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Characteristics of the fetus in pregnant women with thyroid diseases

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ABSTRACT

BACKGROUND: Thyroid dysfunction can cause adverse effects on metabolic changes in the body and disturbances during the gestational period and intrauterine development of the fetus. In developing prevention methods, it is crucial to objectively substantiate and re-confirm theoretical assumptions.

AIM: To assess the functional state of the fetus in pregnant women with certain thyroid diseases.

MATERIAL AND METHODS: The results of instrumental studies in 118 pregnant women, who were divided into three clinical groups, were analyzed. Group 1 (44 people) consisted of patients with autoimmune thyroiditis (AIT). Group 2 (52 people) included patients with diffuse toxic goiter. Group 3 (control group) consisted of 22 pregnant women who had no somatic pathology and gestational complications. Thyroid diseases were diagnosed by an endocrinologist during a consultation in the third trimester of pregnancy based on laboratory and instrumental data. The functional state of the fetus was assessed using the total result of cardiotocographic and ultrasound studies, for which Partecust (Siemens, Germany) and Aloka-1700 (Hitachi, Japan) were used. Statistical processing of clinical material was performed using StatSoft software (Russia).

RESULTS: A comprehensive assessment of the adaptive capabilities of the fetus showed changes in its functional state in pregnant women with thyroid pathology. Prognostically, the most crucial characteristic in pregnant women with autoimmune thyroiditis and diffuse toxic goiter is a decrease to 0–1 point in indicators that determine motor activity and tone, respiratory movements, and reaction to a non-stress test. Among patients with autoimmune thyroiditis and diffuse toxic goiter, a high assessment of the biophysical profile of the fetus occurred 4 and 3.4 times, respectively, less often than among women with a normal pregnancy (among pregnant women without somatic pathology and gestational complications).

CONCLUSION: Disturbances in thyroid gland function during the gestational period can have an adverse effect on the development of the fetus, which is a theoretical basis for the development of treatment and preventive methods aimed at improving perinatal outcomes in this group of patients.

Keywords: pregnant women with thyroid diseases; cardiotocography; fetal biophysical profile.

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К вопросу об особенностях состояния плода у беременных с заболеваниями щитовидной железы

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АННОТАЦИЯ

Обоснование. Нарушения функции щитовидной железы могут оказывать неблагоприятное влияние на метаболические изменения в организме, нарушения течения гестационного периода и внутриутробное развитие плода. Для разработки методов профилактики указанных процессов важным является объективное обоснование подходов к этой проблеме и повторное подтверждение теоретических предположений.

Цель исследования. Оценить функциональное состояние плода у беременных с некоторыми заболеваниями щитовидной железы.

Материал и методы. Проанализированы результаты инструментальных исследований у 118 беременных, которых разделили на 3 клинические группы: 1-я (n=44) — пациентки с аутоиммунным тиреоидитом; 2-я (n=52) — пациентки с диффузным токсическим зобом; 3-я, контрольная (n=22) — пациентки без соматической патологии и гестационных осложнений. Диагноз заболеваний щитовидной железы ставил врач-эндокринолог при консультативном приёме в третьем триместре беременности на основании лабораторно-инструментальных данных. Функциональное состояние плода оценивали по суммарному результату кардиотокографического и ультразвукового исследований, для чего использовали аппараты «Partecust» («Siemens», Германия) и «Aloka-1700» («Hitachi», Япония). Статистическую обработку клинического материала осуществляли с помощью программного обеспечения «StatSoft» (Россия).

Результаты. Комплексная оценка адаптационных возможностей плода показала изменения его функционального состояния у беременных с патологией щитовидной железы. Прогностически наиболее важным у беременных с аутоиммунным тиреоидитом и диффузным токсическим зобом является снижение показателей, определяющих его двигательную активность и тонус, дыхательные движения, а также реакцию на нестрессовый тест. У пациенток с аутоиммунным тиреоидитом и диффузным токсическим зобом высокая оценка биофизического профиля плода встречалась соответственно в 4,0 и 3,4 раза реже, чем у беременных без соматической патологии и гестационных осложнений.

Заключение. Нарушения функции щитовидной железы в гестационном периоде могут оказывать неблагоприятное влияние на развитие плода, что является теоретическим обоснованием для разработки эффективных лечебно-профилактических методов, направленных на улучшение перинатальных исходов у данной категории пациенток.

Ключевые слова: беременные с заболеваниями щитовидной железы; кардиотокография; биофизический профиль плода.

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关于患有甲状腺疾病的孕妇胎儿状况的特征问题

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摘要

论证。 甲状腺功能紊乱会对体内代谢变化、妊娠期病程紊乱和胎儿宫内发育产生不利影响。为了制定预防这些过程的方法，必须客观地论证解决这一问题的方法，并重新确认理论假设。

目的。 评估患有某些甲状腺疾病的孕妇体内胎儿的功能状态。

材料和方法。 我们对118例孕妇的仪器检查结果进行了分析，这些孕妇被分为3个临床组：第1组（44人）包括自身免疫性甲状腺炎患者；第2组（52人）包括弥漫性毒性甲状腺肿患者；第3组，对照组（22人）包括无躯体病变和妊娠并发症的患者。甲状腺疾病的诊断是由内分泌学家在妊娠晚期会诊时根据实验室和仪器数据做出的。胎儿的功能状态通过使用 Partecust（德国 Siemens 公司）和 Aloka-1700（日本 Hitachi 公司）进行的心动图和超声波检查的综合结果进行评估。使用 StatSoft 软件（俄罗斯）对临床材料进行统计处理。

结果。 对胎儿适应能力的综合评估显示，患有甲状腺疾病的孕妇体内胎儿的功能状态发生了变化。对患有自身免疫性甲状腺炎和弥漫性毒性甲状腺肿的孕妇来说，最重要的预后指标是决定胎儿运动活性和张力、呼吸运动以及对非应激试验反应的指标的下降。在自身免疫性甲状腺炎和弥漫性毒性甲状腺肿患者中，胎儿生物物理特征评分高的发生率分别比无躯体病理和妊娠并发症的孕妇低4.0倍和3.4倍。

结论。 妊娠期甲状腺疾病会对胎儿发育产生不利影响，这为开发旨在改善此类患者围产期预后的有效治疗和预防方法提供了理论依据。

关键词： 患有甲状腺疾病的孕妇；心动图；胎儿生物物理特征。

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INTRODUCTION

The incidence of thyroid diseases (autoimmune thyroiditis and diffuse toxic goiter) tends to increase worldwide [1–4]. Endocrine changes associated with thyroid dysfunction are more common in women than in men [1, 5].

It should be noted that during pregnancy a woman's body is exposed to increased endocrine organs stress due to hormonal changes and formation of fetoplacental complex [1, 3, 5].

Thyroid hormones such as thyroxine (T₄) and triiodothyronine (T₃) are pivotal for both intrauterine fetal development and the child's subsequent extrauterine life [2, 4, 6].

Both low and high levels of thyroid hormones are known to be capable of triggering spontaneous abortion, premature birth, low birth weight, hypoxic and ischemic changes in the brain, etc. [1, 3–6]. Therefore, it is important to continue studying the influence of thyroid function on intrauterine fetal status [2–4].

AIM

The aim of the study was to evaluate the functional status of a fetus in pregnant women with certain thyroid disorders.

MATERIALS AND METHODS

The results of functional fetal assessment were evaluated in 118 pregnant women, who were divided into 3 groups: group 1 ($n=44$) included patients with autoimmune thyroiditis; group 2 ($n=52$) patients with diffuse toxic goiter; control group 3 ($n=22$) patients without physical diseases and gestational complications. Thyroid disease was diagnosed by an endocrinologist during a third trimester consultation based on laboratory and instrumental data. It should be noted that all patients with thyroid diseases first consulted a gynecologist for pregnancy only in the third trimester. Until then, patients with these thyroid disorders had not been followed by an obstetrician/gynecologist or a specialist.

For functional assessment of the fetal status, cardiotocographic curves and ultrasound results obtained at 32–40 weeks of gestation were evaluated.

Cardiotocography (CTG) was performed using a Partecust cardiomonitor (Siemens, Germany) to determine

the fetal heart rate, rate variability, fetal movement count, and maximum change in heart rate during movement. CTG data were used for integrated assessment of the fetal status. Computer analysis of CTG was performed using a Fisher score. An International Federation of Gynecology and Obstetrics (FIGO) scale was used for grading.

A fetal biophysical profile was determined using a 6-parameter approach including a non-stress test and ultrasound parameters obtained using an Aloka-1700 system (Hitachi, Japan), such as fetal breathing movements, motor activity and tone, amniotic fluid volume, and placental maturity. Each parameter was scored from 0 to 2.

StatSoft (Russia) was used for statistical processing of the evaluated clinical material. Means and standard deviations were calculated. Student's t-test was used to determine the reliability of the values between the groups compared.

RESULTS AND DISCUSSION

As shown in Table 1, basal fetal heart rate was not significantly different between groups and averaged 140–147 beats/min. In pregnant women with autoimmune thyroiditis and diffuse toxic goiter, fetal basal heart rate variability was significantly ($p < 0.05$) reduced compared to normal pregnant women.

In addition, the control group had a significantly ($p < 0.05$) higher acceleration amplitude (10.4 ± 0.7 per hour) than pregnant women with autoimmune thyroiditis and diffuse toxic goiter. It should be noted that in 4 patients with autoimmune thyroiditis (9.1%), fetal cardiotocography patterns had a monotonous basal rhythm.

In general, the mean fetal CTG score was significantly ($p < 0.05$) lower in pregnant women with autoimmune thyroiditis and diffuse toxic goiter compared to controls. This suggests chronic fetal hypoxia in patients with thyroid disease.

The instrumental study of fetal reactivity (mobility) during exercise testing in pregnant women is important for a comprehensive assessment of the adaptive fetal capacity. Non-stress testing records a response of the fetal cardiovascular system in response to fetal movements [7]. A good outcome is defined as a positive reactive test with at least 2 fetal heart rate increases of 15 beats/min lasting at least 15 seconds associated with fetal movements [7].

Table 1. Features of fetal cardiotocograms in pregnant women studied ($M \pm m$)

Indicator	Group 1 ($n=44$)	Group 2 ($n=52$)	Group 3 ($n=22$)
Basal rhythm (bpm)	145.0 ± 7.0	148.0 ± 2.0	142.0 ± 7.0
Variability (bpm)	$6.3 \pm 1.4^*$	$7.1 \pm 0.8^*$	11.7 ± 0.9
Accelerations (per 1 hour)	$6.6 \pm 0.8^*$	$8.2 \pm 0.2^*$	10.4 ± 0.7
Cardiotocogram assessment (points)	$6.3 \pm 0.4^*$	$7.3 \pm 0.1^*$	8.3 ± 0.4

* Significance ($p < 0.05$) of differences in indicators compared with values in pregnant women from group 3 (control).

Table 2. Results of non-stress test in pregnant women studied, *n* (%)

Non-stress test	Group 1 (<i>n</i> =44)	Group 2 (<i>n</i> =52)	Group 3 (<i>n</i> =22)
Reactive	32 (72.2*)	38 (73.1*)	21 (95.5)
Questionable	10 (23.8)	10 (19.2)	1 (9.1)
Areactive	2 (4.0)	4 (7.7)	—

* Significance ($p < 0.05$) of differences in indicators compared with values in pregnant women from group 3 (control).

The studies conducted showed that during pregnancy, patients with thyroid dysfunction were significantly ($p < 0.05$) less likely to have a reactive positive non-stress test compared to pregnant women in the control group (Table 2).

Table 3 shows results of assessment of fetal biophysical profile in pregnant women from different groups.

A fetal score of 10–12 was observed in only 6 (13.6%) pregnant women with autoimmune thyroiditis, whereas a high score indicating normal fetal condition was 4 times more common in 54.5% of clinical cases in controls.

In patients with diffuse toxic goiter, a fetal biophysical profile with a high score of 10–12 was recorded in 7 (15.9%) cases, which was also significantly less (3.4 times) than in the control group ($p < 0.05$).

In pregnant women with autoimmune thyroiditis and diffuse toxic goiter, 14 (31.8%) and 20 (38.5%) fetuses in groups 1 and 2, respectively, had a satisfactory score. In 10

(45.5%) cases in the control group, such a fetal score was reported according to the biophysical profile.

A controversial fetal biophysical profile was obtained in 18 (40.9%) and 21 (40.4%) pregnant women with autoimmune thyroiditis and diffuse toxic goiter, respectively. In addition, newborns were more likely (90%) to have Apgar scores of 7/7 or 7/8 and various types of postnatal adjustment disorders in the early neonatal period.

An abnormal fetal biophysical profile was reported in 6 (13.6%) pregnant women with autoimmune thyroiditis and in 4 (7.7%) pregnant women with diffuse toxic goiter. In these clinical situations, pregnant women had premature deliveries and neonates were born with moderate asphyxia and required intensive care in the early neonatal period.

It should be noted that changes in CTG parameters and fetal biophysical profile are objective criteria for assessing intrauterine status [7].

Table 3. Assessment of the biophysical profile of the fetus in compared groups, *n* (%)

Indicators	Points	Group 1 (<i>n</i> =44)	Group 2 (<i>n</i> =52)	Group 3 (<i>n</i> =22)
Fetal breathing movements	2	12 (27.3)	29 (57.7)	21 (95.5)
	1	10 (22.7)	4 (7.7)	1 (4.5)
	0	22 (50.0)	15 (26.9)	—
Fetal tone	2	19 (45.5)	41 (80.8)	21 (95.5)
	1	4 (9.1)	5 (11.5)	1 (4.5)
	0	19 (45.5)	4 (7.7)	—
Fetal motor activity	2	30 (68.2*)	41 (80.8)	21 (95.5)
	1	12 (27.3)	10 (19.2)	1 (4.5)
	0	2 (4.5)	—	—
Stages of placental maturity	2	21 (50.0*)	29 (57.7)	17 (77.3)
	1	16 (36.4)	13 (23.1)	4 (18.2)
	0	6 (13.6)	9 (19.2)	1 (4.5)
Amniotic fluid	2	24 (54.5)	37 (73.1)	21 (95.5)
	1	10 (22.7)	8 (15.4)	1 (4.5)
	0	10 (22.7)	5 (11.5)	—
Non-stress test	2	32 (72.7)	36 (69.2)	19 (86.3)
	1	8 (18.2)	6 (23.1)	2 (9.1)
	0	4 (9.1)	4 (7.7)	1 (4.5)

* Significance ($p < 0.05$) of differences in indicators compared with values in pregnant women from group 3 (control).

Our data confirm the findings of other authors [1–6] that thyroid disease significantly contributes to fetoplacental insufficiency with chronic fetal hypoxia.

In pregnant women with autoimmune thyroiditis and diffuse toxic goiter, changes in respiration, motor function, and muscle tone during fetal instrumental assessment serve as crucial prognostic factors. Non-stress testing is also important in assessing intrauterine fetal status and predicting perinatal outcomes.

CONCLUSION

Our study showed that thyroid dysfunction in pregnant women can negatively affect fetal development. Again, it should be noted that the patients included in this study were not followed by an obstetrician-gynecologist and, for various reasons, did not undergo comprehensive examination until the third trimester. It is possible that early detection of endocrine disorders and timely initiation of treatment to normalize thyroid function may be beneficial to a fetoplacental complex and may prevent chronic fetal hypoxia. This study may serve as a theoretical basis for the development of preventive and therapeutic options

to improve perinatal outcomes in pregnant women with thyroid disease.

ADDITIONAL INFO

Authors' contribution. All authors confirm that their authorship meets the international ICMJE criteria (all authors made a substantial contribution to the conception of the work, acquisition, analysis, interpretation of data for the work, drafting and revising the work, final approval of the version to be published and agree to be accountable for all aspects of the work).

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Ethical approval. The study was carried out as part of a comprehensive work at the Department of Obstetrics and Gynecology of the Faculty of Medicine of the Astrakhan State Medical University of the Ministry of Health of the Russian Federation and its implementation was agreed upon by the expert commission of this higher educational institution (extract from the protocol dated 07/26/2021 No. 130).

Consent for publication. All patients participating in the study signed the necessary documents on voluntary informed consent to participate in the study and the publication of their medical data.

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