ORIGINAL ARTICLE

Correlation of Ovarian and Stromal Volumes to Fasting and Postprandial Insulin Levels in Polycystic Ovarian Syndrome Patients

[1]Sonal Panchal, [2]CB Nagori

ABSTRACT

Background: Patients with polycystic ovarian syndrome (PCOS) are believed to have large ovaries due to increased stroma. They also have derangement in luteinizing hormone (LH) and testosterone levels and high insulin resistance. As insulin resistance is thought to be associated with androgen and stromal excess, correlation was expected between insulin resistance and stromal excess.

Aim: To assess if ovarian and stromal volumes in PCOS patients have any correlation with fasting and postprandial insulin levels.

Materials and methods: A prospective study of 153 subfertile patients was done over a period 18 months. After detailed history, clinical examination and informed consent of all patients were scanned by two-dimensional (2D) on day 3 of the cycle. Patients were divided into PCOS and non-PCOS groups according to Rotterdam criteria. Patients with hormonal derangements other than PCOS were excluded from the study.

Patients were assessed by three-dimensional (3D) ultrasound (US) for ovarian and stromal volumes and fasting and postprandial insulin levels were checked on the same day.

Results: With Pearson correlation significance level of 0.354 (2 tailed) correlation for ovarian volume to fasting insulin was 0.588, for ovarian volume to postprandial insulin was 0.523, for stromal volume to fasting insulin was 0.601, and for stromal volume to postprandial insulin was 0.523. No correlation could be established in non-PCOS group.

Conclusion: In PCOS patients, a strong correlation was found between ovarian and stromal volume and fasting and post prandial insulin levels.

Keywords: Polycystic ovarian syndrome, Ovarian volume, Stromal volume, Insulin levels.

[1]Sonologist, [2]Director and Infertility Consultant

[1,2]Dr Nagori's Institute for Infertility and IVF, Ahmedabad, Gujarat India

Corresponding Author: Sonal Panchal, Sonologist, Dr Nagori's Institute for Infertility and IVF, Ahmedabad, Gujarat, India e-mail: sonalyogesh@yahoo.com

INTRODUCTION

Polycystic ovarian syndrome (PCOS) is the commonest problem found in the subfertile women and the least understood one. It is also associated with metabolic derangements like increased insulin resistance and worsened lipid profiles. The treatment, therefore, now demands correction of the entire syndrome rather than subfertility alone. This is only possible if a correlation between endocrinological and metabolic derangements can be established.

MATERIALS AND METHODS

A prospective study of 153 subfertile patients was done over a period of 18 months with history, clinical examination, baseline ultrasound (US) scan with two-dimensional (2D).

They were all scanned by 2D US on day 3 of the cycle. Each ovary was scanned on 2D US in its most longi-tudinal axis to measure long diameter of the ovary. Probe was then rotated 90° to see ovary in transverse section. In this section, transverse and anteroposterior diameter of the ovary was measured. Ovarian volume was calculated using these three diameters, using the formula $(X \times Y \times Z \times 0.523)$ (Fig. 1).

Each ovary was scrolled through to count the number of antral follicles (2-9 mm). Ovaries were considered to be polycystic according to Rotterdam criteria for polycystic ovaries (ovaries of >10 cc in volume and/or 12 or more antral follicles).

Patients with body mass index (BMI) <25 kg/m^2 or >32 kg/m^2 proved diabetes mellitus, any other endocrinological derangement (thyroid, adrenal, etc.), follicles larger than 9 mm or residual corpus lutea on day 3, and ovarian mass lesions (cystic/solid), were excluded from the cohort study. Patients with ovaries <3 cc in volume and <3 follicles per ovary were also excluded from the study.

Informed consent was taken from all those who were recruited for the study. The patients were divided into two groups.

Group A: Patients with normal ovulation, no hirsutism, normal menstrual cycle, and normal ovarian size, <12 antral follicles. Total patients recruited in this group were 67.

Group B: Patients with PCOS, according to Rotterdam criteria. Total patients recruited in this group were 50.
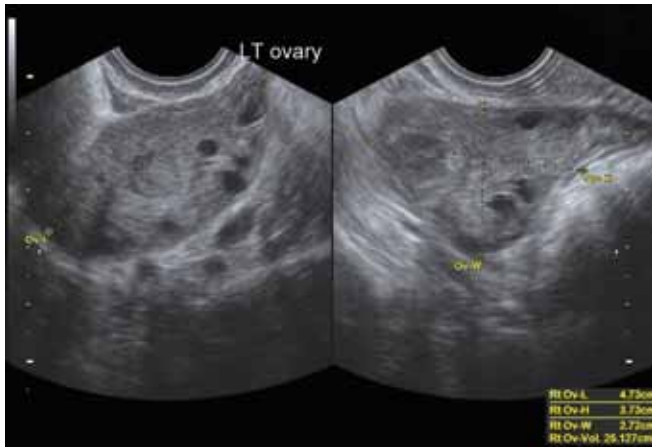
Fig. 1: Two-dimensional ultrasound of ovary, long section, and transverse section
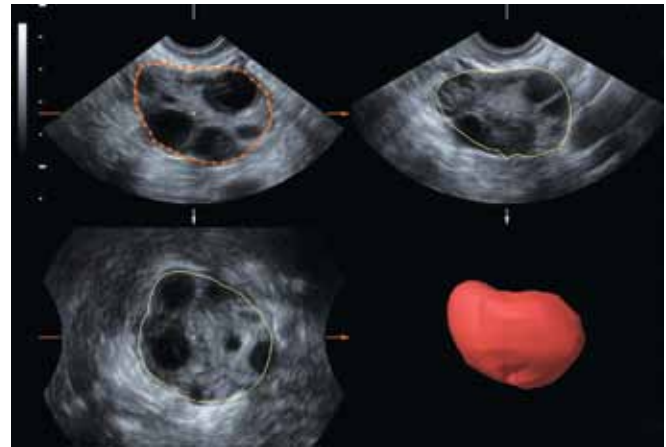

Fig. 2: Ovarian volume by three-dimensional ultrasound VOCAL software

Age range of patients for both groups was between 25 and 35 years with mean age for group A was 30.4 years, mean age for group B was 29.7 years. Mean BMI in both the groups was 28, ranging from 25 to 32 kg/m^2.

Three-dimensional (3D) ultrasound was done on the same day and volume for both the ovaries was acquired.

To acquire a 3D volume, region of interest was selected large enough to include whole ovary and angle of acquisition was wide enough to cover the whole ovary anteroposteiorly. Once the volume was acquired, it was checked for its adequacy by walking through the volume. Then using VOCAL (volume calculation by computer), ovarian volume was calculated. VOCAL software rotates the volume across 180°. Rotating angle of 15° was selected (Fig. 2).

Once volume of the ovary was calculated, threshold volume was switched on. Threshold was set in such a way that all follicles and only follicles were excluded from the volume. On the screen calculated volume shows three values of which one is total ovarian volume, another that is labeled as above threshold is stromal volume and third that is labeled as below threshold is follicular volume. Thus, total ovarian volume and stromal volume were derived. Mean of both

ovarian volumes and both ovarian stromal volumes were taken for all calculations (Fig. 3).

Fasting and postprandial insulin levels were checked for all on the same day. Insulin estimation was done by chemiluminescence method. For postprandial (PP) insulin measurement, patient was given 75 gm of glucose after fasting blood sample and then blood sample for PP insulin was taken after 2 hours. Ovarian and stromal volumes were compared and correlated with both fasting and PP insulin levels. Two-tailed Pearson correlation was checked for ovarian volume, stromal volume, and stromal volume to ovarian volume ratio with fasting insulin and postprandial insulin level each.

RESULTS

Mean	PCOS group	Non-PCOS group
Ovarian volume	9.8 ± 2.3 cc	6.8 ± 2.5 cc
Stromal volume	7.1 ± 2.12 cc	3.9 ± 2.2 cc
Stromal volume/ ovarian volume	82.522 ± 5.424	63.453 ± 6.733
Fasting insulin	45.34 ± 7.66	20.05 ± 8.44
PP insulin	93.21 ± 9.28	54.32 ± 12.12

PCOS: Polycystic ovarian syndrome; PP: Postprandial

(Normal values for fasting insulin: 2.6-37.6 mu/l, postprandial insulin 22-79 mu/l).

Values for correlation were as follows:
- Stromal volume to fasting insulin: 0.601009 for PCOS group and 0.253 for non-PCOS group with significance level of 0.354.
- Stromal volume to postprandial insulin: 0.522969 for PCOS group and 0.213 for non-PCOS group with significance level of 0.354.
- Ovarian volume to fasting insulin: 0.58842 for PCOS group and 0.295 for non-PCOS group with significance level of 0.354.
- Ovarian volume to postprandial insulin: 0.522989 for PCOS group and 0.218 for non-PCOS group with significance level of 0.354.
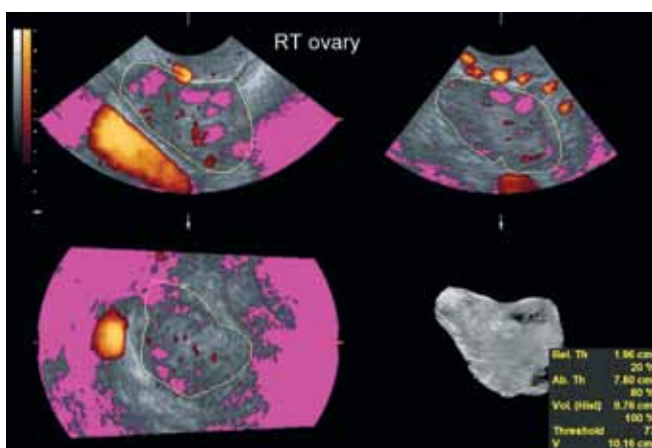

Fig. 3: Ovarian stromal volume by three-dimensional ultrasound VOCAL and threshold volume

DISCUSSION

Approximately, 20 to 30% of women in reproductive age have polycystic ovaries and about half of these have of PCOS. Polycystic ovarian syndrome is a metabolic disease. According to the European Society of Human Reproduction and Embryology/American Society of Reproductive Medicine (ESHRE/ASRM) consensus 2003 (Rotterdam), the diagnosis of PCOS consists of at least two of the three following criteria.

1. Oligo and/or anovulation
2. Hyperandrogenism
3. Polycystic ovaries.

This means if one of the first two clinical features is present, then the diagnosis of PCOS depends on the US picture of ovaries.

Patients with PCOS have large ovaries due to increased stroma and large number of antral follicles on US. They also have derangement in luteinizing hormone (LH) and androgen levels and high-insulin resistance.

Looking into the pathophysiology, theca cells of PCOS women hyper respond to gonadotropins LH and produce excess androgens. This dysregulation is linked to excess of insulin and insulin-like growth factor-1 (IFG-1). Hyperinsulinemia is a key factor in the pathogenesis of PCOS. Insulin augments LH-stimulated androgen production by stromal cells. Androgen in turn causes proliferation of stromal and theca cells. This leads to increased stroma in the PCOS. Stromal volume was positively correlated with serum androstenedione concentrations in patients with PCOS.[1] Increased androstenedione secretion as shown earlier is due to hyperinsulinemia.[2]

Based on these facts, several studies were done to find out if there was any correlation between US features of polycystic ovaries and insulin resistance which is indicated by insulin levels or its ratios with sugar levels. These had controversial results and to quote examples 'Neither insulin sensitivity index, fasting or 2 hours values, or any integrated measures of glucose and insulin varied in women according to either morphology or volume nor was there association with circulating androgen levels.[3]

Pache et al[2] did show correlation between ovarian volume and stromal echogenicity and the degree of insulin resistance in 1993.

But these studies are by 2D US and more accurate determination of stromal volume by 3D US is likely to make the difference.

With the invent of 3D US and more so with the VOCAL software, the volume calculations of the ovary and the stroma can be done much more precisely than ever before. Therefore, this study was initiated to assess if a correlation can be established between the fasting and PP insulin levels, that represent the insulin resistance and ovarian and stromal volume.

CONCLUSION

In PCOS patients, a strong correlation was found between ovarian and stromal volume and fasting and postprandial insulin levels but is the best for ovarian stromal volume to fasting insulin levels. No such correlation was found in non-PCOS group.

REFERENCES

1. Balen AH, et al. Polycystic ovary syndrome: a guide to clinical management. New York: Taylor & Francis, 2005. p. 33-58.
2. Pache TD, de Jong FH, Hop WC, et al. Association between ovarian changes assessed by transvaginal sonography and clinical and endocrine signs of polycystic ovary syndrome. Fertil Steril 1993;59(3):544-549.
3. Legro RS, Chin P, Allen R, Kunselman, Bentley C, William C, Dodson, Andrea. Polycystic ovaries are common in women with hyperandrogenic chronic anovulation but do not predict metabolic or reproductive phenotype. JCEM 2005;90(5):2571-2579.