Systematic Review of Diagnostic Methods for Fetal Hypoxia.

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ABSTRACT

Fetal hypoxia is a serious complication during pregnancy and childbirth, which leads to an increased incidence of perinatal morbidity and mortality. The main reasons leading to fetal hypoxia are acute or chronic changes in the functional system "mother-placenta-fetus".

Hypoxia occurs due to placental insufficiency, a process in which there is a progressive deterioration in the functioning of the placenta when the transfer of oxygen and nutrients to the fetus through the placenta is reduced, leading to decompensated hypoxia and acidosis. The article pays attention to some methods for assessing fetal hypoxia, such as dopplerometry and measuring the acid-base balance of the fetus in umbilical cord blood.

Keywords: fetal hypoxia, acid-base balance, dopplerometry , umbilical cord blood

Today, one of the important causes of stillbirths and other obstetric pathologies is fetal hypoxia . According to international studies for 2010-2015, the percentage of stillbirths per 1000 births is 1.3 to 8.8 cases, but in developing countries this figure was 28.2 cases per 1000 births.

Chronic and acute hypoxia are one of the main causes of adverse pregnancy outcomes, and currently the main hopes for reducing this indicator are related to the timely identification of fetuses at high risk of adverse outcomes in order to select the optimal time and method of delivery [1] . It should be noted that today there are no methods for correcting intrauterine fetal hypoxia, but there are many diagnostic methods, each has its own advantages and disadvantages, but their main goal is timely diagnosis to determine further tactics for pregnancy and delivery .

The purpose of this systematic review is to analyze some diagnostic methods .

Physiological aspects of fetal hypoxia

During pregnancy, gas exchange is ensured in the placenta. Deoxygenated blood is pumped by the fetal heart through the two umbilical arteries into the placenta, while oxygenated blood is transported back into the fetal circulatory system through the umbilical vein. Against the background of increased myometrial tone , perfusion in the placenta may be limited, which can potentially lead to oxygen deficiency and two different types of acidosis - respiratory and metabolic [2].

Respiratory acidosis is caused by the accumulation of carbon dioxide produced as a result of normal metabolism. Although the concentration of H+ ions increases, respiratory acidosis per se is not associated with adverse neurological consequences, since the fetus uses compensatory mechanisms [2].

Metabolic acidosis occurs when the fetus does not receive enough oxygen to maintain normal metabolism, causing a shift to anaerobic metabolism.

This leads to the formation of lactic acid and, when tissue buffering capacity is depleted, to a decrease in pH . Because lack of oxygen ultimately leads to cell death, prolonged exposure to hypoxia can lead to postnatal neurological complications, such as short-term hypoxic -ischemic encephalopathy, or long-term disorders functions, such as spastic quadriplegia [3, 2]. Severe intrapartum asphyxia can lead to stillbirth or early neonatal death [2].

Doppler

Doppler ultrasound plays a fundamental role in diagnosing fetal growth restriction, identifying fetuses with alarming degrees of anemia and other intrauterine pathologies.

Combination of Doppler examination of the umbilical cord with middle cerebral artery and biometry is the best tool for identifying growth-restricted fetuses at high risk of poor outcome and can play an important role in choosing the optimal time for delivery for this pathology [1]. Fetuses with growth retardation respond to insufficient consumption of nutrients and oxygen by disrupting the functioning of the endocrine, cardiovascular , hematological and nervous systems. The fetus may experience numerous complications during the neonatal period.[6].Among these complications, cognitive impairment is the most important due to its dangerous impact on the life of the newborn. In addition, dysfunction of the cardiovascular system in the antenatal period is a significant risk factor for chronic hypertension and coronary heart disease in later life [7].

cardiovascular dysfunction should be prioritized in research . In addition to the standard already calculated blood flow indices - systole -diastolic ratio and pulsatility index, new evaluated parameters may be important for predicting outcomes in relation to central nervous system damage, for example, an increase in peak systolic velocity in the middle cerebral artery in fetuses with FGR without anemia[8], definitions A- waves in the ductus arteriosus and cerebro -placental ratio [9], signs of cerebral vasodilation and redistribution of blood flow during the brain-sparing effect [8].

In addition, signs of increased vascular resistance in the placenta, a reduction in the length of systolic peak velocities in the aorta and lungs, and an increase in the length of peak velocities in the aorta, characteristic of fetuses with growth retardation, are being studied and are now known [6]. Also, fetuses with growth retardation may develop cardiac-sparing an effect characterized by a decrease in the ejection fraction of both ventricles, myocardial hypertrophy without ventricular dilatation, which is associated with severe fetal acidosis and is prognostic unfavorable . In fetuses with asphyxia, the cardiac-sparing effect may include myocardial ischemia and necrosis [10].

In addition to its many advantages, the Doppler method has its disadvantages. Firstly, for its use and adequate assessment of the results an appropriate qualification of a doctor is required, which can be problematic in the conditions of the first level of obstetric and gynecological care in the Arkhangelsk region. Secondly, frequent use of this method over time can lead to false results and a distorted assessment of the fetal condition [11]. Thirdly, this method has high heterogeneity of indicators in the world , which also complicates diagnosis [12].

Indicators of acid-base status in umbilical cord blood

The stability of the acid-base balance of the internal environment is the most important condition for the life of the human body. Maintaining the acid-base state becomes particularly important during pregnancy, when anabolic processes increase significantly and energy metabolism increases, which requires a greater amount of oxygen for the oxidation of substrates and the elimination of H+ and e- [13, 14]. By examining indicators of the acid-base balance of the blood, it is possible to monitor the nature of metabolic processes in the fetus and mother. Changes in the acid-base state during pregnancy are an adaptive reaction aimed at creating optimal conditions for placental gas exchange.

Determination of pH , blood gases, and base deficiency in cord blood is usually performed to assess the metabolic status of the newborn in conjunction with Apgar scores and clinical presentation

Hypoxia is the most common manifestation of fetal stress during labor and, depending on the degree and duration, can lead to significant metabolic acidosis. Although all newborns have a moderate degree of metabolic acidosis, it is the metabolic acids produced in response to anaerobic metabolism during hypoxia-ischemia that, in severe cases, correlate with the risk of permanent neurological impairment in some newborns.

However, measuring the acid-base balance of umbilical cord blood is an important indicator of the status of the newborn.

Based on the foregoing , the author assumes that an analysis of the acid-base balance of umbilical cord blood in grades 2 and 3 NMPK will give a more detailed picture of fetal hypoxia during pregnancy, which will make it possible to select an individual correction for this syndrome in the future.

Conclusion

Adequate assessment of the functional state of the fetus and timely diagnosis of hypoxic conditions of the fetus during labor remain an unsolved problem in obstetrics. Today, there are different methods for assessing the functional state of the fetus in the antenatal and intranatal periods. Unfortunately, each has its own limitations and disadvantages and does not accurately predict severe neonatal outcomes or stillbirths. It should be recognized that the lack of uniform approaches to the diagnosis of fetal hypoxia and algorithms of action in the presence of modern diagnostic tools requires further research in this direction from modern obstetrics.

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