma and three cases after non-surgical severe traumatic brain injury. These cases of hydrocephalus have stabilized and did not need a surgical intervention.

2. There were five types of aspects of ICP during the evolution of severe brain injury:

- a. normal and constant ICP;

- b. initial normal ICP and increased ICP later caused of a secondary surgical intracranial lesion;

## INTRACRANIAL PRESSURE MONITORING STUDY

c.initial normal ICP and gradual increased ICP in connection with brain edema

d.initial increased ICP with constant high values of ICP;

e.initial increased ICP that become normal after surgery.

3. Mortality in severe traumatic brain injuries is correlated with a low GCS score, high ICP values and arterial hypotension. The reduction of ICP and the increase of CPP are individual and they require a continuous pressure control. The favourable outcome is in connection with a high initial GCS score, a decrease of ICP and with normal values of cerebral perfusion pressure.

This study was not found any correlation of the values of ICP (during the ICP&CPP monitoring) and the later appearance of post-traumatic hydrocephalus.

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