Study on Glycemic and Lipidemic Status in Different Trimesters of Pregnancy

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Abstract

Impaired glycemic and lipidemic status during pregnancy may cause severe morbidity both in fetus and mother. Therefore timely evaluation of these parameters throughout the pregnancy is of paramount importance in order to detect impaired glucose tolerance, gestational diabetes and dyslipidemia. This will surely help to take appropriate control measures in order to avoid unwanted health danger to fetus and mother. Focus of this study is to understand and evaluate the variations of glycemic and lipidemic status in different trimesters of pregnancy.

Keywords: *Pregnancy, Dyslipidemia, Gestational diabetes mellitus,*

Introduction

Pregnancy deals with an increase in the cellular proliferation and uterine enlargement including development of placenta and fetal growth [1]. Pregnancy results with continuous physical and physiological adjustments that alters maternal internal environment to provide a favorable condition to the fetus[2]. During gestation there is progressive increase in nutrient stimulated insulin responses despite of only minor deterioration in glucose tolerance, consistent with progressive insulin resistance [3]. Normal pregnancy is associated with an increase level of estrogens, progesterone, cortisol, prolactin and human placental lactogen. Increased concentration of these hormones cause increased secretion of insulin but decreases its sensitivity to target tissues [4]. Earlier it has been reported that on an average 2 to 4% pregnant women develop gestational diabetes mellitus (GDM) [5]. Women with glucose intolerance during pregnancy usually remain asymptomatic but glucose intolerance during pregnancy causes significant increase in feto-maternal abnormalities including congenital fetal malformations, macrosomia, hypoglycemia, hyper viscosity syndrome, respiratory distress syndrome in fetus. Women with GDM have an approximately 50% risk of developing type-II diabetes over the next ten years [6].

Pregnancy is also associated with some normal changes in lipid metabolism necessary for fetal development. But among obese ladies cardiovascular events have been observed before or during pregnancy. Deranged lipid profile before and during pregnancy is associated with gestational hypertension and diabetes and preeclampsia. There is a continuous increase in TG (triglycerides) and TC (total cholesterol), especially with TG level 3-4 folds more during last trimester. Higher level of LDL and lower HDL appear to be the cause of gestational hypertension, diabetes and preeclampsia [7]. LPa is one of the important parameter of atherogenicity has also been seen raised throughout pregnancy. [8]. A study has reported that atherogenic lipid profile during first trimester leads to adverse pregnancy outcome and maternal mortality [9]. Another study conducted among European community showed that elevated TG levels not the TC level in first trimester are independently associated with adverse effects both on mother and fetus [10]. U shaped association between deranged lipid profile and risk of premature birth was reported by a study group [11]. With above background we aim to assess the glycemic and lipidemic status of pregnant women in all

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3 trimesters.

Materials and Method

The study was done in the Department of Biochemistry in collaboration with the Department of Obstetrics & Gynecology, Santosh Medical Hospital, Ghaziabad from May 2018 to January 2019. According to rule of thumb, the sample size should not be less than 30 for short term study [12]. A total of 60 women between age group 20 to 30 year, were assessed in which 30 were healthy non-pregnant women and 30 pregnant women from each three trimesters of pregnancy were sampled for plasma level of glucose and lipid profile.

Exclusion criteria: pregnant women with the following cases were excluded.

- Hypertensive
- Diabetes mellitus
- smoking
- Preterm
- Chronic disease
- Gestational diabetic mellitus (GDM)
- Smokers and Alcoholic

Investigations:

- Fasting and Post prandial blood glucose
- Fasting serum lipid profile which include (Total cholesterol, Triglycerides, LDL - cholesterol, HDL – cholesterol)
- Glycosylated hemoglobin (HbA1c)

The level of significance was set up at 0.05 and P value <0.05 was considered to be statistically significant (*).

Results

The result of analysis in shown in tables 1-4 as follows:

Table 1: Demographic characteristics(mean ± SD)

Parameters	Control(C)	1stTrimester(I)	2ndTrimester(II)	3rdTrimester(III)
Age(years)	22.26±2.71	22.83±2.26	22.83±2.26	22.83±2.26
P-value		0.38 (CvsI)	0.38 (CvsII)	0.38 (CvsIII)
Height(cm)	151.17±4.56	154.23±3.78	154.23±3.78	154.23±3.78
P-value		0.006** (CvsI)	0.006** (CvsII)	0.006** (CvsIII)
Weight(Kg)	51.13±1.97	51.73±1.57	52.77±1.38	54.13±1.454
P-value		0.19 (CvsI)	0.000** (CvsII)	0.000** (CvsIII)
BMIkg/m2	22.42 ± 0.63	21.75±0.68	22.21±0.68	22.78±0.8
P-value		0.000** (CvsI)	0.24 (CvsII)	0.05 (CvsIII)

Table 2:Comparison of Blood Pressure between control and different trimesters of pregnancy(mean±SD):

Parameters	Control(C)	1st Trimester(I)	2nd Trimester(II)	3rd Trimester(III)
SBPmmHg	119.26±0.98	112.33±4.49	114.53±4.19	116.46±3.09
P-value		0.0001** (CvsI)	0.0001** (CvsII)	0.0001** (CvsIII)
DBPmmHg	78.5 ±1.38	77.00±5.93	78.26±4.02	79.13±3.62
P-value		0.17 (CvsI)	0.73 (CvsII)	0.40 (CvsIII)

Table 3: Comparison of FBS, PPBS & HbA1c between control and different trimesters of pregnancy(mean ± SD):

Parameters	Control(C)	1stTrimester(I)	2ndTrimester(II)	3rdTrimester (III)
FBS(mg/dl)	83.33±9.60	92.9±9.9	99.47±14.50	105.36± 9.82
P-value		0.07 (CvsI)	0.001** (CvsII)	0.001** (CvsIII)
PPBS(mg/dl)	108.4±17.56	128.53±12.24	135.23±15.23	152.33±30.01
P-value		0.0001** (CvsI)	0.0001** (CvsII)	0.0001** (CvsIII)
HbA1c(%)	4.8±0.38	4.7±0.48	4.9±0.43	5.2±0.49
P-value		0.31 (CvsI)	0.75 (CvsII)	0.005** (CvsIII)

Table 4: Comparison of lipid profile in control and different trimesters of pregnancy(mean±SD):

Parameters	Control(C)	1stTrimester(I)	2ndTrimester(II)	3rdTrimester(III)
TC(mg/dl)	157.93±29.12	164.9±23.71	182.7±28.44	196.36±27.44
P-value		0.22 (CvsI)	0.000** (CvsII)	0.000** (CvsIII)
TG(mg/dl)	119.8±26.66	140.36±29.65	167.4±32.15	195.7±30.63
P-value		0.002* (CvsI)	0.0001** (CvsII)	0.0001** (CvsIII)
HDL(mg/dl)	45.56±7.52	45.2±6.09	42.3±5.11	42.23±4.17
P-value		0.84 (CvsI)	0.04* (CvsII)	0.038* (CvsIII)
LDL(mg/dl)	90.66±29.5	91.38±21.05	106.91±26.44	121.03±24.06
P-value		0.89 (CvsI)	0.02* (CvsII)	0.0001** (CvsIII)
VLDL(mg/dl)	23.98±5.31	28.07±5.93	33.48±6.43	39.14±6.12
P-value		0.002** (CvsI)	0.0001** (CvsII)	0.0001** (CvsIII)

Discussion

Glucose is a major nutrient for fetal growth and energy. It is thus logical that mechanisms exist during pregnancy to minimize maternal glucose use, so that the limited maternal supply is available to the fetus [13]. However abnormalities of carbohydrate metabolism occur frequently during pregnancy and between 3% to 5% of all pregnant show glucose intolerance. Approximately 90% of those women have gestational diabetes [14]. In the present study, we have found that fasting and postprandial blood sugar were gradually increased with advancing gestational age but mostly they were within normal physiological range. This finding is compatible with Butte, 2000. It may be due to the fact that placental lactogen (FPL), a hormone normally present in abundance in the mother but not in the fetus, blocks the peripheral uptake and use of glucose while promoting the mobilization and use of free fatty acids by maternal tissue [15]. Moreover, increased production of cortisol, estriol and progesterone as well as increased insulin destruction by kidney and placenta might result in increased maternal glucose level [14]. In the present study, the prevalence of gestational diabetes mellitus in 1st, 2nd and 3rd trimester was 3%, 6.3% and 4.1% respectively with cumulative prevalence of 4.7%. This finding coincides with the range of GDM as per WHO estimates in different population study [16,17]. However, our finding is much lower than the prevalence rate of GDM observed by Akirprle, 2011 and Swami, 2008 [18]. It may be due to the fact that they have observed prevalence rate of GDM among women with identified risk factor.

Some previous studies have shown that in normal pregnancy is serum triglyceride is dramatically increased, which may be as high as two to three folds in the third trimester over the levels in non pregnant women [19]. In our study also this observation holds true. In this study, it was observed that the concentration of serum total cholesterol, serum triglyceride, high density lipoprotein cholesterol and low density lipoprotein cholesterol in normal pregnant women increased with increasing gestational age although HDL dropped a little throughout pregnancy with the serum triglyceride concentration showing a very significant increase in the third trimester of normal pregnancy than in the non pregnant women (the mean value being raised almost two folds). Similar observations were reported in studies conducted by Fahraeus et al [20], Jimenez et al [21] and Potter and Nestel [22]. The principal modulator of this hypertriglyceridemia is oestrogen because pregnancy is associated with hyperoestrogenaemia. Oestrogen induces hepatic biosynthesis of endogenous triglycerides, which is carried by VLDL. This process may be modulated by hyperinsulinism found in pregnancy [23].

Pregnancy is accompanied by extra demand of energy with a well-integrated metabolic shift to ensure adequate supply of nutrients to a constantly feeding fetus from an intermittently fasting and feeding mother [24]. Maternal hyperlipidemia and accumulation of fats in maternal tissues and are two consistent manifestations of altered metabolism of fat during uncomplicated pregnancy. The increase in adipose tissue store as anticipation for fetal growth spurt [25] is indicated in this study by the concomitant increase in cholesterol concentration as pregnancy advanced [figure6]. The high energy demand associated with advancing pregnancy necessitates an increase in maternal lipid profile and metabolism which is a collateral pathway for production of energy. This maternal switch from carbohydrate to fat metabolism is accompanied by an increase in hepatic lipase activity and a decrease in lipoprotein lipase activity [26]. Furthermore, the increase in cholesterol may be an adaptation by the body to serve its function as a precursor for the formation of the steroid hormones of pregnancy. Cholesterol is also the precursor of steroid hormones such as progesterone and of metabolic mediators such as oxysterol [27]. Hyperinsulinemia of pregnancy leads to an increase in peripheral glucose utilization, a decline in fasting plasma glucose levels, increased tissue storage of glycogen, increased storage of fats and decreased lipolysis. Maternal fuel adjustments during late pregnancy include a sparing of glucose (for the fetus) and an increased concentration of fatty acids in plasma [28]. Estrogen and progesterone rise considerably during pregnancy to modify the maternal metabolic environment [29]. From this study, no significant change in high density lipoprotein-cholesterol was observed in the first trimester, however the second and third trimester values were statistically significant ($p<0.05$). The same pattern of increase was also observed in the low-density lipoprotein cholesterol, as there was no significant increase in the first trimester of pregnancy. The possible empirical increase in lipid profile in the first trimester may be due to the counter effect of anorexia, nausea and vomiting on the hyperlipidemic effect of the hormones of pregnancy. [30]. LDL-C levels peak at mid-third trimester, probably as a consequence of the hepatic effect of estradiol and progesterone [31]. It has been suggested

that the increase in plasma triglycerides and LDL-C patterns during pregnancy might be used to identify women who will develop atherogenic changes later in life. The study showed that there was a discrepancy in the pattern of increase of serum concentration of LDL-C and HDL-C. for instance, relative to the first trimester, the increase in LDL-C in the second and third trimesters of pregnancy were 46.3% and 85% respectively, whereas the pattern of decrease for serum HDL-C concentration were 5.9% and 7.5% respectively. This discrepancy can be explained by previous studies which showed that the daily production of progesterone increases thirty fold, while that of oestrogen increases tenfold during pregnancy. Progesterone increases plasma levels of LDL cholesterol and total cholesterol while lowering HDL-cholesterol but oestrogen has an opposite effect [32]. Generally, normal pregnancy is also associated with high concentrations of estrogens which may contribute to the rise in total cholesterol, low-density lipoprotein cholesterol (LDL-C) and triglyceride especially in the late half of pregnancy [33]. In our study we found decrease HDL-C level in 2nd and 3rd trimester of pregnancy when compared with control. The concentrations of lipids, lipoproteins and apolipoproteins in the plasma increase appreciably during pregnancy because of the rise in insulin, progesterone, 17-β estradiol and human placental lactogen [34].

Conclusion

Pregnancy presents a challenge to mother who gets prepared to face the metabolic stress for growth and development of fetus. Maternal adaptation is aimed to maintain proper balance between mother and fetus by means of some effective changes in carbohydrates and lipid metabolism for fetal development while maintaining adequate maternal nutrition in various trimesters of pregnancy. In our current study there is slight increase in FBS levels in different trimesters of pregnancy as compared to control but rise in post-prandial glucose level was consistently high in different trimesters as compared to pregravid levels. Similarly, glycated Hb levels raised gradually in different trimesters although it always remained much below the upper limit of normal. We have demonstrated dyslipidemia during pregnancy with sustained risk in various lipid parameters and fall of HDL-C. Hyperlipidemia if not diagnosed at onset might lead to atherosclerosis risk in both maternal and fetal health which may complicate the pregnancy.

Hence we insist for constant monitoring of lipid profile during different trimesters of pregnancy, so that if required proper treatment can be initiated to expectant mothers for best maternal and fetal outcomes.

Ethical Clearance: Taken From Institutional Ethical Committee

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Conflict of Interest: Nil

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