Brief Report

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A Comparison of Color Doppler Sonography Findings in Polycystic Ovarian Syndrome Patients and Healthy Women

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ABSTRACT

BACKGROUND AND OBJECTIVE: Polycystic ovarian syndrome (PCOS) is the most common endocrine disorder in reproductive-age women. The assessment of uterine and ovarian artery resistance indices (RI) can provide additional information on pathophysiology of the syndrome, and can be applied as a diagnosis criterion in suspected cases of PCOS. This study aims to compare the parameters of uterine artery blood flow and ovarian stromal artery in PCOS patients and healthy women.

METHODS: This cross-sectional study was performed on 20 women with PCOS (PCOS group) and 20 healthy women (control group). In the initial evaluations, age, body mass index, levels of follicle stimulating and luteinizing hormones, as well as severity of hirsutism and acne were recorded. Then, ovarian volume, uterine and ovarian artery RI and the rate of vascularization of ovarian stromal arteries were measured and compared with each other using Gray-scale and color Doppler sonography (CDS).

FINDINGS: Uterine artery RI on both sides in the PCOS patients (0.94) was significantly higher than the healthy women (0.86) ($p<0.001$). Ovarian artery RI on both sides in the PCOS group (0.65) was lower than the control group (0.71) ($p<0.001$). The rate of vascularization of ovarian stromal arteries was higher in the PCOS patients (45%), as compared to the healthy women (0%) ($p<0.001$).

CONCLUSION: According to the CDS findings, ovarian stromal and uterine blood flow parameters were significantly different in the PCOS and control groups.

KEY WORDS: Color Doppler ultrasound, Ovarian artery, Polycystic ovary syndrome, Uterine artery.

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Introduction

Polycystic ovarian syndrome (PCOS) is the most common endocrine disorder in reproductive-age women, which affects 5-10% of women in this age group (1). Irregular menstrual cycles, anovulation, infertility, obesity and hirsutism are the most common indicators of this disorder, one or all of which may appear in patients with PCOS (2, 3). Presence of two of the following criteria is necessary for PCOS diagnosis: 1) oligomenorrhea or anovulation, 2) clinical or laboratory signs of hyperandrogenism and 3) polycystic ovarian morphology on ultrasound. This syndrome is characterized by the presence of 12 or more follicles with diameters less than 10 mm and increasing ovarian volume to over 10 cc based on grayscale ultrasound images (4, 5). Ultrasound evaluation of the ovarian morphology is essential for diagnosis of PCOS, since the laboratory and clinical features may not be observed in all patients. Today, transvaginal ultrasound is the most common modality for PCOS diagnosis which can provide new morphological and pathophysiological data on uterine and ovarian arteries (6, 8).

Color Doppler sonography (CDS) is an ultrasound imaging which shows the amount of blood flow in vessels and tissues, and measures some criteria such as uterine and ovarian artery resistance indices (RI) (9). Uterine and ovarian artery RIs can give additional information on pathophysiology of the syndrome and can be applied as a diagnostic criterion in suspected cases of PCOS. Additional investigation and follow-up of patients after medication and repeating the CDS might offer a deeper insight into PCOS treatment (10).

Few studies have been done regarding ultrasound parameters in women with PCOS, which may be crucial in understanding the pathophysiology of PCOS. Numerous studies conducted on PCOS have reported: some important alterations in vascularization of the internal ovarian arteries, symptoms such as increased blood flow, as well as decreased resistance and pulsatility indices in the involved ovarian stroma. Doppler analysis of the ovarian stromal artery can help with PCOS diagnosis and may provide additional information regarding the pathophysiology of PCOS and ovulation process (10, 11).

Previous studies have reported mixed results on the vascularization of ovarian stromal arteries in women with PCOS. According to Miguel et al., Doppler examination of the uterus and ovaries showed that there were no significant differences in the vascularization of ovarian stromal arteries in PCOS and healthy women (2). The results of CDS of uterus and ovaries in a study by Jarvel et al. suggested that vascularization of ovarian stromal arteries was equal in the PCOS patients and those with normal ovaries; moreover, no significant differences were found between them (4). In contrast to these studies, the results of CDS in a study done by Resende et al. showed higher vascularization of ovarian stromal arteries in women with PCOS, as compared to healthy women (3).

Given the scarcity of studies on this subject, particularly in Iran, and their conflicting results (1-5, 7), also due to high incidence of PCOS and significance of early diagnosis and treatment of this disorder, this study aims to determine the differences in ovarian stromal blood flow between women with PCOS and healthy cases. Also in this study, variables such as endocrine tests and severity of hirsutism and acne were assessed to determine their relationship with uterine and ovarian artery RI in the patients with PCOS.

Methods

This cross-sectional study was performed on 20 PCOS patients (PCOS group) and 20 healthy women (control group), referring to Imam Reza Hospital of Kermanshah, Iran. The participants were selected through convenience sampling. The inclusion criteria for the control group were no symptoms relevant to PCOS, menstrual disorder or infertility. The appropriate sample size was calculated to be 12 cases in each group, with 95% confidence and power of 90%; however, for greater certainty we performed the study with two groups of 20 participants. Additionally, based on the literature concerning this issue, the mean±standard deviation of the PCOS and healthy women groups were assumed to be 0.98±0.11 and 0.86±0.06, respectively (8).

After obtaining written consent from the participants, all the women with PCOS were introduced to the research assistant and their demographic information including age, body mass index (BMI), levels of follicle stimulating hormone (FSH) and luteinizing hormone (LH), severity of hirsutism and acne were gathered and recorded in

checklists. The patients who had received hormonal drugs in the last three months or had blood pressure higher than 140/90 mmHg, endoctrine disorders which increased androgens level, follicles larger than 10 mm, ovarian cysts and history of previous ovarian surgery were excluded from the study.

Then, in the presence of the researchers, CDS of uterus and ovaries was performed in the early follicular phase using an ultrasound device (Siemens Sonoline G40, Germany) which was equipped with 5/3 MHz color doppler probe.

The ovarian stromal blood flow was measured and instead of measuring the blood flow of the ovarian parenchyma, ovarian artery RI of one of the vessels, as well as uterine artery RI were assessed using one of the ascending branches in the lateral of the cervix, in sagittal view. Using grayscale ultrasound, the size of ovaries, the number of follicles, ovarian stromal echogenicity, stromal thickness and the size of follicles were obtained and recorded in checklists. Additionally, these information were obtained and recorded from the control group, as well. Severity of hirsutism was determined based on Ferriman Gallwey Score (12) and acne severity was determined based on the number, type and distribution of skin lesions (13). Independent t-test and Mann-Whitney, as well as Chi-square test were performed to compare the quantitative and qualitative variables between the two groups. $p<0.05$ were considered significant.

Results

There were no significant differences between age and FSH levels of the PCOS patients and healthy women ($p>0.05$) (table 1). Based on the ultrasound findings, there were significant differences in BMI, severity of hirsutism and acne, LH level, menstrual cycle and other characteristics of PCOS between the PCOS patients and healthy women ($p<0.05$) (tables 2 & 3).

Right and left ovarian volumes were larger in the PCOS patients than the control group. Left and right ovarian artery RIs were lower in the PCOS patients than the healthy women, and right and left uterine artery RIs were higher in the PCOS patients, as compared to the women in the control group. The rate of vascularization of ovarian stromal arteries was also higher in the PCOS patients. Additionally, there were significant differences between the PCOS and control groups in terms of ovarian stromal arteries vascularization, as well as ovarian volumes, ovarian artery RIs and uterine arteries on both sides ($p<0.05$) (table 4).

Table 1. The comparison of the body mass index (BMI), follicle stimulating hormone (FSH) and luteinizing hormone (LH) in women with polycystic ovary syndrome (PCOS) and healthy women

Group / Variables	PCOS Mean±SD	Control Mean±SD	P-value
Age (year)	23.2±5.43	23.2±5.59	1
BMI (Kg/m^2)	27.5±4.67	23.1±1.16	<0.001
FSH (IU/ml)	5.75±2.44	4.67±1.37	0.097
LH (IU/ml)	15.97±13.27	6.66±1.02	<0.001

Table 2. Comparison of hirsutism and acne severity in women with polycystic ovary syndrome (PCOS) and healthy women

Groups	PCOS N(%)	Control N(%)	P-value
Hirsutism			
Normal	1(5)	16(80)	<0.001
Mild	4(20)	4(20)	
Moderate	3(15)	0(0)	
Severe	12(60)	0(0)	
Acne			
Normal	4(20)	16(80)	<0.001
Mild	5(25)	4(20)	
Moderate	7(35)	0(0)	
Severe	4(20)	0(0)	

Table 3. Comparison of the menstrual cycle and polycystic ovary syndrome (PCOS) based on the ultrasound findings in the two groups

Groups	PCOS N(%)	Control N(%)	P-value
Menstrual Cycle			
Normal	0(0)	18(0)	<0.001
Oligomenorrhea	20(100)	2(10)	
PCOS Based on Ultrasound Findings			
Positive			
Negative	17(85)	0(0)	<0.001
	3(15)	20(100)	

Table 4. Comparison of ovarian volumes, ovarian and uterine artery resistance indices (RI) on both sides in the polycystic ovary syndrome (PCOS) and control groups

	PCOS Mean±SD	Control Mean±SD	P-value
Right Ovarian Volume (ml)	10.7±2.59	6.7±0.92	<0.001
Left Ovarian Volume (ml)	9.95±2.83	6.1±0.85	
Right Ovarian Artery RI	0.65±0.034	0.71±0.036	<0.001
Left Ovarian Artery RI	0.64±0.3	0.7±0.032	<0.001
Right Uterine Artery RI	0.94±0.051	0.86±0.029	<0.001
Left Uterine Artery RI	0.92±0.055	0.84±0.027	<0.001

*Standard Deviation

Discussion

According to this study, vascularization of ovarian stromal arteries was higher in PCOS patients (45%) than the healthy women. The ovarian volumes on both sides in PCOS group was significantly larger than that of the control group. Also, the uterine artery RIs on both sides were significantly lower in PCOS patients than the healthy women, moreover, in comparison to the control, ovarian artery RIs on both sides were significantly lower in the PCOS group.

Our results are consistent with the results of many other studies; however, the results of a few studies were not in agreement with ours as follows: doppler examination of uterus and ovaries in a study by Miguel et al., performed on 65 patients with PCOS and 25 healthy women, showed that there were no significant differences in vascularization of ovarian stromal arteries between the two groups (2). Quite in line with our results, in a study by Resende et al., the obtained results of CDS from PCOS patients and healthy women showed that vascularization of ovarian stromal arteries was significantly higher in PCOS group, as compared to the control group (3). In addition, the obtained results of Jarvel et al. study demonstrated that the ovarian volume was larger in PCOS patients than the healthy women; however, vascularization of ovarian stromal arteries was equal in the two groups and there were no significant differences between them (4). In a study conducted by Tugrul et al., the examination of ovarian volume on both sides of 80 female subjects (40 PCOS patients and 40 healthy women) was consistent with the results of our study (15). Similar to our study, the results of CDS of uterus and ovaries in 43 PCOS patients and 43 healthy women in the Ozkan et al. study, showed the ovarian volume on both sides was significantly larger in the PCOS groups than the control group. In addition, as compared to the healthy women, ovarian artery RI on both sides was significantly lower in the PCOS patients; however, in contrast to our results, uterine artery RIs on both sides were equal in the two groups (16). Similar to our study, the results of doppler sonography in a study by Mala et al., which was performed on 25 PCOS patients and 25 healthy women showed the uterine artery RI was significantly higher in PCOS group than the control group, and ovarian artery RI was significantly lower. Moreover, vascularization of ovarian stromal arteries was significantly higher in PCOS patients than the healthy women (17).

According to the Mehmet et al. study, the results of CDS of uterus and ovaries on 20 PCOS patients and 20 healthy women showed that there were considerable differences in the uterine artery and ovarian stromal artery RIs between the PCOS patients and healthy women. They found that the uterine artery RI was higher and ovarian stromal artery RI was lower in the PCOS patients than in the control group, these findings were in agreement with ours (8). According to the results of this study, ovarian volume and uterine artery RI on both sides and rate of vascularization of ovarian stromal arteries were higher in the PCOS group than the control group, whereas, ovarian artery RI on both sides was lower in the PCOS group, as compared to the control group. The results of this study advocate an approach which can be employed as a part of the treatment protocol for early diagnosis of PCOS patients.

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