

To Study Correlation of Ovarian Volume with Menstrual Abnormalities in PCOS

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Abstract

Background: The aim is to study correlation of ovarian volume with menstrual abnormalities in PCOS. **Material and Methods:** This prospective study was conducted in the department of Obstetrics & Gynaecology, Radiology at Aarupadaiveedu Medical College & Hospital in total of 100 women with PCOS. After taking a proper history, all patients were thoroughly examined clinically (by the same Gynecologist), and their findings were recorded. The following information were obtained including name, age, gravida, parity, duration of infertility, menstrual disorders, evidence of hyperandrogenism (hirsutism and acne), family and drug history. **Results:** The ultrasound appearance of the ovaries is illustrated in [Table 2]). The ovaries showed characteristic polycystic morphology. Mean total ovarian volume was $(14.8 \pm 4.3 \text{ cm}^3)$ and the mean total follicular number $(13.5 \pm 1.9 \text{ mm})$. Both ovaries were enlarged in 80 (80%) with a mean ovarian volume of $(16.8 \pm 2.06 \text{ cm}^3)$. The ovaries were of normal size in 20 (20%) with a mean ovarian size of $(7.8 \pm 1.3 \text{ cm}^3)$. All polycystic ovaries were found to have thick capsule. The mean total follicular numbers were $(14.8 \pm 1.4 \text{ mm})$ in women with enlarged ovarian size and $(12.4 \pm 0.9 \text{ mm})$ in women with normal ovarian size. There was no statistical significant difference obtained between the mean ovarian volume of right and left ovaries in women with PCOS. Positive correlations were found between total ovarian volume and hirsutism ($r=0.281$, $p=0.002$), & acne ($r=0.228$, $p=0.009$) and obesity ($r=0.371$, $p=0.0001$), while oligomenorrhoea and amenorrhoea showed negative correlations with total ovarian volume ($r=0.062$, $p=0.258$) and ($r=0.032$, $p=0.225$) respectively. **Conclusion:** We have shown that in patients with classic PCOS, enlarged ovaries are present in 78.5% & 21.5% of patients had normal ovarian volume and all of these patients, have altered ovarian morphology.

Keywords: PCOS, Ovarian volume, Ovarian capsule, Hirsutism, Ovarian stroma.

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Introduction

Hirsutism is a common endocrine disorder, defined as increased growth of terminal hair in a male pattern.^[1,2] Polycystic ovaries are one of the most frequent cause of hirsutism which affect 4- 10% women of reproductive age group.^[3,4] Women with idiopathic hirsutism have normal menstrual cycle and androgen levels.^[5] whereas women with hirsutism and oligo/oligohypomenorrhea represent one of the presentation of polycystic ovaries, as polycystic ovary syndrome reflects multiple etiology and variable presentation.^[6] Polycystic ovarian syndrome (PCOS) affects 5-12% of women of reproductive age.^[7] The relation of the syndrome to menstrual cycle abnormalities has been already described and it seems that menstrual irregularities seem to precede the presence of PCOS.^[8,9] Current evidence supports a close relation between the degree of cycle irregularities and the grade of endocrine and metabolic disorders among these women.^[10-12] Hyperandrogenism has been previously described as a significant metabolic risk factor in women. Specifically, Shaw et al reported that post-menopausal women who had a history of menstrual abnormalities and elevated androgen levels had increased odds of developing coronary arterial disease and of cardiovascular events which could ultimately result to death compared with a control population.^[13] Obesity also seems to be significantly associated with menstrual function whereas, weight loss results in significant improvement of menstrual cycle patterns.^[14-19] According to Strowitzki et al normocyclic PCOS patients have significantly better metabolic (BMI, fasting insulin, HOMA-IR) and hormonal (LH, FSH, FAI and testosterone) parameters.^[10]

Materials and Methods

This prospective study was conducted in the department of Obstetrics & Gynaecology, Radiology at Aarupadaiveedu Medical College & Hospital at in a total of 100 women with PCOS. After taking a proper history, all patients were thoroughly examined clinically (by the same Gynecologist), and their findings were

recorded. The following information were obtained including name, age, gravida, parity, duration of infertility, menstrual disorders, evidence of hyperandrogenism (hirsutism and acne), family and drug history.

All women studied had no other endocrine disorders such as galactorrhoea, thyroid dysfunction, diabetes mellitus, Cushing's syndrome, non-classical adrenal hyperplasia and androgen secretory tumors. None of the patients received any form of hormonal treatment in the preceding 3 months. The diagnosis of PCOS was established on the basis of the association one of the clinical criteria (hyperandrogenism, and chronic anovulation (which was defined by the absence of ovarian function for at least three consecutive months with the exclusion of other endocrine disorders. Oligomenorrhoea can be defined arbitrarily as one in which the intermenstrual cycle lasts longer than 35 days. Secondary amenorrhoea can be defined as absence of menstruation for six months.^[20] The degree of oligomenorrhoea was classified according to the normative data of Treloar and colleagues.^[21]

General examinations including built, hair distribution, thyroid and breast examination. Body weight and height were recorded for determination of body mass index (BMI) measured by weight (kg) / height (squared meters)²² normal BMI range (19-25kg/m²), hirsutism was staged according to established criteria of (Ferriman and Gallwey scores).^[23,24]

Hormonal measurements: In all women with oligomenorrhoea & amenorrhoea, withdrawal bleed was induced with 5 mg oral medroxyprogesterone acetate (provera) twice daily for 7 consecutive days.^[25] Basal serum testosterone levels, LH, FSH, & prolactin were assessed on day 3 of the cycle in the same hospital laboratory and read by the same person. Testosterone concentrations were measured by radioimmunoassay. The intra-assay variation was <4% and the inter-assay variation were <11%, results are expressed as ng /mL. Serum LH and FSH concentrations were measured by means of conventional immunodiometric assay. The intra-assay variation was < 5% and the inter-assay was < 8%, results are expressed as mIU/mL.

A raised serum testosterone level, LH level, FSH level and PRL were defined as > 0.9ng /mL, > 8mIU / mL, > 12mIU/ mL and > 20ng/mL respectively. As these values were the upper limits of the normal reference range of our local laboratory. LH / FSH ratio was estimated and raised ratio was defined as >2.23.

Ovulation was confirmed by serum progesterone levels measurement on day twenty first of the cycle. Ovulation was considered satisfactory when serum progesterone measurements were > 30 nmol / L in two successive cycles.^[26]

Ultrasound assessment: In all patients ovarian volume and morphology were determined by two experienced Radiologists, using 2.5 MHZ curved array Linear scanner MIND RAY DC80 (Trans Abdominal Ultrasound) on the same day as hormonal measurement were taken. After visualization of the ovaries with the use of a full bladder technique, the following sonographic findings were recorded: 1- Ovarian volume was calculated by the formula for a prolate ellipsoid: (1/2 x length x width x thickness).^[27] 2- Total number, diameter and distribution of the cystic structures per ovary were counted and recorded in mm. 3- Ovarian capsule, whether thick or thin. Polycystic ovarian morphology was diagnosed when there were >10 follicles with diameter 2-9 mm arranged peripherally or scattered throughout an echo dense stroma and thick capsule.^[15,28] Average normal sized ovaries are (2-10mm). Ovarian volume > (10 cm³) was considered increased.^[29]

According to ultrasound findings, all patients who had enlarged ovaries were compared with those who had normal-sized ovaries regarding clinical and hormonal findings in order to determine a possible association between clinical, and hormonal findings and ovarian volume.

Statistical analysis was performed in SPSS 25.0 for windows statistical package.

Results

One hundred seven women were included in this study. Their ages range from 18-40 years, mean (28.30 ± 4.6 years) & mean BMI was (30.79 ± 4.02 kg /m²). [Table 1] All women with menstrual dysfunction had a withdrawal bleed within 2-7 days after completing the progestational agent course.

Table 1: Age and body mass index of women with PCOS

Parameter	Total No : (100)
Age (in years)	28.30 ± 4.6
BMI(kg/m ²)	30.79 ± 4.02

The ultrasound appearance of the ovaries is illustrated in [Table 2]. The ovaries showed characteristic polycystic morphology. Mean total ovarian volume was (14.8 ± 4.3 cm³) and the mean total follicular number (13.5 ± 1.9mm). Both ovaries were enlarged in 80 (80%) with a mean ovarian volume of (16.8 ± 2.06 cm³). The ovaries were of normal size in 20 (20%). with a mean ovarian size of (7.8 ± 1.3 cm³). All polycystic ovaries were found to have thick capsule. The mean total follicular numbers were (14.8 ± 1.4 mm) in women with enlarged ovarian size and (12.4 ± 0.9mm) in women with normal ovarian size.

Table 2: Ovarian ultrasound features in women with PCOS

Parameter	Total No: (100)	Women with enlarged ovariesNo:%(80)(80%)	Women with normal ovarian sizeNo:%(20)(20%)
Ovarian volume	14.8 ± 4.3	16.8 ± 2.06	7.8 ± 1.3
Total follicular number(mm)	13.5 ± 1.9	14.8 ± 1.4	12.4 ± 0.9

There was no statistically significant difference were obtained between the mean ovarian volume of right and left ovaries in women with PCOS. [Table 3]

The clinical features are presented in [Table 4]. Eighty-two (82%) were found to have primary infertility and 18(18%) of woman were found to have secondary infertility. Hirsutism was present in 84 (84%), acne in 73 (73%), oligomenorrhoea in 83 (83%),all women with oligoamenorrhoea were found to have vaginal bleeding at interval of 45 days -3 months, secondary amenorrhoea in 24 (24%) and obesity (BMI >25 kg/m2) was recorded in 94 (94%) of women with PCOS.

Comparison between PCO women who had enlarged ovaries versus those who had normal ovarian size showed that hirsutism, acne and obesity were found to be higher in group with enlarged ovaries. The values were (84.5% vs. 56.5%), (73.8% vs. 47.8%) and (92.9% vs.69.6%) respectively. The differences were statistically significant p. <0.05.

Table 3: Right and left ovarian volume in women with PCOS

Parameter	Total ovarian volume in women with PCOS No: (100)	Ovarian volume in women with enlarged ovaries No: (80)	Ovarian volume in women with normal ovarian size No:(20)
Right ovary	14.8 ± 4.4	16.8 ± 2.5	7.8 ± 1.4
Left ovary	14.7 ± 4.2	16.6 ± 2.02	7.8 ± 1.3
P value	N S	N S	N S

Table 4: Clinical features of women with PCOS

Clinical feature	Total No:(100)	Women with enlarged ovarian volume. No:(80)	Women with normal ovarian size. No :(20)	P- value
Infertility				
Primary infertility	82 (82%)	73 (91.25%)	15 (75%)	0.01 S
Secondary infertility	18 (18%)	7 (8.75%)	5 (2.5%)	0.01 S
Hirsutism	84 (84%)	71 (88.75%)	13 (65%)	0.01 S
Acne	73 (73%)	62 (77.5%)	11 (55%)	0.001 S
Oligomenorrhea	83 (83%)	64 (80%)	19 (95%)	N S
Secondaryamenorrhoea	24 (24%)	20 (25%)	4 (20%)	N S
Obesity	94 (97%)	78 (97.5%)	16 (80%)	0.001 S

In spite of higher percentage of secondary amenorrhoea was detected among women who had enlarged ovaries in comparison to women with normal ovarian size (23.8% vs. 17.4%), the difference was statistically non-significanton the other hand, higher percentage of oligoamenorrhoea was found among women who had normal ovarian size in comparison to women who had enlarged ovaries (82.6% vs. 76.2%); the difference was statistically non-significant[Table 4].

Biochemical indices are illustrated in [Table 5]. Women with PCOS were found to have elevated mean serum testosterone, Serum LH and LH/FSH ratio. The values were (2.5±0.76), (12.82±4.4) and (2.92±1.05) respectively, whereas the mean FSH (6.8± 3.8) and PRL (11.10±4.2) levels were found to be within a normal ranges. Comparing these biochemical findings between patients who had enlarged ovaries and those who had normal ovarian size, this study has confirmed that mean serum testosterone level, mean LH level and LH/FSH were found to be significantly higher among women with enlarged ovaries. (2.6±0.71 vs. 0.71±0.67), (12.14±4.25 vs. 7.8±3.10) & (3.07±1.08 vs. 2.39±0.92) respectively. P values-0.001, 0.001 & 0.001. While mean FSH level among women who had enlarged ovaries was (6.11±3.99) in comparison to (5.86±2.02) among women who had normal- sized ovaries. The difference was statistically non-significant. The mean serum prolactin levels showed normal levels in all women with PCOS. The values were (11.7±4.04) in women who had enlarged ovaries and (12.6±4.02) in those who had normal ovarian size.

Table 5: Biochemical indices in women with PCOS

Parameter	Testosterone ng/ml	LH miu/ml	FSH miu/ml	LH/FSH ratio	Prolactin miu/ml
Women with PCOS Total No:(100)	2.5 ± 0.76	12.82 ± 4.4	6.8 ± 3.8	2.92 ± 1.05	11.10 ± 4.2
Women with enlarged ovarian volume No: (80)	2.6 ± 0.71	13.14 ± 4.25	6.11 ± 3.99	3.07 ± 1.08	12.6 ± 4.2
Women with normal ovarian size No: (20)	0.71 ± 0.67	7.8 ± 3.10	5.86 ± 2.2	2.39 ± 0.92	11.7 ± 4.04
P- value	0.0001 S	0.001 S	0.212 N.S	0.001 S	0.277 N.S

Positive correlations were found between total ovarian volume and hirsutism ($r=0.281$, $p=0.002$), & acne ($r=0.228$, $p=0.009$) and obesity ($r=0.371$, $p=0.0001$), while oligomenorrhoea and amenorrhoea showed negative correlations with total ovarian volume ($r=0.062$, $p=0.258$) and ($r=0.032$, $p=0.225$) respectively.

Table 6: Correlations between total ovarian volume with clinical findings.

	Hirsutism	Acne	Oligoamenorrhoea	Amenorrhoea	Obesity(BMI>25kg/m ²)
Ovarian volume	$r = -0.281$	$r = -0.228$	$r = 0.062$	$r = 0.032$	$r = 0.371$
	$P=0.002^{**}$	$P=0.009^{**}$	$P=0.258$ N S	$P=0.225$ N S	$P=0.0001^{**}$

[Table 7] shows the correlations between the total ovarian volume and hormonal parameters. Positive correlations were found between total ovarian volume and serum testosterone, serum LH and LH / FSH ratio ($r=0.519$, $p=0.0001$), ($r=0.562$, $p=0.0001$) and ($r=0.267$, $p=0.01$) respectively. Negative correlations were found between total ovarian volume and serum FSH ($r=0.203$, $p=0.479$).

Table 7: Correlations between total ovarian volume with biochemical indices in women with PCOS.

	Testosterone levels	LH levels	FSH levels	LH / FSH Ratio
Ovarian volume	$r = 0.519$	$r = 0.562$	$r = 0.203$	$r = 0.267$
	$**0.0001$	$**0.0001$	N S	$**0.01$

P-value was determined by Pearson s correlation coefficient test

Discussion

Hirsutism is a common endocrine disorder, defined as increased growth of terminal hair in male pattern. It is most often caused by polycystic ovarian syndrome (PCOS).^[2] PCOS is a heterogeneous syndrome of hyperandrogenic anovulation that is typically due to intrinsic ovarian dysfunction.^[28] The main manifestations of PCOS include the following: menstrual irregularity, excess body hair, infertility, acne, androgenetic alopecia and obesity. These manifestations appear quite heterogeneously, with marked difference in prevalence and intensity among different groups of women with PCOS.^[29]

In this study, we found that altered ovarian morphology occur in all women with clinical diagnosis of PCOS. Our findings are close to study done by Eneico et al.^[30] After calculation the ovarian volume, we found 78.5% of women had increased ovarian size while 21.5% were found to have normal ovarian volume, but with classical ovarian findings on US [Table 2]. Our results are close to that reported by.^[26,31]

It is interesting that in creating the new criteria for the diagnosis of PCO, the consensus panel did not find the classical appearance of follicle distribution and increased stromal mass to be necessary for the diagnosis.^[32] Although other investigators have stressed the importance of increased ovarian stroma, or the ratio of stroma / total area,^[33] the consensus panel stated that this is reflected in total volume determination.^[32] Because the peripheral orientation of cystic structures is not a criterion for the diagnosis for the current diagnosis.^[32,34,35] In the present study the clinical features in women with PCOS were evaluated and we found all women with PCOS presented with anovulatory infertility. Our finding is higher than that of Kosta et al.^[22] In this study, hirsutism and acne were present in (78.5%) and (68.2%) of patients respectively. Our results were higher than that reported by Gulekli, Pache.^[36,37] When comparing these clinical findings in women who had enlarged ovaries with those who had normal- sized ovaries, we found hirsutism and acne were higher in women who had

enlarged ovaries [Table 4]. The differences were statistically significant and in agreement to that reported by Tabbakh.^[24,31,38]

Another finding in our study, obesity has been proven to be important and common clinical findings. It was present in (87.8%) of patients. This result is in agreement to that of Ahmed, Michelmor.^[38,39] A higher significant relationship of obesity was found in women who had enlarged ovaries in comparison to women with normal ovarian size. Our result is in agreement to that of Tabbakh.^[24] Menstrual disorder is another main clinical presentation, was also evaluated in our study. Approximately (77.6%) of patients presented with Oligomenorrhoea. Our result is similar to that of Abdel Gadir.^[40] The prevalence of oligomenorrhoea was higher among women who had normal- sized ovaries compared with women who had enlarged ovaries [Table 4]. The difference was statistically non-significant and in agreement with other studies.^[24,36] Amenorrhoea was present in (22.4%) of women with PCOS, our finding is higher than that of Ahmed.^[38] In this study a higher nonsignificant percentage of secondary amenorrhoea was found among women who had enlarged ovaries (23.8%) in comparison to those women with normal sized ovaries (17.4%). Our results are in agreement to that of biochemical data analyzed in our study. Serum testosterone levels & LH were elevated in women with PCOS. Our finding is in agreement to that of Carmina, Puzigaca.^[30,31,36,39] In this study, we documented that woman who had enlarged ovaries had higher mean serum testosterone levels compared with women who had normal ovarian size [Table 5]. The difference was statistically significant and in agreement with other studies.^[27,31] In this study we document that a significant differences existed between ovarian volume & serum testosterone levels. Elevated serum testosterone was found in (75%) & normal testosterone in (25%) of women who had enlarged ovaries. Whereas elevated serum testosterone levels was found in (34.8%) & normal testosterone in (65%) of women who had normal ovarian size. Also we reported that women who had enlarged ovaries had a higher mean serum LH levels compared with those who had normal-sized ovaries (Table V). The findings are in contrast to that of.^[24] In this study we also document that a significant differences existed between ovarian volume & serum LH levels. Elevated serum LH was found in (73.8%) & normal LH in (26.2%) of women who had enlarged ovaries. Whereas elevated serum LH levels was found in (47.8%) & normal LH in (52.2%) of women who had normal ovarian size. Our results are in agreement to that of.^[27] Correlations of total ovarian volume with clinical features and hormonal parameters were evaluated in the present study. We demonstrate that hirsutism, acne and obesity correlated positively with ovarian volume [Table 6]. These results are in agreement to that of.^[37,41] Menstrual disorders are a characteristic feature of women with PCOS. However, it is interesting that we found a negative significant correlation between total ovarian volume and oligomenorrhoea and amenorrhoea. These results are in agreement to that of.^[24] The present study demonstrates that total ovarian volume had apposite correlations with serum testosterone levels, LH and LH /FSH ratio [Table 7]. These findings are in agreement to that of.^[30,37,41] Hyperandrogenism is a characteristic feature of women with PCOS; however, it is expecting to find a positive significant relationship between total ovarian volume and testosterone levels, hirsutism and acne.

Conclusion

We have shown that in patients with classic PCOS, enlarged ovaries are present in 78.5% & 21.5% of patients had normal ovarian volume and all of these patients, have altered ovarian morphology.

USG image showing features of PCOS in the form of increased ovarian volume (more than 10cc) with number of follicles more than 10.



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