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Ultrasonographic prevalence of polycystic ovarian morphology among women of reproductive age group

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Abstract

Background and objective: Polycystic ovarian cyst is the most common and complex reproductive endocrinopathy affecting females of childbearing age. This study aimed to investigate the sonographic prevalence of polycystic ovary morphology among women of reproductive age group, and correlate it with age, menstrual disturbances, fertility problems, obesity, and hormonal profile.

Methods: This study was carried out in the Rizgary Teaching Hospital and private clinic in Erbil city, Kurdistan region of Iraqfrom 1st August 2016 to 1st June 2017. A total of 782 women were included in this study. Inclusion criteria were any woman attending to pelvic ultrasound for whatever the cause other than pregnancy. The prevalence of polycystic ovary morphology was determined depending on Rotterdam's criteria; correlation with clinical history and biochemical indices was done.

Results: Of the total study sample of 782 women, 147 (18.8%)had polycystic ovarian cyst. The highest prevalence (32.7% and 43%) was among the age group 18-27 years and participants with high body mass index (31-≥40).There was a statistically significant correlation between menstrual cycle irregularities and serum prolactin andserum testosterone. The highest polycystic ovary prevalence was found among participants with a history of amenorrhea and oligomenorrhoea, 92.3% and 75.2%, respectively.

Conclusion: We observed that polycystic ovary is an age-related disease and the prevalence of the disease decreases with age. The highest prevalence was seen among the age group of 18-27 years and least in the age group of 38-47 years. No patients with polycystic ovary were found above 48 years.

Keywords: Polycystic ovary; Ultrasound; Infertility; Rizgary Teaching Hospital.

Introduction

Polycystic ovarian disease (PCOD) is known as hyperandrogenic anovulation and Stein-Leventhal syndrome which is first described in 1935.[1] It is the most common and complex reproductive endocrinopathy affecting females of childbearing age[2] with a reported prevalence of 5-10% using biochemical and or clinical criteria.[3] Patients with polycystic ovarian disease are at increased risk of developing infertility (75%), dysfunctional uterine bleeding, endometrial carcinoma, secondary amenorrhea(30%), oligomenorrhoea(75%), hirsutism (90%) and a number of metabolic disorders including insulin resistance diabetes mellitus, hypertension, dyslipidemia and cardiovascular disease, and increased risk of multiple gestations from infertility treatment.[4] Obesity is also found in 40-60% of cases,[5] though the disease is often seen in women with normal body mass index(BMI).[6] At the joint American Society for Reproductive Medicine/European Society of Human Reproduction and Embryology (ASRM/ ESHRE) sponsored PCOS Consensus Workshop Group Fertility and Sterility meeting in Rotterdam in 2003,[7] a refined definition of the PCOS was agreed. The definition encompassed a description of the morphology of the polycystic ovary

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(PCO), and ultrasound criteria have been added to the criteria in the National Institutes of Health (NIH) definition, i.e., hyperandrogenism and oligoanovulation.[8] As defined by the Rotterdam; the criteria fulfilling sufficient specificity & sensitivity to define the PCO should have at least one of the following: either 12 or more follicle measuring 2-9 mm in diameter, or increased ovarian volume more than 10 ml (The ASHRE Rotterdam/ASRM, 2004). If there is a follicle more than 10 ml in diameter, the scan should be repeated at a time of ovarian quiescence in order to calculate volume and area. The presence of a single ovary with PCO morphology is sufficient to provide the diagnosis.[7] PCO morphology occurs in 19-33% of the western population of whom around 80% have symptoms of PCO syndrome,[9] up to 25% of patients with PCO morphology on sonography are asymptomatic.[10] In addition, not all patients with hyperandrogenic oligoovulation have PCO morphology on ultrasound.[11] This study aimed to investigate the prevalence of polycystic ovarian morphology among women of reproductive age group (using diagnostic criteria of the Consensus of Rotterdam), to correlate with age, menstrual disturbances, fertility problems, obesity, and hormonal profile**.**

Methods

Study design:
A cross-sectional prevalence study.
Sample size:
A total of 782 women of reproductive age group
Inclusion criteria:
All women of reproductive age who attended for pelvic US scan regardless of the cause.
Exclusion criteria:
Females with incidental findings of early pregnancy and follow up cases.
Informed consent was obtained from all subjects; the following information was obtained: name, age, marital state, parity, menstrual cycle, fertility state and the reason for attendance. Menstrual irregularities were classified as chronic anovulation as amenorrhea of 6 months or more duration, oligomenorrhoea as intermenstrual interval of more than 35 days less than six months duration, polymenorrhoea as cycles occurring more frequently than every 21 days, regular menstruation as a 21-35 days duration; 9-16 cycles within a year and no more than a 4 day difference in duration between cycles.[12] Fertility state was classified as fertile (had a previous pregnancy with no subsequent infertility), infertile (primary or secondary infertility of at least one-year duration) and unproved (pregnancy not attempted).[13] Body mass index (BMI) was estimated for each woman with polycystic ovarian morphology (weight in kilogram & height in square meter). BMI classification according to the National Institute for Health guidelines as follows.[14]
1. Underweight BMI <19Kg/ m^2
2. Normal weight BMI 19-24.9Kg/ m^2
3. Overweight BMI 25-29.9 Kg/ m^2
4. Class 1 obesity BMI 30-34.9 Kg/ m^2
5. Class 2 obesity BMI > than 35 Kg/m^2

Transabdominal US scan (using Samsung SONOACE R5 machine) was done for the participants in a moderately filled urinary bladder, measurements were taken in real time B mode grey scale using 3-5MHz curvilinear probe(type of device) , optimum gain setting was obtained with particular attention to the size of the patient and the amount of pelvic fat; difficult and doubtful cases were transformed into 7.5 MHz transvaginal (approach after emptying urinary bladder (all US scans were performed in a private room after getting patient consent). After identification of ovaries; the size of ovaries were measured in three orthogonal planes, the highest possible magnification was used to examine the ovaries. The evaluated US criteria of PCOM were: the presence of 12 or more 2-9 ovarian follicles; distribution of ovarian follicles; an ovarian volume of more than 10 ml& a highly echogenic ovarian stroma. Only one ovary fitting this

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definition was considered enough to label PCO.[7] The follicular size was measured, according to the method described by Pache et al.[15] The ovarian volume was calculated with the formula of an ellipse: 1/2(AXBXC); where A is the longitudinal diameter is the anteroposterior diameter & C is the transverse diameter of the ovary.[16] All those women who were diagnosed as PCOS clinically and sonographically, their available hormonal profile data were checked and entered into data analysis. The normal cutoff values of Serum free testosterone of 0.5-2.6 ng/ml, FSH of 3.2-10 mIU/ml, LH of 1.2-10mIU/ml in the early follicular phase of menstrual cycle, ratio of LH/FSH less than 2.5,serum prolactin of 3-25ng/ml and TSH of 0.4-4mIU/ml. Data were stored on a Microsoft Excel sheet for further evaluation; follow up cases were examined during the first week of the next cycle (follicular phase) and ruled out from the entry into data. Those with a follicular size of more than 10 mm also excluded and requested to be examined in the next cycle during the period of quiescence to avoid ovarian false magnification.

Ethical considerations

Before collecting the data, the researchers approval of the Ethics Committee at the College of Medicine, Hawler Medical University.

Statistical analysis

The statistical package for the social sciences (SPSS, Chicago, IL, USA, version 18) was used for data entry and analysis. Two approaches were used; descriptive and analytic. The descriptive approach included calculation of frequencies, percentages, means, and standard deviaitons. In the second approach, Chi-square test of association was used to test the association between categorical variables. The correlation coefficient (r) was used to assess the strength of the correlation between two numerical variables. A *P* value of ≤0.05 regarded as statistically significant.

Results

Of 782 study participants, 736 (94.1%) were married, and 46 (5.9%) were singles. The mean age ± SD of participants was 29.98 ± 7.5 years (range 14-49 years. The current study showed that 70% of ultrasound findings were normal, and the prevalence of PCO was 18.8%, (147 out of total 782) as shown in Table 1.

Table 1: Percentages of ultrasound abnormalities among the study sample.

US finding	No.	Percent (%)
Normal	548	(70.1)
Cyst (any)	52	(6.6)
PCO*	128	(16.4)
Fibroid	29	(3.7)
Cyst+PCO*	6	(0.8)
Cyst+Fibroid	6	(0.8)
Fibroid+PCO*	13	(1.7)
Total	782	100.0

* Total PCO prevalence=147 (18.8%).

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There was a statistically significant association between PCO and age, marital status and BMI of the participants. The highest prevalence (32.7%) of PCO was among the age group 18-27 years (*P* <0.001). The highest prevalence (43%) of PCO was also found among participants of high BMI (31-≥40), *P* <0.001. The highest prevalence of PCO was among infertile, untried and singles (32.7%, 40.7%, and 41%, respectively, *P* <0.001). This study also showed the highest PCO prevalence among participants with history amenorrhea (92.3%) and oligomenorrhoea (75.2%), *P* <0.001 (Table 2).

Table 2: Association between certain characteristics of participants and PCO (N=695).

Variables	US finding				Total		*P* value
	Normal		PCO				
	No.	(%)	No.	(%)	No.	(%)	
Age group							
<18	26	(76.5)	8	(23.5)	34	(100.0)	<0.001
18-27	183	(67.3)	89	(32.7)	272	(100.0)	
28-37	220	(82.7)	46	(17.3)	266	(100.0)	
38-47	114	(96.6)	4	(3.40)	118	(100.0)	
≥48	5	(100.0)	0	(0.00)	5	(100.0)	
Marital status							
Married	522	(80.1)	130	(19.9)	652	(100.0)	0.002
Single	26	(60.5)	17	(39.5)	43	(100.0)	
BMI							
<19	3	(100.0)	0	(0.00)	3	(100.0)	<0.001
19-25	331	(83.2)	67	(16.8)	398	(100.0)	
26-30	158	(77.5)	46	(22.5)	204	(100.0)	
31-≥40	45	(57.0)	34	(43.0)	79	(100.0)	
Fertility							
Fertile	436	(86.0)	71	(14.0)	507	(100.0)	<0.001
Infertile	64	(59.3)	44	(32.7)	108	(100.0)	
Pregnancy not attempted	23	(59.0)	16	(40.7)	39	(100.0)	
Single	25	(61.0)	16	(41.0)	41	(100.0)	
Menstrual cycle							
21-35_Normal	507	(93.2)	33	(6.80)	544	(100.0)	<0.001
35-90_Oligomenorrhoea	32	(24.8)	97	(75.2)	129	(100.0)	
>90_Amenorrhoea	1	(7.80)	12	(92.3)	13	(100.0)	
<15_Polymenorrhoea	8	(88.9)	1	(11.1)	9	(100.0)	
Total	548	(78.85)	147	(21.15)	695*		

*87 cases are excluded, having other abnormalities (fibroid, any cyst or combined).

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Regarding hormonal abnormality among PCO patients (N=147), LH/FSH ratio was more than 2.5 in 84.4% of cases. The value of serum prolactin was >25ng/ml in 73.5% of cases, and the value of serum free testosterone was >2.6ng/ml in about 70.7%. Details of hormonal changes are shown in Table 3. The current study showed that the follicular number and ovarian volume were increased in both left and right sides, Table 4.

Table 3: Frequency of hormonal values among PCO patients.

Variables	No.	%	Normal Values
Serum_TSH			
≤4	79	53.7	0.4-4 mIU/ml
>4	68	46.3	
LH_FSH_Ratio			
≤2.5	23	15.6	<2.5
≥2.5	124	84.4	
Serum Prolactin			
≤25	39	26.5	3-25ng/ml
>25	108	73.5	
Serum_TSH			
≤10	147	100.0	3.2-10mIU/ml
Serum_LH_group			
≤10	92	62.6	1.2-10mIU/ml
>10	55	37.4	
Serum_Free_Testosteron			
≤2.6	43	29.3	0.5-2.6ng/ml
>2.6	104	70.7	
Total	147	100.0	

Table 4: Frequency of follicular numbers and ovarian volume among PCO patients.

Variables	No.	(%)
Lt. Follicular Number		
≤12	34	(23.1)
>12	113	(76.9)
Rt. Follicular Number		
≤12	33	(22.4)
>12	114	77.6
Lt. Ovarian Volume		
≤10	34	(23.1)
>10	113	(76.9)
Rt. Ovarian Volume		
≤10	32	(21.8)
>10	115	(78.2)
Total	147	100.0

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Statistically significant weak positive correlation was found between menstrual irregularities with serum prolactin and serum testosterone, (r = 0.279, *P* = 0.001; r = 0.221, *P* = 0.007, respectively). There was statistically non-significant inverse correlation between menstrual cycle with serum TSH level and LH/FSH ratio (r = -0.019, *P* = 0.824; r = -0.085, *P* = 0.308) as shown in Figures 1 and 2.

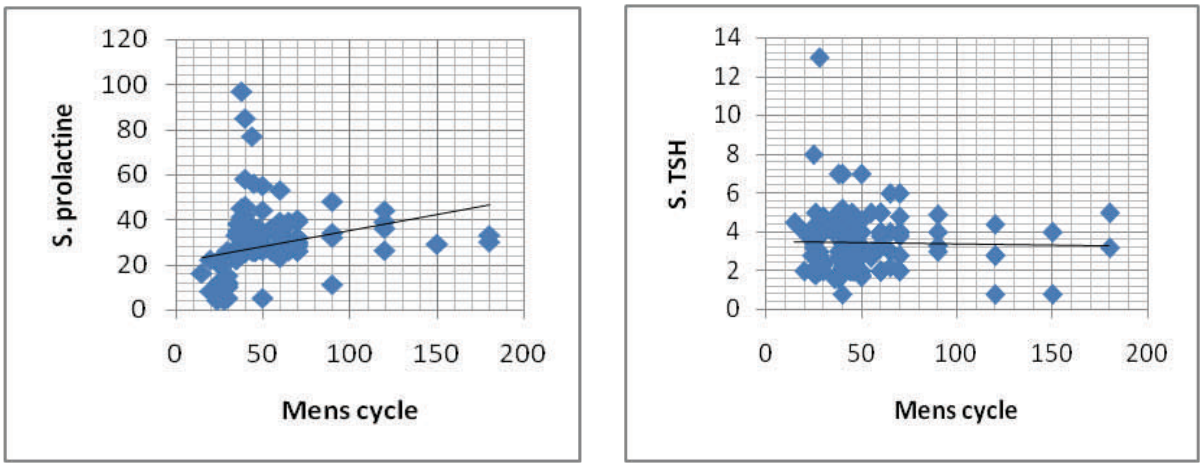

Figure 1: Scatter diagram showing a linear association between serum prolactin and serum TSH with the menstrual cycle

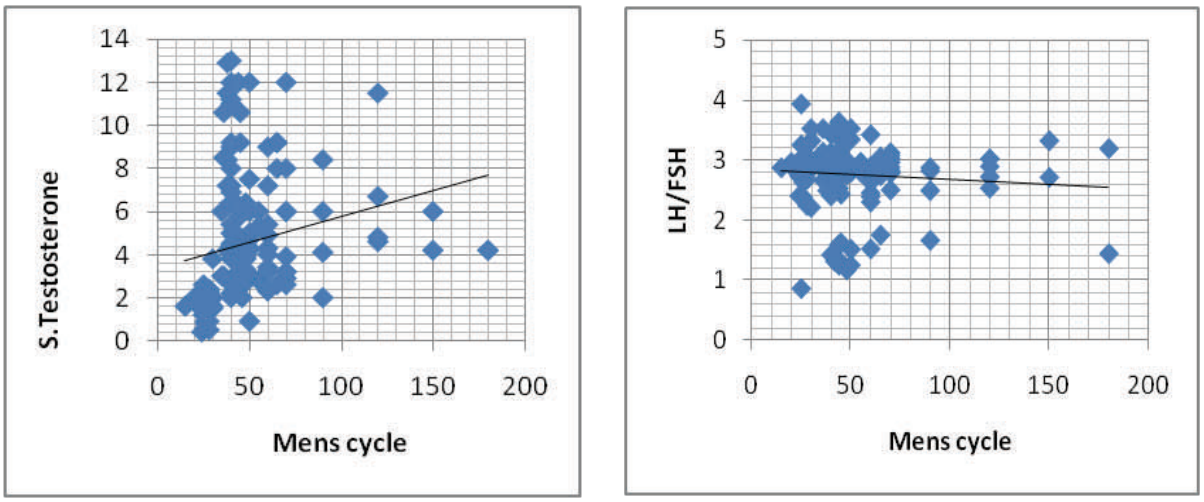

Figure 2: Scatter diagram showing a linear association between serum testosterone and serum LH/FSH with the menstrual cycle

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Discussion

Although pro believed to be one of the most common endocrine disorders among women of reproductive age group; to our knowledge, there is no data available on the sonographic prevalence of PCO morphology in our locality. Many types of research have been done for the diagnosis of PCOS, and every investigator had their preferred methodology for the diagnosis of PCO syndrome. Mujeeb et al. revealed 87.7% sensitivity and 99% sensitivity of ultrasound in diagnosing PCOS.[17] we also use revised 2003 Rotterdam consensus as a diagnostic criteria of PCO morphology. Out of total study sample, 782 women; about 70% of ultrasound finding was normal, while PCO constitutes only 18.79% (147 women) and PCO in combination with cyst and fibroid constitute 2.5% of the study sample. This finding is similar to D Botosis et al. who found that the incidence of PCO morphology is 17.5% in Areteion Hospital, Athens, Greece.[18] The results of Nidhi et al. was 9.13%, Williamson et al. results was 26%.[19] The highest prevalence (32.7%) of PCO was among the age group 18-27 years. Similarly, Koivunem et al. reported that sonographic PCO is much more common among younger less than 35 years (21.6 prevalence) than in older women.[20] Tabassum K also found the highest prevalence of PCO among the age group of 15-24 years and least in the age group of 35-44 years.[21] In our study the highest prevalence (43%) of PCO was also found among participants of high BMI (31-≥40) and 22.5% among overweight women, Gambinri et al. have reported that 50% of PCOS women were overweight or obese,[22] Joan et al. were of the view that Asians PCOS women had the lowest prevalence of obesity whereas blacks and Hispanics had the highest.[23] A study conducted on 29 -43 years old Saudi Arabia female patients with the suggested diagnosis of PCOS illustrated the prevalence of 64.5% obese and 24.2% overweight cases.[24] Hussein et al. and Rich-Edwards et al. also found an increased prevalence of PCO among obese females above 15 years of age.[25,26] Regarding the biochemical indices, among 147 women with sonographic PCO morphology; the FSH value was normal, while LH value was increased in 55 women (37.4%) and LH/FSH ratio was more than 2.5 in 84.4% of cases, and there was a linear correlation between LH/FSH with menstrual irregularities as shown in Figure 5. Although the characteristic increase in LH relative to FSH release has long been appreciated as a feature of PCOS but Cho et al.[27] found that LH/FSH had little use in diagnosing PCOS because the median LH/FSH ratio did not differ significantly between the PCOS and non-affected groups. Legros et al.[28] found a modest association between raised LH/FSH in women with PCO morphology. In our study we found that there was the statistically significant correlation between menstrual cycle irregularity with serum prolactin, serum testosterone (as shown in Figure 2 and 4); it is well known that women with PCOS have elevated biochemical profile.[18,36] Duijkers et al.[29] indicated that PCO morphology can be seen in healthy women with regular menstrual cycles, in our study we found that 6.8% (33 women among 147 women with PCO morphology) have the normal menstrual cycle. This study also showed highest PCO prevalence among participants with history amenorrhea and oligomenorrhoea, 92.3%, and 75.2%, respectively, this is in consistent with results in a large series of women diagnosed to have PCOS by Azziz et al.,[30] as approximately 75-85% of women with PCOS had clinical evidence of menstrual dysfunction. Crosignani and Nicolosi also reported a high percentage (54%) of oligomenorrhoea among Italian women with PCO.[31]Ramanand et al. also found nearer 66% prevalence of PCOD among oligomenorrheic females.[32] In Pakistan, Haq et al. found that the frequency of PCOS in women attending infertility clinics was 17.6%.[33] Couzin and Jennifer

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estimated that 40% of women who attend infertility clinics have PCOS.[34] The prevalence of PCOS among infertile Kurdish women attending Infertility Care and IVF center in Erbil was 33%.[35] This result is similar to our finding of 32.7% incidence of infertility among women with PCO morphology. In addition, we included newly married females with PCO morphology but who were not undergone investigations for infertility. The ovarian volume >10 ml is considered to be diagnostic for polycystic ovaries according to Rotterdam's criteria, in the current study; the right ovarian volume was >10 ml in 78.2%, and the left ovarian volume was > 10 ml in 76.9%, similar results as increase in ovarian volume were seen in patients with PCO according to a study in Turkey.[36] Botosis et al.[18] also found that mean ovarian volume was higher in women with PCO in both regular and irregular cycles.

Conclusion

Transvaginal ultrasound should be used wherever possible, particularly in obese females as it provides the more accurate view of the internal structures of ovaries, avoiding apparently homogenous ovaries as described with trans abdominal scanning. Unmarried females were also included in the study; this necessitated the application of pelvic transabdominal scanning which is certainly less informative than transvaginal route especially in obese females. We observed that PCO is an age-related disease and the prevalence of the disease decreases with age. The highest prevalence was seen among the age group of 18-27 years and least in the age group of 38-47 years. No patients with PCO were found above 48 years. Ovarian imaging is crucial in the evaluation of patients with suspected PCOS; the imaging report should be specific and include ovarian volume, antral follicle counts in addition to pertinent findings such as the presence of a dominant follicle or corpus luteum. Although findings of PCO morphology at routine ultrasound scanning are common; awareness of the criteria and definitions used to diagnose PCOS is important particularly in patients who are referred for evaluation of ovulatory dysfunction or hyperandrogenism. Thus to participate in the workup; radiologists must have a working knowledge of the clinical and imaging criteria of PCOS as early diagnosis and intervention will reduce the long-term health complications associated with PCOS.

Competing interests

The authors declare that they have no competing interests.

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