II. NEONATOLOGY

COMPLICATIONS OF PERI/ INTRAVENTRICULAR HEMORRHAGE

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Abstract

Peri/Intraventricular hemorrhage is one of the most frequent diseases of the premature newborn with low birth weight. The most severe complications are: evolving hydrocephalus and multicystic encefalomalacia. The authors intend to present the posthemorrhagic encephaly as a severe and invalidating complication. Cranial ultrasound is used for optimal diagnosis of the disease, dimensions follow-up of the ventricular system, to establish the moment of placing the derivation valve and shunt dynamic follow-up.

Key words: intraventricular hemorrage, hydrocephalie

Introduction

The most frequent and serious complication is posthemorrhagic hydrocephalus which appears at 75% from the survivors of severe forms (degree III and IV).

Generally patients with intracranial hemorrhage evolve to regression in 75% of cases and to ventricular dilatation in 25% of cases.

Only in 10% of cases with ventricular dilatation is needed a ventriculoperitoneal shunt.

From the echographic point of view the dilatation of trigon and occipital horns, before frontal horns, could be the only sign of hydrocephalus development. Initially these areas are the only one dilated in small hemorrhage, while in large hemorrhages the entire ventricular system is dilated.

Posthemorrhagic ventricular dilatation can be asymmetric and can affect more the lateral ventricles than the IIIrd ventricle. The volume increase of the IVth ventricle is very rare and usually, represents a ventriculitis override to a hemorrhage or an obstruction of Sylvius aqueduct and also of Luschka and Magendie orifice, leading to an isolated ventricle IV.

Posthemorrhagic hydrocephalus

Posthemorrhagic hydrocephalus occurs by modifying the normal flow of CSF during the organization process and reaction to the blood in ventricles leaking secondarily through the fourth ventricle into pericerebellar leptomeninges.

At the distance of two weeks after hemorrhage, ultrasound will show small protein- containing particles floating about in the CSF and most probably contributing to the obliteration of its distal flow. Obstruction may be found in the lateral ventricle, near the foramen of Monro, in the cerebral aqueduct, near the foramina of the fourth ventricle, in the pericebellar cisterns, near the tentorial groove, in the pericerebral arachnoid spaces and in the arachnoid granulations of sinuses.

Depending on the obstruction location can occur unilateral, bilateral, internal, external or mix hydrocephalus (of communicating type).

In four out of five cases can appear communicating variant due to obliterative arachnoiditis in the pericerebellar and pericerebral spaces. In some situations both aqueduct and foramina of the fourth ventricle may be obstructed, giving rise to an ''isolated fourth ventricle'': continued CSF production in the plexus of the lateral and fourth ventricle gives rise to hydrocephalus above and below the tentorium despite occlusion of the aqueduct. Isolation of the fourth ventricle is a rare complication especially after reseated (or revision) repeated shunt. It may be accompanied by transtentorial upward herniation of that ventricle.

Ventricular widening increases progressive in the weeks after hemorrhage from 5% in the case of hemorrhage grade II up to 40-80% for grades III and IV. The immediate and distance prognosis is modifying at infants with posthemorrhagic hydrocephalus in comparison with those who present only hemorrhage. Factors contributing to this may be subependymal damages from within the ventricular cavity and cerebellar cortical injury from within the leptomeninge. Injury to the inferior olive may follow cerebellar cortical damage. Some authors observed a slow first stage of ventriculomegaly which in 50% of cases subsequently regresses but in other 50% persists, evolving towards symptomatic hydrocephalus. Clinical signs may nearly always be anticipated by serial sonography of the cranium.

Cranial ultrasound plays an important role in the detection and follow-up of posthemorrhagic complications.

1. Evaluation of the severity of ventriculomegaly via repeated measurements: it is possible to determine the laterolateral diameter of both lateral ventricles together on a coronal section through the foramen the foramen of Monro, thr roof to floor diagonal height on the same section, and then proceed to precise measurement of the third ventricular width in an axial section through the sphenoidal fontanelle. The latter measurement is facilitated by the existence of dense ependymal lining. As for lateral ventricular diameters, normal values have been established for gestational age. Treatment will be almost certainly necessary when this value is above the 97th centile.

The lateral ventricles can be symmetrically dilated, isolated ventriculomegaly or ventricular asymmetry can occur. Thus, it could be only a widening of the posterior horns of the lateral ventricles, situation called colpocephaly (discrepant overdilatation of the occipital horns). Also, on a coronal section can be observed the boomerang – shape of the frontal horns above the caudate nuclei. Balloon – shaped frontal horns are usually an indicator for treatment (fig.1).

Besides the lateral ventricles in posthemorrhagic hydrocephaly is very reliable the monitoring of the third ventricle, best estimated in sagittal and parasagittal sections. We also mention that the third ventricle does not necessarily widen uniformly and quite late after the lateral ventricles (fig.2). Normally the width of neonatal third ventricle does not exceed 2 mm (or 2,8 mm by some other authors).

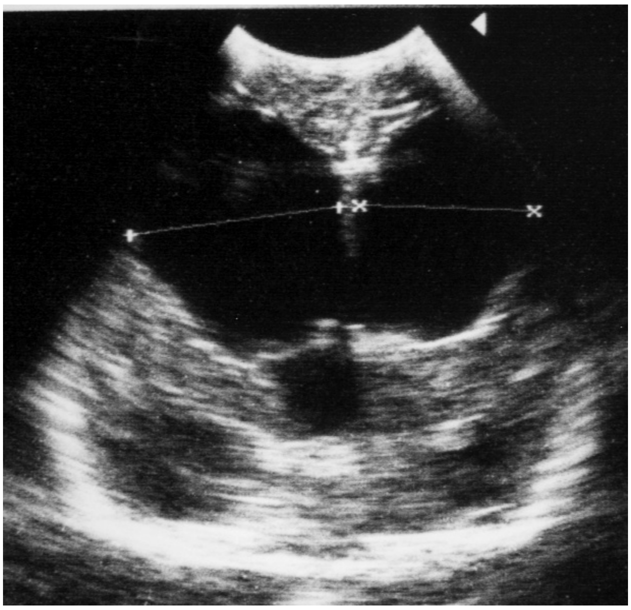

Fig. 1. Coronal section. Severe dilatation of frontal horns.

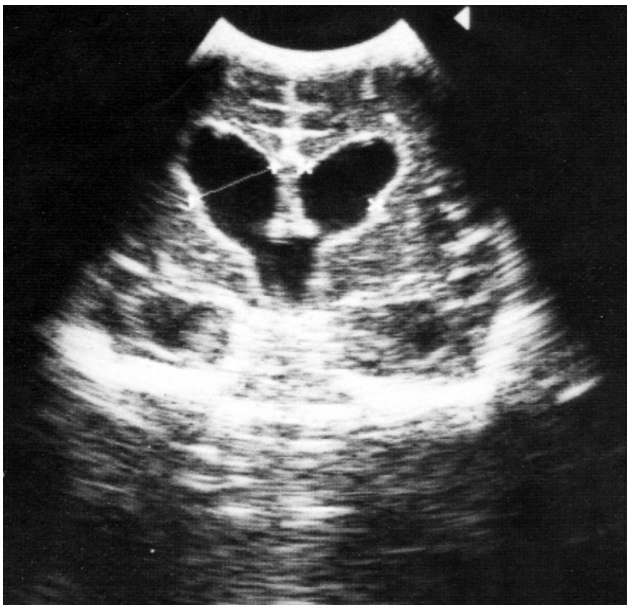

Fig. 2. Coronal section. Dilatation of lateral ventricles.

The position of the neonate does not have a significant influence on the ventricles' shape. Some of the authors underlined that if the baby lies on its side the underlying lateral ventricle may widen more than the proximal ventricle.

Any follow-up of ventriculomegaly in the case of an infant with a fontanelle opening should be done with ultrasound. Depending on the devices' performances and on the scanhead dimension both ventricular system and cerebral parenchyma can be followed-up until the complete ossification of the cranium. It can be also determined the moment of placing the ventriculoperitoneal derivation valve and shunt follow-up. Due to ultrasound performances repeated CT scanning is unjustifiable.

2. Sagittal and axial sections reveal a discrepancy between dilatation of the supratentorial ventricles and the fourth ventricle. In these cases can be well seen the aqueduct of Sylvius, even in the case of stenosis (shape of a cleft); it can be underlined a discrepant dilatation of the fourth ventricle and, in the absence of a large cisterna magna, can be predicted the absence of communication between the fourth ventricle and the pericerebellar spaces.

Normally, the fourth ventricle shows like a triangular structure following the third ventricle, near the brainstem. When dilating, will attempt to find the way of least resistance and form a round or more tubular structure in the cerebellar vermis. In the severe forms, when dilatation happens suddenly, a life-threatening pressure can be generated on the vital centres in the brainstem.

3. Sonographic measurements before and after lumbar puncture are used in medical practice to show the communication between the ventricular system and the lumbar subdural space. The shape of the lateral ventricle can be also significantly changed.

4. In case of posthemorrhagic hydrocephalus, the severity of intracranial hypertension can be evaluated by several methods: recording the head circumference; measuring the pressure by means of applanation tonometry over the anterior fontanelle; serial measurements of ventricular diameters. Ultrasounds also give the possibility to study the transependymal CSF resorption.

The measurement of arterial flow rates by means of calculation of the resistance index is useful for evaluating the functionality and the vascularization of the cerebral parenchyma. Either due to the mechanical pressure on the arteries caused by the ventricle contours, or more likely due to intracranial hypertension, can be observed that hydrocephalus requiring treatment induces a decrease or even inversion of diastolic flow rates in the anterior, middle or cerebral arteries. Resistance indices above 0.8 (RI=S-D/S, where S=systolic peak rate and D=end diastolic rate) suggest that the vessel bed has been affected. Necrosis of the medial part of the occipital lobe occurs with hydrocephalus and is probably the result of compression of the posterior cerebral artery.

5. The installation of the derivation shunt can be guided by ultrasound: in order to avoid early plexus in – growth it is ideally to position the shunt tip in the frontal and not in the temporal horn (fig. 3).

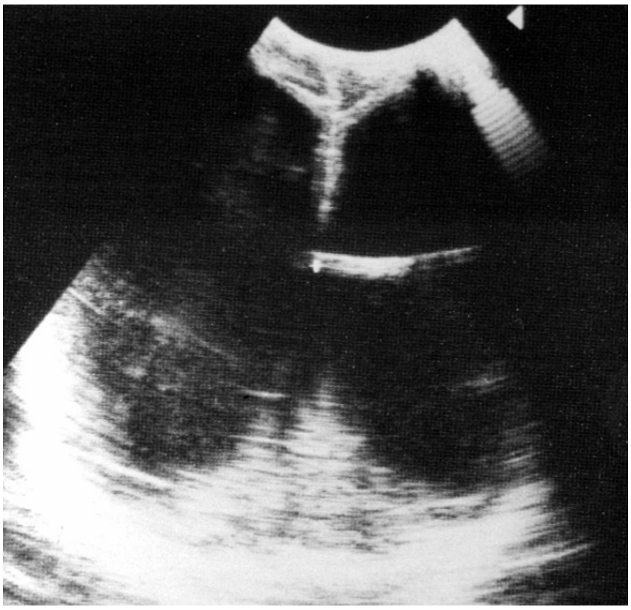

Fig. 3. Two months premature newborn with severe evolutive hydrocephaly - derivation shunt.

Conclusions

1. Posthemorrhagic hydrocephalus is the most severe complication of the periventricular hemoraege. It occurs in 75 % of the surviving severe cases.
2. Cranial ultrasound plays an important role in the detection and follow-up of the disease: the enlargement of the lateral ventricle; increase of the diameter of the III- rd ventricle; the measuring of the remaning cerebral parenchim.
3. Finding the proper moment for ventriculo- peritoneal shunt and fallow-up of the derivation.

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