PEDIATRICS

Gonchar M., Teslenko T., Boichenko A., Kondratova I.

CEREBRAL HEMODYNAMICS IN NEWBORNS WITH SEIZURES

Kharkiv National Medical University; Kharkiv Regional Perinatal Center, Ukraine

Abstract: The research deals with cerebral hemodynamics in newborns with seizures. The study involved examination (including Doppler neurosonography of cerebral vessels and amplitude-integrated electroencephalography) of 56 infants undergoing neonatal intensive care. The study showed that 37.5% of neonates had convulsions (including 17.9% with atypical subclinical seizures). Disorders of cerebral hemodynamics in neonates with seizures were characterized by hyperperfusion in 52.4% and hypoperfusion in 33.3% of infants.

KeyWords: newborns, neonates, infants, seizures, convulsions, cerebral hemodynamics.

INTRODUCTION

International and domestic perinatology has made a huge step forward at the present stage of medicine development. These improvements provided possibilities to maintain pregnancy and successfully nursed newborns with low and extremely low birth weight as well as effectively treat children who had severe asphyxia at birth [1,2].

The opening of perinatal centers in Ukraine offers the opportunity to use the up-to-date equipment and render advanced neonatal monitoring and treatment technologies to provide the successful nursing of newborns at the gestational age of 22 weeks and more with a weight starting from 500 grams [1]. There has been a progress in the treatment of full-term and preterm infants with asphyxia at birth. A significant amount of these patients is admitted to the intensive care unit in a severe condition and needs a highly qualified and timely support during the early neonatal period. This group of newborns is often found to have disorders of the central nervous and cardiovascular systems. Neonatal seizures are a common manifestation of neurological dysfunction in infants [3].

Corresponding Author:
Tatiana Teslenko, MD, PhD-student of Department of Pediatrics No.1 and Neonatology, Kharkiv National Medical University, Ukraine. E-mail: tta777@yandex.ua

Perinatal abnormalities in a significant number of patients are triggered by a hypoxic-ischemic injury of the central nervous system caused by asphyxia [1, 3]. Disorders of cerebral hemodynamics are considered to be the leading mechanism of newborns' brain injury from the early neonatal period [4]. Seizures are a severe indicator of a grave damage to the nervous system in newborns. Contemporary studies have provided evidence that seizures can often be subclinical and cannot be detected by physical examination of newborns [5].

Disorders of cerebral blood flow are an important mechanism for the pathogenesis of perinatal injury of the central nervous system. Displacement of individual parameters of dynamic and metabolic regulation outside the physiological values promotes a disruption in the cerebral autoregulatory mechanism. It triggers cerebral hypoperfusion, vasogenic and then cytotoxic cerebral edema accompanied by an increase in intracranial pressure. As a result, these events condition the development of cerebral ischemia [4].

The amplitude-integrated electroencephalography in examination of newborns with convulsive syndrome is an important stage in the diagnosis of abnormal brain activity especially in preterm infants according to the frequency of atypical (subclinical) seizures [5,6].

The early diagnosis of cerebrovascular perinatal CNS injury is based on a comprehensive assessment of

cerebral blood flow according to Doppler neurosonography of cerebral blood vessels and edtermination of amplitude-integrated EEG patterns can improve the early diagnosis, individual therapy and may also reduce the neurological morbidity and disability in children.

2 PURPOSES, SUBJECTS AND METHODS:

2.1 Purpose

to improve diagnosis of cerebral hemodynamics disorders in neonates with seizures by means of Doppler neurosonography of cerebral blood vessels.

2.2 Subjects

The study involved the examination of 56 newborns (66.1% boys, 33.9% girls) with the assessment of obstetric records, clinical and instrumental examination (ECG, echocardiography, Doppler neurosonography of cerebral blood vessels and amplitude-integrated EEG). They were at the gestational age from 26 to 41 weeks (mean gestational age 32.1±4.8 weeks). The control group comprised 20 healthy newborns (55% boys, 45% girls) at gestational age of 39-40 weeks and within the normal fetal and early neonatal period.

2.3 Methods

All the examined newborns underwent Doppler neurosonography of cerebral blood vessels followed by the assessment of resistance index on ultrasonic unit MyLab25Gold (Italy), amplitude-integrated EEG on encephalograph “Olympic CFMTM 6000" (USA/Canada). All the infants were examined by a neurologist.

Conflict of interests

There is no conflict of interests.

3 RESULTS AND DISCUSSION

The group of examined infants included 26 (46.4%) full-term and 30 (53.6%) premature ones. Of them 25 (44.6%) children were delivered by cesarean section whereas 31 (55.4%) infants were born by vaginal delivery.

The main diagnoses of the newborns admitted to the neonatal intensive care unit of Kharkiv Regional Perinatal Center were as follows:

- birth asphyxia (R21.0 and R21.1 in ICD-10);
- respiratory distress syndrome (R22.0 in ICD-10).

Convulsive syndrome (clinical or subclinical seizures) was detected in 21 (37.5%) examined newborns. Subclinical seizures were diagnosed in 10 (17.9%) children. Subclinical seizures were identified only by the convulsive patterns on the amplitude-integrated electroencephalogram without generalized convulsions (Fig.1).

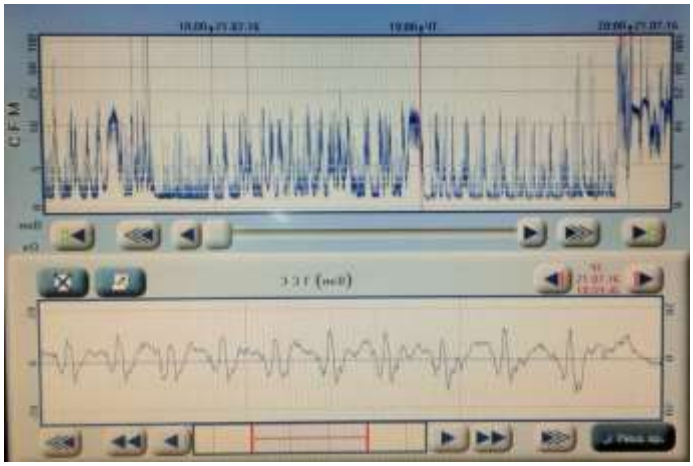

Fig.1. Subclinical seizures on the amplitude-integrated EEG

Other leading neurological syndromes diagnosed in the examined children during the neonatal period include:

- tonicity disorders syndrome – 64.3% ($p < 0.05$);
- CNS depression syndrome – 21.4% ($p < 0.05$);
- hypertension-hydrocephalic syndrome – 8.9% ($p < 0.05$);
- vegetative-visceral disorders syndrome – 8.9% ($p < 0.05$).

Echography showed the following abnormalities:

- cerebral edema in 39.3% cases,
- periventricular areas edema in 42.9% cases,
- periventricular ischemia in the late neonatal period in 64.3% of children.

Furthermore, 13 (23.2%) infants had intracranial hemorrhage including 1st degree intraventricular hemorrhage

(classification by Papile L.-A. et al, 1978) found in 8 (14.3%) children whereas 6 (75%) of them were premature newborns.

Changes of cerebral hemodynamics in neonates with seizures were characterized by signs of hyperperfusion in 52.4%. According to neurosonography data, they had a low resistance index in the anterior cerebral artery, i.e. 0.49±0.05 ($p<0.05$) and 0.52±0.08 ($p<0.05$) standard units in the middle cerebral artery. A disruption of the cerebral blood flow autoregulation mechanism was evident due to hypotension and postnatal homeostasis changes. In 33.3% the changes of cerebral hemodynamics were characterized by signs of hypoperfusion. According to neurosonography data this group of patients had a high resistance index in the anterior cerebral artery, i.e. 0.78±0.05 ($p<0.05$) and 0.78±0.08 ($p<0.05$) standard units in the middle cerebral artery. We also examined other infants without seizures undergoing treatment in neonatal intensive care unit. Normal perfusion in the brain structures was found in 51.4% cases [7].

4 CONCLUSIONS

1. Neurological disorders in newborns were manifested mostly as tonicity disorders syndrome, convulsive syndrome and CNS depression syndrome.
2. The study showed that 37.5% of newborns had convulsions (including 17.9% of children with subclinical seizures).
3. Disorders of cerebral hemodynamics in newborns with seizures were characterized by brain hyperperfusion symptoms in 52.4% and hypoperfusion in 33.3% of patients.

REFERENCES

1. Znamenska, T.K., Tolstanov, O.K., Pokhylko, V.I., Kovalova, O.M., Slabkyi, H.O., Kurilina, T.V., Znamenska, M.A. (2015). Neonatolohiia z pozytsii simeinoho likaria. [Neonatology from the position of the family doctor]. Kyiv, Ukraine: Polosatkot. (in Ukrainian)
2. Steward, D.K., Pridham, K.F. (2002). Growth patterns of extremely low-birth-weight hospitalized preterm infants. Obstetrics, Gynecology, Neonatal Nursery, 31(1), 57-65.
3. Nakaz MOZ Ukrayiny no. 225. (2014). Pochatkova, reanimatsiyna i pislyareanimatsiyna dopomoha novonarodzhenym v Ukrayini: unifikovanyy klinichnyy protokol nadannya neonatolohichnoyi dopomohy dityam [Primary aid, resuscitation and postresuscitation assistance for newborns in Ukraine: standardized clinical protocol of neonatal care providing]. Kyiv, Ukraine: MOZ. (in Ukrainian)
4. Kireev, S.S., Larchenko, V.I. (2011). Tserebralnaya gemodinamika i vozmozhnosti ee optimizatsii pri kritiche - kih sostoyaniyah u novorozhdennyih v usloviyah otdeleniya reanimatsii. [Cerebral hemodynamics and possibilities for its optimization in newborns from intensive care unit with critical condition]. Neonatolohiia, khirurhiia ta perynatalna medytsyna, vol. 1, no 2, pp. 51-54. (in Russian)
5. Abalova, V.V., Degtyareva, M.N., Volodin, N.N. (2012). Sovremennyie predstavleniya o diagnosticheskoy i prognosticheskoy informativnosti amplitudno-integrirovannoy elektroentsefalografii u novorozhdennyih s perinatalnyim porazheniem tsentralnoy nervnoy sistemyi. [Modern views on the diagnostic and prognostic informat - veness of amplitude-integrated EEG in newborns with perinatal damage of the central nervous system.]. Voprosy prakticheskoy pediatrii, vol. 7, no 4, pp. 17-26. (in Russian)
6. Hellström-Westas L., S de Vries L., Rosen I. (2008). An Atlas of Amplitude-Integrated EEGs in the Newborn. UK: Informa UK Ltd.
7. Zubareva, E.A., Dvoryakovskiy, I.V., Zubarev, A.R., Sugak, A.B. (1999). Dopplerografiya perinatalnyih porazheniy golovnogo mozga. [Doppler sonography of perinatal cerebral damages]. Moscow, Russia: Vidar. (in Russian)

Received: 01 - May. – 2016
Accepted: 15 - May. - 2016