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Review article

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Intrauterine Hypoxia: Causes, Mechanisms, Symptoms,Diagnosis, Compensation, Prevention

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Abstract

The review is devoted to substantiating the importance of the functional test with apnea of a pregnant woman before childbirth to assess the resistance of the fetus to intrauterine hypoxia and the choice of the type of delivery in order to prevent encephalopathy, asphyxia and death of the newborn. It is shown that the human fetus cannot avoid repeated periods of intrauterine hypoxia during physiological childbirth in women. The reason for this incident is established: the cause of periodic and transient placental ischemia and intrauterine fetal hypoxia is the uterus. The fact is that the uterus contracts during childbirth and at the same time it squeezes not only the fetal bladder inside its cavity, but also the blood vessels inside its wall. As a result, at each contraction of the uterus, the blood vessels inside the uterus are squeezed, so the blood supply to the placenta worsens and/or completely stops.In this regard, it is proposed to use the apnea-test to assess the survival of the fetus in hypoxia.It is shown that the results of the apnea-test for fetal survival allow us to reliably assess the readiness of the fetus at each pregnant woman to withstand the hypoxia tests that await him during physiological childbirth. Technologies for new functional test are described.

Keywords: Adaptation;Apnea-test;Diagnostics; Fetus survival; Intrauterine hypoxia;Pregnancy;Prevention

Introduction

Intrauterine hypoxia remains the main threat to the health and life of fetuses from the second half of pregnancy and during childbirth regardless of the quality of life and health status of pregnant women[1,2]. Fetal hypoxia scares every pregnant woman and every obstetrician who wants a live newborn with excellent mental abilities. The fact is that the cells of the fetal cortex have the weakest survival rate in hypoxia, so they are the first to die[3]. Moreover, sometimes fetuses in some pregnant women have very low reserves of adaptation to acute hypoxia, so acute hypoxia lasting more than 5-10 seconds is very dangerous for cortical cells in such situations[4].

In this regard, an apnea-test for fetal survival in hypoxia was proposed[5].The fact is that this functional apnea-test for the survival of the fetus at acute hypoxia allows you to assess the reserves of the fetus to the upcoming hypoxia in childbirth and timely use a Cesarean section instead of delivery through the natural birth canal.

However, these facts are still ignored by most obstetricians and gynecologists around the world. But over the past 10 years, no alternative to the proposed functional test has been proposed. This allows us to recall this functional test again, since the previously proposed apnea test cannot be replaced by any other test today.

Material and Methods

The literature research was conducted in the period up to 2020 using the Google Patents, EAPATIS, RUPTO, USPTO, Espacenet, PATENTSCOPE, PatSearch, DWPI, E-Library, Google Scholar, Scopus, PubMed, Questel-Orbit, Science Direct and Yandex databases. The search strategy keywords were as follows: pregnancy, physiological delivery, fetus, uterus, uterine contractions, placenta, gas exchange, newborn, fetal hypoxia, intrauterine hypoxia, placental ischemia, causes, prevention, treatment, survival, stability, adaptation, adaptation reserves, newborn asphyxia, meconium, amniotic fluid, encephalopathy, Apgar scale, Cesarean section. The information was limited to the possibility of using it in the second half of pregnancy, as well as before and during childbirth to assess the survival of the fetus in acute hypoxia.

Results

We analyzed the scientific literature on assessing fetal survival at acute intrauterine hypoxia for prevention of neonatal asphyxia and postpartum encephalopathy. The results of the analysis showed that pregnant women, obstetricians and researchers around the world do not use apnea-test for fetus survival at hypoxia and other methods of assessing the reserves of adaptation of the fetus to hypoxia, which will have to survive each fetus in future physiological childbirth. At the same time, the apnea-test for fetal survival at hypoxia was developed and proposed in 2011[5].

But there is no criticism of this functional test in the literature and no claims about its adequacy. At the same time, the analysis of scientific and patent literature shows that the problem of preventing intrauterine hypoxia during childbirth has not yet been completely solved.

In obstetrics and gynecology, there is no officially recognized scale for evaluating fetal survival in model conditions similar to those that the fetus will face during future physiological labor. Instead of one such indicator, until now, as more than 100 years ago, everyone is trying to prove the possibility of perinatal asphyxia in the presence of preeclampsia, prolonged labor and meconium-stained amniotic fluid [1,2,6,7].

On this basis, we can conclude that the prognosis and prevention of asphyxia and encephalopathy of newborns has not undergone drastic improvements in official obstetrics and gynecology.At the same time, there is no generally recognized rating scale in obstetrics that would allow timely selection of the" right " type of delivery, namely through the natural birth canal or by Cesarean section, in order to exclude asphyxia of newborns and encephalopathy.So far, the indication for a Caesarean section is high blood pressure in the mother, a double pregnancy, childbirth in the buttock area, problems with the placenta or umbilical cord, prolonged delivery[7,8].

In this situation, there is no alternative to using the previously proposed apnea-test for fetal survival in hypoxia in every pregnant woman, since this can allow to choose the type of delivery in a timely manner for actually reduce the mortality rates of newborns and the frequency of postpartum encephalopathy.In this case, we rely on the fact that the results of research conducted in the period 2010-2020 in the field of obstetrics and gynecology do not refute the reasonableness of apnea-test for fetal survival at hypoxia.

This is surprising, but the fact is that in obstetrics, there are still many gaps in understanding how the uterus supplies blood to the placenta during physiological childbirth and how the placenta supplies the fetus with oxygen in the womb[6].It seems that women do not want to know the truth about the fact that normally their uterus contracts so much during physiological childbirth that it squeezes the blood vessels inside itself and causes placental ischemia, which automatically causes fetal hypoxia [3,9].However, this is true. There is a particularly high probability of intrauterine hypoxia in the final period of physiological delivery, when the uterus contracts for a period of 60-90 seconds [10,11].

Thus, the most dangerous for the fetus is the end of physiological labor, when oxygen with arterial blood stops coming to the fetus for the longest periods of time[1,11,12].

This is surprising, but the fetus is ready for such repeated periods of hypoxia. It seems that he is waiting for them! Research results show that as soon as the supply of oxygen stops, the fetus immediately begins to save its use. In particular, it immediately stops motor activity [2,4,13]. Despite the fact that the oxygen reserves of the fetus are not infinite, usually these reserves of adaptation to acute hypoxia are enough for the fetus to successfully survive all periods of hypoxia during childbirth and was born alive, healthy, and pink, immediately screamed and that the Apgar scores were high [14-16].

However, regardless of the uterus and placenta, hypoxia can occur from other causes. It is established that viability of the brain cells of the fetus inside the uterus depend on many factors [17].At the same time, no one knows what factor is most important at each pregnant woman to preserve the viability and health of her fetus during future physiological childbirth. Therefore, when preparing for childbirth and choosing the type of delivery, it is desirable to rely on the results of such a test, which would be an integral indicator of all possible and variable factors affecting the process of fetal survival in the childbirth of every pregnant woman.

It seems that apnea-test for fetal survival at hypoxia meets these requirements, and the value of this test is an integral indicator of all factors that affect the blood supply, gas exchange, metabolic rate and survival of the fetal brain inside the uterus of each woman in each period of time.

The essence of the proposed apnea-test for fetal survival at hypoxia is as follows [5].A pregnant woman shortly before the expected date of delivery turns to a specialist for ultrasound of the fetal condition. At the end of the standard procedure, the specialist performs sonographic registration of fetal motor activity. At the same time, he waits for the immobile state of the fetus, in which the specialist asks the woman to hold her breath for as long as possible, registers the time and begins video recording of the fetus during apnea. Video shooting is carried out until the end of apnea or until the appearance of respiratory movements in the chest of the fetus and the extension of their arms, after which the duration of the period of immobility of the fetus during apnea is calculated.

Previously, the following interpretation of the obtained apnea test values was proposed[18]. If the fetal motionless state

during apnea persists for more than 25 seconds, the fetus has a high survival rate for intrauterine hypoxia and can survive during physiological delivery without hypoxic damage to cortical cells.

If the immobile state of the fetus during apnea persists for less than 10 seconds, physiological delivery is contraindicated for it, since it has a low survival rate in hypoxia. With such a low value of apnea-test for fetal survival at hypoxia, delivery using the natural birth canal will cause fetal asphyxia, hypoxic damage to some of the cells of the fetal cortex, the development of encephalopathy after physiological delivery, drowning of the fetus in amniotic fluid, clogging of the respiratory tract with fecal matter, pneumonia, a low value on the Apgar scale, and/or clinical death of the newborn.

It was shown that this functional test has a high prognostic value, as it increases the accuracy of predicting the perinatal outcome of the birth process, and can also serve as a basis for recommending a Caesarean section[14,19].

The fact is that the duration of the fetus immobile state during apnea at pregnant woman is preserved the longer, the more reserves of adaptation to hypoxia the fetus has.Therefore, the value of the apnea test for fetal survival in hypoxia, expressed in seconds, directly depends on the size of the reserves of adaptation of the fetus to hypoxia and is detected by the maximum duration of hypoxia, which the fetus is able to survive without tragic consequences for itself.

Most likely, pregnant women are not accidentally endowed with the ability to give birth to their fetus by a series of intermittent contractions of the uterus, which last no more than 90 seconds and which follow each other with significant interruptions even in the final stage of labor. The fact is that the human fetus at the end of pregnancy is not able to survive a longer continuous contraction of the uterus without harm. It is obvious that evolution, in order to preserve the species, or rather, to preserve the life and health of the fetus, has limited the maximum duration of uterine contractions during childbirth. The fact is that only such a restriction on the duration of contractions guarantees that the uterus will expel the fetus outside alive and healthy. It is also obvious that the duration of the longest bout cannot exceed the period that the fetus cannot survive without harm to its health.

Therefore, it is the maximum possible margin of safety for the fetus, which allows it to survive uterine contractions lasting up to 90 seconds and repeated at intervals of about 2 minutes, that is the limiting factor for the duration and strength of contractions during physiological childbirth.

In other words, nature has genetically recorded a correspondence between the maximum possible amount of adaptive reserve in the fetus and the maximum permissible duration and strength of uterine contractions in a pregnant woman. Moreover, it is obvious that nature has secured in the normal fetus such an amount of adaptive reserve that ultimately ensures the fetus's survival during the longest uterine contraction that is possible in normal conditions. The fact is that during the period of contractions, the uterus squeezes the blood vessels in its wall (that is, inside itself), which creates an ischemia of the uterus, restricts the production of energy in its smooth muscle myocytes and the period of reduction of the actin-myosin complex, which after exhausting intracellular energy relaxes.

This presentation of the essence of the functional impact of the uterus on its fetus when it is expelled out through the natural birth canal allows a new approach to the problem of preventing asphyxia, encephalopathy and death of newborns, and also confirms the adequacy of the previously proposed apnea-test for fetal survival at intrauterine hypoxia for diagnosing fetal readiness for physiological childbirth.

In particular, the described essence of uterine test for the fetus in childbirth allows us to admire the amazing sequence of uterine contractions and relaxations in the process of physiological childbirth, since in this case, the gradual increase in the duration of periods of uterine contraction appears to us in the light of training the fetus, opening its reserves of adaptation to hypoxia and developing maximum resistance to it. That is why a few years ago a test was proposed for the resistance of the fetus to repeated hypoxia[20].

This test can be used for select the type of delivery. For this purpose, from the term of 36 weeks' pregnancy for many days at least after every 7 days the fetal condition is assessed with the help of ultrasound. In this case, a pregnant woman repeatedly holds her breath for the maximum possible period or until the appearance of respiratory movements of the chest in the fetus. The next apnea is applied 2 minutes after the end of the previous one.During each apnea, the duration of the fetal immobility period is determined. Repeated apnea stops after stabilization of the values of the duration of the stationary state of the fetus during apnea. The final conclusion is issued and the method deliveries are selected based on the results last rating.

The following interpretation of the obtained data was proposed. If the time interval for repeated hypoxia remains short, decreases or increases, but does not reach 15 seconds, the fetus's adaptation to repeated hypoxia is assessed as poor. Delivery via the natural birth canal in such cases is contraindicated and you should plan a Caesarean section.

If the time interval increases and exceeds 15 or 30 seconds, the adaptation of the fetus to repeated hypoxia is evaluated as satisfactory or good (respectively). Delivery through the natural birth canal is possible.

Conclusion

The impact of intrauterine hypoxia on the fetus in the second half of pregnancy and during childbirth is very dangerous for its brain, health and life.Normally, the fetus survives during apnea of a pregnant woman lasting more than 30 seconds and during contractions of the uterus lasting 60-90 seconds during physiological delivery. But not always. Sometimes the fetus has great difficulty surviving 5 -10 seconds of apnea, that is, sometimes the fetus can have very low resistance to hypoxia.In such a situation, the brain cells of the fetus can die from hypoxic damage during delivery, because the uterus during labor causes more prolonged in utero hypoxia. However, it is possible to keep the fetus alive in this situation. To do this, you need to apply a Caesarean section.

However, official medicine does not have a method for assessing the danger of upcoming physiological childbirth for the

fetus in every pregnant woman in the second half of pregnancy in real time.

So, in the period between 2010 and 2020, 2 functional tests were proposed that allow using ultrasound to determine the duration of fetal immobility inside the uterus during the Stange test for single and repeated apnea at intervals of 2 minutes in pregnant women in the second half of pregnancy.

Using this apnea-test for fetal survival at hypoxia in Russia demonstrated that in the second half and at the end of pregnancy, the fetus normally remains motionless for 30 seconds or more while holding the breath of a pregnant woman.In this case, the fetus can be born alive and healthy as a result of both physiological delivery and Cesarean section.It was also found that sometimes in some pregnant women, the fetus is in a stationary state during apnea 2-3 times shorter. In this case, delivery via natural routes is contraindicated and it is necessary to apply a Caesarean section.

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