https://doi.org/10.46344/JBINO.2021.v010i01.27

THERMAL IMAGER CAN PREDICT INTRAUTERINE HYPOXIA DURING PREGNANCY AND CHILDBIRTH

The local temperature of the fingers of a pregnant woman and the surface of the fetal head during childbirth is an indicator of the oxygen supply to the fetal brain.

[1]L.V.Lovtsova, [2,3]A.L.Urakov*, [2]N.A.Urakova, [3]Z.V.Shubina and [3]A.P.Stolyarenko

[1]Department of General and Clinical Pharmacology of the Volga Region Research Medical University of the Ministry of health Russian Federation
[2]Department of General and Clinical Pharmacology and
[3]Department of Obstetrics and Gynecology of the Izhevsk State Medical Academy of the Ministry of Health Russian Federation - 426034

E-mail: urakoval@live.ru

ABSTRACT

It is proposed to use a thermal imager to diagnose the health of a pregnant woman and her fetus due to the dependence of the intensity of heat release in their bodies on the sufficiency of arterial blood and oxygen in them. It is shown that adaptive mechanisms of careful use of oxygen inside the body of a pregnant woman can change the dynamics of regional blood circulation and heat radiation in the body of the mother and fetus. In particular, apnea (an example of hypoxia) or cuff occlusion test (an example of ischemia) in the mother after 11-15 seconds are manifested by local hypothermia in her fingertips. In turn, a longer oxygen deficiency that occurs in the body of a pregnant woman, for example due to thrombophilia, is manifested by local hypothermia in the phalanges of her fingers and toes. Moreover, the local temperature of the fetal head immediately after its surface exits the birth canal also depends on the supply of arterial blood and oxygen to the child's brain, so intrauterine hypoxia is manifested by local hypothermia of the skin in the area of the fontanelles. In this regard, infrared imaging of the hands and feet of a pregnant woman and the visible part of the surface of the fetal head is a new method for preventing intrauterine fetal hypoxia.

Key words: fetus, newborn, hypoxia, oxygen, infrared thermography, local temperature.

Introduction.

Intrauterine fetal hypoxia is a common cause of termination of pregnancy, miscarriage of the fetus, postpartum encephalopathy, and even death of the child [1-5]. One of the insufficiently studied causes of fetal hypoxia remains thrombophilia in women [6,7]. It is believed that thrombophilia is the cause of miscarriage of the fetus due to thrombosis of the mother's blood vessels. In this regard, to preserve pregnancy, heparin and its derivatives (direct-acting anticoagulants) are introduced. However, even the "correct" use of anticoagulants does not exclude termination of pregnancy and fetal death. Despite this, treatment of pregnant women with heparin is considered correct, and the low effectiveness of heparin is explained by the complexity of its individual dosage [2,6].

On the other hand, fetal hypoxia can occur from other causes. The likelihood of fetal asphyxia increases with increasing gestation and during physiological delivery. Sometimes the fetus is delayed for a long time in the birth canal due to the weakness of labor while simultaneously clamping the umbilical cord and/or premature placental abruption. In this case, part of the surface of the fetal head may already be visible due to its exit from the birth canal to the outside. However, there are no generally accepted methods for assessing fetal brain oxygen supply [1-3].

Results

Under these conditions, it was assumed that the cause of premature termination of pregnancy and miscarriage in a woman with thrombophilia is ischemic damage to the placenta, which occurs due to thrombosis of blood vessels in it [6]. This assumption allowed to take a new look at the cause of miscarriage in a pregnant woman with thrombophilia and suggest that the immediate cause of fetal death is intrauterine hypoxia, and not hypercoagulation of the mother's blood plasma. Therefore, this view of this problem was used to form a new hypothesis about pathogenesis.

This hypothesis is based on the following. First, the body of a pregnant woman is prepared by evolution to preserve pregnancy and fetal life in all natural conditions, including hypoxia. Secondly, a pregnant woman has a reserve of adaptive mechanisms sufficient for her survival together with the fetus in conditions of lack of oxygen. Third, backup adaptation mechanisms aimed at increasing the fetus' resistance to hypoxia are universal, and are used in all similar situations, regardless of whether there is a pregnancy. Third, the mother's body promptly diagnoses intrauterine fetal hypoxia, assesses the degree of hypoxic damage in it and prevents their development due to the fact that during fetal hypoxia, hypoxia markers enter the mother's blood. Due to the appearance of hypoxia markers, the mother's body rearranges blood circulation in favor of the brain to the detriment of the hands and feet. At the same time, the fingers and toes get less blood and get colder. Local hypothermia in them begins with the pads of the fingers. This local hypothermia can be easily detected using infrared thermography [6].

Studies have shown that the local temperature in all fingers and toes of all pregnant women with thrombophilia is 7-8 °C lower than the temperature in the middle of the hand and in the middle of

the foot (respectively). In addition, some pregnant women with thrombophilia had their fingertips and toes 1.5-2.0 °C colder than room temperature. Zones of local hypothermia occupied areas from 1/3 to 3/3 of the length of the phalanges. The coldest were the pads of the fingers and toes. At the same time, a direct relationship was found between the degree of plasma hypercoagulation and the size of local hypothermia zones in the hands and feet [6].

Therefore, pregnancy in a woman with thrombophilia can cause her body to adjust and turn on the universal compensatory mechanism of protection against hypoxia, in which pregnant women get cold hands and feet. Most likely, this is due to a reflex spasm of blood vessels and is a universal reaction to a lack of oxygen. The beginning of the mother's adaptation to hypoxia may indicate the possibility of hypoxia in the fetus. In all likelihood, one of the first symptoms of the beginning of adaptation to hypoxia in a pregnant woman with thrombophilia is local hypothermia of the fingertips and toes. Infrared thermography reveals an early adaptive response of a pregnant woman's body to a complicated pregnancy.

Other causes of intrauterine fetal hypoxia are compression of the uterine blood vessels by the uterus itself due to its strong contraction during childbirth, compression of the umbilical cord when the fetus moves in the birth canal, and premature placental abruption during childbirth [8-10]. It is shown that fetal ischemia during labor leads to inhibition of oxygen exchange and to a decrease in heat production in the fetal body, which can be easily diagnosed using a thermal imager, but only after the fetal head leaves the birth canal [11,12]. The fact is that after the head comes out, its surface immediately begins to cool, since the ambient temperature is usually lower than the mother's body temperature by 10-12 °C [13,14].

Studies have shown that during childbirth and immediately after the full birth of a child, the local head surface temperature in live fetuses is in the range of +31.6 - +36.1°C. In this case, the values of the local temperature of the fetal head at the time of its eruption correspond to the body temperature of its mother. It was found that normally the local temperature of the fetal head surface is always high, and with fetoplacental insufficiency and low fetal resistance to intrauterine hypoxia, a zone of local hypothermia may occur on the surface of the head during uterine contraction. The temperature in this area of local hypothermia immediately rises to normal after hyperventilation of the lungs of a woman in labor with respiratory gas until the first symptoms of oxygen poisoning appear [12-14].

Therefore, recording the local temperature of the fetal head using a thermal imager during childbirth allows to judge the sufficiency of oxygen supply to it with arterial blood. The appearance of a zone of local hypothermia allows to diagnose fetal hypoxia in real time, and an increase in temperature in this zone indicates successful elimination of fetal hypoxia.

In conclusion, it should be pointed out that the described dynamics of the local temperature of the fetal head surface before and after hyperventilation of the lungs in the mother completely repeats the dynamics of the local temperature in the fingertips of adults

during and after apnea and/or ischemia of the hand [15-17].

Conclusion

Thus, it may well happen that very soon progress in obstetrics and gynecology will not be possible without the use of a thermal imager, because without it, it will be difficult to exclude intrauterine fetal hypoxia [13,18]. The thermal imager is a temperature navigator (compass) that helps detect fetal hypoxia. Very soon, the effectiveness of gynecological and obstetric aids will be evaluated by the dynamics of local temperature in the fingers of pregnant women and on the surface of the fetal head in the area of the projection of fontanelles, namely, by the absence of local hypothermia zones and/or by the timeliness and effectiveness of their elimination.

Financial Support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

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