

## Clinical-dopplerographic correlations of brain's hypoxic-ischemic injury in newborns

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### ABSTRACT

Hypoxic-ischemic encephalopathy encompasses a spectrum of neuropathologic and neurologic features that comprise a major portion of neonatal neurology. Hypoxic causes deep metabolic, cerebrovascular and brain's organic disorders which are the reasons of severe neurological disturbance. The aim of our study was to determine the injurious affect of hypoxic-ischemic factors on the newborns brain, the correlations of clinical-dopplerographic patterns and prognosing CNS disorders. We have observed 198 full-term neonates by clinico-dopplerographically. The ultrasonic investigation was produced on the devices of "SIEMENS SONOLINE ELEGRA" and " LOGIC 700". Katamnestic period covered 1,5-2 years. **CONCLUSION:** 1.The decreased parameter of PI pulsatility index presents the high risk of development of brain hypoxic-ischemic injury. 2.Stable dopplerographic pathological patterns indicate severity of brain injury and poor prognoses. 3.Color flow mapping represents the high effective method for estimation the degree of brain's hypoxic-ischemic injury and prognosing the course of disease.

**KEYWORDS:** hypoxic-ischemic encephalopathy, pulsatility index, doppler, newborn

**H**ypoxic-ischemic encephalopathy encompasses a spectrum of neuropathologic and neurologic features that comprise a major portion of neonatal neurology. This encephalopathy is the major cause of neurologic morbidity in the full-term infants. Factors cause brain's organic disorders which are the reasons of severe neurological disturbance.

Hypoxic causes deep metabolic and cerebrovascular disorders and is due to different kinds and severity of clinical manifestation of central nervous system injury [3,4].

Volpe [2] have shown that vascular autoregulation in the human newborn is very sensitive to perinatal asphyxia. Infants who by most criteria would be considered to have sustained minimal or even no significant hypoxic-ischemic insult exhibited impaired vascular autoregulation. Disturbance of feto- placental blood circulation cause hypoxia, hypercapnia, acidosis, due to which develops cerebral ischemia and disorders.

It is difficult to establish frequency of hypoxic-ischemic encephalopathy because there is no exact criterias for this disease. Frequency of hypoxic-ischemic encephalopathy in Georgia reached 35/1000 newborns in 2001 year [1].

Neurological examinations, such as: neurosonography, dopplerography evoked potentials EEG neuroradiological researches and others give us the opportunity to establish

exact cerebral injuries. Due to that patients will be recieved adequate treatment, which predicts severe cerebral disorders.

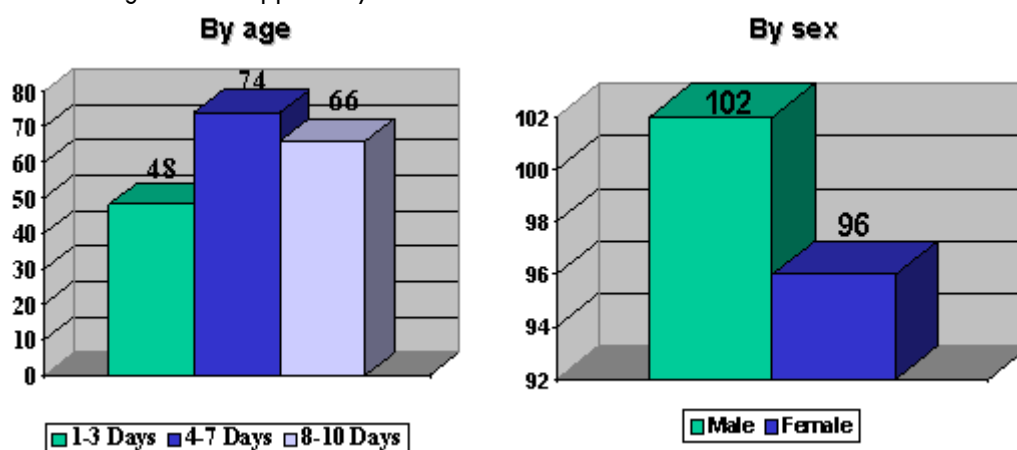
In global cerebral ischemia the deep cerebral structures of the basal ganglia, thalamus and hippocampus are tended to injury because of less or absent collateral blood flow compared with the cerebral cortex [2,5].

In the cerebral cortex of full-term neonates, border zones between the major artery territories (anterior, middle and posterior cerebral arteries) and the subcortical border zones within each vascular territory are tended to injury in global ischemia.

The aim f our study was to determine the injurious affect of hypoxic-ischemic factors on the newborns brain, the correlations of clinical-dopplerographic patterns and prognosing CNS disorders.

The ultrasonic investigation was produced on the devices of "SIEMENS SONOLINE ELEGRA" and " LOGIC 700". In neonatal period the investigation was produced once per 10 days, later -once per month. Katamnestic period covered 1,5-2 years.

We have observed 198 full-term neonates at Pediatric Clinic of Tbilisi State Medical University. The patients profile was (Fig.1): male - 102, female - 96; by age 1-3 days 48 patients, 4-7 days 74 patients and 8-10 days 66 patients.



**Fig.1** Patient profile.

After clinical investigations along with neurosonography cerebral hemodynamic was examined by using Color Flow Mapping dopplerography, which permitted to measurement the resistant index (RI), pulsatility index (PI), systolic and diastolic velocity in the cerebral anterior, middle, posterior and intracranial basilar arteries.

By clinical manifestation of CNS injury the patients in neonatal period were divided into three groups according to the course of disorder: I gr. - mild, II gr. - moderate and III gr. - severe.

**Clinical syndromes in each group were:** I gr. - MILD-68 patients: Apgar scale - 7-8 scores 68, Neuroreflex excitability syndrome 57,

Suppression syndrome changing with excitability 9, Low threshold of Moro reflex 39,

Motor hyperactivity 61, Pyramidal deficit syndrome 49. II gr. - MODERATE-98 patients:

Apgar scale - 6-7 scores 98, Suppression syndrome 58, Neuroreflex excitability changing with suppression 69, Hypotonia 27, Epileptic syndrome 18, Cranial nerves impairment 32,

Hypertension syndrome 65. III gr. - SEVERE-32 patients: Apgar scale- 34 score 32,

Sopor 20, Coma 12, Relapsing epileptic syndrome 28, Status epilepticus 6, Cranial nerves impairment 29, Rough hypo- hypertonia 27.

Ultrasound investigation indicated normal dopplerographic patterns in mild cases of hypoxic encephalopathy, pathological patterns were observed in 30 per cent of moderate patients. These patterns reflect changes of both: blood flow velocity and indexes. These disorders were transient. In all severe cases were revealed robust and rough changes of dopplerographic patterns. In 8

cases from the third group of patients were revealed significant deterioration of dopplerographic patterns (fluctuative blood flow, significant decrease of pulsatility index PI and et.), which were connected with cerebral autoregulation failure. All these cases had lethal outcome.

**Clinical outcome was following:** In the I group: recovery – 48 p., minimal cerebral dysfunction 28 p., In the II group: recovery – 12 p., minimal cerebral dysfunction 16p., motor impairment 17 p., epileptic syndrome 10 p., mental retardation 8 p., hydrocephalic syndrome 11 p.; In the III group: minimal cerebral dysfunction 2 p., cerebral palsy 7 p., epileptic syndrome 12 p., motor impairment 6 p., hydrocephalic syndrome 5 p.

Significant evidence was, that decrease of PI pulsatility index preceded the development of neurosonographic patterns of brain injury and clinical manifestation. The increased parameters of RI resistant index was observed in patients with intracranial hypertension.

Complete recovery and minimal cerebral impairment were observed in those patients, who had normal ultrasound patterns or transient disorders in neonatal period. Conversely, leicomalacia or deep injury of CNS took place in that group of patients, where was found refractory stable disorders of dopplerographic criteria, especially diastolic velocity.

**Conclusion:** 1. The decreased parameter of PI pulsatility index presents the high risk of development of brain hypoxic-ischemic injury.

2. Stable dopplerographic pathological patterns indicate severity of brain injury and poor prognoses.

3. Color flow mapping represents the high effective method for estimation the degree of brain's hypoxic-ischemic injury and prognosing the course of disease.

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## Клинико-доплерографические корреляции гипоксически-ишемического повреждения головного мозга у новорожденных

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### РЕЗЮМЕ

Гипоксически-ишемическая энцефалопатия объединяет спектр неврологических нарушений, составляющих большую часть неонатальной неврологии. Гипоксия вызывает тяжелые метаболические и цереброваскулярные нарушения, органические поражения головного мозга, определяют развитие тяжелых неврологических нарушений. Целью работы являлось исследование клинико-доплеровских корреляции для прогнозирования возможности развития нарушений в ЦНС. Обследовано 198 доношенных новорожденных с проведением клинико-доплерографических. Сопоставлений ультразвуковое обследование проводилось на аппаратах "SIEMENS SONOLINE ELEGRA" и "LOGIC 700". Катамнез составлял 1,5-2 года. Выводы: 1. Низкие показатели пульсационного индекса представляют большой риск развития гипоксически-ишемического повреждения ЦНС. 2. Рефрактерные патологические доплерографические паттерны коррелируются с тяжелым повреждением головного мозга. 3. Цветное доплерографическое сканирование имеет высокую диагностическую разрешимость для установления степени гипоксически-ишемического повреждения головного мозга и прогнозирования исхода болезни.

**Ключевые слова:** гипоксически-ишемическая энцефалопатия, пульсационный индекс, доплер, новорожденные

□ **International committee of medical journal editors. Uniform requirements for manuscripts submitted to biomedical journals.** Ann Intern Med 1997;126:36-47.

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