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Risk Factors for Postpartum Thyroid Dysfunction in Euthyroid Women Prior to Pregnancy

Boyan I. Nonchev^{1,2}, Antoaneta V. Argatska^{1,2}, Blagovest K. Pehlivanov³, Maria M. Orbetzova^{1,2}

¹ Section of Endocrinology, Department of Internal Diseases, Faculty of Medicine, Medical University of Plovdiv, Plovdiv, Bulgaria

² Clinic of Endocrinology and Metabolic Diseases, St. George University Hospital, Plovdiv, Bulgaria

³ Department of Midwifery cares, Faculty of Public Health, Medical University of Plovdiv, Plovdiv, Bulgaria

Correspondence:

Antoaneta V. Argatska, Section of Endocrinology, Department of Internal Diseases, Faculty of Medicine, Medical University of Plovdiv, 15a Vassil Aprilov Blvd., 4002 Plovdiv, Bulgaria
E-mail: lakalma@abv.bg
Tel: +359 898 411 049

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Background: Thyroid dysfunction is common during the postpartum and the predisposing factors for its development are considered specific for the population studied. The aim of this study was to evaluate the risk factors for the occurrence of postpartum thyroid dysfunction (PPTD) in euthyroid women prior to pregnancy.

Materials and methods: Forty-five women with PPTD and 55 age-matched euthyroid postpartum women from Plovdiv, Bulgaria were included in the study. TSH, FT4, FT3, TPOAb, TgAb, TRAb were measured and ultrasound evaluation of the thyroid was performed in the first trimester of pregnancy and during the postpartum.

Results: The study found higher risk of developing PPTD in women with family history of thyroid disease (OR 4.42; 95% CI 1.87,10.43), smokers (OR 4.01; 95% CI 1.72,9.35), personal history of autoimmune thyroid disease (OR 5.37; 95% CI 1.15,28.53), positive TPOAb (OR 18.12; 95% CI 4.93,66.65) and thyroid US hypoechogenicity during early pregnancy (OR 6.39; 95% CI 2.53,16.12) and those who needed levothyroxine during pregnancy (OR 3.69; 95% CI 1.28,10.61). BMI before pregnancy was significantly lower in women with PPTD than in euthyroid postpartum women (22.80 ± 0.55 vs 26.25 ± 0.97 , $p=0.013$). The multivariate logistic regression analysis identified as most important independent risk factors for PPTD occurrence the TPOAb positivity during early pregnancy, family history of thyroid disease, smoking and lower BMI before pregnancy.

Conclusion: Our data suggest that in the population studied several factors are associated with an increased risk of PPTD and screening for thyroid disorders among those women can be beneficial.

BACKGROUND

Postpartum thyroiditis (PPT) presents either with thyrotoxicosis or hypothyroidism within the first year after delivery with a variable prevalence in different geographic regions.^{1,2} Many factors known to affect thyroid function have been studied and the evidence regarding their predictive value is abundant, but still remains inconclusive. At present, universal screening for thyroid dysfunction either during or after pregnancy is not generally recommended.^{1,3} Therefore further studies are needed to elucidate the risk factors for the development of postpartum thyroid dysfunction (PPTD) and to contribute to the promotion of appropriate cost-effective screening programs suited for the region and population studied.

AIM

The aim of this study was to evaluate the risk factors for the occurrence of thyroid dysfunction during the postpartum period in euthyroid women prior to pregnancy.

MATERIALS AND METHODS

One hundred and forty-one Caucasian first-trimester pregnant women from Plovdiv, Bulgaria were referred to the Clinic of Endocrinology at St. George University Hospital in Plovdiv over a 3-year period (2012-2014) for thyroid function screening. They were followed during the first year after delivery for assessment of thyroid function. Thirty-one women who had been taking either levothyroxine or antithy-

roid drugs for the past 12 months before pregnancy were excluded from the study as well as 8 women who did not return for follow-up after delivery. Two women who presented with high levels of thyroid hormones along with unsuppressed TSH were also excluded and later were diagnosed with thyroid hormone resistance syndrome. The study included the rest 100 women of whom 45 developed PPTD and 55 euthyroid postpartum euthyroid women as a control group. All women were in euthyroid state before pregnancy without any thyroid treatment and had no concomitant diseases or conditions that could interfere with the thyroid function tests.

The study complied with the recommendations of the Declaration of Helsinki and was approved by the local Ethic Committee at the Medical University of Plovdiv. The general purpose of the study and its design were explained to the patients and all participants signed a written informed consent form.

Serum levels of thyroid stimulating hormone (TSH), free triiodothyronine (FT3), free thyroxine (FT4), thyroid peroxidase antibodies (TPOAb) and thyroglobulin antibodies (TgAb) were measured using chemiluminescence immunoassay (Beckman Coulter, Access2). Measurement units and reference ranges were as follows: TSH, 0.34 – 5.60 mIU/l; FT4, 7.86 – 14.40 pmol/l; FT3, 3.60 – 6.00 pmol/l. TPOAb levels were considered positive if greater than 9 IU/ml (normal range 0 – 9 IU/ml) and TgAb – greater than 4 IU/ml (normal range 0 – 4 IU/ml).

Ultrasound examination was performed by an experienced clinician both during pregnancy and during the puerperal period using 5-13 MHz linear transducer (Siemens Acuson U300). Thyroid volume was calculated for each lobe individually using Brunn's formula: $V \text{ (ml)} = 0.479 \times \text{length} \times \text{depth} \times \text{width}$.⁴ Thyroid parenchyma hypoechogenicity was determined by a 4-grade scale compared to the echoic pattern of the prethyroid muscles. For the purpose of the study thyroid echogenicity was classified into two groups: normoechoic (grade 0) and hypoechoic (grades 1, 2 and 3).

Clinical examination, thyroid function tests, serum thyroid auto-antibody measurement and ultrasound evaluation of the thyroid were performed between 6 and 14 week of gestation and between 2 and 7 months after delivery. Personal and medical information recorded included height and weight before pregnancy, family history of thyroid disease, tobacco use, personal history of autoimmune thyroid disease (autoimmune thyroiditis, Grave's disease or

previous episode of PPT), number of pregnancies prior to current gestation, history of infertility and miscarriages, presence of concomitant autoimmune disorders, blood group and rhesus factor. Levothyroxine (LT4) was initiated in women with TSH levels above trimester-specific ranges at the initial visit ($\text{TSH} \geq 2.5 \text{ mIU/l}$ during the first trimester).¹ After parturition women on supplementation therapy were advised to discontinue treatment. Clinical examination was performed and information regarding the course of pregnancy was obtained.

Postpartum women were considered euthyroid when TSH was within 0.34-4.2 mIU/l after delivery; thyrotoxicosis was defined as suppressed levels of TSH ($< 0.34 \text{ mIU/l}$) and hypothyroidism - elevated TSH ($> 4.20 \text{ mIU/l}$) during the postpartum.

The statistical package for the social sciences (SPSS, Inc., Chicago, IL) version 17.0 was used to analyze the collected data. Descriptive data were presented as mean $\pm$ standard error of the mean and/or percentage. Parametric (Student's t-test) and non-parametric (Mann-Whitney U-test) were applied. Categorical variables were analysed using Fisher's exact test. Univariate and multivariate logistic regression were used to identify factors associated with the risk for PPTD development. $P < 0.05$ was considered significant.

RESULTS

PPTD presenting with thyrotoxicosis occurred in 26 (57.8%) of the women studied 4.77 ± 0.33 months postpartum and the other 19 (42.2%) were afflicted with hypothyroidism 6.26 ± 0.46 months after delivery. Characteristics of the studied women are presented in **Table 1**.

At follow-up at the end of the postpartum period thyroid function assessment showed that 31.1% of the women had restored their euthyroid state (17.8% had experienced transient thyrotoxicosis and 13.3% - transient hypothyroidism). Biphasic course of the disease with thyrotoxic phase followed by hypothyroidism was found in 28.9% of the women with PPTD. Persistent thyrotoxicosis was found in 11.1%, and persistent hypothyroidism – in 28.9% of the patients.

33 (73.3%) of the women experienced overt form of thyroid dysfunction while in the other 12 (26.7%) thyroid functional abnormalities were present without clinically overt signs and symptoms and the diagnosis was made on the basis of hormonal results. Thyroid antibodies were present in the majority of women (80%) whereas in 9 (20%)

Table 1. Characteristics of the studied women

		PPTD n=45	Euthyroid n=55
		n (%)	n (%)
Age (years)	mean±SE range	30.07±0.70 18-37	29.95±0.67 18-39
BMI before pregnancy	mean±SE range	22.80±0.55 16.4-31.3	26.25±0.97 18.6-56.8
Family history of AITD			
	no	19 (42.2)	42 (76.4)
	yes	26 (57.8)	13 (23.6)
Personal history of AITD			
	no	37 (82.2)	53 (96.4)
	yes	8 (17.8)	2 (3.6)
Personal history of other AID			
	no	39 (86.7)	44 (80)
	yes	6 (13.3)	11 (20)
Previous pregnancies			
	no	17 (37.8)	30 (54.5)
	yes	28 (62.2)	25 (45.5)
Smoking			
	no	19 (42.2)	42 (74.5)
	yes	26 (57.8)	14 (25.5)
Blood group			
	0	10 (22.2)	17 (30.9)
	A	20 (44.4)	19 (34.5)
	B	9 (20)	9 (16.4)
	AB	6 (13.3)	10 (18.2)
Rh factor			
	positive	41 (91.1)	48 (87.3)
	negative	4 (8.9)	7 (12.7)
Obstetric complications			
	no	32 (71.1)	31 (56.4)
	yes	13 (28.9)	24 (43.6)
Infertility history			
	no	30 (66.7)	30 (54.5)
	yes	15 (33.3)	25 (45.5)

AITD – autoimmune thyroid disease

AID – autoimmune disease

of the patients with PPTD both TPOAb and TgAb titers were negative. US examination revealed hypoechoic pattern of thyroid parenchyma in 95.6% of the patients with hormonal abnormalities and only in 4.4% of the women PPTD developed without morphological changes.

Univariate analysis estimated a significantly higher risk for PPTD among women who were positive for TPOAb, had hypoechoic US pattern of the thyroid during pregnancy, women with family and personal history of autoimmune thyroid disease,

smokers and women who were on levothyroxine treatment during pregnancy. The analysis also found that women who developed PPTD had significantly lower BMI before pregnancy compared to euthyroid postpartum women (**Table 2**). The sensitivity and specificity of the predictive model were 75.56% and 87.27%, respectively.

None of the following parameters was related to the development of PPTD: age ($p=0.901$); parity ($p=0.110$); history of infertility, including spontaneous abortion ($p=0.305$); history of other autoim-

Table 2. Factors associated with increased risk of developing PPTD

		Euthyroid	PPTD	OR [95%CI]	P
History of AITD	yes	2	8	5.37	0.040
	no	53	37	[1.15,28.53]	
Family history of AITD	yes	13	26	4.42	0.001
	no	42	19	[1.87,10.43]	
Smoking	yes	14	26	4.01	0.002
	no	41	19	[1.72,9.35]	
TPOAb in the 1st trimester	positive	3	23	18.12	0.000
	negative	52	22	[4.93,66.65]	
Thyroid US in the 1st trimester	normal	46	20	6.39	0.000
	hypoechoic	9	25	[2.53,16.12]	
LT4 during pregnancy	yes	6	14	3.69	0.022
	no	49	31	[1.28,10.61]	
BMI before pregnancy					
Mann-Whitney U-test	mean±SE	26.25±0.97	22.80±0.55		0.013

Table 3. Independent predictors of PPTD

Factors	Standardized coefficient	Standard error	Exp. (B)	Sig.	95%CI
TPOAb+	2.202	0.894	9.047	0.014	1.568, 52.203
Family history of AITD	1.281	0.559	3.600	0.022	1.203, 10.771
Smoking	1.281	0.559	3.600	0.022	1.158, 11.200
BMI	-0.151	0.067	0.860	0.024	0.754, 0.981

mune diseases ($p=0.432$); blood group ($p=0.602$) and rhesus factor ($p=0.750$); TSH ($p=0.081$), thyroid volume ($p=0.055$) and positive titers of TgAb in the first trimester of pregnancy ($p=0.222$).

A multifactorial analysis was performed using the variables defined as risk factors for developing PPTD. The logistic regression analysis selected as most important independent risk factors for PPTD the TPOAb positivity in early pregnancy, family history of thyroid disease, smoking and BMI (**Table 3**).

DISCUSSION

PPTD is a relatively common finding during the first year after delivery in a significant part of the affected women. The estimated high prevalence of

the disease, the considerable morbidity related to it and its occurrence in subsequent pregnancies has prompted a discussion about early identification of women at increased risk of thyroid disease in order to ensure proper treatment and to prevent further complications.

At present TPOAb is generally recommended as an useful prognostic factor for development of PPTD⁵⁻⁹ and particularly first-trimester TPOAb titers showing positive predictive value in assessing the risk of postpartum thyroid disorders.¹⁰ In our study the presence of TPOAb in early pregnancy proved to be a significant prognostic factor for the occurrence of PPTD. However, PPTD has been observed in a small percentage of women in the absence of thyroid antibodies.^{11,12} A small but considerable part of the studied women developed thyroid dys-

function without laboratory signs of autoimmune thyroiditis suggesting that in populations where postpartum thyroid disorders occur in the absence of thyroid antibodies the value of this parameter as a screening marker may be questionable.

Some authors confirm that thyroid hypoechogenicity predates the hormonal changes in PPTD but did not prove to be a reliable prognostic factor for its development.¹³ Others suggest that structural and echogenic changes might be of predictive value for the development of PPTD¹⁴ especially when TPOAb are borderline during pregnancy.¹⁵ Furthermore, TPOAb positivity in pregnant women is not invariably associated with prominent autoimmune pattern on thyroid US.¹⁶ Thus, thyroid US changes in early pregnancy may be considered an independent risk factor for development of postpartum thyroid disorders.

Women with personal history of thyroid disorders are at a higher risk of experiencing an episode of PPTD during the postpartum period.^{17,18} Consequently, a history of autoimmune thyroid disorder particularly Hashimoto thyroiditis, Graves' disease or previous PPT is a predisposing factor leading to a higher risk of developing PPTD (56.1-68%; 44% and 70% respectively).¹⁹⁻²² In accordance with this data, we also found an increased incidence of PPTD among women with AITD antedating pregnancy.

PPTD occurs more commonly among women with family history of thyroid disease.^{1,3,18} The results of our study confirm that having a first- or second degree relative with AITD is associated with a significant risk for PPTD. Although some authors found no significant correlation between the occurrence of PPTD and family history of thyroid disease²³, a positive history of thyroid disease in the family is widely considered a risk factor for its development.

Smoking is associated with an increased risk of developing Hashimoto thyroiditis as well as postpartum thyroiditis.²⁴ In our series women who had ever smoked were more likely to experience an episode of postpartum thyroid dysfunction than women who were non-smokers. This finding is consistent with the report of Kuijpers et al. that smoking regardless of the duration and intensity was an independent risk factor for the occurrence of PPT (OR 3.1).²⁵

Few studies concerning the possible impact of BMI as a risk factor for thyroid dysfunction during the postpartum period are currently available. In a series of 157 women Díaz et al. estimated a

higher risk for PPTD in women with minor BMI before pregnancy.²⁶ Analysis of our data support this finding as PPTD was more prevalent in women with a lower BMI before pregnancy compared to the postpartum euthyroid women.

In our series, women who were treated with levothyroxine during pregnancy were more likely to develop PPTD. Taking into account the results of the initial thyroid tests, replacement therapy was prescribed to 20 of the patients studied and treatment was discontinued following parturition. PPTD was observed in 14 (70%) of that group of patients indicating that the reduced thyroid functional capacity during pregnancy may progress to further deterioration of thyroid function after delivery.

It has been suggested that with the increasing number of pregnancies the incidence of TPOAb positivity and the risk of PPTD rise²⁷, but we did not find any differences in the prevalence of PPTD between primiparous and multiparous women. The data on the relation between PPTD and other autoimmune disorders apart from thyroid pathology indicate that PPTD occurs more commonly in patients with autoimmune diseases than in the general population, especially patients with type 1 diabetes mellitus^{28,29} or systemic lupus.³⁰ In our series, 14 of the 17 women with underlying autoimmune disease had type 1 DM, but the risk of PPTD was not associated with the presence of this disorders.

Current guidelines recommend that pregnant women with infertility history, including recurrent miscarriages be screened for thyroid abnormalities due to the higher risk of obstetric complications and postpartum thyroid dysfunction.^{1,3,8} The results of our study did not establish either a greater frequency of PPTD or a higher prevalence of TPOAb in women with history of spontaneous abortion and in vitro fertilization. Evidence concerning the possible impact of blood group on the risk of developing thyroid dysfunction is scarce and unlike Díaz who found an increased frequency of PPT in Rh-negative women²⁶ we did not prove association between blood group or rhesus factor and the risk for PPTD.

CONCLUSION

Postpartum thyroid dysfunction is a common disorder and is often characterized by significant fluctuations of thyroid hormones. The results of this study justify a thorough evaluation and close follow-up of thyroid function after delivery in women with

positive TPOAb titers and US hypoechogenicity in early pregnancy, family and personal history of autoimmune thyroid disease, smoking, lower BMI and those taking levothyroxine during pregnancy.

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Факторы риска появления послеродовой дисфункции щитовидной железы у женщин с эутиреоидным состоянием до наступления беременности

Боян И. Нончев^{1,2} Антоанета В. Аргатска^{1,2} Благовест К. Пехливанов³, Мария М. Орбецова^{1,2}

¹ Секция „Эндокринология“, Кафедра внутренних болезней, Факультет медицины, Медицинский университет - Пловдив, Пловдив, Болгария.

² Клиника эндокринологии и метаболических заболеваний, Университетская больница „Св. Георгий“, Пловдив, Болгария

³ Кафедра акушерства и гинекологии, Факультет медицины, Медицинский университет - Пловдив, Пловдив, Болгария

Адрес для корреспонденции:

Антоанета В. Аргатска, Секция „Эндокринология“, Кафедра внутренних болезней, Факультет медицины, Медицинский университет - Пловдив, бул. „Васил Априлов“ 15А, 4002 Пловдив, Болгария
E-mail: lakalma@abv.bg
тел: +359 898 411 049

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Введение: Дисфункция щитовидной железы часто проявляется во время послеродового периода, а предрасполагающие факторы для её развития принято считать специфическими для исследуемого населения. Целью настоящего исследования является оценка факторов риска для появления послеродовой дисфункции щитовидной железы (ПДЩЖ) среди женщин с эутиреоидным состоянием до наступления беременности.

Материалы и методы: 45 женщин с ПДЩЖ и 55 эутиреоидных женщин примерно одинакового возраста после родов из города Пловдива, Болгария были включены в исследование. TSH, FT4, FT3, TPOAb, TgAb, TRAb были измерены и было проведено ультразвуковое исследование щитовидной железы во время первого триместра беременности и во время послеродового периода.

Результаты: Анализ установил более высокую степень риска развития ПДЩЖ среди женщин с семейным анамнезом заболевания щитовидной железы (OR 4.42; 95% CI 1.87,10.43), курящих (OR 4.01; 95% CI 1.72,9.35), с персональным анамнезом аутоиммунного заболевания щитовидной железы (OR 5.37; 95% CI 1.15,28.53), положительным TPOAb (OR 18.12; 95% CI 4.93,66.65) и гипозогогенностью щитовидной железы при УЗ во время ранней беременности (OR 6.39; 95% CI 2.53,16.12) и среди нуждающихся в левотироксине во время беременности (OR 3.69; 95% CI 1.28,10.61). ИТМ до наступления беременности был значительно более низким среди женщин с ПДЩЖ по сравнению с эутиреоидными женщинами в послеродовом периоде (22.80 ± 0.55 срещу 26.25 ± 0.97 , $p=0.013$). Многофакторный анализ логистической регрессии идентифицирует в качестве важнейших независимых факторов риска появления ПДЩЖ наличие положительных TPOAb во время ранней беременности, семейный анамнез заболеваний щитовидной железы, курение и низкий ИТМ до наступления беременности.

Заключение: Наши результаты устанавливают, что несколько факторов можно связывать с повышенным риском наступления ПДЩЖ среди исследованного населения и скрининг заболеваний щитовидной железы среди данной группы женщин может быть весьма полезным.