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ULTRASOUND EVALUATION OF AMNIOTIC FLUID IN PREGNANT WOMEN

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УЛЬТРАЗВУКОВАЯ ОЦЕНКА ОКОЛОПЛОДНЫХ ВОД У БЕРЕМЕННЫХ

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Abstract

Oligoamnios and polyhydramnios is a universal integrated response of the female body to any pronounced disadvantage in the state of health of a pregnant woman or fetus associated with past infections, endocrine pathology and other adverse factors of the internal and external environment.

Objective: to present a modern view on the study of amniotic fluid in pregnant women.

Results. The data from available literature sources are summarized and the results of our own research on ultrasound examination of amniotic fluid in pregnant women are presented.

Conclusions. The conducted studies strongly indicate the need for a correct assessment of the amount of amniotic fluid in pregnant women in order to exclude the causes of violations of the amount of amniotic fluid such as fetoplacental dysfunction, fetal pathology, placental pathology, extra genital pathology of the mother.

Key words: pregnancy, ultrasound examination, amniotic fluid.

Реферат

Маловодие и многоводие – универсальный интегрированный ответ женского организма на любое выраженное неблагополучие в состоянии здоровья беременной или плода, связанное с перенесенными инфекциями, эндокринной патологией и другими неблагоприятными факторами внутренней и внешней среды.

Цель исследования: представить современный взгляд на исследование околоплодных вод у беременных.

Результаты исследования. Обобщены данные доступных источников литературы и представлены результаты собственных исследований по ультразвуковому исследованию околоплодных вод у беременных.

Выводы Проведенные исследования, убедительно свидетельствует о необходимости правильной оценки количества околоплодных вод у беременных с целью исключения причин нарушения количества околоплодных вод таких как: фетоплацентарная дисфункция, патология плода, патология плаценты, экстрагенитальная патология матери.

Ключевые слова: беременность, ультразвуковое исследование, околоплодные воды.

Introduction. Amniotic fluid is a biologically active medium surrounding the fetus and performing various functions throughout pregnancy and childbirth (protects the fetus from the effects of chemical, mechanical, infectious agents, direct contact with the inner surface of the fetal sac; circulation of amniotic fluid serves as a powerful shaping and training factor for the respiratory and excretory systems of the fetus) [2, 5].

Oligoamnios and polyhydramnios is a universal integrated response of the female body to any pronounced disadvantage in the state of health of a pregnant woman or fetus associated with past infections, endocrine pathology and other adverse factors of the internal and external environment. Polyhydramnios is an excessive accumulation of amniotic fluid; oligoamnios is a decrease in amniotic fluid of less than 0.5 liters. To date, there is no clear understanding of the etiology and pathogenesis of amniotic fluid pathology. According to V.O. Orchakov (2002), E.F. Magann et al. (2003), idiopathic oligoamnios and polyhydramnios, when no pathology of the mother and fetus is detected, occurs in 20.1-66.7% of cases [1].

Determining the amount of amniotic fluid is of great practical importance, since pregnant women with low and polyhydramnios often have congenital malformations of the fetus. Perinatal mortality is also significantly higher with a disturbed amount of amniotic fluid compared to their normal amount.

To date, the exact echography criteria for determining the amount of amniotic fluid remain undeveloped. The conducted studies have shown that ultrasound diagnostics of low and polyhydramnios, based on a general approximate assessment by the researcher of the amount of amniotic fluid, is relatively accurate [3].

Objective: to present a modern view on the study of amniotic fluid in pregnant women.

Results. Polyhydramnios has different etiologies and is an early symptom of various pathological processes in the body of the mother and fetus. Polyhydramnios is defined as an excessive amount of amniotic fluid more than two standard deviations above the average for a given period of pregnancy. Ultrasound criteria are taken into account, which include a maximum vertical pocket of more than 8 cm, or an amniotic fluid index of more than 24. The incidence of polyhydramnios is approximately 15% [4].

The frequency of polyhydramnios in different periods of pregnancy ranges from 0.12 to 3% and varies widely at different gestation periods: 16-19 weeks – 1.5%; 20-23 weeks – 8.9%; 24-27 weeks – 12.2%; 28-32 weeks – 28.4%; 33-38 weeks – 19.6%.

Classification of polyhydramnios.

Depending on the amount of amniotic fluid: mild degree (1500-3000 ml); medium degree (3100-5000 ml); severe degree (>5000 ml). Depending on the rate of increase in the amount of amniotic fluid: acute (severe); chronic (moderate and mild). Depending on the time of occurrence by the time of gestation: primary (18-25 weeks); secondary (after 25 weeks).

The mechanism of amniotic fluid formation is not fully understood. However, many researchers consider the following mechanisms of amniotic fluid formation depending on the gestation period.

Therefore, in the first trimester, the amniotic fluid is a transudate of maternal plasma through the chorion and amnion during the remodeling of spiral arteries. In the II-III trimester, the main source of amniotic fluid formation is the fetus (urine and alveolar fluid). The main source of amniotic fluid is fetal urine. In full-term pregnancy, the daily amount of urine is 400-1200ml. From the 20th to the 40th week, the amount of urine increases 10 times. Urine is a hypotonic fluid. The

lungs of a full-term fetus secrete 300-400 ml of fluid per day. The pulmonary fluid is a transudate, practically devoid of protein, with an osmolality equal to the osmolality of the fetal plasma. Pulmonary fluid is not directly related to the regulation of fluid homeostasis in the fetal body. The main role of the pulmonary fluid is to promote its expansion of the lung tissue, which ensures the growth of the lungs. By the time of birth, the amount of pulmonary fluid should decrease due to the transition to external respiration.

The constancy of the volume of amniotic fluid is ensured by: the production of urine and pulmonary fluid, resorption of amniotic fluid by the fetus as a result of ingestion and outflow through the chorionic and amniotic membranes into the system of maternal and fetal blood flow. Amniotic fluid is completely renewed every 3 hours. It was found that during full-term pregnancy, about 500-600 ml is exchanged within 1 hour, that is, 1/3 of them. Their complete exchange takes place within 3 hours, and the change of all substances dissolved in them takes 5 days. In the exchange of amniotic fluid, some researchers assign a role to the paraplacental pathway, that is, through the extraplacental parts of the fetal membranes.

The causes of polyhydramnios are numerous, they can be grouped as follows:

1. The main reason is fetoplacental dysfunction, in which there is a decrease in resorption and an increase in amniotic fluid production.
2. Causes associated with maternal diseases (diabetes mellitus, infectious and inflammatory pathology).
3. Causes associated with fetal pathology: fetal-fetal hem transfusion syndrome; fetal hemolytic disease; malformations of the gastrointestinal tract (presence of atresia), central nervous system (development of swallowing dysfunction); chromosomal abnormalities and hereditary diseases (most often trisomy 21, and then trisomy 18 and 13-th chromosome); malformations of the cardiovascular system, arrhythmias (development of heart failure and fetal dropsy).

It has been established that polyhydramnios is more often the result of fluid transudation through the meninges in encephalocele or the results of neurological disorders leading to changes in swallowing movements of the fetus, a decrease in the production of antidiuretic hormone or a consequence of mechanical compression in the cervical

region of the fetus. The presence of polyhydramnios in intestinal malformations is due to the fact that a normal fetus swallows a large amount of amniotic fluid, thereby regulating the amount of amniotic fluid. Therefore, with high intestinal obstruction, more often atresia of the small intestine, polyhydramnios occurs.

4. Causes related to the pathology of the placenta: chorionangioma; placenta surrounded by a roller (placenta circumvallate). In these cases, ultrasound examination often determines pronounced changes in the placenta.

5. Idiopathic polyhydramnios.

During ultrasound examination, polyhydramnios is characterized by the presence of large echo negative spaces in the uterine cavity. At the same time, as correctly, there is an increased motor activity of the fetus, as well as its limbs, internal organs and umbilical cord are better visualized.

Oligoamnios is characterized by a significant decrease in echo negative spaces in the uterine cavity. Therefore, with little water, it is much more difficult to conduct an examination of the internal organs of the fetus and measure its biometric parameters, unlike polyhydramnios. Oligoamnios usually accompanies fetal kidney malformations: bilateral kidney agenesis, bilateral multicystic kidney dysplasia, etc.

Instrumental methods for the study of colic of amniotic fluid.

There are two main methods for determining the amount of amniotic fluid: 1. Measurement of a single vertical pocket, 2. Determination of the amniotic fluid index.

The first most reliable echography technique for diagnosing water scarcity is the method proposed by F.A. Manning and co-authors in 1981. The method is based on measuring the free space of water from parts of the fetal body to the surface of the uterus. When measuring a single vertical pocket, the vertical size of the largest pocket with amniotic fluid is estimated, which does not contain the umbilical cord or fetal limbs and is measured at right angles to the contour of the uterus and perpendicular to the floor. A single vertical channel is a criterion that is used to evaluate the biophysical profile of the fetus to document compliance with the volume of amniotic fluid.

The second method is based on the assessment of the amniotic fluid index. The amniotic fluid index is calculated by summing the depth in centimeters of four different pockets of fluid that do not contain the umbilical cord or fetal limbs in the four quadrants of the abdomen, with the sensor positioned perpendicular to the floor and the navel used as a reference point.

Diagnostic criteria for assessing the volume of amniotic fluid:

The maximum depth of a single vertical channel: 2-8 cm – normal; 2 cm – borderline; less than 2 cm – oligoamnios; more than 8 cm – polyhydramnios.

Amniotic fluid index: less than 5 cm – oligoamnios, more than 24 cm – polyhydramnios.

With polyhydramnios, the maximum depth of a single vertical channel is determined to be more than 8 cm or the amniotic fluid index is more than 25 cm. With the size of a single vertical channel of 8-11 cm, mild polyhydramnios is diagnosed; 12 to 15 cm – moderate polyhydramnios; above 16 cm – severe polyhydramnios. With an amniotic fluid index of 25-29.9 cm, mild polyhydramnios is diagnosed; 30-34.9 cm – moderate polyhydramnios; more than 35.0 cm – pronounced polyhydramnios.

In case of oligoamnios, the maximum depth of a single vertical channel is less than 2 cm or the amniotic fluid index is less than 5 cm. When measuring the amniotic fluid index, according to the degree of oligoamnios, the following are divided: mild degree – 5-4 cm; moderate degree – 3.9-2.1 cm; severe degree – less than 2 cm.

In multiple pregnancies, the method of choice is to measure a single vertical channel.

An extremely unfavorable prognostic sign is the detection of severe oligoamnios in the second trimester of pregnancy. In almost all cases with water scarcity at the age of 18-26 weeks, pregnancy is usually terminated, or antenatal fetal death occurs or newborns die in the first days of life. In 40.3% of cases, the presence of congenital malformations of the kidneys is noted. Many other authors also bring data on very high perinatal mortality in the presence of water scarcity at the age of 13-25 weeks. That is why, when progressive oligoamnios is detected during dynamic ultrasound examination in the second

trimester of pregnancy, it is necessary to raise the question of its termination.

Some researchers believe that oligoamnios is one of the important diagnostic criteria for fetal developmental delay syndrome. It was found that in 89.4% of cases with fetal development delay syndrome, the volume of amniotic fluid decreases. Echography detection of water scarcity can be used as a screening test for the diagnosis of fetal development delay, with the sensitivity of the method being 84% and the specificity 97%. However, according to most authors, oligoamnios is only of auxiliary importance in the diagnosis of this syndrome. Therefore, the researchers conclude that, at least the detection of oligoamnios during ultrasound examination increases the suspicion of the presence of fetal development delay syndrome, however, this criterion does not guarantee high accuracy and reliability of the diagnosis of the syndrome.

Given that oligoamnios is also observed in many other complications of pregnancy, it cannot be considered as a specific sign of fetal growth retardation syndrome. Nevertheless, if water scarcity is detected during ultrasound examination, it is necessary to conduct a thorough examination of the fetus from the point of view of both identifying its possible developmental delay and diagnosing congenital malformations of the urinary system.

Along with determining the amount of amniotic fluid, it is also important to evaluate their qualitative composition. Ultrasound scanning in real time allows you to clearly visualize the presence of free-floating small echo positive particles, which in most cases are detected near the end of pregnancy. When using high-resolution ultrasound devices, these particles can be visualized already from the beginning of the second trimester of pregnancy and are not a sign of impaired fetal activity during these periods. The particles detected by ultrasound examination in the amniotic fluid are the exfoliated epithelium and elements of the cheese-like lubrication of the fetus. According to a number of authors, visualization of a large number of free-floating small echopositive particles in amniotic fluid is an additional echography criterion for the maturity of fetal lungs in the third trimester of pregnancy. In full-term pregnancy, the degree of

acoustic density of amniotic fluid is in a wide range, sometimes reaching high values.

Conclusions. The conducted studies strongly indicate the need for a correct assessment of the amount of amniotic fluid in pregnant women in order to exclude the causes of violations of the amount of amniotic fluid such as fetoplacental dysfunction, fetal pathology, placental pathology, extra genital pathology of the mother.

Литература

1. Зубкова, М. В. Клинико-генетическая характеристика маловодия и многоводия: Автореф. дис. ...канд. мед. наук. – М., 2007. – 21 с.
2. Клинико-морфологическая характеристика фетоплацентарного комплекса при много- и маловодии инфекционного генеза / О. А. Пустотина [и др.]. // Акушерство и гинекология. – 2007. – № 3. – С. 42–6.
3. Многоводие: диагностика и лечение / Н. М. Побединский [и др.]. // Акушерство и гинекология. – 2004. – № 1. – С. 7–10.
4. Ушинская, Е. К. Современное представление о многоводии инфекционного генеза: Автореф. дис. ... канд. мед. наук. – М., 2004. – 19 с.
5. Malyar, V. V. Pathogenetic mechanisms of moderate idiopathic polyhydramnios and ways of its correction // The Pharma Innovation Journal. – 2015. – Vol.4(6). – С. 22–4.

References

1. Zubkova M. V. *Ed* (2007) *Cliniko-geneticheskaja harakteristika malovodiiia i mnogovodiiia. Avtoreferat dissertacii na soiskanie uchenoj stepeni kandidata medicinskih nauk.* Moskva.pp. 1–21 (in Russian).
2. Pustotina O.A., Bubnova N.I., Ezhova L.S., Mladkovskaya T.B. (2007) *Cliniko-morfologicheskaja harakteristika fetoplacentarnogo kompleksa pri mnogo- i malovodii infekcionnogo geneza. Akusherstvo i ginekologija.* Vol. 3. pp. 42–6 (in Russian).
3. Pobedinskii N.M., Botvin M.A., Kiriushchenkov A.P. (2004) *Mnogovodie: diagnostika i lechenie. Akusherstvo i ginekologija.* Vol. 1. pp. 7–10 (in Russian).
4. Ushinskaia E.K. *Ed* (2004) *Sovremenny`e predstavlenie o mnogovodii infekcionnogo geneza. Avtoreferat dissertacii na soiskanie uchenoj stepeni kandidata medicinskih nauk.* Moskva.pp. 1–19 (in Russian).
5. Malyar V.V.. (2015). Pathogenetic mechanisms of moderate idiopathic polyhydramnios and ways of its correction. *The Pharma Innovation Journal.* Vol.4(6). pp. 22–4 (in English).

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