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Original Research Article

Correlation of ovarian and stromal volume to fasting and postprandial insulin levels in polycystic ovarian syndrome patients

Archana K.^{1*}, Preet Agarwal²

¹Department of Obstetrics and Gynecology, Government medical College, Omandurar Government Estate, Chennai, Tamil Nadu, India

²Department of Obstetrics and Gynaecology, Sri Ramachandra Research Institute and Higher Centre, Chennai, Tamil Nadu, India

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***Correspondence:**

Dr. Archana K.,

E-mail: archanasrijay@gmail.com

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ABSTRACT

Background: Polycystic ovary syndrome (PCOS) is a heterogeneous disorder with incidence of 5-10% in the reproductive-aged female population. With 3D ultrasound, we can precisely evaluate the ovarian anatomy. Hyperinsulinemia produces hyperandrogenism which in turn causes increased stromal production, increasing stromal volume and ovarian volume. This study aimed to find out if this ovarian and stromal volume increase, has any correlation with insulin levels.

Methods: The study was an observational study conducted in Sri Ramachandra College and Hospital, Chennai. This study comprised 100 patients in their reproductive age group with PCOS. After informed consent patients diagnosed with PCOS were asked to come on day 3 of cycle. On day 3 of cycle, fasting and 2 hours (75 gm glucose) postprandial insulin levels were measured. Ovarian and stromal volume using 3D ultrasound was measured on the same day. Results were then analysed for correlation.

Results: A total of 100 patients were involved in the study. Mean age group was 25 years. The mean fasting and postprandial insulins of the women in the study were 20.19 mIU/l and 48.73 m IU/l respectively. The mean ovarian and stromal volume was 12.48 cm³ and 7.34 cm³ respectively. 2 tailed Pearson correlation was obtained and was found that stromal volume had a positive correlation with fasting and postprandial insulin levels but not ovarian volume.

Conclusions: Stromal volume alone rather than total ovarian volume had a strong correlation with fasting and postprandial insulin levels in polycystic ovarian syndrome patients.

Keywords: Infertility, Insulin resistance, Ovarian volume, PCOS

INTRODUCTION

Polycystic ovarian syndrome (PCOS) is universally recognized as the commonest endocrinopathy of reproductive aged women.¹ The definition and the etiological hypothesis of PCOS are continuously evolving to accommodate expanding knowledge on the syndrome, which is now known to be more complex than purely a reproductive disorder. It is the main cause of anovulatory infertility, with incidence of about 5-10% in the

reproductive-aged female population.^{1,2} PCOS is characterized by the presence of polycystic ovaries, menstrual irregularities and clinical/biochemical hyperandrogenism.

Etiology of PCOS has been linked to hereditary and environmental factors including genetics, insulin resistance, obesity and birth weight. It is associated with an increased prevalence of adverse health conditions such as the metabolic syndrome, cardiovascular disease and

type II diabetes mellitus.³ Insulin resistance is believed to play a key role in the development of PCOS and in the development of related conditions.

With advances in ultrasonographic technology- 3D ultrasound, the application of high frequency scanning probes can evaluate the ovary in the analysis of morphological anatomy and in volume measurements, and is highly reproducible.⁴ The 3D volume measurements of ovary and stroma using virtual organ computer aided analysis (VOCAL) can be determined more precisely by outlining meticulously the region of interest.⁵⁻⁷

Hyperinsulinemia produces hyperandrogenism by stimulating ovarian androgen production and by reducing serum sex hormone binding globulin (SHBG).⁸⁻¹⁰ Hyperandrogenism in turn causes increased stromal production, increasing stromal volume and ovarian volume.² This study aimed to find out if this ovarian and stromal volume increase, has any correlation with insulin levels.

METHODS

The present study was a prospective observational study conducted in Sri Ramachandra university gynecology OPD from August 2014- August 2016. The sample size was calculated with Medcalc software with 99% confidence interval and power of sample 99% was 74 (80-100).

Inclusion criteria

The following were the inclusion criteria: patients with PCOS (according to Rotterdam's criteria).

Rotterdam's criteria

1. Oligo ovulation or oligomenorrhea (<6-9 menses/year).
2. Excess androgen activity (Ferriman-Gallwey score >8) or biochemical hyperandrogenism (elevated total/free testosterone).
3. Polycystic ovaries (by ultrasound ≥ 12 antral follicles in each/one ovary or ovarian volume $\geq 10\text{cm}^3$).

Exclusion criteria

The exclusion criteria were patients with diabetes mellitus and ovarian mass lesions (cystic/solid).

Methodology

After informed consent patients diagnosed with PCOS were asked to come on day 3 of cycle. On day 3 of cycle: fasting and 2 hours (75 gm glucose) postprandial insulin levels are measured. Ovarian and stromal volume using 3D ultrasound is measured on the same day.

After an overnight fasting of 10 hours, patient is asked to give a blood sample for fasting glucose and fasting insulin.

Insulin estimation was done by chemiluminescence method. 75 grams glucose was given and glucose and insulin were measured after 2 hours.

On the same day bilateral ovarian and stromal volume was measured using 3D ultrasound. The region of interest was selected and whole ovary was covered anteroposteriorly. Then using VOCAL ovarian volume was calculated. Threshold volume was switched on such that all follicles were excluded. Thus, ovarian volume and stromal volume was acquired. Mean of bilateral volumes were obtained.

Statistical analysis

Pearson correlation was used to correlate various parameters. It was frequently of interest to establish if there was a relationship between the two; i.e., to see if they correlate.

RESULTS

Maximum number of patients about 51% were in the age group 26-35 years. Mean age in our study was 25.88 years.

Table 1: Age distribution.

Age (years)	Number of patients	Percentage
15-25	46	46
26-35	51	51
36-45	3	3

Table 2: BMI.

BMI (kg/m ²)	Number of patients	Percentage
<18.5	1	1
18.5-24.5	35	35
25-29.9	50	50
>30	14	14

Maximum number of patients of about 50% were with BMI 25-29.9 kg/m². The mean BMI in our study was 25.66 kg/m². The commonest presenting complaint was irregular cycles (62%) followed by problems of increased hair growth (15%). It was found that maximum number of patients were multiparous (43%). The mean fasting insulin of the women in the study was 20.19 mIU/l. 24 patients (24%) had fasting insulin >27 mIU/l. The mean postprandial insulin level was 48.73 mIU/l. 81 patients (81%) had postprandial hyperinsulinemia of >27 mIU/l. It was found that the mean ovarian volume in this study was 12.48 cm³ and the mean stromal volume was 7.34 cm³.

2-tailed Pearson correlation was obtained between fasting and postprandial insulin levels and the ovarian and stromal volume.

In this study stromal volume correlated with fasting insulin with a significance level of 0.000. In our study stromal volume correlated with postprandial insulin with a

significance level of 0.001. In the present study there was no significant correlation obtained between fasting and postprandial insulin with ovarian volume.

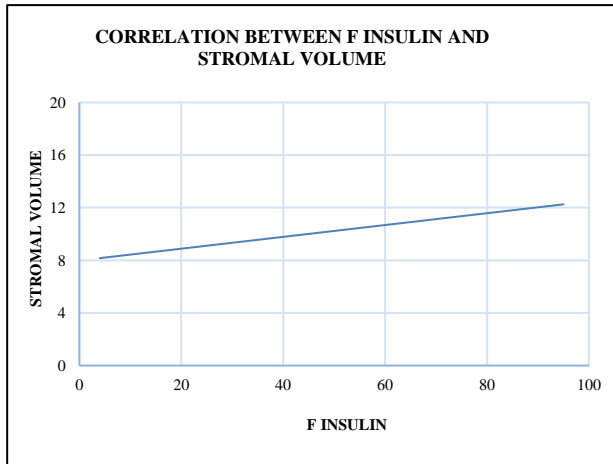


Figure 1: Scattered diagram showing positive correlation between fasting insulin and stromal volume.

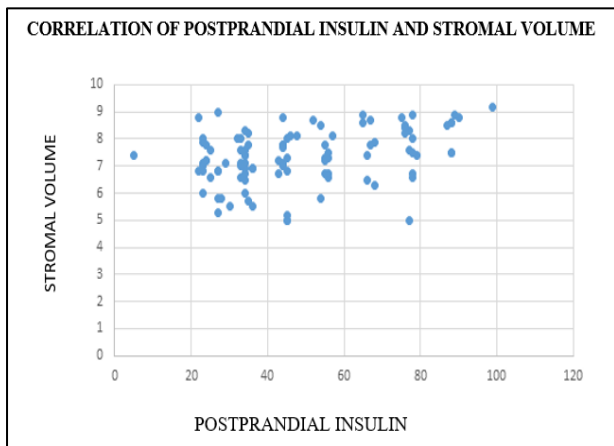


Figure 2: Scattered diagram showing correlation of postprandial insulin with stromal volume.

DISCUSSION

Polycystic ovarian syndrome (PCOS) is a multisystem endocrinopathy affecting 5-10% of women of reproductive age group. Insulin resistance is found to be the major factor in the etiology. The resulting hyperinsulinemia plays a major role in pathogenesis of reproductive disorders. Hyperinsulinemia in turn causes excess androgen production. These androgens cause proliferation of stromal cells and theca cells.⁴ This leads to increase in stroma in PCOS. With the advent of 3D ultrasound precise ovarian morphology can be obtained.³

Thus, in this study we wanted to assess if this hyperinsulinemia has any significant correlation between ultrasound assessed ovarian volume and stromal volume which is expected to occur.⁵

Age

The mean age in the present study was 25.88 years with maximum number of patients (51%) between 26-35 years.

BMI

The mean BMI of the present study was 26.66 kg/m² with 50% of patients were overweight (BMI 25-29.9). In our study, we found no correlation between BMI and ovarian volume and stromal volume and insulin levels. In a research by Sikka, the ovarian volume was positively correlated with BMI and WHR.² However, Norman et al reported that increase BMI was not always associated with high glucose and insulin levels. In that study, the insulin levels were higher in those patients with BMI>28 and WHR>0.08 than in their counterparts. Although the relations were not significant, it may support the common view of the positive relationship between obesity and hyperinsulinaemia.¹² Fulghesu et al reported a positive correlation between BMI and insulin levels (fasting and glucose stimulated insulin).¹¹

Fasting insulin

The mean fasting insulin in our study of 100 patients was 20.19 mIU/l.

Our study showed a significant correlation (by 2-tailed Pearson correlation) between fasting insulin and stromal volume (significance level of 0.000) in PCOS patients. No such correlation was found between fasting insulin levels and ovarian volume.

In a study by Panchal and Nagori, they reported a strong correlation of ovarian and stromal volume to fasting insulin.³

Sikka reported a significant correlation between ovarian volume and insulin levels.

Postprandial insulin

The mean postprandial insulin level in our study was 48.73 mIU/l.

In a similar study with 100 patients by Panchal and Nagori, they reported a strong correlation between ovarian and stromal volume postprandial insulin levels.³

In a study by Saxena et al, they reported that 2 hours post-glucose insulin levels significantly correlated with AUC of glucose and insulin and insulinogenic index.⁷ They concluded that 2 hours post-glucose insulin level appears to be a good indicator of Insulin resistance.

In our study ovarian volume did not correlate with either the fasting insulin levels nor the postprandial insulin levels, a similar observation was reported by Legro et al in 2005. Legro et al concluded that neither the insulin

sensitivity index, fasting or 2-hour values, or any integrated measures of glucose and insulin varied in women according to either morphology or volume.¹²

In a study by in 1993 Pache et al, they reported correlation between ovarian volume and degree of insulin resistance. No such correlation was obtained in the present study.

However, studies by Legro et al and Pache et al used 2D ultrasound for measuring the ovarian morphology, Panchal and the present study used much precise 3D ultrasonography in studying ovarian morphology.³

Ovarian volume and stromal volume

Our study showed mean ovarian volume of 12.48 cm³ and mean stromal volume of 7.349 cm³.

Sonam and Nagori showed a positive correlation between ovarian and stromal volume to fasting and postprandial insulin levels.³

In a study involving 1275 Caucasian women with PCOS by Neokalis et al in 2016, he reported that all indices of insulin resistance studied (fasting glucose and insulin) in comparison with the PCO morphology as ovarian volume and increased ovarian stroma had any significance with insulin levels.⁴ In contrary our study proved significance between stromal volume and fasting and postprandial insulin levels.

Markussis and co-workers studied the role of insulin in ovarian size in patients with the polycystic ovary syndrome.⁵ They reported that fasting insulin levels correlated positively with ovarian volume. This study showed that insulin seems to be an important determinant of ovarian volume in women with PCOS.

The present study, though establishing a positive correlation between ovarian volume and insulin levels we need further studies with larger sample size.

CONCLUSION

Stromal volume alone rather than total ovarian volume had a strong correlation with fasting and postprandial insulin levels in polycystic ovarian syndrome patients.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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