ASSESSMENT OF INTRAOVARIAN ARTERIAL DOPPLER ULTRASOUND OF POLYCYSTIC OVARIAN SYNDROME

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ABSTRACT

Background: The fact indicates the importance of transabdominal color Doppler sonography of intra-ovarian arteries in the clinical diagnosis of polycystic ovary syndrome. At present, the lack of uniform data and absence of cut-off values make vascular indices impractical for discriminating between polycystic and normal ovaries. The aim of this study is to investigate the importance of transabdominal color Doppler sonography of intra-ovarian arteries in the clinical diagnosis of polycystic ovary syndrome. Patients & methods: A case control study done in Salah Al-Deen general hospital. The study carried out during the period (1st Jan-12th June 2021). A simple random sample of 35 patients with PCOs compared with 35 normal patients. Data were collected through:1-Questionnaire:containing information regarding demographic and general information of the patients: age, body weight, height, Marital status and BMI, clinical and obstetrical information’s. 2-Transabdominal US examination for identification of PCOS with standard sonographic criteria, & Intra-ovarian artery Pulsatility and Resistive indices measurement in both diseased and normal group.3-Laboratory exam of the luteinizing hormone, follicle stimulating hormone, LH/FSH ratio & prolactin.

Results: The mean ovarian PI was significantly lower among cases (1.29 ±0.94) compared to controls (1.98 ± 0.38). The mean ovarian RI was significantly lower among cases (0.62 ± 0.14) compared to controls (0.78 ± 0.07. The mean ovarian volume was significantly higher among cases (14.35 ± 3.17) compared to controls (6.10 ± 2.71). The ovarian PI show significant negative correlation with serum LH (mIU/L) (r=-0.65), LH/FSH ratio (r=-0.76), BMI (r=-0.34), prolactin (r=- 0. 41), ovarian volume (r=-0.57). Ovarian RI show significant negative correlation with serum LH (mIU/L) (r=-0.631), LH/FSH ratio (r=-0.775), BMI (r=-0.36), prolactin (r= 0. 37), ovarian volume (r=-0.51). Conclusions: Ovarian artery Doppler analysis show decrease in PI & RI among PCOS patients & this indicate that it is a cheap, easily available, non-invasive technique in diagnosis of PCOS patients.

Keywords: Intraovarian Arterial Doppler Ultrasound of polycystic ovarian syndrome, Doppler Ultrasound of polycystic ovarian syndrome

I. INTRODUCTION:

Poly-Cystic Ovary Syndrome (PCOS) is a widespread complex endocrine disorder of women in the reproductive age group. Clinically, PCOS may manifest as a mild menstrual disorder or a severe disturbance of reproductive and metabolic functions. PCOS results in chronic anovulation. There is abnormal production of oestrogen and androgens due to imbalance of LH and FSH. LH/FSH ratio is elevated. Women with PCOS are prone to insulin resistance, type II diabetes mellitus, obesity and infertility, psychological disorder like depression, cardiovascular diseases, and endometrial and ovarian cancer. Presenting symptoms may be acne and hirsutism. [1] To define PCOS, there has to be two of the three following features- menstrual irregularity, clinical and biochemical evidence of androgen excess and multiple cysts in the ovary. PCOS is manifestation of various interrelated mechanisms; it may not be known which if any, is primary. Probably PCOS is a common end & result of different mechanisms and pathologies. There may be pituitary dysfunction resulting in high serum LH and high serum prolactin. Menstrual cycles may be anovulatory presenting as oligomenorrhea, secondary amenorrhea [2]. Patients are prone to obesity which leads hyperglycaemia and elevated oestrogen and sometimes insulin
resistance leading to type II diabetes mellitus, dyslipidaemia and hypertension. However, despite significant progress in understanding the pathophysiology and diagnosis of the disorder, over the past 20 years, the disorder remains underdiagnosed and misunderstood.

The diagnostic criteria are indefinite with numerous intricacies, PCOS remains a challenging area of research. Pelvic ultrasound (US) is a safe, accurate, and noninvasive method to examine uterine and ovarian size and appearance. [3] Women with PCOD have significant differences in intraovarian and uterine artery haemodynamics compared with women with normal ovaries. These women have an increased ovarian stromal blood flow velocity in the early follicular phase of the normal menstrual cycle. [1] Colour Doppler facilitates the detection of small vessels in the utero-ovarian circulation and the measurement of impedance to flow in this vascular tree.[4]. The fact indicates the importance of transabdominal color Doppler sonography of intra-ovarian arteries in the clinical diagnosis of polycystic ovary syndrome (PCOS). To investigate the importance of transabdominal color Doppler sonography of intra-ovarian arteries in the clinical diagnosis of polycystic ovary syndrome.

II. PATIENTS AND METHODS

A case control study done in Salah Al-Deen general hospital /gynecology and obstetrics department and sonography unit. The study carried out during the period (1st Jan-12th June 2021). A simple random sample of 35 patients with PCOs compared with 35 normal patients.

Inclusion criteria were the following; women of reproductive age diagnosed with PCOS, & normal women.

Exclusion criteria were the following; women with the history of DM, hypertension, CVD or any other uterine and ovarian diseases. Data collection done through:1-Questionnaire: a standardized questionnaire designed by the researcher was used containing information regarding demographic and general information of the patients: age, body weight, height, Marital status and BMI. Clinical and obstetrical information’s regarding: infertility type, primary Infertility, secondary Infertility, duration of infertility, gravidity, party, and abortion. Oligomenorrhea (<6 menstrual periods in preceding year) and/or anovulation: Increased ovarian volume of more than 10 cm3. Twelve or more follicles measuring 2-9mm. 2- Transabdominal US examination for: identification of PCOS with standard sonographic criteria & intraovarian artery Pulsatility and Resistive indices measurement in both diseased and normal group. RI and PI recording will be at the follicular and ovulatory phase of menstrual cycle in normal group. The PI and RI of the intra-ovarian arteries were measured in PCOS and normal groups women. RI and PI were recorded in normal group at the follicular and ovulatory phase of menstrual cycle. Spectral Doppler indices were compared in diseased and normal groups. All Doppler examinations were performed using an ultrasound machine (Philips HD-7. Bothell, WA, USA). All patients were studied by means of color and power Doppler flow imaging, color signals were searched in the ovarian stroma away from the ovarian surface and not adjacent to the wall of a follicle. Areas of maximum color intensity, representing the greatest Doppler frequency shifts, were chosen for pulsed Doppler examination. Then, after angle correction, optimal flow velocity waveforms were chosen for analysis. The pulsatility index (PI) and resistance index (RI) were electronically calculated for each selected Doppler wave. [25], 3- Laboratory examination of the following hormones was assayed: luteinizing hormone (LH), follicle stimulating hormone (FSH), LH/ FSH ratio & prolactin (PRL). Peripheral blood was obtained on the same day as the ultrasonographic and Doppler examination.

III. RESULTS

The mean age was (30.57±6.3) among cases and (30.4±4.7) among controls. The age distribution show that most of the PCOs patient were 20-25 years 13(37.1%) followed by 26-30 years 8 (22.9%), and among controls the commonest age was 31-35 years 17(48.6%). The mean BMI was higher among cases (31.3±5.8), than controls (24.45±1.7), and the commonest BMI among cases was ≥ 30 Kg/m2 18(51.4%), while among the controls was (18.5-24.9) 18 (51.4%), these relations was statistically significant (P value < 0.05). Most of the cases and controls were married 25(71.4%), and 27(77.1%) respectively as shown in table 1.

Table 1. General characteristics of study sample

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>study group</th>
<th>P value</th>
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<tbody>
<tr>
<td></td>
<td>Cases</td>
<td>Controls</td>
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Most of the married PCOs patient were infertile 18(72%) while all the married controls were fertile 27(100%), as shown in table 2. the mean duration of then infertility was (4.5 ± 2.9).

Table 2. The distribution of study groups according to fertility status and duration of infertility.

<table>
<thead>
<tr>
<th>Fertility status</th>
<th>Cases</th>
<th>Controls</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>F %</td>
<td>F %</td>
<td></td>
</tr>
<tr>
<td>Fertile</td>
<td>7 28 %</td>
<td>27 100.0%</td>
<td>&lt; 0.05 *</td>
</tr>
<tr>
<td>Non fertile</td>
<td>18 72 %</td>
<td>0 0.0%</td>
<td></td>
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</tbody>
</table>

Duration of Infertility 4.5 ± 2.9

Total 35 100.0% 35 100.0%

*significant

The clinical parameters of PCOs patient were as followes; Increased ovarian volume of more than 10 cm³ found among 31(88.6%) of the patients. Twelve or more follicles measuring 2-9mm found among 28(80%), clinical/biochemical signs of hyperandrogenism 24(68.6%), and Oligomenorrhea (<6 menstrual periods in preceding year) and/or anovulation 31(88.6%) of the patients, as shown in table 3.

Table 3.3. The clinical presentation of PCOs patients

<table>
<thead>
<tr>
<th>Clinical presentation</th>
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<tbody>
<tr>
<td>Increased ovarian volume of more than 10 cm³</td>
<td>31</td>
<td>88.60%</td>
</tr>
<tr>
<td>Oligomenorrhea (&lt;6 menstrual periods in preceding year) and/or anovulation</td>
<td>31</td>
<td>88.60%</td>
</tr>
<tr>
<td>Twelve or more follicles measuring 2-9mm</td>
<td>28</td>
<td>80.00%</td>
</tr>
</tbody>
</table>
The mean LH (mIU/L) was higher among cases (12.23 ±2.31) compared to controls (5.46 ±2.25). The mean FSH (mIU/L) was lower among cases (5.46 ±1.05) compared to controls (6.79 ± 1.84). The mean LH/FSH ratio was higher among cases (2.3 ±0.53) compared to controls (0.85 ± 0.17), as shown in table 4.

The mean prolactin ratio was higher among cases (30.94± 8.6) compared to controls (18.26 ± 4.5), this relation was statistically significant as shown in table 4.

The mean ovarian PI was lower among cases (1.29 ±0.94) compared to controls (1.98 ± 0.38), this relation was statistically significant as shown in table 5. The mean ovarian RI was lower among cases (0.62 ± 0.14) compared to controls (0.78 ± 0.07), this relation was statistically significant as shown in table 5. The mean ovarian volume was higher among cases (14.35 ± 3.17) compared to controls (6.10 ± 2.71), in a statistically significant relation as shown in table 5.

The correlation analysis of the Ovarian PI show significant negative correlation with serum LH (mIU/L) \((r=-0.65)\), LH/FSH ratio \((r=-0.76)\), BMI \((r=-0.34)\), prolactin \((r=-0.41)\), ovarian volume \((r=-0.57)\), these relations was as shown in table 3.6 and figures 1, 2, 3. The correlation analysis of the Ovarian RI show significant negative correlation with serum LH (mIU/L) \((r=-0.631)\), LH/FSH ratio \((r=-0.775)\), BMI \((r=-0.36)\), prolactin \((r=-0.37)\), ovarian volume \((r=-0.51)\), as shown in table 6.
**significant**

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>P value</th>
<th>r</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LH (mIU/L)</td>
<td>-0.65**</td>
<td>0.000</td>
<td>-0.631**</td>
<td>0.000</td>
</tr>
<tr>
<td>LH/FSH ratio</td>
<td>-0.76**</td>
<td>0.000</td>
<td>-0.775**</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI</td>
<td>-0.34**</td>
<td>0.004</td>
<td>-0.36**</td>
<td>0.004</td>
</tr>
<tr>
<td>Prolactin</td>
<td>-0.41**</td>
<td>0.000</td>
<td>-0.37**</td>
<td>0.001</td>
</tr>
<tr>
<td>Ovarian volume</td>
<td>-0.57**</td>
<td>0.000</td>
<td>-0.51**</td>
<td>0.000</td>
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</table>

### IV. DISCUSSION

In the current study revealed that most of the PCOs patients were 20-25 years (37.1%) followed by 26-30 years (22.9%). This goes with Jamal AF et al 2019 in Iraq [6] who found that the highest prevalence (32.7% and 43%) was among the age group 18-27 years. Tabassum K IN 2014 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. [7] The mean BMI was higher among cases (31.3±5.8), than controls (24.45±1.7), and the commonest BMI among cases was ≥ 30 Kg/m2 (51.4%). This goes with Jamal AF et al 2019 in Iraq [6] who found that the highest prevalence (43%) of PCO was also found among participants of high BMI (≥ 30) and 22.5% among overweight women. Hussein et al 2013 in Iraq also found an increased prevalence of PCO among obese females. [8] Dhingra D et al 2017 who found that 48.6% of participants were overweight. [9] The current study revealed that most of the married PCOs patients were infertile (72%), the mean duration of then infertility was (4.5 ± 2.9), this goes in accordance with Haifaa S Ajaj et al who found that primary infertility affect (58.7%), while secondary was (41.3%). [10] Alhindawi Zena found that the (71.7%) of women with infertility. [11] Eleawi HR found that There was higher frequency of primary infertility (74%) among the PCOs infertility group with a higher percentage of <5 years was more in PCOS infertility group. Eleawi HR found that PCOs cause of infertility had a significantly higher frequency (55%). [12]

The current study revealed increased Levels of LH were high in patients with PCOS with increased ratio of LH/FSST. This agrees with the study of Haifaa S Ajaj et al in 2020, Eleawi HR in 2015, Deliwala K J., et al in 2020, Ahmad A et al in Egypt in 2015, Kaiser UB in (2002), Laven JS in 2003, Ajossa, (2001), who found raised serum LH concentrations in most of PCOS patient. [10, 12, 13, 14, 15, 16, 17] The current study revealed that the mean ovarian PI was significantly lower among cases (1.29 ±0.94) compared to controls (1.98 ± 0.38). Ahmad A et al in Egypt in 2015 found that The PI of uterine arteries was significantly higher in patients with PCO than in control women. [14] A significant positive correlation between higher serum LH levels lower RI values of ovarian stromal artery has been reported for PCOS patients [18]. Resende et al was found no correlation was between PI and luteinizing hormone, testosterone or androstenedione levels [10, 19].

The current study revealed that the ovarian PI show significant negative correlation with serum LH (mIU/L) (r=-0.65), LH/FSH ratio (r=-0.76), BMI (r=-0.34), prolactin (r=-0.41), ovarian volume (r=-0.57). Also reported that the Ovarian RI show significant negative correlation with serum LH (mIU/L) (r=-0.631), LH/FSH ratio (r=-0.775), BMI (r=-0.36), prolactin (r=-0.37), ovarian volume (r=-0.51).

Ng EH in 2006 found that a significant positive correlation between higher serum LH levels lower RI values of ovarian stromal artery has been reported for PCOS patients [20] The mean ovarian PI was significantly lower among cases (1.29 ± 0.94) compared to controls (1.98 ± 0.38), this goes with Dhinra D et al 2017 who found that the PI of the ovarian stromal artery was significantly lower (1.96±0.19 in cases and 2.6±0.26 in controls). Ovarian stromal PI among PCOs patient was (0.98 ± 0.37) and among controls was (1.73 ± 0.35) [21] The low PI values indicate that ovarian stromal vessels are probably dilated and engorged and more abundant in the ovaris of women with PCOS [22] Similar results found by Deepali Dhingra et la who reported that mean values of PI of ovarian stromal artery was 0.96±0.19 in cases and 2.6±0.26 in controls and the mean values of uterine artery PI was 2.8±0.41 in cases and 2 ±0.27 in controls. PI of ovarian stromal artery was significantly low in cases as compared to controls (p<0.05). Correlating the ovarian stromal artery pulsatility indexes with rest of parameters there was positive and significant correlation with LH, LDL in cases and negative and significant correlation with DHEAS i.e. ovarian blood flow is directly proportional to LH and inversely proportional to DHEAS in cases. This means that blood flow in ovarian stromal artery was higher in patients with PCOS compared with the
controls. [21] This also goes in accordance with Adali et al 2009 (Ovarian PI, 1.40 ± 0.63 in cases and 2.90 ± 0.20 in controls) and Battaglia et al 1995.[23, 24]

The low PI values indicate that ovarian stromal vessels are probably dilated and engorged and more abundant in the ovaries of women with PCOS reported by Loverro et al. 2001. [22] Zaidi et al 1995 studied the intraovarian vasculature and found a higher intensity of color flow in the ovarian stroma of patients with PCOS. They postulated that the increased ovarian stromal blood flow velocity in combination with a relatively unchanged impedance to blood flow may reflect increased ovarian perfusion and thus a greater delivery of gonadotropins to the granulosa cells of the developing follicles. [25]

Study done by Mala, Ghosh and Tripathi 2009; Resende et al. 2001 did not find ovarian PI to be lower in PCOS patients i.e. ovarian blood flow is not increased in PCOS patients. [19, 26] In the present study there was no correlation of BMI with uterine and ovarian artery blood flow as in similar studies by Aleem and Predanic 1996 and Resende et al. 200110. [27, 20] This is in contrast to as reported by Battaglia et al 1995 who found elevated uterine PI among obese PI among obese patients. They attributed these findings to the presence of hyperinsulininaemia among obese patients. [24] The current study revealed that the mean ovarian volume was significantly higher among cases (14.35 ± 3.17) compared to controls (6.10 ± 2.71). Heba I Ali 2016 found that in only (16.6%) of PCOS patients showed volume above normal and that the other, the ovarian volume ranged from 6.7 to 12.6 ml, with an average of 9.65 ml. [28].

Balen AH in 2003 found that women with PCOS are frequently ovulatory. The presence of a dominant follicle (defined as a follicle that’s longitudinal, transverse, and anteroposterior diameters average more than 10 mm) or corpus luteum may increase the ovarian volume above the 10-cm3 threshold. Such a finding should prompt repeat scanning during the next menstrual cycle. [29]

V. CONCLUSIONS

The mean ovarian PI was significantly lower among cases compared to controls. The mean ovarian RI was also significantly lower among cases compared to controls. The mean ovarian volume was significantly higher among PCOS cases compared to controls. The ovarian PI show significant negative correlation with serum LH (mIU/L) (r=−0.65), LH/FSH ratio (r=−0.76), BMI (r=−0.34), prolactin (r=−0.41), ovarian volume (r=−0.57). Ovarian RI show significant negative correlation with serum LH (mIU/L) (r=−0.631), LH/FSH ratio (r=−0.775), BMI (r=−0.36), prolactin (r=−0.37), ovarian volume (r=−0.51).

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