Asphyxia in newborns is a pathological condition characterized by a lack of efficiency of gas exchange in the lungs immediately after birth, inability to breathe independently in the presence of palpitations and/or other signs of live birth such as spontaneous muscle movement and pulsation of the umbilical cord [1]. According to World Health Organization 4 million children are born in asphyxia in the world every year, as well as 1 million newborns die from asphyxia and about 1 million newborns is suffered annually from hypoxic-ischemic encephalopathy of varying severity after asphyxia [2]. The American Academy of Pediatrics and the American College of Obstetricians and Gynecologists gives the following diagnostic criteria for "severe asphyxia at birth": assessment of the child's condition in accordance with the Apgar score was 3 or less in the first 5 minutes of life; the presence of clinical symptoms of severe CNS damage (stage 3 of hypoxic-ischemic encephalopathy) that occurred in the first 72 hours of life in children born with gestational age ≥ 32-34 weeks; signs of dysfunction of the one vital organ or system during the first 3 days of life. And also the presence of metabolic or mixed acidosis (pH <7.0 and (or) base deficiency greater than - 12 mmol / L) in the blood from the umbilical artery [3, 4, 5).

The most severe consequence of asphyxia is hypoxic-ischemic encephalopathy (HIE). According to world statistics, the frequency of severe HIE in newborns ranges from 0.37 to 3 per 1000 live births, 10-15% of them die in the neonatal period, and 25-30% of children have severe neurological consequences [6, 7, 8, 9]. Hypoxic-ischemic encephalopathy in a newborn is a dynamically developing process initiated by an episode of hypoxia, leading to a violation of cerebral blood flow (primary injury or ischemia phase), followed by its recovery and the development of secondary damage (reperfusion phase) in 2-12 hours after the primary injury caused by the activation of a number of pathological mechanisms (glutamate and calcium stress, free radical damage, aseptic inflammation), leading to additional apoptosis and an increase in the volume of neuronal damage, deterioration of the prognosis for life and health [10, 11, 12, 13].

Currently, there is not a single neuroprotective drug known in world practice, the effectiveness of which would be confirmed in high-level clinical studies, the therapeutic properties of which could significantly reduce the damaging effect of hypoxia on the child's brain [1, 2, 6, 14]. One of the most promising methods to reduce the adverse effects of CNS damage in newborns, after asphyxia, is therapeutic hypothermia [10, 15]. This method of treatment helps to reduce the metabolic requirements of the body, reduce secondary energy deficiency of cells, block the release of glutamate, block the synthesis of free radical particles, inhibit inflammation and apoptosis [16, 17, 18, 19, 20, 21]. Clinical studies about the use of therapeutic hypothermia in newborns demonstrate a significant reduction in mortality and severe neurological disorders at 18-22 months of life, as well as at an older age (7 years of life). At the same time, the risk of developing pronounced neurological deficits in children who have suffered moderate and severe asphyxia at birth and have undergone therapeutic hypothermia is reduced by 20-25% [6, 22].

**Purpose of the work** is to conduct a comparative assessment of the severity of neurological disorders, ophthalmological changes, otoacoustic examination data and duration of treatment in newborns who have suffered severe asphyxia.

**Materials and methods.** A retro-selective analysis was performed and based on 27 medical histories of children for the period of 2018-2019, who were diagnosed with "severe asphyxia" from birth. Children’s health was "extremely severe" in 100% of...
patients on admission from the delivery room to the Neonatal Intensive Care Unit (NICU) of The Perinatal Center. "Passive hypothermia" in the delivery room (T = 18-24 °C) was performed by 40% of newborns. The gestational age of the examined was from 37 to 41 weeks, the weight category was from 2230 g to 3790 g. The patients were divided into two groups. Group I included children (n=15) who received therapeutic hypothermia in 1-2 hours after birth (total – 12 people, craniocerebral - 3 children), lasting 72 hours. Group II (n=12) included children who suffered severe asphyxia at birth, but did not receive therapeutic hypothermia for a number of reasons. Indications for therapeutic hypothermia are set out in the Clinical Guidelines "Therapeutic hypothermia in newborns" and have the selection criteria, which are divided into three groups "A", "B", "C". It is necessary to consistently evaluate the newborn in these groups. The presence of at least one criterion in each of the three groups is an indication for therapeutic hypothermia [2, 10]. The method of therapeutic hypothermia is based on a controlled decrease of the central body temperature to 33-34 °C in a patient.

We didn't find significant differences between the comparison groups of newborns in the detailed study of the anamnesis, the volume of resuscitation care, the clinical picture of the disease, survey data and the use of drug therapy. Therefore, a number of the above indicators are given for both groups of examined children.

10 newborns, after providing assistance in the Perinatal Center, were transported to the NICU for further treatment and examination and 17 children at the age of 6 to 28 days (on average 2 weeks) were transported to the second stage of nursing, which is “The Voyno-Yasenetsky Scientific and Practical Center of Specialized Medical Care for Children of The Moscow Healthcare Department”. Transportation of patients was carried out through the air ambulance, accompanied by a resuscitator. Newborns aged 10-15 days of life were transferred after NICU to the second stage of nursing at the above-mentioned specialized center. The children's age did not exceed 3 months of life at the time of discharge from the hospital.

Research results and their discussion.

According to the anamnesis data in groups of newborns we found:
- the prevalence of the mother's age >30 years (late-giving birth) was in 63% of the surveyed;
- burdened somatic history: hypothyroidism, acute and chronic gastritis, cholelithiasis, hypertension, impaired fat metabolism, coronary heart disease, myocardial infarction, allergies, frequent acute respiratory infections, surgical interventions, etc. diseases were revealed in 88,88% of women;
- burdened obstetric history: abortions, miscarriages, chronic urogenital infection, uterine fibroids, ectopic pregnancy were established in 70,37% of expectant mothers;
- burdened pregnancy: toxicosis, preeclampsia, polyhydramnios, threat of termination, anemia, exacerbation of foci of chronic urogenital infection, fetoplacental insufficiency, chronic fetal hypoxia were detected in all pregnant women;
- pathological childbirth: acute fetal hypoxia, cesarean section (90%), true umbilical cord knot, tight cord entanglement around the neck, oxytocin delivery stimulation, vacuum extraction, amniotomy, premature placental abruption, uterine hypertonic bleeding were observed in 100% of women in labor;
- amniotic fluid is light (meconial - 7,4%; dirty green, fetid 3,7%) was in 88,9% of women.

Here is the child health at birth (criteria "A" for therapeutic hypothermia in our patients) [2, 10]:
1. Low Apgar score (1-2 points were in 16 (59,26%) patients):
   - at 1 minute – 1 point (81,25%)
   - at 5 minutes - ≤ 3 points (68,75%)
   - at 10 minutes - ≤ 3 points (50%).

The Apgar score was 3 and 5 in 11 (40,74%) patients.
Accordingly, the volume of resuscitation measures in the delivery room was as follows:
- ventilator bag and mask - 100%
- tracheal intubation and ventilation - 59,26%
- indirect heart massage - 59,26%
- adrenaline injection - 29,63%
2. 100% of newborns had a continuing need for respiratory support at 10 minutes of life;
3. Data on the acid-base state of blood from birth (77,77% of children):
   - pH <7,0 (norm=7,35-745)
   - BE ≥ 16 mM/l (norm = -2.0)
- Lactate ≥20 mmol/L (norm = <2.0 mmol/ L).

Here is the child health at birth (criteria "B" for therapeutic hypothermia in our patients) [2, 10]:
4. Clinically pronounced seizures in children (after 30 minutes-24 hours of life):
   - 96,29% - convulsive syndrome
   - 3,7% - depression syndrome;
5. Muscle atony and areflexia were in 100% of newborns;
6. Violation of the pupillary reflex (wide pupils - 88,88%; narrow pupils - 11,11%) which means that photoreaction was not detected in all examined newborns;
Here is the child health at birth (criteria "C" for therapeutic hypothermia in our patients) [2, 10]:
7. The results of amplitude-integrated electroencephalography were not received and the study was not performed due to the lack of equipment. Constant monitoring of vital functions in the newborn was carried out.

The next diseases were detected in a newborn in The Perinatal Center:
1. Intrauterine infections were diagnosed in 100% of children:
   - intrauterine pneumonia - 74%
   - intrauterine pneumonia + pleurisy - 3,7%
   - sepsis - 7,4%
   - unspecified infections - 14,81%;
2. Respiratory insufficiency was grade III and requiring artificial lung ventilation in 100% of patients;
3. Hypoxic-ischemic CNS lesion (P91.0) was diagnosed in 100% of cases, accompanied by:
   - convulsive syndrome - 96.29%
   - coma – 14.81%
   - paresis – 7.4%
   - birth trauma: skull bone fracture - 3.7%; cephalomatomas - 11.11% in newborns;
4. Pathology of the urinary system (edematous syndrome, oliguria) - were in 81.48% of patients;
5. Generalized hemorrhagic syndrome requiring transfusion of fresh frozen plasma was in 14.81% of children;
6. Hemodynamically significant open fetal communications were detected in 14.81% of the examined;
7. Functional problems of the gastrointestinal tract had 48.15% of newborns;
8. Severe anemia at birth, with the need for emergency transfusion of erythrocyte mass was in 7.4% of children.

Therapeutic measures in the conditions of the Perinatal Center:
1. Respiratory support (artificial lung ventilation, CPAP, "oxygen cap" was carried out to all 100% of newborns;
2. Infusion therapy + parenteral nutrition according to physiological needs was in all patients; 3. Cardiotonic support (Dopamine, Dobutamine, Adrenaline) was received by all examined patients; 4. Antibacterial therapy (Ampicillin, Gentamicin, Vancomycin, Sulperazone, Meronem, Imipenem+Cilastin, Veloobactin, Aztreonam, Amoxiclav, Amikacin, Ceftriaxone, Linezolid, Polymyxin "B", etc.) was needed by 10% of children;
5. Antifungal therapy (Diflucan) was received by 70.37% of newborns;
6. Anticonvulsant therapy (GOMK, Relanium, Convulex, Pagluferal, Keppra) was needed by 96.29% of patients;
7. Neuroprotective therapy (Cytolflavin, Mexidol, etc.) was in 7.4% of the examined;
8. Hormonal drugs (Dexazone, Solu-cortef) were used by 7.4% of children;
9. Passive immunotherapy (Immunoglobulin) was held in 14.81% of newborns;
10. Symptomatic therapy (cardiotrophic, diuretics, insulin therapy, antireflux, eubiotics) was used in all patients.

Newborns of group I (n=15) underwent therapeutic hypothermia (total – 12 people, craniocerebral - 3 children), lasting 72 hours in 50 minutes - 5 hours after birth. Group II children (n=12) did not receive therapeutic hypothermia. After the relative stabilization of the newborns in the NICU of the Perinatal Center, the children in the transport incubator were transported for further treatment and examination by a team of resuscitators to a specialized medical center.

10 newborns of the examined children were sent to the NICU of “The Voyno-Yasenetsky Scientific and Practical Center of Specialized Medical Care for Children of The Moscow Healthcare Department”:

1. All newborns had the general "severe" condition;
2. Respiratory support: 90% of patients were on a ventilator and only 10% were on oxygen therapy with a free flow of oxygen through a facial mask;
3. Cardiotonic support (Dopamine, Dobutamine) was needed by 10% of children;
4. Anticonvulsant therapy (Sodium thiopental) was performed by 10% of patients;

Laboratory indicators of newborns upon admission to the NICU of the specialized center:
1. Clinical blood test: severe anemia - 40%; moderate anemia - 50%; leukopenia - 20%; hyperbilirubinemia - 50%; an increase in alkaline phosphatase - 20%; an increase in creatinine - 10% - an increase in urea - 20%; a high level of CRB (mg / l) - 40%; an increase and drop in glucose levels - 20%; hypokalemia - 40%.
2. Biochemical blood parameters: hypoproteinemia - 40%; hypoalbuminemia - 50%; increase in AST - 40%; increase in ALT - 20%; hyperbilirubinemia - 50%; an increase in alkaline phosphatase - 20%; an increase in creatinine - 10% - an increase in urea - 20%; a high level of CRB (mg / l) - 40%; an increase and drop in glucose levels - 20%;

3. Coagulogram study (disseminated intravascular coagulation syndrome) was diagnosed in 30% of children.

The remaining 17 newborns were immediately sent to the second stage of nursing after the NICU of the Perinatal Center: the severity of the children’s health corresponded to the diseases suffered.

Conducting magnetic resonance imaging (MRI) studies of the brain in newborns makes it possible at an early stage to identify structural changes that do not always correspond to clinical manifestations, but determine the subsequent neurological outcome [1, 6]. The MRI indicators in newborns in the NICU of the specialized medical center (the average age of the child is two weeks) were as follows: signs of hypoxic-ischemic CNS lesion were in 100% of children; hydrocephalus (external/internal) in 30%; subtotal leukomalacia of the brain (with damage to the basal nuclei, brainstem and cerebellum) in 20%; diffuse cerebral edema persisted in 10%; cephalohematoma was in 30%; subdural hematoma in 10% of the examined.

Therapeutic tactics in the NICU of the specialized medical center were as follows: therapeutic and protective regime; newborns were nursed in an open intensive care crib (90%) and in a cuvette (10% of cases); oxygen therapy with blood gas composition control (ventilator, CPAP, oxygen through a facial mask) was needed by all examined; infusion therapy was carried out according to physiological needs with partial parenteral nutrition (taking into account enteral load) for all children; also, antibacterial therapy (Meronem, Vancomycin, Linezolid, Polymyxin "B", Imipenem+Cilastin, Cefotaxime, Amikacin, etc.) was continued for all patients; antifungal therapy (Fluconazole, Amphotericin, Micafungin) was prescribed in 100% of cases; anticonvulsant therapy (Valproic acid, Phenobarbital, Levetiracetam, etc.) was needed by 90% of children; nootropic drugs
(Hopanthenic acid, Citicoline, etc.) were used by 70% of patients; 40% of newborns needed antihemorrhagic therapy (sodium ethamzylate); methylxanthines (Caffeine) were prescribed to 30% of the examined; all children received symptomatic therapy (probiotics, diuretics, trophic therapy, vitamin therapy, etc.).

**Outcomes of treatment of 10 newborns in the NICU of the specialized center:**

- Level of consciousness: coma - 10%; sopor - 20%; stun - 30%; oppression - 40%.

The newborns at the age of 10-15 days of life were transferred after stabilization to the second stage of nursing for further examination and treatment. The severity of hypoxic-ischemic damage to the central nervous system in newborns, who suffered severe asphyxia at birth, was assessed in this department (Table 1).

<table>
<thead>
<tr>
<th>Examined children (n=27)</th>
<th>Severity of hypoxic-ischemic lesions of the central nervous system</th>
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<tbody>
<tr>
<td></td>
<td>II degree of severity</td>
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<tr>
<td></td>
<td>n</td>
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<tr>
<td>I group (n=15)</td>
<td>3</td>
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<tr>
<td>II group (n=12)</td>
<td>1</td>
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</tbody>
</table>

As can be seen from the above table, newborns who suffered severe asphyxia at birth and did not receive therapeutic hypothermia as part of complex therapy in 2.25 times more likely to have a more severe degree of hypoxic-ischemic damage to the central nervous system than comparable group I.

100% of children had manifestations of convulsive syndrome, dysphagia, muscle tone disorders (hypotension, hypertension, dystonia), hyperkinesia (local and general pathological tremor) under assessing the neurological status in the early recovery period. 92,59% of children had motor disorders of the central type (diplegia, hemiplegia, tetraparesis).

According to the results of MRI the diffuse nature of hypoxic-ischemic changes in the brain is characteristic of all examined children who have suffered severe intranatal asphyxia. It was noted, according to the results of MRI of the brain, that signs of deep ischemic damage to the brain substance at the stage of cystic degeneration and hypoxic-ischemic damage to subcortical structures were in children of group II (who did not receive therapeutic hypothermia) and there were 2 times more common (in 10 out of 12 examined) than in children who received therapeutic hypothermia (in 6 out of 15 newborns).

Electroencephalography (EEG) was performed in all newborns, which showed the following results: there is a diffuse violation of the formation of bioelectric activity of the cerebral cortex in the form of the prevalence of diffuse slow wave activity in all patients, the absence or decrease of zonal differences, a delay in the formation of bioelectric activity of sleep (against the background of anticonvulsive therapy). However, 4 (33,33%) patients from the group of children who did not receive therapeutic hypothermia (group II) revealed the presence of a "flash-suppression" pattern, alternating asynchronous theta-delta flashes with the inclusion of peak, spike and island wave components.

All newborns in the dynamics of observation were consulted by an ophthalmologist. According to the literature data, it is known that 70-80% of cases of hypoxic brain damage are accompanied by the involvement of the pathways of the visual analyzer in the pathological process [1, 12, 13, 14]. In our data organic damage to the pathways of the visual analyzer under examining the fundus in newborns with severe hypoxic-ischemic damage to the central nervous system was in 2,6 times more common in children of group II (59,26%) than in children of group I (22,22%).

Practically similar results were obtained during the otoacoustic emission test in the examined newborns. Thus, a negative test is observed in 59,26% of newborns with severe hypoxic-ischemic lesions of the central nervous system from children in group II of and in 33,33% of patients from group I.

The composition of the complex therapy at the second stage of nursing newborns with hypoxic-ischemic lesions of the central nervous system included: anticonvulsants (Valproic acid, Levetiracetam, Phenytoin); neurotrophic (Levocarnitine); nootropic agents (Hopanthenic acid) and additional therapies (positional styling, therapeutic exercise in a gentle mode for the prevention of early contractures and motor activation, segmental massage for the purpose of functional activation of physiological feeding).

Patients who have suffered hypoxic-ischemic damage to the central nervous system are held generally accepted and mandatory conditions for discharge from the hospital. There are: absence of foci of infection; relief of seizures; regression of dysphagic disorders or adaptation of parents to the care of a gastric probe [1, 2, 6]. With this in mind, we present to you the results of a comparative assessment of the duration of treatment in the hospital of patients by comparison groups (Table 2).

According to the obtained data, newborns who received therapeutic hypothermia in the first 2 hours of life, had a much faster improvement in the dynamics of the condition against the background of the treatment.
Thus, the duration of treatment for 10-14 days was typical only for children of group I; the duration of 15-20 days was typical for patients of group I (11,11% of cases) and for patients of group II it was in 7,4%; the duration of 20 to 30 days was observed in patients of both groups equally often (11,11%) and the duration of more than 30 days was 7 times more common in patients in group II, compared with children who received therapeutic hypothermia in the first hours of life.

Conclusions: the obtained data allow us to confirm that despite the small sample size and the early age of patients under evaluating the results of treatment, therapeutic hypothermia is a method that improves neurological outcomes in surviving children, who were born with severe asphyxia, and reduces their hospital stay. The unique neuroprotective effect of hypothermia is achieved by influencing a wide range of pathological processes and helps to reduce the severity of disability.

Table 2

<table>
<thead>
<tr>
<th>Average bed/day</th>
<th>Newborns with hypoxic-ischemic CNS lesion of the central nervous system (n=27)</th>
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<tr>
<td></td>
<td>I group (n=15)</td>
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<tr>
<td>10-14</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>29,6%</td>
</tr>
<tr>
<td>15-20</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>11,11%</td>
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<tr>
<td>20-30</td>
<td>3</td>
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<tr>
<td></td>
<td>11,11%</td>
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<tr>
<td>More 30</td>
<td>1</td>
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<td></td>
<td>3,7%</td>
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</table>

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Literature:
EFFECT OF CHITOSAN, PHOTOMODULATION AND PHYSICAL EXERCISES ON THE HEALING OF THE SURGICAL WOUND IN RATS

Below G.V.
Doctor of Medical Sciences, Professor,
Head of the Department of Pathology of the International School of Medicine
of the International University of Kyrgyzstan;
Uzakov T.B.
postgraduate student of the Kyrgyz State Medical Institute
for Retraining and Advanced Studies;,
Chyangyshova J.A.
Doctor of Medical Sciences, Head of the Department of Anesthesiology
of the Kyrgyz State Medical Institute for Retraining and Advanced Studies

Abstract. In an experiment on 30 white rats, the effect of the chitosan complex, photomodulation with methylene blue and physical exercises on postoperative wound healing was studied. The animals are divided into 5 groups of 6 rats. Group 1 - intact animals. For other groups, hair was cut on the lateral surface of the abdomen and a layer-by-layer skin incision 3 cm long was performed under local anesthesia. Group 2 - rats with natural wound healing for 10 days. Animals of group 3 were daily smeared with chitosan cream, 4 groups underwent daily photomodulation of the skin surface treated with methylene blue. The fifth group of rats, along with chitosan core and photomodulation, from the third day after the operation, received low-intensity exercise on a treadmill for 30 minutes. Wound healing was recorded by determining the area of the wound by photographing and histological examination of the skin and internal organs.

Obtained results: The best wound healing according to planimetry and histological examination was reliably noted in the 5th group during the complex treatment of the surgical wound.

Conclusions: The rehabilitation complex for large surgical wounds should include early local impact on the wound of physiotherapy procedures and physical exercises.

Key words: surgical site infection, rehabilitation, chitosan, photomodulation, physical exercise.

The problem of effective healing of postoperative wounds is clear to every surgeon. Inflammation of the wound, up to the separation of the sutures, is very common and often negates the effectiveness of the operation itself [10, 14]. Many creams and dressings are proposed for the prevention of inflammation, in particular on the basis of chitosan [1, 2, 4, 6, 8, 12, 13]. Also a proven fact is the effectiveness of the use in the early rehabilitation period of local exposure to the wound of physiotherapeutic procedures, in particular