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Uterine artery pulsatility index among polycystic ovary disease; case control study

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Abstract:

Introduction: Polycystic ovarian syndrome is a multiple organ disorder affects 5 to 10 % female population. The world occurrence of PCOS is 105 million in the age ranges from 15 to 45. The polycystic ovarian syndrome is a set of disorders like amenorrhea, infertility, polycystic ovaries, hyperinsulinemia, hirsutism, acne vulgaris and other symptoms of hyperandrogenism. Color Doppler and Pulse Doppler play a major role in evaluation of uterine artery Resistive index for access correlation with PCOS. PCOS patients suffer from primary and secondary infertility. This study aimed to show assess uterine blood flow and whether there is a correlation between these patterns and specific hormonal parameters.

A case control study done in Salah Al-Deen governorate during the period of 1st May–1st October 2022. Twenty-five patients with polycystic ovary disease compared with 25 normal healthy women. The ultrasound and Doppler analyses were performed for all women during the

follicular phase of the menstrual cycle. Uterine artery blood flow velocities were analyzed and the pulsatility index, were calculated .

The current study showed that oligomenorrhea found among (72%) of the patients, clinical/biochemical signs of hyperandrogenism found among (76%). The mean LH (mIU/L) was significantly higher among PCO disease cases and also that the mean FSH (mIU/L) was significantly lower among PCO disease cases than control group. There was at increased ovarian volume of > 10 cm3 found among (80%), and ≥12 follicles measuring 2-9 mm found in (84%) of the PCO disease patients. The mean Uterine artery PI was significantly higher among PCO disease cases 2.3 ± 0.5 than control group 1.8 ± 0.4 (P value <0.05).

The mean ovarian volume was significantly higher among PCO disease cases than control group. The mean Uterine artery PI was significantly higher among PCO disease cases than control group.

Keywords: PCOS, uterine resistant index, RI, Doppler study of polycystic ovary.

مؤشر نبض الشريان الرحمي بين مرض تكيس المبايض. دراسة الحالات والشواهد

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الخلاصة:

متلازمة تكيس المبايض هي اضطراب متعدد الأعضاء يصيب ٥ إلى ١٠٪ من الإناث. يبلغ معدل حدوث متلازمة تكيس المبايض في العالم ١٠٥ ملايين في الفئة العمرية من ١٥ إلى ٤٥. متلازمة تكيس المبايض هي مجموعة من الاضطرابات مثل انقطاع الطمث ، والعقم ، وتكيس المبايض ، وفرط أنسولين الدم ، والشعرانية ، وحب الشباب ، وأعراض أخرى لفرط الأندروجين. يلعب دوبلر اللون والدوبلر النبضي دورًا رئيسيًا في تقييم مؤشر مقاومة الشريان الرحمي من أجل ارتباط الوصول مع متلازمة تكيس المبايض. يعاني مرضى متلازمة تكيس المبايض من العقم الأولي والثانوي. هدفت هذه الدراسة إلى إظهار تقييم تدفق الدم في الرحم وما إذا كان هناك ارتباط بين هذه الأنماط والمعايير الهرمونية المحددة.

دراسة حالة تم إجراؤها في محافظة صلاح الدين خلال الفترة من ١ مايو إلى ١ أكتوبر ٢٠٢٢. خمسة وعشرون مريضة مصابة بمرض تكيس المبايض مقارنة مع ٢٥ امرأة سليمة طبيعية. تم إجراء تحاليل الموجات فوق الصوتية والدوبلر لجميع النساء خلال المرحلة الجرابية من الدورة الشهرية. تم تحليل سرعات تدفق الدم في الشريان الرحمي وحساب مؤشر النبض.

أظهرت الدراسة الحالية أن قلة الطمث وجدت لدى (٧٢٪) من المرضى علامات سريرية / بيوكيميائية لفرط الأندروجين عند (٧٦٪). كان متوسط LH (mIU / L) أعلى بشكل ملحوظ بين حالات مرض PCO وأيضًا أن متوسط FSH (mIU / L) كان أقل بشكل ملحوظ بين حالات مرض PCO من المجموعة الضابطة. كان هناك زيادة في حجم المبيض> ١٠ سم ٣ بين (٨٠٪) ، و١٢ بصيلة مقاس ٢-٩ ملم وجدت في (٨٤٪) من مرضى PCO. كان متوسط الشريان الرحمي PI أعلى بشكل ملحوظ بين حالات مرض PCO 2.3 ± 0.5 من مجموعة التحكم ١,٨ ± ٠,٤ (قيمة P <0.05).

كان متوسط حجم المبيض أعلى بشكل ملحوظ في حالات مرض PCO منه في مجموعة السيطرة. كان متوسط PI في الشريان الرحمي أعلى بشكل ملحوظ بين حالات مرض PCO مقارنة بمجموعة التحكم.

الكلمات المفتاحية: مؤشر نبض الشريان الرحمي في متلازمة تكيس المبايض. دراسة حالة تحكم ، مؤشر نبض الشريان الرحمي في متلازمة تكيس المبايض

1. INTRODUCTION:

PCOS is a heterogeneous pathological disorders characterized by reproductive abnormality, and usually associated with hyperandrogenism, obesity, hyperinsulinemia, and insulin resistance. It represents the commonly prevalent endocrinopathy in women, and its prevalence is around 6-8% in the reproductive age **[1]**. Though polycystic ovaries can be described in about 33% of the women, they are not essentially related with the typical symptoms and PCOS, which may be presented at some period during the reproductive life span when provoked by, for example, weight gain or insulin resistance **[2, 3]**. A refined definition of PCOS declared by a joint ESHRE/ASRM consensus meeting in 2003, "namely the presence of two out of the following three criteria: (1) oligo- and/or anovulation, (2) hyperandrogenism (clinical and/or biochemical), and (3) polycystic ovaries, with the exclusion of other etiologies "**[4]**. PCO morphology of the PCO was redefined as an ovary with ≥12 follicles of diameter of 2-9 mm in and/or elevated ovarian volume (> 10 cm3) **[5]**. One of the essential methods in PCOS diagnosis and the gold standard for defining polycystic ovary (PCO) is the Ultrasound assessment of ovarian morphology. The women with the polycystic ovary syndrome have the morphological ovarian phenotype this known as the polycystic ovary **[6]**. Transvaginal Doppler sonography has participated greatly to the improvement of ultrasound diagnosis and has provided greatly new information morphologically and pathophysiologically on blood flow dynamics within the female pelvis **[7,8]**. Battaglia and co-workers found that PCOS patients develop obvious ovarian vascularization changes at the level of the intraovarian arteries **[9]**, Zaidi and co-workers **[10]** and Aleem and co-workers **[11]** proved that, in PCOS patients, great

intraovarian vessels changes occur. Additionally, PCOS has increased uterine artery resistance. Doppler analysis of ovarian stromal arteries in PCOS may be helpful in diagnostic improvement, and provision great extra information regarding the evolution & pathophysiology of the PCOS **[9-11]**. Doppler ultrasound Over the last twenty years Doppler has become a reliable and frequently used method to monitor the fetoplacental unit of risk pregnancies in the last two decades **[12-17]**. Pulsatility index measure the increased resistance in the uterine artery measured and it determines a reduced blood flow to the placenta and may be an early sign of placenta pathology and/or hypertensive disorder in pregnancy **[12,17,18]**. PCOS is linked to pregnancy complications, such as gestational diabetes mellitus, preterm delivery, and preeclampsia **[19-21]**. Research of UtAPI in females with PCOS are dispersed, but some of them have documented reduced blood flow in the uterine artery in women with PCOS either non-pregnant or pregnant **[22-25]**. Palomba, et al in 2010 found that a significantly higher rate of PCOS females with abnormal UtAPI measurements during first and mid-second trimesters compared to controls. Only little information exists in the literature regarding the details of ultrasound parameters in women with PCO only and PCOS, which may be important in the understanding of the pathophysiology of PCOS. An understanding of vascular changes in women with PCO may allow us to gain further insights into the underlying pathophysiology of the condition and differences between PCOS and PCO only patients**[26]**.This study aimed to show assess uterine blood flow and whether there is a correlation between these patterns and specific hormonal parameters.

2. Patient and methods:

This is a case control study done in Salah Al-Deen governorate during the period of 1st May 2022 – 1st October. The patients were recruited from the ultrasound clinic of the Department of radiology in Salah Al-Deen general hospital. Sample was collected randomly from the ultrasound clinic, 25 patients with polycystic ovary disease compared with 25 normal healthy women. The inclusion criteria for cases group were "(i) oligomenorrhoea/amenorrhoea for months at least; (ii) Ferrimane- Gallway score >7; (iii) LH: FSH ratio >2; (iv) PCO pattern diagnosed on US showing at least one of the following: either 12 or more follicles measuring ≤ 9 mm in diameter or increased ovarian volume (>10 cm3)". All patients were evaluated for the clinical and biochemical profile to see if the patients meet the Rotterdam criteria. Oligomenorrhoea was defined as cycle length >35 days and amenorrhoea were defined as absence of vaginal bleeding for >3 months in individuals who previously had experienced periodic menstruation at least for 6 months. Hirsutism was evaluated using the modified

Ferriman–Gallwey score, which ranges from 1 to 36; scores of 7 or more indicate hirsutism [27]. Body mass index was calculated, and ultrasound and Doppler analyses were performed by the same physician for all women during the follicular phase of the menstrual cycle (between the third and fifth day) using a 6.5 MHz vaginal transducer equipped with color and pulsed Doppler. Ovarian volume was calculated using the formula for an ellipse (length×width×height×0.523) .

Uterine artery blood flow velocities were analyzed from the ascending branches of both main arteries at the level of the internal cervical os in a longitudinal plane. At least 3 satisfactory blood flow velocity waveforms were obtained and used for statistical analysis of the average from 3 waveforms. The angle of insonation was always changed to obtain maximum color intensity. When good color signals were obtained, blood flow velocity wave forms were recorded by placing the sample volume across the vessel and entering the pulsed Doppler mode. The pulsatility index (PI), defined as the difference between peak-systolic and end diastolic flow divided by the mean maximum flow velocity was determined using calculation software. [28] The research was approved by the Salah Al-Deen research Committee, and every Participant informed about the objectives, benefits, purpose, and risks the study before they agree joining the study. Data analyzed using SPSS version (23), and Excel sheets. Student 't' test was used to test the significance of the relations. p value <0.05 was considered statistically significant.

3. Results

The oligomenorrhea found among 18 (72%) of the patients , clinical/biochemical signs of hyperandrogenism found among 19(76%), Increased ovarian volume of more than 10 cm3 found among 20(80%), and Twelve or more follicles measuring 2-9mm found among 21(84%) of the PCO disease patients, as shown in **Figure 1**. Mean BMI was significantly higher among PCO disease cases 33.1 ± 6.3 than control group 25.4 ±5.7, (P value <0.05). Mean Hirsutism score was significantly higher among PCO disease cases 9.6 ± 3.7 than control group 4.9 ±1.2, (P value <0.05). The mean LH (mIU/L) was significantly higher among PCO disease cases 11.6 ± 1.8 than control group 6.5 ±1.3, (P value <0.05). The mean FSH (mIU/L) was significantly lower among PCO disease cases 4.8±1.2 than control group 7.1 ±2.0, (P value <0.05). Mean prolactin (ng/ml) was significantly higher among PCO disease cases 34.6 ± 3.5 than control group 20.9±5.1 (P value <0.05). Mean ovarian volume was significantly higher among PCO disease cases 11.4±3.4 than control group 7.2 ± 1.5 (P value <0.05). The mean Uterine artery

PI was significantly higher among PCO disease cases 2.3±0.5 than control group 1.8±0.4 (P value <0.05), as shown in **Table 1**.

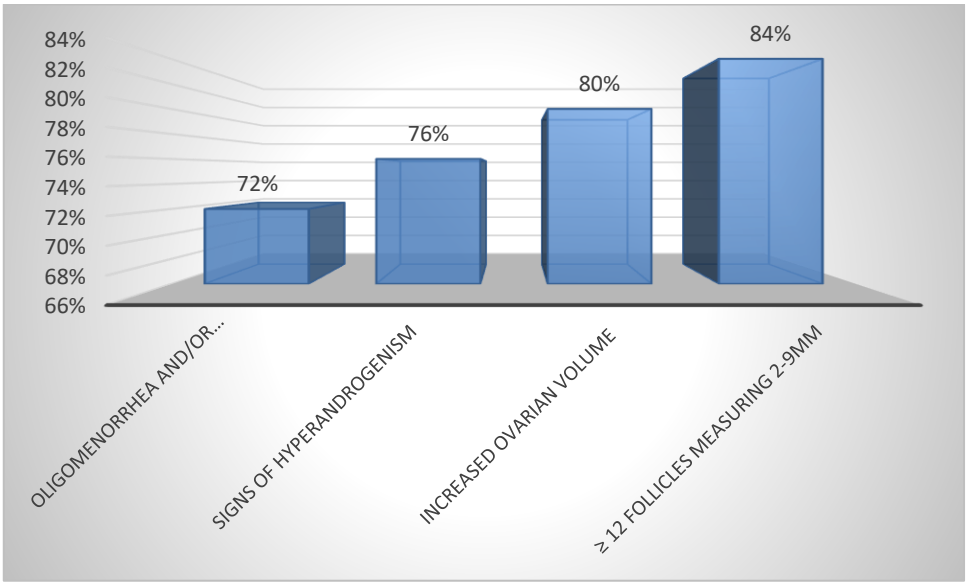

Fig. 1: The signs and symptoms of PCOD patients

Table 1: The mean hormonal and sonographic parameters among study groups.

clinical biochemical and sonographic characteristics	Cases		Controls		
	Mean	Std. Deviation	Mean	Std. Deviation	P value
Age	26.7	7.8	25.9	6.5	>0.05
BMI	33.1	6.3	25.4	5.7	<0.05*
Hirsutism score	9.6	3.7	4.9	1.2	<0.05*
LH (mIU/L)	11.6	1.8	6.5	1.3	<0.05*
FSH (mIU/L)	4.8	1.2	7.1	2.0	<0.05*
LH/FSH ratio	2.1	0.4	1.1	0.1	<0.05*
prolactin (ng/ml)	34.6	3.5	20.9	5.1	<0.05*
Total testosterone, ng/dL	59.7	10.2	41.6	12.3	>0.05
Ovarian volume cm^3	11.5	3.4	7.2	1.5	<0.05*
Uterine artery PI	2.3	0.5	1.8	0.4	<0.05*

***Significant**

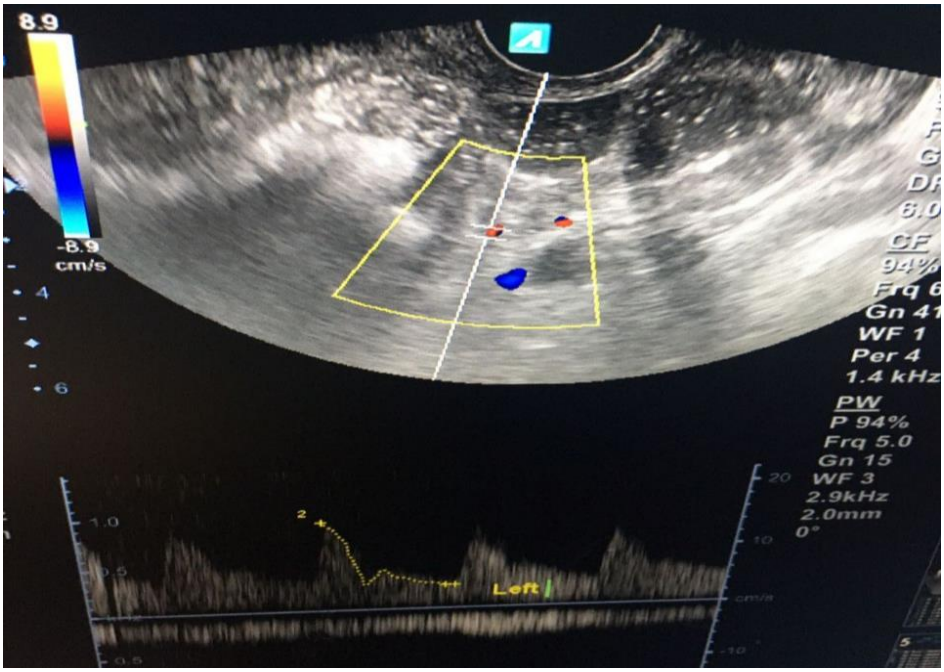

Fig. 2: The Doppler study of uterine artery.

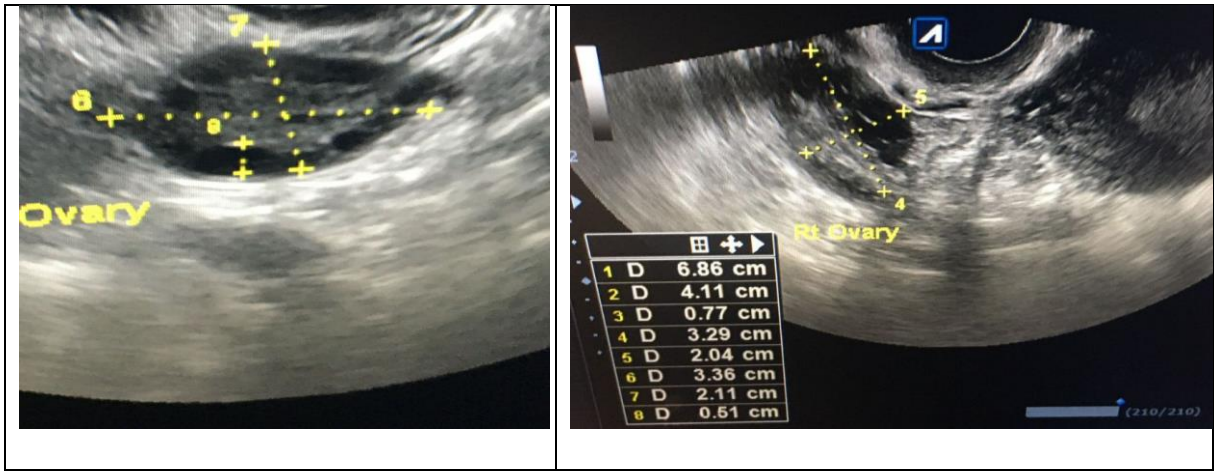

Fig. 3: The ultrasonic features of the ovary in a patient aged 29 years with PCOS and secondary infertility history.

4. Discussion

The current study showed that oligomenorrhea found among (72%) of the patients, clinical/biochemical signs of hyperandrogenism found among (76%). This is like a study carried out by Adams et al in 2004 found that most of the patients with PCOD presented with

oligomenorrhoea (82.5%) followed by infertility (30%) and secondary amenorrhoea (15%) like previous studies[29] .

The current study showed that the mean LH (mIU/L) was significantly higher among PCO disease cases and that the mean FSH (mIU/L) was significantly lower among PCO disease cases than control group. The current study showed that increased ovarian volume of > 10 cm3 found among (80%), and ≥12 follicles measuring 2-9 mm found in (84%) of the PCO disease patients. This may be explained by the fact that the mean ovarian volume in the present study also correlated with the serum LH and explained that the enlarged ovarian volume was under the effect of high LH. This is like Pache et al. also found similar correlation of ovarian volume with LH (r¼0.30, p¼0.003). In the present study, all PCOD patients had multiple follicles. [30] The present study also indicates the high LH:FSH ratio. This is like Vrtacnik-Bokal & Meden-Vrtovec, and Arroyo et al . [31,32]

The current study showed that the mean BMI was significantly higher among PCO disease cases than control group. This is like a study of Franks in 2004 found that more than 50% had obesity. [33] The current study showed that the mean Uterine artery PI was significantly higher among PCO disease cases 2.3 ± 0.5 than control group 1.8 ± 0.4 (P value <0.05). Goswamy and Steptoe first who reported significantly elevated PI values in the uterine arteries of infertile females (Goswamy, R. K., & Steptoe, P. C. 1988) [34].

According to different studies, there are a lot of variations in the pulsatility index and Resistive index of uterine arteries in PCOS patients. Asma, B. et al. in Lahore in 2016 on PCOS found that mean values of pulsatility index of uterine arteries bilaterally were High in PCOS - patients. [35] Maciołek- Blewniewska, G. et al., 1999 observed elevated pulsatility index of uterine arteries in females with PCOS. [36] Dolz, M. et al., 1999 found that that PCOS had greater values of uterine artery pulsatility index and Resistive index (Dolz, M. et al., 1999). [37] Anum S in 2019 found that there is no significant difference of uterine artery resistive index in polycystic ovarian syndrome patients and normal females. [38]

5.Conclusions

The mean Uterine artery PI was significantly higher among PCO disease cases than control group, and its useful in diagnosis of polycystic ovarian syndrome and its differentiation from polycystic like ovary cases. The mean ovarian volume was significantly higher among PCO disease cases than control group.

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