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Pathogenetic mechanisms of moderate idiopathic polyhydramnios and ways of its correction

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Abstract

As a result of performed studies it was determined that in the basis of the moderate idiopathic polyhydramnios development there are two pathogenic mechanisms: violation of gestational transformation of endometrial part of spiral arteries or alteration of the hydration of pregnant woman's organism, which are closely associated with the structural components of fetal membranes.

Keywords: polyhydramnios, gestational transformation, osmolarity.

1. Introduction

One of the most significant complications of pregnancy and childbirth in terms of prognosis is the idiopathic pathology of amniotic environment, in particular, polyhydramnios^[1, 2, 3]. In the structure of inevitable losses perinatal mortality reaches 30-32%^[2, 8]. The volume of amniotic fluid, intensity of its exchange, composition and properties are important in fetal life support^[4, 7, 9].

We know that a complete renewal of amniotic fluid is normally every 3 hours, and the exchange of amniotic ingredients during 5 days^[1, 3, 7].

Reducing or increasing of amniotic fluid volume indicates placental pathology in the fetoplacental system^[2, 3, 10].

Of particular note is the fact that more than 60% of the causes of amniotic environment pathology remain unclarified^[1, 3].

Mechanisms of idiopathic polyhydramnios are not fully established even today, although it is known that a significant role in the metabolism of amniotic fluid is owned by fetal membranes, including structures of decidua^[3, 7]. There is no single approach to the prevention and treatment of this disorder.

Taking into account the above said it is important to study further pathogenetic mechanisms of idiopathic polyhydramnios and improvement of existing and development of the new technologies of pregnancy management and labour in hydramnion.

2. The Aim of Research

The aim of this study is to establish the main mechanisms of moderate idiopathic hydramnion and to improve diagnostic and therapeutic measures to reduce perinatal pathology.

2.1. Materials and Methods

Group of observation was composed of 50 pregnant women who during the 30th-32nd weeks of gestational period were diagnosed mild idiopathic polyhydramnios. Polyhydramnios was revealed on the basis of the identification of diagnostic features during dynamic sonographic observation with the help of camera “Toshiba” model SAL – 38 AS (Japan).

For standardization of determining of amniotic fluid amount, amniotic index (AI) was calculated by the method of S. Phalan *et al.* (1987). If AI was within the confidence interval (CI) from 20 cm to 24 cm the diagnosis of moderate idiopathic polyhydramnios was made according to the classification of E.F. Magann (1995)^[13, 14].

The evaluation of blood flow velocity curves (BFVC) was performed by determination of systolic diastolic ratio (S/D), pulsation index (PI) and resistance index (RI)^[10].

With the help of fetal monitor Sonicaid Team Care the registration of cardiocogram and hysteroogram was performed in semi-Fowler's position for 20 minutes on the tape that was moving at a speed of 1 cm/min. In the analysis of the CTG first of all, the basal heart rate (BCHSS) of the fetus, oscillations, quantity, amplitude, and duration of accelerations and decelerations were taken into account.

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Study of fetal breathing movements (FBM) was performed in m-mode in longitudinal and cross sections for 30 minutes of ultrasound examination. Translational fetal breathing movements were distinguished: regular episodic ones on the type of inhale – exhale (usual), double, triple (with a delay of inspiration), which were characterized by the predominance of exhalation on inhalation with expressed amplitude of the diaphragm movements. The length of episodes of permanent FBM and interval between them were determined [4].

Assessment of pregnant's organism hydration was performed on the basis of maternal plasma osmolarity, the oncotic pressure, concentration of Na⁺ ions, hematocrit, urine specific gravity, definition of which were performed by conventional methods.

Histological examination determined the following structural elements of fetal membranes: amniotic epithelium, compact and eosinophilic layer of cytotrophoblast, decidual layer (stroma, uterine glands, blood vessels).

The effectiveness of therapeutic-preventive measures was carried out based on obstetric and perinatal outcomes of delivery. Statistic processing of the study results was performed using modern methods of variation statistics with the help of standard statistical analysis software Microsoft Excel 5.0. The differences in $p \leq 0.05$ were believed reliable (95.5%).

3. Results

As a result of dopplerometric study it was determined that in 33 (66.0%) pregnant women with moderate idiopathic polyhydramnios (AI: 18.9±5.1 cm) on the background of the thick decidua (2.97±1.12 mm) with the reduced echogenicity and vascularity (3-4/cm² coloured spots) stertorous formation of low-resistant blood flow was observed in the microcirculatory bed of vascular decidua plate. This is evidenced by the growth of systolic-diastolic ratio (S/D) and vascular resistance indexes (RI and PI). Thus, the index of S/D was 1.88±0.17, RI – 0.45±0.03, PI – 0.64±0.05 vs 1.83±0.18, 0.40±0.06, 0.58±0.04 relative to the control group ($P < 0.05$).

In these cases, in 48.0% were morphologically observed a significant decrease of relative area of stroma and especially vessels in the decidua plate. On the background of the relative area decrease of decidual vascular plate an increase 7 times of the area of vascularized cytotrophoblast, a compact layer in 1.4 times, and the appearance of folding and extra amniotic epithelial outgrowths were observed (Fig. 1).

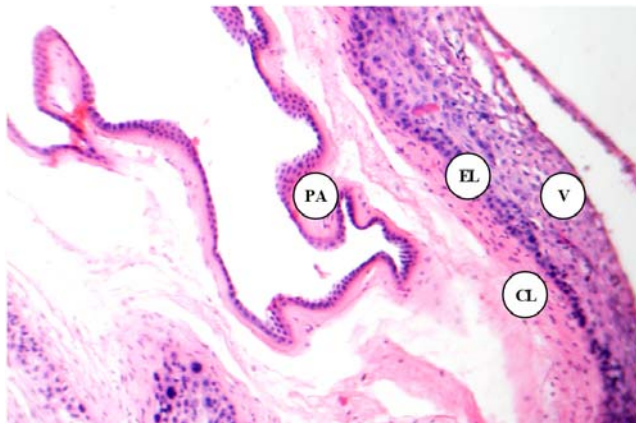


Fig 1: Processes of amniotic epithelium and sharp thickening of compact layer. Staining – by hematoxylin-eosin. Magnification: eyeglass×20, objective×10. PA – process of amniotic epithelium, CL – compact layer, EL – eosinophilic layer, V – vessel.

Our studies indicate that the major mechanism of mild idiopathic polyhydramnios development with the increased resistance of blood flow in the vessels of the decidua in the basis of which are the structural changes – is the increase of the compact layer thickness, reduction of the vascular network, vacuolization of cytotrophoblast in unchanged hydration during pregnancy. This is confirmed by the maternal plasma osmolarity (284.4±9.6 mOsm/kg H₂O versus 287.2±12.9 mOsm/kg H₂O, $P > 0.05$), the concentration of ions Na⁺ (126.3±8.4 mmol/l versus 125.1±5.3 mmol/l, $P > 0.05$), hematocrit (0.30±0.01 l/l versus 0.31±0.02 l/l, $P > 0.05$) and urine specific gravity (1.011±0.03 versus 1.009±0.002, $P > 0.05$).

Antenatal monitoring of fetal heart rate (HR) showed that in these cases against the background of normal spontaneous activity and slightly increased uterine tone the state of fetus was compensated. Basal heart rate (BCHSS) of the fetus was 152.7±0.8 beats/min. There was an undulating type of fetal heart rate variability (amplitude of oscillations was – 5.5±0.4 beats/min, frequency – 6.1±0.6 beats/min).

In response to a spontaneous uterine reduction fetus reacted with early accelerations (amplitude – 26.8±2.1 beats/min, duration – 57.6±3.8 s) or light decelerations (amplitude – 15.3±0.6 beats/min, duration – 47.1±2.8 s). Respiratory fetal movements (RFM) had sporadic character according to the type inhale – exhale (normal) with the predominance of expiratory component that contributes to pulmonary outflow of fluid [10].

Study of vascular resistance index in the decidual vessels showed that 17 (34.0%) were observed low-resistant blood flow (S/D – 1.85±0.16, RI – 0.42±0.02, PI – 0.61±0.04), which is not significantly different from the control group (S/D – 1.83±0.18, RI – 0.40±0.06, PI – 0.58±0.04, $P > 0.05$) respectively.

In these cases, according to our data, the main mechanism of mild idiopathic polyhydramnios is the reduced hydration of the pregnant. Thus, the average maternal plasma osmolarity was 264.2±9.5 mOsm/kg H₂O, vs 287.2±12.9 mOsm/kg H₂O in physiological pregnancy ($P > 0.05$).

In most cases (64.0%) threat of premature birth was noted, as evidenced by increased uterine tone and the availability of high-amplitude uterine cycles which had the form of disorganized that conditioned the development of compensated fetal distress. The characteristic features of CTG thus were the reduction of the heart rate variability (amplitude oscillations – 4.7±0.8 beats/min, frequency – 4.5±0.6 beats/min), the appearance of a few accelerations (1.6±0.6 during 20 min. observation). The amplitude of the last ones was 18.3±1.4 beats/min, duration – 21.6±1.7 s. There was observed mainly undulating type of fetal heart rate variability. Respiratory fetal movements (RFM) had sporadic character according to the type inhale – exhale with the predominance of inspiratory component. Duration of episode RFP was 37.5±5.4 s, the interval between the RFM did not exceed 6 s. There were also observed double, triple and palpebrate movements that differed by brief returns to the inspiratory phase during the expiratory phase.

These data indicate that in the case of low resistant blood flow and the reduction of the maternal plasma osmolarity, major pathogenetic mechanism of idiopathic polyhydramnios is to change oncotic pressure (5099.1±147.5 mm Hg vs 5542.9±187.8 mm Hg in physiological pregnancy, $p < 0.05$).

High frequency of compensated fetal distress in these cases was both due to a low maternal plasma osmolarity, and also

due to long threat of preterm labor.

Based on the foregoing, the scheme of complex treatment of moderate idiopathic polyhydramnios against the backdrop of high resistant blood flow in the pool of decidual blood vessels included oktovehin (200 mg intraorally for 3-4 weeks), which activates angiogenesis, improves microcirculation and metabolic processes [6].

In cases of low resistant blood flow in the microcirculatory bed of decidua and reduced plasma osmolarity of mother with the aim to restore oncotic pressure we had used 20% albumin solution in the mode of the low rate intravenous infusion controlled by maternal plasma osmolarity and oncotic pressure [11].

Based on the received results it was determined that timely taken adequate therapeutic-preventive measures made it possible to ensure the reduction of perinatal mortality in 2 times.

4. Conclusions

1. The basic mechanisms of moderate idiopathic polyhydramnios should be considered the incomplete transformation of endometrial segments of the uterine spiral arteries or alteration of maternal plasma osmolarity on the background of the increased activity of the uterus.
2. Determination of resistance indexes in the decidual bloodstream and maternal plasma osmolarity can be a means of early diagnosis of idiopathic polyhydramnios and selection of differentiated therapy.
3. Registration of sporadic RFM character type inhale – exhale with the predominance of inspiratory component indicates the high possibility of aspiration syndrome in the fetus after birth.
4. The main principles of therapy in case of moderate idiopathic polyhydramnios should be: a differentiated approach, taking into account indicators of vascular resistance, blood plasma osmolarity, CTG, type of respiratory movements of the fetus and spontaneous activity of the uterus.

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