

Changes in blood glucose level in normal pregnancy

¹Dr. Meena Cherian, ²Dr. Sophiamma Joseph

¹Assistant Professor, Department of Physiology, Government Medical College, Paripally, Kollam, Kerala, India

²Assistant Professor, Department of Physiology, Government Medical College, Kottayam, Kerala, India

Corresponding Author:

Dr. Sophiamma Joseph

Abstract

Gestational diabetes mellitus (GDM) is the most common metabolic abnormality during gestation. Gestational diabetes mellitus is defined as abnormal glucose tolerance was 25% in lean women and 50% in obese women compared with a 5-10% prevalence in a control population. Women attending the Obstetrics & Gynecology outpatient department of the Govt. Medical College, were interviewed and from many volunteers 31 were selected as being in good general health, of average build, free from any family history of diabetes, and were sure of their last menstrual dates. Each patient gave her informed written consent. None of them had a history of impaired glucose tolerance. The mean (\pm SD) fasting plasma glucose levels during the 1st, 2nd and 3rd trimester and at term were 69.9 ± 9.2 mg/dl, 71.7 ± 7.5 mg/dl, 75.9 ± 8.3 mg/dl, and 76.8 ± 8.5 mg/dl respectively. And the mean fasting plasma glucose in the non-pregnant state is 71.5 ± 7.2 mg/dl. The mean (\pm SD) blood glucose values 1 hour after ingestion of 50 g oral glucose load (GCT) were 98.9 ± 15.2 mg/dl, 105.3 ± 14.5 mg/dl, 105.2 ± 13.7 & 104.9 ± 11.6 mg/dl during the 1st, 2nd and 3rd trimesters and at term respectively.

Keywords: Blood glucose level, normal pregnancy, gestational diabetes mellitus

Introduction

The interaction of pregnancy and impaired glucose tolerance requires special consideration because of the increased risks to the well-being of the fetus and because the presence of the conceptus (fetus and placenta) alters substrate and hormone metabolism in the mother. The net result is that various aspects of diagnosis and management of impaired glucose tolerance are either altered or require emphasis during pregnancy ^[1].

It has been known for long that pregnant women with diabetes mellitus need additional insulin as pregnancy progresses (Spellacy 1969).

Further-more in healthy individuals glucose tolerance is reported to be impaired inspite of elevated serum insulin levels ^[2].

Normal pregnancy is characterized by mild fasting hypoglycemia, postprandial hyperglycemia, and hyperinsulinemia. The fasting plasma glucose concentration falls somewhat, possibly due to increased plasma levels of insulin. This cannot be explained by a

change in the metabolism of insulin because its half-life during pregnancy is not changed^[3]. Abnormal carbohydrate metabolism must be defined and detected, because it is associated with an increased risk for fetal abnormalities and perinatal mortality^[4].

Gestational diabetes mellitus (GDM) is the most common metabolic abnormality during gestation. Gestational diabetes mellitus is defined as abnormal glucose tolerance was 25% in lean women and 50% in obese women compared with a 5-10% prevalence in a control population. Most women with gestational diabetes mellitus are at risk for non-insulin dependent diabetes mellitus (IDDM) but not for insulin-dependent diabetes mellitus^[5,6].

Methodology

Thirty one normal pregnant women were selected for this study. The study was approved by the ethical committee of the Medical College.

Selection of subjects

Women attending the Obstetrics & Gynecology outpatient department of the Govt. Medical College, were interviewed and from many volunteers 31 were selected as being in good general health, of average build, free from any family history of diabetes, and were sure of their last menstrual dates. Each patient gave her informed written consent. None of them had a history of impaired glucose tolerance. None had any other disease or were taking any medications (such as corticosteroids, anti-convulsants or warfarin sodium) that might affect glucose metabolism. Women who had multiple gestations or pregestational diabetes were excluded from the study. Subjects were also excluded if a first degree relative had type I diabetes mellitus or received treatment for hyperglycemia. Women who had fasting blood glucose levels exceeding 105 mg/dl in 1st trimester were excluded from the study because pregestational diabetes could not be ruled out; and women with elevated screening levels (at least 135 mg/dl) were instructed to have the 3 hour oral GTT. Each patient subsequently delivered a healthy child at term without difficulty.

On the first visit the aim of the study was explained to the patients, and their cooperation was requested. The tests were performed under similar circumstances during 1st trimester, 2nd trimester, 3rd trimester and at term and 10 to 12 weeks after delivery. The last test during pregnancy was at 38 weeks rather than at 40 weeks gestation to avoid patients being lost to the series due to early onset of labor. The post-delivery tests provided non-pregnant control data.

Test Procedure

To ensure homogenous testing conditions, the patients were asked to attend the unit between 8:00 and 9:00 am after overnight fasting. After sitting quietly in a chair, 50 g. of glucose in about 200 ml of water was given orally over one to two minutes. The patients remained in the chair for the whole test. Capillary blood samples were taken by finger-prick method under aseptic conditions. Prior to the glucose drink and at 60 minutes from the time the drink was started blood samples were taken. A small drop of blood is applied to the test strip and it is inserted into the glucometer. The meter showed the amount of blood glucose on its digital display.

Results

Table 1: Mean plasma glucose levels by trimester

Time after glucose load	Plasma glucose mg/di				
	1st trimester	2nd trimester	3rd trimester	Term	Postpartum
0H (Fasting)	69.9 ± 9.2	71.7 ± 7.5	75.9 ± 8.3	76.8 ± 8.5	71.5 ± 7.2
1H	98.9 ± 15.2	105.3 ± 14.5	105.2 ± 13.7	104.9 ± 11.6	96.2 ± 12.1

(Mean ± SD)

The mean (± SD) fasting plasma glucose levels during the 1st, 2nd and 3rd trimester and at term were 69.9 ± 9.2 mg/di, 71.7 ± 7.5 mg/di, 75.9 ± 8.3 mg/di, and 76.8 ± 8.5 mg/di respectively. And the mean fasting plasma glucose in the non-pregnant state is 71.5 ± 7.2 mg/di. The mean (± SD) blood glucose values 1 hour after ingestion of 50 g oral glucose load (GCT) were 98.9 ± 15.2 mg/di, 105.3 ± 14.5 mg/di, 105.2 ± 13.7 & 104.9 ± 11.6 mg/di during the 1st, 2nd and 3rd trimesters and at term respectively.

The mean plasma glucose at 1st trimester (69.9 mg/di) was lower than the mean non pregnant level (71.5 mg/di). But the difference did not reach significance (p=0.46).

During the 2nd trimester mean fasting glucose level (71.7 mg/di) is similar to that at non pregnant state (71.5 mg/di) which means a gradual increase in fasting glucose as the patient enter the 2nd trimester.

In the 3rd trimester (75.9 mg/di) and at term (76.8 mg/di) the fasting glucose values are significantly higher than the non-pregnant level (71.5 mg/di) with a "p" value of 0.003 and 0.001 respectively. The fasting glucose values at the 3rd trimester and at term were significantly higher than the 1st trimester level with a "p" value of 0.006 & 0.005 respectively. The 3rd trimester (75.9 mg/di) and term (76.8 mg/di) fasting values were significantly higher than the 2nd trimester fasting glucose level (71.7 mg/di) with a "p"

Table 2: Comparison of the results of fasting Plasma glucose and the GCT values

	Fasting Plasma Glucose mg/di	GCT Results mg/di
1st trimester	69.8	98.9
After delivery	71.5	96.2
P value	0.46	0.49
2nd trimester	71.7	105.3
After delivery	71.5	96.2
P value	0.92	0.001 t
3rd trimester	75.9	105.2
After delivery	71.5	96.2
P value	0.003 t	0.001 t
Term	76.8	104.9
After delivery	71.5	96.2
P value	0.001 t	0.002 t
1st trimester	69.8	98.9
2nd trimester	71.7	105.3
P value	0.31	0.06
1st trimester	69.8	98.9
3rd trimester	75.9	105.2
P value	0.006 t	0.09
1st trimester	69.8	98.9
term	76.8	104.9
P value	0.005 t	0.11
2nd trimester	71.7	105.3
3rd trimester	75.9	105.2
P value	0.02 t	0.98

2 ^o trimester	71.7	105.3
term	76.8	104.9
P value	0.01 t	0.87
3 rd trimester	75.9	105.2
Term	76.8	104.9
P value	0.57	0.84

t significant difference

During the latter part of gestation fasting glucose level increases. Though there is an increase in mean fasting glucose level in the 2nd trimester (71.7 mg/dl) compared to the 1st trimester (69.8 mg/dl) it did not reach significance ($p=0.31$). But there is a significant increase in fasting level in the 3rd trimester (75.9mg/dl) compared to the 2nd trimester (71.7 mg/dl) with a p value of 0.02 and the mean fasting glucose at term (76.8 mg/dl) were higher than the level at 2nd trimester (71.7 mg/dl) with a p value of 0.01. The mean fasting values are increasing towards term (76.8 mg/dl) but it was not statistically significant.

Thus the present study shows a gradual increase in fasting glucose levels until term.

Unlike the fasting levels, the mean GCT values in the 1st trimester (98.9mg/dl) are higher than the non-pregnant levels (96.2mg/dl) but it was not statistically significant.

In the 2nd trimester the mean GCT value (105.3mg/dl) is found to be higher than that in the 1st trimester (98.9mg/dl) but it could not attain statistical significance since the p value is 0.06.

The mean GCT in the 3rd trimester (105.2mg/dl) and at term (104.9mg/dl) were higher than that of the 1st trimester but it was not significant since the p values were 0.09 and 0.11 respectively.

Discussion

While comparing the mean GCT values of the 2nd (105.3mg/dl) and 3rd trimester (105.2mg/dl) there is not much difference between the two values and near term (104.9mg/dl) there is a slight reduction in mean GCT level.

Therefore, in the present study the GCT results reaches a high level during the 2nd trimester (105.3 mg/dl) and remains there for the rest of pregnancy and near term there is a slight reduction in the mean GCT value (104.9mg/dl).

In the present study, the mean GCT values in the 2nd (105.3mg/dl) and 3rd trimester (105.2mg/dl) were significantly higher than the non-pregnant (96.2mg/dl) level with p values of 0.002 & 0.001 respectively.

The mean GCT value in the 2nd trimester (105.3mg/dl) were higher than that of 1st trimester (98.9mg/dl) but it was statistically insignificant ($p=0.06$). After the 2nd trimester there is not much change in the GCT value until term. There was a small reduction in mean GCT result near term but it was not statistically significant. Therefore this study shows that the subjects attain a high GCT value during the 2nd trimester and that high level is maintained throughout gestation until term.

At the 4th International Workshop-Conference on GDM in 1997, universal screening using the SO g 1 hr glucose challenge test (GCT) is recommended for all pregnant women without regard to the fasting or fed state. The effect of prior meal ingestion is minimal & has been ignored as a matter of practice & convenience during GCT [7].

A plasma glucose value of 135 mg/dl is commonly used as a threshold for performing the diagnostic 100 gm OGTT in the clinical settings as recommended by Carpenter & Coustan in 1982. A cut *off* value of 135 mg/dl yielded a sensitivity of 100% and a specificity of 80% for GDM. There may be uncommon occasions when a patient with a screening test value below 135 mg/dl has an abnormal glucose tolerance test. The probability of GDM increased sharply at GCT results 183 mg/dl with 95% of them having gestational diabetes. The GCT results of

all women requiring insulin treatment were over 200 mg/dl^[8].

With respect to blood glucose control, insulin is considered as the major regulatory hormone, while glucagon, catecholamines, cortisol and growth hormone are collectively referred to as counterregulatory hormones. The presence of insulin resistance during pregnancy results in the tendency of postprandial hyperglycemia.

The basis of this insulin resistance is not entirely established but it may be related to the elaboration of hormones which antagonize the actions of insulin as well as stimulate the secretion of insulin. The increased insulin levels measured in pregnancy are biologically active and there is no shift to the more inactive precursor proinsulin^[10].

Several factors which are changed during pregnancy could be responsible for an enhanced insulin release. Prolactin increases markedly during pregnancy and it is suggested that prolactin exerts a direct beta cytotropic action on the islets. A striking similarity of glucose induced hyperinsulinemia in late pregnancy and prolactin excess due to pituitary tumors is present.

During late pregnancy both estrogens and progesterone levels are much higher than during the non-pregnant state. There is substantial evidence that these sex steroids modulate the beta cell function directly leading to an enhanced insulin release and addition pregnancy leads to a hyperplasia of the beta cells and to a more sensitive mechanism for the response to glucose and other stimuli. Therefore hyperinsulinemia in pregnancy may be the consequence of a direct beta cytotropic effect of these hormones during gestation^[10].

Conclusion

- In summary, the present study shows a highly significant increase in mean fasting glucose level in the 3rd trimester (75.9 mg/dl) and at term (76.8 mg/dl) compared to non-pregnant controls (71.5 mg/dl) with p values of 0.003 & 0.001 respectively. This study also shows a highly significant increase in mean fasting glucose levels in the 3rd trimester (75.9 mg/dl) and at term (76.8 mg/dl) compared to 1st trimester (69.8 mg/dl) with p values of 0.006 and 0.005 respectively.
- The mean fasting glucose in the 3rd trimester (75.9 mg/dl) and at term (76.8 mg/dl) were also significantly higher than the mean fasting glucose level at the 2nd trimester (71.7 mg/dl) with p values of 0.02 and 0.01 respectively.
- The mean GCT results in the 2nd trimester (105.3 mg/dl), 3rd trimester (105.2 mg/dl) and at term (104.9 mg/dl) were significantly higher than the mean GCT of non-pregnant controls (96.2 mg/dl) with p values of 0.001, 0.001 & 0.002 respectively. These results show hyperglycemia associated with advancing gestation which is consistent with previously done experiments.
- Future studies may be done experimentally to show which hormone contribute the most to the insulin resistance during pregnancy.

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