Hydrocephaly represents the accumulation of cerebrospinal fluid at cerebral level and it associates with the increasing of intracranial pressure with multiple effects at the level of cerebral tissue. The cerebrospinal fluid (CSF) is a fluid with a clear appearance, with a composition that changes depending on gestational age and associated pathology. Newborns, especially premature, are more susceptible to develop hydrocephaly and a significant percentage out of these will develop neurological deficits and complications associated with ventriculo-peritoneal shunt. The study was carried out in the Department of Neonatology and Premature from the Clinical Emergency Hospital for Children Louis Turcanu Timisoara, in a period of 3 years (2014-2016). There were 26 patients included in the study, who presented hydrocephaly diagnosis supported clinically, by ultrasound and CT. There were conducted dosages in dynamics of CSF composition, depending on pathology: malformative, infectious or hemorrhagic.

Keywords: prematurity, hydrocephaly, ventricular-peritoneal drainage, cerebrospinal fluid

Hydrocephaly is characterized by abnormal accumulation of cerebrospinal fluid in the ventricular system. This can lead to increased intracranial pressure resulting in progressive growing of cranial diameter, appearance of seizures and retardation of psychomotor development. Hydrocephaly can be caused by congenital or acquired factors. The congenital causes include hydranencephaly, holoprosencephaly, porencephaly, schizencephaly, spina bifida, Arnold-Chiari malformation, Dandy-Walker syndrome. The acquired causes include intracranial hemorrhage, intracranial infections and cerebral tumors.

The cerebrospinal liquid is a fluid with a clear and transparent appearance that fills the cerebral ventricular system, ependimar channel, brain and spinal subarachnoid spaces being secreted mainly by choroid plexus from the level of ventricular system [1]. The cerebrospinal fluid is a metabolically active substance with a composition that changes depending on gestational age and associated pathology. Comparative with plasma, the cerebrospinal fluid has a low concentration of proteins, glucose, potassium and calcium, but high in chlorine and sodium [2, 3] (table1).

### Table 1

| CEREBROSPINAL FLUID PARAMETERS AT TERM AND PREMATURE NEWBORNS |
|---------------------------------------------------------------|
| Nr. of elements/mm^3 | 5.1 | 5.3 |
| Proteins (mg/dl)    | 2.6 | 68.2 |
| Glucose (mg/dl)     | 50.3 | 55 |
| Chlorides (mEq/l)   | 110 | 200 |

Experimental part

It was aimed to follow the association degree between prematurity, hydrocephaly and the causes that determine hydrocephaly, as well as the biochemical composition of the cerebrospinal fluid reported to the associated pathology. The purpose of evaluation of the biochemical composition of the cerebrospinal fluid was to follow the evolution of the patients with ventriculo-peritoneal shunt, ventricular external drainage and the complications of the shunt, especially infections and shunt failure.

The study was carried out prospectively in the Department of Neonatology and Premature from the Clinical Emergency Hospital for Children Louis Turcanu Timisoara, in a period of 3 years (2014-2016). There were 26 patients included in the study, who presented hydrocephaly diagnosis supported clinically, by ultrasound and CT. There were conducted dosages in dynamics of cerebrospinal liquid composition, depending on pathology: malformative, infectious or hemorrhagic, the cerebrospinal liquid being harvested in the first week from the placement of ventriculo-peritoneal shunt or external ventricular drainage and then in dynamics, either by lombar puncture or directly from the tap attached to the drainage device.

Results and discussions

From the 26 cases included in the study 19 patients were premature newborns (gestational age under 37 weeks) and 7 patients were term (gestational age over 37 weeks). From the premature newborns 7 were with low birth weight (LBW-low birth weight), 8 were with very low birth weight (VLBW-very low birth weight) and 4 with extreme low birth weight, under 1000 grams (ELBW-extreme low birth weight) (table2).

The predominant cause of hydrocephaly in the studied lot was intraventricular hemorrhage (53.8%), followed by cerebral malformations (myelomeningocele associated with Arnold Chiari type II malformation, spina bifida occulta, semilobar holoprosencephaly, porencephaly and encephalomeningocele) with a percentage of 30.8%. In the studied lot 2 cases developed hydrocephaly secondary
to intracranial infections (7.8%) and 2 cases were with isolated hydrocephaly (7.8%), (Table 3).

At the lot of premature newborns, especially those with VLBW and ELBW, hydrocephaly was secondary to intraventricular hemorrhage. At LBW hemorrhage the predominant cause of hydrocephaly were cerebral malformations (5 cases), only two of them having intraventricular post-hemorrhage hydrocephaly. At the lot of term newborns predominant is the hydrocephaly associated with cerebral malformations.

From the 26 newborns with hydrocephaly, 24 needed surgical intervention with installation, depending on the etiology, of an external ventricular drainage or of a ventricular-peritoneal shunt. Only 2 cases had a favorable evolution (http://www.revistadechimie.ro REV.CHIM.(Bucharest) • No. 2 • 2019)

At the 24 patients that had ventricular-peritoneal shunt or external ventricular drainage it was harvested in dynamics cerebrospinal liquid in order to monitor the disease evolution or the complications of shunt and ventricular drainage. At premature with intraventricular post-hemorrhage hydrocephaly there were highlighted, in the cerebrospinal liquid, an increased number of elements up to 15-30/mm³, without being an indicator of cerebral infection [7]. Also, proteins concentration in cerebrospinal liquid is slightly increased at newborns and especially at premature newborns [8]. According to a study performed by Lenfestey et al. the presence of the ventricular-peritoneal shunt or of an external ventricular drainage modifies the biochemical of cerebrospinal liquid with increasing, especially, of the number of elements and proteins (Lenfestey, Smith et al. 2007)[9]. In our study all newborns with valve complications. Due to the severe intraventricular hemorrhage (Vassilyadi M, Tataryn Z et al. 2009)[6].

The cerebrospinal liquid at adults contains approximately 5 elements/mm³. At newborns the cerebrospinal liquid can present a bigger number of elements up to 15-30/mm³, without being an indicator of cerebral infection [7]. Also, proteins concentration in cerebrospinal liquid is slightly increased at newborns and especially at premature newborns [8]. According to a study performed by Lenfestey et al. the presence of the ventricular-peritoneal shunt or of an external ventricular drainage modifies the biochemical of cerebrospinal liquid with increasing, especially, of the number of elements and proteins (Lenfestey, Smith et al. 2007)[9]. In our study all newborns with valve complications. Due to the severe intraventricular hemorrhage (Vassilyadi M, Tataryn Z et al. 2009)[6].

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Conclusions

The newborns and especially the premature ones are more susceptible to develop hydrocephaly. The most frequent cause was the peri/intraventricular hydrocephaly.

The perspective for these patients have improved significantly in the last decades, even so despite the medical progress, a small subgroup of newborns will still be under treatment with medicine with stabilizing effects.
continue to develop complications of hydrocephaly and ventricular-peritoneal shunt, being a negative prognostic predictor on a long term.

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Manuscript received: 15.07.2018