

Comparative Study of Variations in Blood Glucose Concentration in Different Phases of Menstrual Cycle in Young Healthy Women Aged 18-22 Years.

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Abstract: Hormones- estrogen and progesterone control the menstrual cycle in women. These hormones also affect the blood glucose. Many women notice fluctuations in blood glucose at certain times in their monthly cycle, such as an increase in blood glucose a few days prior to the beginning of their period and then a decrease once the period begins. This increase usually occurs after ovulation and before menstruation. These changes are caused by the hormones, estrogen and progesterone. When these hormones are at their highest level just before the menstruation, they affect another important hormone, insulin, which may in turn cause the blood glucose to rise. The study was carried out to know whether or not there are any consistent variations in the blood glucose levels in women with different phases of menstrual cycle and to compare the variations in blood glucose levels in different phases of menstruation between individuals. This study included 50 healthy women aged 18-22 years with regular menstrual cycles of 23-32 days who were non smokers and non alcoholics. Colorimetric technique was used for glucose measurement, enzyme linked immune sorbent assay technique (ELISA) for measurement of hormones. The results of the present study revealed significant increase in mean (\pm SD) values of serum glucose ($p < 0.0001$) and serum progesterone levels ($p < 0.0001$) with significant decrease of serum estradiol mean (\pm SD) values ($p < 0.0001$) in luteal phase than follicular phase of menstrual cycle of healthy women. The rise in blood glucose concentration during luteal phase compared to follicular phase in the same subject and between the individuals indicated faster carbohydrate metabolism during follicular phase as compared to luteal phase. The reason is probably due to changes in the level of endogenous female sexual hormones particularly progesterone which causes insulin resistance.

Key words: blood glucose, menstrual cycle, female sex hormones, young healthy women.

I. Introduction

It is common for women with diabetes to have difficulty with blood glucose control during the week prior to their menstrual period, with glucose levels being either higher or lower than usual. This problem seems to be more prevalent in women who say they suffer from the symptoms associated with premenstrual syndrome (PMS) ^(1,2).

During the first half of each cycle, levels of estrogen and progesterone hormones are relatively low. During the second part of the cycle, after ovulation, these hormone levels increase, causing the lining of the uterus to thicken in preparation for nourishing a fertilized egg. If fertilization does not happen, the ovary stops making these two hormones, and their sudden loss causes the uterus to shed the lining that is not needed; this shedding is known as menstruation ⁽¹²⁾.

A woman's glucose levels are controlled by certain hormones, just as hormones regulate the menstrual cycle. Indeed, the interference between certain hormones can lead to irregular blood sugar levels. For women with both type 1 diabetes as well as those with type 2 diabetes, fluctuations in blood glucose levels that are associated with menstruation can be a cause for concern ⁽³⁾. Most commonly, women with diabetes will experience a rise in blood glucose levels the week prior to menstruation, just after ovulation. Once a woman's period begins, her blood sugar levels will tend to drop. This fluctuation is caused by a rise in estrogen and progesterone levels, which interfere with insulin activity ⁽⁴⁾.

Many studies ^(5,9) recommended that women with diabetes monitor changes resulting from menstruation the same way they would monitor blood glucose levels. In order to find a correlation between menstruation and diabetes, make a note of the onset of your period in your blood glucose record book, and watch for any emerging patterns between glucose levels and the menstrual cycle over time. Women with diabetes should already be keeping a record book as part of a standard diabetes management. Women with type 1 diabetes (who should be recording glucose levels at least four times a day) will tend to experience the most fluctuations in the fasting blood glucose measured before breakfast just prior to the onset of menstruation ⁽¹³⁾.

II. Subjects And Methods

This study was conducted at the department of Physiology, Mysore Medical College and Research Institute, Mysore.

A total of 50 female students studying their MBBS Course in Mysore Medical College, Mysore were selected. The selected students were in the age group 18-22 years who were having regular, 28-day menstrual cycles for at least 6 months prior to this study. After detailed enquiry of the medical history of the subjects, those with history of smoking, alcoholism, medical illness were excluded. Subjects on oral contraceptive pill, hormonal replacement therapy were also excluded from the study. Informed written consent was obtained from all participants, and the experiment protocol was approved by Ethics Committee of the college.

Venous blood (5 ml) was collected during the follicular phase (5-11 days of menstrual cycle) and the luteal phase of the cycle (19-28 days of menstrual cycle). Serum glucose concentration, serum estradiol, progesterone were measured during follicular and luteal phase of the cycle. Colorimetric technique was used for glucose measurement, enzyme linked immune sorbent assay technique (ELISA) for measurement of hormones.

Statistical analysis:

The statistical analysis was done student's paired T test. P value less than 0.0001 was taken as significant.

III. Results

The mean (\pm SD) of serum glucose, estradiol, and progesterone concentration are illustrated in table:1

	On follicular phase (5-11 days of menstrual cycle)	On luteal phase (19-28 days of menstrual cycle)
Serum glucose (mg/dl)	91.14 \pm 4.93	111.26 \pm 5.89
Serum estradiol (pg/ml)	302.54 \pm 6.66	102.26 \pm 6.06
Serum progesterone (ng/ml)	0.97 \pm 0.29	26.12 \pm 6.79

* $p < 0.0001$

Significant increase observed in glucose concentration of healthy female with regular menstrual cycle with ($p < 0.0001$), as well as significant increase observed in progesterone concentration of healthy female with regular menstrual cycle with ($p < 0.001$), while it was found significant decrease in estradiol level ($p < 0.0001$) during the luteal phase in comparison with follicular phase of menstrual cycle. It was found that 22% of these 50 healthy female with regular menstrual cycle showed elevation in serum glucose concentration (reference value 100 mg/dl) with mean

107 mg/dl during the luteal phase of menstrual cycle, while the reminders have normal glucose concentration during this period.

IV. Discussion

Women with diabetes frequently report problems with blood glucose control around the time of menstruation. In the present study, healthy women showed that 22% of them have high levels of glucose during the luteal phase, while the rest have no significant change in either phases, probably may be related to the changes in female hormones (estrogen and progesterone) throughout the menstrual cycle⁽¹³⁾. One theory is that increased levels of progesterone cause increased insulin resistance. In turn this leads to hyperglycemia, while the decrease of glucose concentration during follicular phase can be concerned to high estrogen causing increased insulin sensitivity⁽⁶⁾.

The results of the present study are in agreement with other studies^(15, 18) which reported that many factors have been attributed to this phenomenon. These studies have reported elevated progesterone levels during premenstrual hyperglycemia and suggested that premenstrual symptoms may explain the unsatisfactory blood glucose control found during this period.

Other studies^(7,16) which showed that it is possible that eating patterns change in the week before menstrual cycle and affect glucose levels; that women often have increased appetites and cravings during the days leading up to menstruation "many women experience cravings for high-carbohydrate foods during the late luteal phase of their cycle", However these studies suggest that this cannot be the sole cause of premenstrual hyperglycemia.

Many studies^(10,14) found that progesterone is thought to be the main culprit in decreased insulin sensitivity during the luteal, or post-ovulation, phase, it's not completely understood. The hormone progesterone plays a vital role in controlling blood sugar levels. One of the many functions of progesterone is blood sugar regulation in all vertebrates. If the level becomes either too high or too low, loss of consciousness occurs, followed by death. Blood sugar imbalances are an increasingly common problem and in some measure can be laid at the door of hormone imbalances. The other theory reported that the variation in insulin sensitivity over the menstrual cycle was minimal and probably associated with psychological stress^(11,20) and have correlated psychological stress, presented as constituting part of the premenstrual syndrome in some diabetic women, with poor metabolic control including diabetic ketoacidosis and hypoglycemia during this period. These

investigators even suggested that treatment of the premenstrual syndrome may mitigate any menstrual cycle-related effects, improving insulin sensitivity and blood glucose control

The study is in disagreement with other study^(8,17) which compared 10 male and 20 female type 1 diabetes patients, using diaries in which variations in insulin dose were recorded. These investigators failed to detect any statistically significant difference in insulin sensitivity related to gender or to the phases of the menstrual cycle. Moreover, they suggested that changes in metabolic control during the menstrual cycle are probably attributable to Metabolic Control.

V. Conclusion

The study revealed that blood glucose level changes along the period of menstrual cycle, due to the interaction between the hormones that control menstruation (estrogen and progesterone) and the insulin hormone.

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