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ULTRASONIC INVESTIGATIONS OF BRAIN IN INFANTS WITH SOME NEUROLOGICAL DISEASES

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The authors have studied 197 infants (1–12 months old) with normal psychomotor development and with various neurological disturbances. Neurosonography and dopplerometry were used to investigate the blood flow pattern and structural changes in the brain.

Diagnosis of neurological disturbances in infants aged 1–12 months, especially in newborns, is frequently very complicated. It is sometimes difficult to determine localization, character, and expression of cerebral disturbances on the basis of clinical data only [1, 2]. In such cases ultrasound investigation (USI) of the brain, which is highly efficient in assessment of the structure of cerebral tissue and cerebral blood flow appears very useful [3-5].

The goal of this work is to study clinical manifestations, the character of structural changes in the brain, and cerebral blood flow in infants (1–12 months) with some neurological disturbances.

Materials and Methods. Results of ultrasound investigations and clinical examinations were compared in 197 patients among which there were 90 full-term newborns and 77 infants aged 1 to 6 months. For all patients we used neurosonography (NSG) and dopplerometry of cerebral vessels, using Aloca-650 and Biomedica apparatus with 5.0 and 7.5 MHz sensors combined with a pulse doppler. The maximal systolic (V_{max}), medium (V_m), and final diastolic (V_{min}) blood flow velocities were estimated in the anterior, medial, posterior, and basilar arteries. Since the blood flow velocities were almost equal in all these vessels, the anterior cerebral artery was used for general estimation as it is the most convenient for investigation.

Results. Among newborns, four groups of 30 infants in each were investigated.

Group 1 consisted of infants with normal psychophysical development. In 19 of them USI did not show any changes and as few as four infants demonstrated enhanced echogeneity in periventricular regions, which can be considered a normal variant with a sufficient blood flow. In two cases observed expansion of anterior horns of lateral ventricles of up to 10 mm, was accompanied by a decrease in V_{min}, and in two children periventricular heamorrhage of the first degree (PVH-1) was recorded, which was accompanied by a decrease in V_{min} (Fig. 1). In three infants aged 1 day subependymal pseudocysts were observed, which probably indicated that the infants had intrauterine PVH-1; in these cases the blood flow velocities were unchanged and no neurological disturbances were found. Subsequent observation of these infants and repeated USI revealed development of moderate internal hydrocephaly without any clinical manifestations.

The second group represented the increased neuroreflex irritability syndrome. Main manifestations of the syndrome consisted in increased spontaneous motor activity and segmentary motor automatisms as well as inconstant horizontal nystagmus, muscular dystonia, fine tremor of the extremities and the chin, elongation of the active awakening period and hard falling asleep, and enhanced response of visual, audial, and tactile sensors to ordinary external stimuli. With this syndrome neurological symptoms were not distinct, which did not allowed physicians to distinguish between the norm and pathology in the first days after birth. In 17 infants from this group NSG and dopplerometry indices were within variations of the norm. In the other 13 infants the following changes were found: distinctly enhanced echogeneity in periventricular regions accompanied by higher V_{max} (8); moderate

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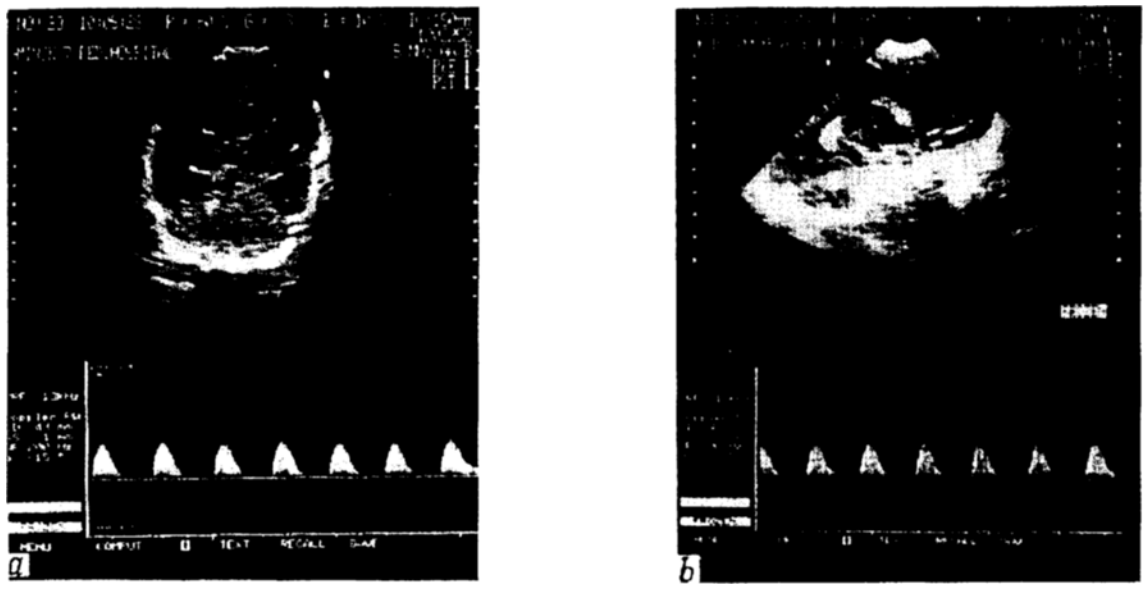

Fig. 1. Dilatation of lateral ventricles (a) and periventricular hemorrhage of the first degree (b) with simultaneous decrease in final diastolic velocity.

expansion of anterior horns of lateral ventricles within 10–20 mm without any changes in the blood velocity (3); PVH-1 with decreased V_{min} (2). Subsequently, the infants from this group were generally normal and in as few as three cases retarded development of motor functions and speech were found in the patients with expansion of the ventricular system (2) and PVH-1 (1).

The third group was composed of infants with the syndrome of general suppression of the central nervous system, characterized by flabbiness, hypodynamy, decreased spontaneous motor activity, general muscular hypotonia, hyperreflexia, and suppression of physiological reflexes in the newborn period. In 11 cases no changes were found in NSG and dopplerometry. In 19 patients the following pathological disturbances were found: distinctly enhanced echogeneity in periventricular zones (5), PVH-1 (6), PVH-3 (3), and moderate expansion of the ventricular system (5). In two cases with distinctly enhanced echogeneity in the periventricular regions all cerebral blood velocities were decreased (Fig. 2). In the case of PVR-3 V_{max} increased in initial stages and as cerebral ventricular expansion progressed, V_{min} decreased.

Subsequently, in 3–4 weeks in three infants with distinctly enhanced echogeneity in periventricular regions porencephalic cysts were visualized whose NSG diagnosis failed at six months. The blood flow was unchanged. In one patient with PVH-3 subcompensated hydrocephaly developed and in one infant hydrocephaly was compensated. In one infant with a porencephalic cyst rear generalized tonic and clonic fits were observed and the infants with hydrocephaly had retarded psychomotor development.

The fourth group contained infants with the spasmodic syndrome that is mainly exhibited by fragmentary clonic and tonic fits. The fragmentary fits were characterized by isolated or associated jerks that usually started with unilateral spasms of eyebulbs upward or laterally, followed by transition to particular areas of extremities. These spasms were short and almost imperceptible; they somewhat resembled myoclonic jerks, which hindered their differential diagnosis. Myoclonic fits were short and exhibited as spontaneous shudders of the whole body without visible exogenic actions. Isolated myoclonias of some parts of the body were revealed whose localization changed from fit to fit. In five cases USI revealed edema of brain tissues accompanied by a decrease in the blood velocities during the fits or immediately after them; enhanced echogeneity was observed in deperiventricular region in five cases of which two infants showed an increase in V_{max}. In three patients PVH-3 was observed; expansion of anterior horns of large ventricles was found in four patients, and isolated expansion of the third ventricle was observed in two cases. Nine patients showed no changes. At six months in those infants who had had brain edema moderate expansion of the ventricular system was recorded without any changes in the blood flow. In two cases in

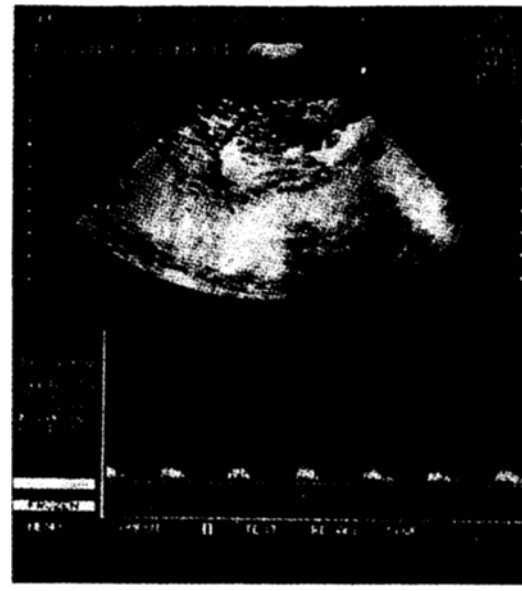

Fig. 2. Distinctly enchanced echogeneity in periventricular regions and decreased blood flow velocities.

patients who had had PVH-3 subcompensatory hydrocephaly developed and as it progressed, V_{min} decreased; spasmodic fits persisted after the age of 12 months.

At the age of 1–6 months patients with retarded psychomotor development (28), spasmodic syndrome (32), current (serous (2) and purulent (2) meningites and meningoencephalites (2)) or these who had had inflammatory diseases of brain were examined.

In 15 infants with retarded psychomotor development that was exhibited as absent or weak eye fixation, weak head holding, inability to turn from back to belly and from belly to back and to take a toy, different degrees of expansion of the ventricular system were observed, the blood flow was not changed.

In 21 infants with the spasmodic syndrome expansion of the ventricular system was found that was expressed to various extents, and in four infants edema of the brain tissues and decreased blood flow velocity was observed against the background of a spasmodic fit. In these patients spasmodic fits were predominantly generalized tonic and clonic, generalized tonic, and myoclonic. The tonic and clonic fits were exhibited as successive tonic and clonic phases, but changes of the phases were not sufficiently distinct. Generalized tonic spasms were short and accompanied by stretching and stressing of the whole body or only upper and lower extremities but were alway: symmetric. In five infants with spasmodic fits the NSG was not changed.

In all infants with purulent meningitis, edema of brain tissues was observed, which was accompanied by a decreased blood flow velocity followed by dilatation of the ventricular system expressed to various extents and expansion of the interhemispheric fissure. In ventricular cavities unclear hyperechogenic cords were visualized. Subsequently, in one infant ventriculitis developed and another had internal hydrocephaly that was compensated by 12–18 months. In the case of serous meningitis the ultrasound pattern in the acute period did not differ substantially from that described above. Subsequently, in both infants dilatation of the cerebral ventricular system was noticed. Meningoencephalits was accompanied by diffuse edema of tissues and a decrease in the blood flow velocity in the acute period. As the process developed further, dilatation of the cerebral ventricular system and focal changes in various areas of the brain exhibited as foci of higher echogeneity with unclear contors were found in the infants. Subsequently, after three weeks, multiple porencephalic cysts appeared and retarded psychomotor development was observed in one infant.

In infants who had had cerebral inflammations, dilatation of the ventricular system was recorded that in five cases was accompanied by retarded psychomotor development. In one infant a porencephalic cyst was visualized in the parietofrontal brain. In this case focal symptoms and focal seizures were observed.

CONCLUSIONS

1. Ultrasound investigation of the brain reveals quite early intracerebral pathological processes in newborns, even with normal psychomotor development. These changes are moderately pronounced; however, they require follow-up of the infant and, in some cases, medication.

2. Disturbances in the cerebral blood velocity early reflect the presence of acute or subacute cerebral changes, which allows physicians to predict these changes to some extent.

3. The blood flow velocity becomes normal rather soon after disappearance of the acute process or its stabilization.

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