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Comparison uterine and stromal ovarian Doppler flow in patients with polycystic ovary

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ABSTRACT

Context: Polycystic ovarian syndrome (PCOS) is prevalent in Kurdistan region/Iraq. Earlier identification of PCOS is essential in proper management. Objective: Comparing women with PCOS to healthy ovulatory fertile women in order to evaluate the Doppler haemodynamic alterations in uterine artery and ovarian artery. Methods: A prospective case control study conducted in two major hospitals located at Erbil city in duration of one year from 1st of February 2024, to 31st of January, 2025 on sample of fifty women with PCOS and another sample of fifty controls. Detection of PCOS was implemented in regard to Rotterdam criteria. Findings: In comparison to controls, women with PCOS had considerably larger ovarian volumes and follicle counts on ultrasonography. Women with PCOS had a considerably lower Doppler right ovarian systolic/diastolic ratio than controls. The pulsatility index of the right and left uterine arteries was markedly elevated in women with PCOS compared to the control group. The mean resistance index of the left uterine artery was considerably elevated in women with PCOS compared to the control group. Conclusions: The polycystic ovarian syndrome can be recognized with the help of colour Doppler ultrasound.

KEYWORDS: Doppler, Polycystic ovarian syndrome, Ultrasound.

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INTRODUCTION

For women of reproductive age, PCOS is the most prevalent endocrine and metabolic disorder. It induces period irregularities and manifestations of hyperandrogenism, impacting 10% of women with age at reproduction.[1] Ultrasound (US) polycystic ovaries are shown in about 20 to 30% of females at child bearing age.[2] PCOS was confirmed in 23% of adolescent Iraqi females.[3] PCOS is commonly manifested by infertility, irregular menstrual cycles and high level of androgens. The infertility is the main PCOS related complaint. The primary cause of ovarian dysfunction, which is closely linked to infertility, is PCOS.[4] In Erbil city-Kurdistan region/Iraq, 33% of infertile women had PCOS.[5]It also presented with insulin resistance, obesity, alopecia, dyslipidemia and increased susceptibility to ailments such as type 2 diabetes mellitus and cardiovascular illnesses.[6]

Increased pregnancy problems, including preeclampsia and gestational diabetes mellitus, are associated with PCOS.[7] Higher rates of comorbidity, early infant mortality, and miscarriage risk are linked to PCOS.[8] Numerous co-morbidities, including metabolic diseases, cardiovascular disorders, psychological ailments, and low standards of living, are also brought on by PCOS. [9]

According to the Rotterdam requirements, at least 2 of the 3 requirements listed below must be met, are frequently used to diagnose PCOS: oligo-ovulation/anovulation, biochemical and clinical indicators of hyperandrogenism, and PCOS ultrasound (US) results.[10] The structural characteristics of PCOS, as assessed by transvaginal ultrasonography (defined as the presence of twenty or more follicles and an ovarian volume of ten mL or greater in at least one ovary), serves as a prognostic indicator for PCOS in the absence of clinical or laboratory evidence.[10-12] With different criteria, transabdominal ultrasonography is another excellent substitute.[10] Another method for diagnosing PCOS is the antral follicular count. Eight follicles is the normal mean number for women at reproductive age.[1, 13] Nonetheless, variable morphology is observed in around one-fourth of healthy women.[14] The incidental discovery of PCOS via ultrasound aids in diagnosis and subsequent evaluation through physical examination and laboratory tests.[10]

With a better sensitivity, Doppler ultrasonography is a great non-invasive diagnostic technique for PCOS.[15, 16] Research has demonstrated that women with PCOS exhibit varied blood flow patterns in their uterine and ovarian arteries, particularly decreased peak systolic and end-diastolic velocities when compared to healthy women.[17] Investigating the correlations between Doppler ultrasonographic measurements and other criteria for PCOS is beneficial for confirming diagnosis. Incorporating additional diagnostic criteria in clinical and radiological domains is essential for cost reduction, minimising intrusive procedures, and facilitating earlier diagnosis and treatment.[18]This study aimed to evaluate how women with PCOS differ from normal ovulatory fertile women (controls) in terms of Doppler haemodynamic alterations in the uterine and ovarian stromal arteries in the follicular phase of cycle in both ovaries.

METHODS

During the course of a year, from February 1, 2024, to January 31, 2025, the gynecological outpatient clinic of maternity and Rizgari teaching hospitals in Erbil city, Kurdistan region, Iraq, hosted the current investigation, which was intended as a

prospective case control design. The subject cohort consisted of women who visited outpatient clinics with PCOS. Women of reproductive age who had been diagnosed with PCOS in accordance with Rotterdam criteria [10] were eligible to participate. Those with hypertension, diabetes mellitus, cardiovascular disease, autoimmune disease, thyroid disorders, hyperprolactinemia, Cushing syndrome, congenital adrenal hyperplasia, androgen-secreting tumours, ovarian follicular cysts larger than 20 mm, those taking ovulation-inducing medications, those taking exogenous androgens and contraceptive pills, those with a history of tubal or ovarian surgery, and women who declined to participate were excluded. The study protocol received approval from the Kurdistan Higher Council of Medical Specialists Ethics Committee, hospital administration, and women's oral informed consent. Following their eligibility for inclusion and exclusion criteria, fifty women with polycystic ovarian syndrome were chosen. From among women of reproductive age who visited outpatient clinics and had no prior history of PCOS, another sample of 50 healthy women (controls) was chosen.

Researchers obtained the information from the women who were enrolled directly and had them complete a prepared questionnaire. The researchers created the survey. The survey asked about the following: the general characteristics of women (age, body mass index, hirsutism, and menstruation status); the ultrasound findings of women (ovarian volume, number of follicles on the right and left ovary); the ultrasound Doppler indices of the foetal uterine arteries (RI, PI, and S/D); the ovarian artery resistance index [RI], pulsatility index (PI), and systolic/diastolic (S/D) ratio; and the ultrasound Doppler indices of the uterine arteries (RI and PI). During the early follicular phase, a greyscale transvaginal ultrasound scan was performed utilising a VOLUSON E8 transvaginal transducer with a frequency of 4–9 MHz (GE Healthcare, USA). Using a VOLUSON E8 (GE Healthcare, USA) device with an IC5-9-D probe with a 4-9 MHz transvaginal transducer, colour Doppler ultrasound was used in the early follicular phase.To statistically examine the collected data, the Statistical Package of Social Sciences software, version 26, was utilised. Continuous variables were examined using the independent sample t-test, while categorical variables were examined using the chi square or Fisher's exact tests. The study employed a significance threshold of 0.05 or below.

FINDINGS

One hundred women participated in the current study, fifty of whom had PCOS and fifty of whom were control subjects. Age and body mass index did not differ statistically significantly in regard to study groups. Women with PCOS were related to hirsutism ($p<0.001$). The PCOS was shown to have a highly significant correlation ($p<0.001$) with menstrual problems. Table (1).

There were no discernible variations between the control group and PCOS-afflicted women's ovarian artery indices for either the left or right ovaries ($p>0.05$), other from the right ovarian S/D, which was significantly lower in PCOS-afflicted women than in controls ($p=0.03$).Table (3) and Figure (1).

Table 1: Basic features in regard to study groups.

Variable	Study groups				P
	PCOS case		Control		
	No.	%	No.	%	
Age					
<20 years	2	4.0	4	8.0	0.1 NS
20-29 years	39	78.0	29	58.0	
30-38 years	9	18.0	17	34.0	
Body mass index					
Normal	13	26.0	13	26.0	0.8 NS
Overweight	19	38.0	21	42.0	
Obese	18	36.0	16	32.0	
Hirsutism					
Yes	38	76.0	0	-	<0.001 S
No	12	24.0	50	100.0	
Menstruation status					
Regular menstruation	4	8.0	46	92.0	<0.001 S
Menstruation disorder	37	74.0	4	8.0	
Amenorhhea	9	18.0	0	-	

S=Significant, NS=Not significant.

Compared to the control group, women with PCOS had significantly larger average volumes in both the right and left ovaries ($p<0.001$). When comparing women with PCOS to the control group, the mean numbers of right and left ovarian follicles were significantly higher ($p<0.001$).Table (2).

Table 2: Ultrasound findings in regard to study groups.

Variable	Study groups		P
	PCOS case	Control	
	Mean±SD	Mean±SD	
Right ovarian volume	14.5±2.9	6.6±1.7	<0.001 S
Left ovarian volume	14±3.4	6.3±1.4	<0.001 S
Number of ovarian follicles in right	20.6±4.9	6.5±2.3	<0.001 S
Number of ovarian follicles in left	20.2±4.8	5.9±1.7	<0.001 S

S=Significant, NS=Not significant.

Table 3: Ovarian artery Doppler findings in regard to study groups.

Variable	Study groups		P
	PCOS case	Control	
	Mean±SD	Mean±SD	
Right ovarian artery RI	0.67±0.17	0.72±0.3	0.3 NS
Right ovarian artery PI	1.8±1.5	2.1±1.7	0.5 NS
Right ovarian artery S/D	2.5±1.7	4.1±4.9	0.03 S
Left ovarian artery RI	0.63±0.11	0.72±0.84	0.4 NS
Left ovarian artery PI	1.29±0.6	1.6±1.2	0.07 NS
Left ovarian artery S/D	2.7±1.6	4.1±4.9	0.07 NS

S=Significant, NS=Not significant.

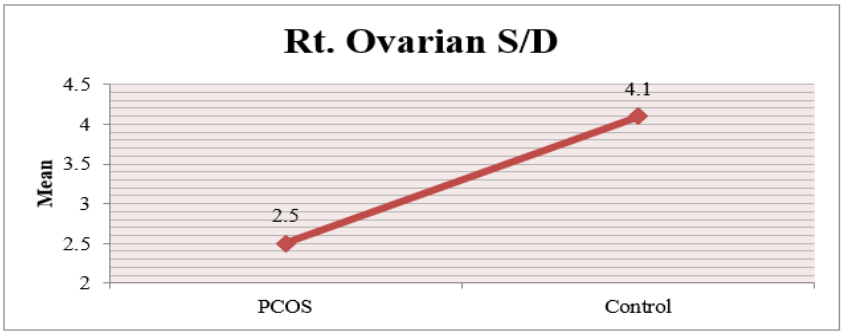

Figure 1: Right ovarian S/D in regard to study groups.

Women with PCOS were not substantially different from controls in terms of their means of RI, S/D ratio, and left S/D ratio (p>0.05). When comparing women with PCOS to controls, the mean pulsatility index of the right uterine artery was significantly higher(p=0.004). Compared to controls, women with PCOS had noticeably higher levels of the left uterine RI and PI (p≤0.05).Table (4).

Table 4: Uterine artery Doppler findings in regard to study groups.

Variable	Study groups		P
	PCOS case	Control	
	Mean±SD	Mean±SD	
Right uterine artery RI	0.84±0.21	0.78±0.21	0.1 NS
Right uterine artery PI	4.9±6.8	2.03±1.3	0.004 S
Right uterine artery	4.1±2.4	3.8±2.6	0.5 NS
Left uterine artery RI	0.86±0.25	0.77±0.16	0.03 S
Left uterine artery PI	5.3±7.4	2.1±1.2	0.004 S
Left uterine artery S/D	3.7±2.3	3.9±2.6	0.6 NS

S=Significant, NS=Not significant.

Table (5) demonstrates a substantial positive correlation between the age of women with PCOS and the right ovarian S/D, left ovarian PI, and left ovarian S/D (p<0.05). The quantity of ovarian follicles had a significant positive correlation with the right ovarian RI, right ovarian PI, and right ovarian S/D (p<0.05).

Table 5: Correlation of ovarian artery Doppler findings with variables of PCOS women.

Variable		R.O. RI	R.O.PI	R.O.S/D	L.O.RI	L.O.PI	L.O.S/D
Age	r	0.1	-0.1	0.3	0.2	0.28	0.29
	P	0.4	0.2	0.01[S]	0.052	0.04[S]	0.03[S]
Ovarian volume	r	-0.06	0.2	-0.17	-0.04	-0.12	-0.08
	P	0.6	0.1	0.2	0.7	0.39	0.5
Follicular number	r	0.4	0.4	0.3	0.12	0.12	0.2
	P	0.002[S]	0.002[S]	0.02[S]	0.4	0.4	0.14

S=Significant.

Table (6) demonstrates a strong negative correlation between the age of women with PCOS and left uterine pulsatility index (p=0.03). The quantity of ovarian follicles had a highly significant positive correlation with right uterine S/D (p<0.001). A substantial negative connection existed between the quantity of ovarian follicles and the left uterine resistance index (p=0.04).

Table 6: Correlation of uterine artery Doppler findings with variables of PCOS women.

Variable		R.U.RI	R.U.PI	R.U.S/D	L.U.RI	L.U.PI	L.U.S/D
Age	r	-0.2	-0.2	-0.12	-0.03	-0.29	0.05
	P	0.1	0.054	0.3	0.7	0.03[S]	0.7
Ovarian volume	r	-0.06	-0.12	-0.27	-0.21	-0.08	-0.1
	P	0.6	0.4	0.053	0.12	0.5	0.2
Follicular number	r	0.06	-0.02	0.5	-0.28	0.01	0.1
	P	0.6	0.89	<0.001[S]	0.04[S]	0.9	0.2

S=Significant.

DISCUSSION

PCOS is a heterogeneous endocrinal multi-systemic disorder. ultrasonography is pivotal in determining the presence of PCOS, and Doppler ultrasonography greatly improves the accuracy of diagnosis as well as assessment for the condition.[19] There were no statistically significant variations in age or body mass index between the two study groups in this investigation. In terms of body mass index, this result contradicts other studies that found a strong correlation between women with PCOS and obesity.[20] This disparity may be ascribed to the elevated prevalence of obesity among women in Erbil city.[21] Women with PCOS were related to hirsutism (p<0.001) in our study. This discovery parallels the results of the prospective birth cohort research conducted in America, referenced as.[22] Researchers also found a strong correlation (p<0.001) between women with PCOS and menstrual problems. A prior American case-control research consistently demonstrated a strong relationship between menstrual irregularities and PCOS.[23]Compared to controls, PCOS women had considerably greater means of right and left ovarian volumes on ultrasound (p<0.001), according to the current study. This conclusion aligns with reports of a recent literature conducted in Italy.[24] Women with PCOS had considerably greater means of both left and right ovarian follicle counts than controls in our study (p<0.001). Similar findings were seen in a prior cross-sectional study carried out in Thailand, which showed that a higher number of follicles identified by the US was indicative of PCOS.[25]

The majority ovarian artery indices of the right and left ovaries did not differ substantially between PCOS women and controls, according to the current study (p>0.05). Findings of a prior thesis implemented in Iran [26] are comparable to our conclusion. Nonetheless, our research revealed that PCOS women had considerably lower right ovarian S/D than controls (p=0.03). This discovery is in line with findings from a recent prospective case-control research conducted in Erbil, Iraq's Kurdistan area, which showed that right ovarian S/D in PCOS women had significantly decreased.[27] In comparison to controls, PCOS women had significantly higher mean values for both right and left uterine artery PI (p≤0.05). Similar findings were made by a recent Iraqi case control research, which found that women with PCOS had higher uterine artery PI than controls.[28] PCOS women had a substantially greater mean left uterine artery RI than controls in our study (p=0.03). According to present Indian project, females with PCOS had a greater average uterine artery RI, which is consistent with this conclusion.[29]The present investigation revealed a strong positive correlation between the age of women with PCOS and the right ovarian S/D, left ovarian PI, and left ovarian S/D (p<0.05). These findings contradict the conclusions of a previous cross-sectional study conducted in Egypt.[30] This discrepancy may be attributable to variations in sample size and inclusion criteria between the two studies. Our investigation demonstrated a strong positive correlation between the number of ovarian follicles and each of the right ovarian RI, right ovarian PI, and right ovarian S/D (p<0.05). These findings align with the results of a recent Chinese meta-analysis research.[31] In our study, the age of women with PCOS exhibited a strong negative correlation with left uterine pulsatility index (p=0.03). This conclusion aligns with the results of a prior study conducted in Norway.[32] Our investigation demonstrated a highly significant positive correlation between the number of ovarian follicles and right uterine S/D (p<0.001). This conclusion parallels the results of a prior cross-sectional study conducted in Iran.[26] Our investigation revealed a strong negative connection between the number of ovarian follicles and the left uterine resistance index (p=0.04). This conclusion aligns with the results of a recent observational research conducted in India.[33]In conclusion, the polycystic ovarian syndrome can be recognised with the help of colour Doppler ultrasound. This study recommended use of colour Doppler ultrasound in screening of polycystic ovarian syndrome.

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Conflict of interest
Declared none.

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