Original Article

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Thyroid Profile and Serum Lipid Level in Women with Normal Pregnancy

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Abstract

Objective: To evaluate the changes in thyroid profile and serum lipid level in normal pregnancy.

Methods: This observational study was conducted at the Department of Biochemistry of Santosh Medical College, Ghaziabad, UP, India, from June 2021 to February 2022. In this study, 200 average pregnant women were enrolled. The thyroid profile was estimated using the ELISA method, and the lipid profile was measured using the enzymatic kit method. All data were expressed as means and standard deviations, and SPSS version 17 was used for statistical analysis.

Results: This observational study observed that the mean T3, T4, and TSH levels increased significantly in the second trimester compared to the first trimester. In contrast, the mean value of T3, T4, and TSH decreased in the third trimester as compared to the second trimester. The mean levels of total cholesterol, triglyceride, and LDL-cholesterol increased significantly, while the mean value of HDL-cholesterol decreased significantly in the second and third trimesters when compared to the first trimester.

Conclusion: This study demonstrated abnormal lipid and thyroid metabolism. Changes in thyroid profile may be associated with adverse obstetric outcomes. The altered lipid parameters, mainly High TG and low HDL-C concentrations, may promote vascular dysfunction and oxidative stress.

Keywords: Pregnancy, thyroid hormones, triglycerides, trimester

Introduction

Pregnancy is known as the period of gestation. During this period, new life grows inside a female's uterus. Pregnancy causes alterations in internal and external physiological status of a woman. Many external physiological changes are observed in this time, such as changes in blood values, which may appear pathological if seen in non-pregnant women. However, these pregnancy-related changes are beneficial for the development and growth of the fetus because the altered physiology greatly affects and helps in supplying proper nutrients and protection to the developing fetus until the time of delivery.[1] These changes are also contributed by various endocrinal changes in pregnancy, in which the thyroid gland plays a critical role in regulating the thyroid hormones synthesis necessary for the infant's brain and nervous system development. Since the fetus completely depends on the mother's thyroid hormone throughout the first trimester, the mother's thyroid gland is enlarged to produce more thyroid hormones. Thyroid gland dysfunction is also common during pregnancy. If it remains untreated, it may trigger adverse effects on the pregnancy and fetal outcomes.[2]

During pregnancy, the mother physically changes and increased blood levels of progesterone, estrogens, and pancreatic beta-cell hyperplasia change the maternal metabolic milieu. A significant part of the lipid profile's disturbance is due to the insulin resistance and ovaries-estrogens in women. So, identification of these disorders and their treatments are necessary to prevent complications related to pregnancy. Changes in thyroid hormones and in TSH may be a factor in a disrupted lipid profile, particularly in the third trimester. Many studies have examined the alterations in pregnant women's lipid profile, T3, T4, and TSH during the three stages of pregnancy to ascertain why these characteristics change during pregnancy.[3] Reports on the relationship between dyslipidemia, pregnancy outcomes, and thyroid gland malfunction have resulted in conflicting results, with the first trimester receives less attention as most studies tend to concentrate on the late stages of pregnancy. Hence, this study aimed to determine serum lipid level and thyroid profile in all trimesters of normal pregnancy.

Methods

This study was conducted at the Department of Biochemistry of Santosh Medical College Ghaziabad, Uttar Pradesh, India from June 2021 to February 2022. Institutional ethical committee clearance [SU/2020/536(50)] and inform consent from patient were obtained prior to the study. This study included 200 pregnant healthy women of 21–32 years of age. Women on hormonal therapy, steroid therapy, already diagnosed thyroid patients, having abnormal liver function and kidney function, and experiencing acute or chronic inflammatory diseases were excluded. Blood samples were collected after 8-12 hours of fasting, three times from the women (in first, second and third trimester) in fluoride/plain vials under all aseptic precautions. Plasma/serum were separated and all parameters were measured on the same day as the collection. Fasting blood glucose, total cholesterol, HDL-cholesterol, triglyceride, and LDL-cholesterol were measured by enzymatic kit method using a fully automatic analyzer (Beckman Coulter- AU-480). Serum T3, T4 and TSH were tested by commercially available ELISA kits using Beckman Coulter-Chemistry Analyzer Access-2. The parameters of blood glucose and lipid were measured using a fully automated analyzer (Beckman Coulter –AU-480), while an automated analyzer (Chemistry Analyzer-Access-2's) was used to measure the thyroid profile. Statistical Package for Social Sciences (SPSS) version 17 was used for statistical analyses and the statistical test results were summarized as means and standard deviations in several tables. The confidence intervals for each of the presented p-values were determined at the 95% level with $p < 0.05$ was considered significant.

Results

This study involved 200 normal pregnant women above 20 year of age. The mean value of the T3 and TSH increased in the 2nd and 3rd trimester of pregnancy as compared to the 1st trimester, and it was statistically significant. The mean value of T4 increased in the 2nd trimester but decreased in the 3rd trimester, and it was statistically significant. The mean values of total cholesterol, triglyceride (TG), and LDL-cholesterol were found to be increased

Table 1 Comparison of Biochemical Parameters in 1st and 2nd Trimester of Pregnancy (n=200)

Variable	1st Trimester	2nd Trimester	p-value
T3 (ng/mL)	1.07 ± 0.15	1.19 ± 0.27	0.038
T4 (µg/mL)	5.54 ± 2.06	7.56 ± 2.11	0.004
TSH (µlU/mL)	1.76 ± 0.74	3.97 ± 1.96	<0.0001
Fasting blood Glucose (mg/dL)	81.03 ± 11.89	90.43 ± 15.42	0.01
Total Cholesterol (mg/dL)	155.73 ± 27.61	171.8 ± 30.11	0.035
HDL-cholesterol (mg/dL)	49.67 ± 5.05	46.20 ± 5.80	0.016
Triglyceride (mg/dL)	154.83 ± 26.02	186.30 ± 32.38	0.0001
LDL-cholesterol (mg/dL)	72.10 ± 8.43	85.23 ± 11.23	<0.0001

*p-value less than 0.05 is considered statistically significant

Table 2 Comparison of Biochemical Parameters in 1st and 3rd trimester of Pregnancy (n=200)

Variable	1st Trimester	3rd Trimester	p-value
T3 (ng/mL)	1.07 ± 0.15	1.32 ± 0.17	<0.0001
T4 (µg/mL)	5.54 ± 2.06	6.58 ± 1.06	=0.017
TSH (µlU/mL)	1.76 ± 0.74	4.87 ± 1.45	<0.0001
Fasting blood Glucose (mg/dL)	81.03 ± 11.89	97.12 ± 8.78	<0.0001
Total Cholesterol (mg/dL)	155.73 ± 27.61	194.10 ± 44.33	=0.0002
HDL-cholesterol (mg/dL)	49.67 ± 5.05	41.87 ± 4.50	=0.0001
Triglyceride (mg/dL)	154.83 ± 26.02	208.7 ± 47.71	<0.0001
LDL-cholesterol (mg/dL)	72.10 ± 8.43	111.45 ± 18.91	<0.0001

*p-value less than 0.05 considered as statistically significant

significantly in the 2nd and 3rd trimester when compared to the values in the 1st trimester and the mean value of HDL-cholesterol decreased significantly in the 2nd and 3rd trimester when compared to 1st trimester (Table 1 and 2).

Differences in all the studied parameters in the 2nd and 3rd trimester were statistically significant (Table 3).

Discussion

Pregnancy is one of the most vital phases in the life of a woman. During pregnancy, various changes in the hormonal, vascular, metabolical, immunological, and psychological conditions are seen, which are beneficial to nurture the developing fetus and also affect the levels of normal biochemical parameters while others may mimic symptoms of medical diseases. In the current study, a total of 200 pregnant women were recruited and were followed up in all three trimesters. The age range of the participants was from 20 to 30 years old, which is line with a previous study that stated that the most probable fertile years and reproductive age of a woman is 20–30 years, with the best reproductive years are in the 20s.[4] Lipid profile is significantly affected by the endogenous sex hormones of females. Endocrine changes during pregnancy, e.g., rising levels of estrogen, progesterone, and cortisol, will cause lipogenesis and fat accumulation associated with hyperphagia. Pregnancy-related increases in lipid synthesis are required as an energy source to meet the metabolic requirements of both the mother and the fetus.[4] In the present study, the mean value of total cholesterol, triglyceride, and LDL-cholesterol in the first, second, and third trimesters of pregnancy were found to be increased significantly. These results are line with the findings of previous studies that reported gradual increases of lipid fractions in all three stages of pregnancy.[4, 5] Another related

Table 3 Comparison of Biochemical Parameters in 2nd and 3rd Trimester of Pregnancy (n=200)

Variable	2nd Trimester	3rd Trimester	p-value
T3 (ng/mL)	1.19 ± 0.27	1.32 ± 0.17	0.295
T4 (µg/mL)	7.56 ± 2.11	6.58 ± 1.06	0.03
TSH (µlU/mL)	3.97 ± 1.96	4.87 ± 1.45	0.047
Fasting blood Glucose (mg/dL)	90.43 ± 15.42	97.12 ± 8.78	0.04
Total Cholesterol (mg/dL)	171.8 ± 30.11	194.10 ± 44.33	0.026
HDL-cholesterol (mg/dL)	46.20 ± 5.80	41.87 ± 4.50	0.002
Triglyceride (mg/dL)	186.30 ± 32.38	208.7 ± 47.71	0.037
LDL-cholesterol (mg/dL)	85.23 ± 11.23	111.45 ± 18.91	<0.0001

*p-value less than 0.05 is considered statistically significant

study reported the gradual increases in the mean values of cholesterol and triglycerides in the second and third trimesters which is similar to this study.[4] In their study, Kumari *et al*. demonstrated a significant increase in cholesterol during all three trimesters.[6] Another study also showed that TC and TG concentrations rise up in late pregnancy when compared to non-pregnant women.[7] Evidence also suggests that blood lipids return to pre-pregnancy levels after delivery, which implies that the elevated serum lipids may play a significant role in fetal development. However, a high cholesterol level during pregnancy may lead to pregnancy-induced hypertension, a cardiovascular risk which can threaten the life of both the mother and child. On the other hand, a low cholesterol level can lead to early and premature labor and low birth weight.[8]

A previous study also reported the presence of hypertriglyceridemia in pregnancy and gradual increase in TG level in all trimesters, and also found a significant difference in the TG level when compared to non-pregnant women.[9] To explain this phenomenon, one study stated that due to the high energy demand in pregnancy, the energy production to meet the maternal need of fuel is switched from carbohydrate metabolism to lipid metabolism. Therefore, increased lipid deposition and decreased lipolysis are observed in early pregnancy.[4] Another explanation for the rise in triglyceride and other lipid components during normal pregnancy seen in parallel with the rise in gestational age is the rise in estrogen and progesterone levels during gestation.[4,9]

Decreased HDL-C was found in this study. A low HDL-C level is said to increase the risk for coronary heart disease, and many pregnancies have mixed outcomes. It is thought that the fall in serum HDL-C during the third trimester of a typical pregnancy may be a potential risk factor for atherosclerosis to occur. Another explanation of increased LDL-C is the high levels of progesterone and estrogen during pregnancy.[4] The higher LDL-c during pregnancy may be used to identify women who may experience atherogenic alterations in the future.[10] Similar pattern of variations in lipid profile is also presented by other previous studies just like in the present study.[4,10] A previous study stated that there may be two factors that increase the TG level; first, increased activities of hepatic lipase which is responsible for the synthesis of hepatic triglycerides and, second, reduced lipoprotein lipase activity which results in a reduction in the catabolism of adipose tissues.[10] During pregnancy, significant changes are also seen in thyroid hormone physiology and thyroid gland anatomy.[10]

In the present study, an elevated pattern in TSH level is observed in the first, second and third phase of pregnancy. However, despite being observed in a normal limit, increasing TSH value indicates the risk for developing hypothyroidism. To support this Yoganathan *et al.*, studied the thyroid status in pregnant women and found an increase in the TSH value of pregnant women with hypothyroidism with a positive correlation.[11] Another study of Mehta *et al*.,[12] reported increased TSH concentration in the third trimester compared with the second trimester. This study stated that increased TSH value may be considered as a risk factor for decreased neurological development and preterm birth.[13]In the present study, the mean T3 level increases significantly in the 2nd and 3rd trimester as compared to the 1st trimester but it is still in the normal range. The T4 level increases in the 2nd trimester as compared to the 1st trimester, but decreases in the 3rd trimester as compared to the 2nd trimester. Iodine is organized and oxidized by the thyroid peroxidase enzyme, which also produces the fT4 and fT3 hormones.[14] A glycoprotein called thyroglobulin serves as a substrate for the production and storage of thyroid hormones.[15] Hypothyroidism is the outcome of these antibodies in autoimmune thyroid diseases. Thyroid autoimmunity is linked to recurrent miscarriage, which is probably brought on by generalized immune system activation and transplacental transfer of antibodies that result in fetal rejection.[16]

Women have a high risk for experiencing thyroid dysfunction, including hypothyroidsm, which is linked to increased lipid fractions, i.e. TC, LDL, and TG, and decreased HDL-C. Elevated LDL-C levels result in increased oxidation of LDL-C, which is a high risk factor of atherosclerosis. Hypothyroidism is also linked with a decreased activity of lipoprotein lipase that leads to decreased clearance of TG-rich lipoprotein.[17] In line with this study, Sangeeta *et al*. also reported elevated levels of TC, LDL-C, and TG with an elevated level of TSH. Decreased HDL-C is also linked to hypothyroidism due to increased transfer of cholesterol esters from HDL to VLDL, mediated through CETP, which increases the HDL catabolism.[18]

Both thyroid profile and lipid profile have a vital role in pregnancy. In early pregnancy, thyroid impairment is common and prevalent and is associated with dyslipidemia. During

pregnancy, a poor metabolic phenotype is associated with thyroid dysfunction. The effect of body weight on the association of lipid parameters and thyroid hormones are not well studied yet. A woman's physiological weight increase during pregnancy may have an impact on her lipid profile and thyroid hormone levels. A bigger sample size and prospective methodological investigations in different centers are required in the future to examine the association of thyroid profile with lipid profile with a larger sample size, as the current study was only done in one hospital, thus becomes the limitation of this study.

In the present study, it was observed that T3, T4 and TSH levels are raised. Obstetric problems can result from aberrant thyroid hormones. Thyroid disorders have an impact on both the mother and the fetus. Early in pregnancy, maternal thyroid hormones and TSH are linked to dyslipidemia and a number of unfavorable pregnancy outcomes. Total cholesterol, triglycerides, and LDL are shown to be significantly higher across all lipid profile indicators as a result of endothelial dysfunction. Conventional maternal thyroid in early pregnancy may help improve the lipid levels and decrease several possible adverse pregnancy outcomes.

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