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Using Ultrasound in the Confirmation of Polycystic Ovary Syndrome

Diana Sulieman Aljammal. MD[1*], Shefaa Saleh Almashaqbeh. MD[1], Hend Moqbel Harahsheh. MD[1], Rana Ahmed Alkrimeen. MD[1], Rawan Nahed Hiyari. MD[1]

[1]Department of Radiology, Jordanian Royal Medical Services, King Hussein Medical Center, Amman, Jordan

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***Corresponding author:** Diana Sulieman Aljammal. MD
Department of Radiology, Jordanian Royal Medical Services, King Hussein Medical Center, Amman, Jordan

Abstract **Original Research Article**

Background: Polycystic ovary syndrome (PCOS) is found in 6–15% of females of reproductive age (1, 2) with polycystic ovaries on pelvic ultrasonography. Polycystic ovaries are nonspecific on ultrasound, overlapping with findings in 40% of people who do not have the syndrome. ***Aim:*** To assess the advantages of transabdominal pelvic ultrasound in the confirmation of PCOS. ***Methods:*** This prospective investigation compared 45 female participants with PCOS, average age 14.9 years (group I) with 82 female participants with acute appendicitis, average age 14.3 years (group II), at Hashim Bin Al-hussein Military Hospital, Zarqa, Jordan, during the period 2018-2020. Transabdominal pelvic ultrasound was assessed in the two groups. Ovarian volume (0.5 x length x width x thickness) and follicle (3–10 mm in a single plane (follicle number per section) for each ovary) were followed up. The modified Rotterdam criteria (volume more than 10 ml +/- number of follicles more than 10) for polycystic ovaries were used. Pelvic transabdominal ultrasound was performed in cases of doubtful appendicitis with longitudinal and transverse images of the two ovaries and uterus (and endometrial stripe). Correlation between continuous variables was conducted using nonparametric Wilcoxon tests and correlation between categorical variables was performed using Fisher's exact test. A P-value of less than 0.05 was considered statistically significant. ***Results:*** The modified Rotterdam criteria for polycystic ovary morphology (PCOM) were recorded more commonly in group I (66.7% [30/45]) than in group II (10.97% [9/82]). In group I, 30 participants were positive for PCOM: 12/30 (40%) by number of follicles more than 10, 4/30 (13.3%) by volume and 14/30 (46.7%) by number and volume. Most ultrasounds were accurate for confirmation (group I = 93.3% [42/45] and group II = 91.5% [75/82]). In group II, nine participants were positive for PCOM: three by follicle criteria, two by volume and four by volume and number of follicles. The participants positive for ultrasound were older (P< 0.05); older subjects had larger ovary volume (P<0.05). Age was not statistically correlated with an increased number of follicles (P>0.05). Increased weight was correlated with increased ovary volume (P<0.05) but not with increased follicle number (P>0.05). ***Conclusions:*** The incidence of ovarian morphology according to modified Rotterdam criteria by transabdominal pelvic ultrasound in group I was statistically higher than in group II. Transabdominal pelvic ultrasound is useful in the assessment of PCOS.

Keywords: polycystic ovary syndrome; ultrasound, transabdominal pelvic, modified Rotterdam criteria.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is found in 6–15% of females of reproductive age [1, 2] with polycystic ovaries shown on pelvic ultrasonography. It is correlated with obesity, endometrial hyperplasia and cancer [3]. Early confirmation is crucial to avoid delayed consequences. Confirmation of PCOS has involved various types of criteria. National Institutes of Health criteria included menstrual abnormalities with hyperandrogenism. Rotterdam criteria (RC) included two of three of: oligomenorrhea with or without anovulation, hyperandrogenism and polycystic ovaries seen by transvaginal ultrasound [1] (ovarian volume more than 10 ml and/or more than 12 follicles of 2–9 mm) [4]. The Androgen Excess and Polycystic Ovary Syndrome Society criteria included hyperandrogenism and ovarian abnormality (oligoanovulation and/or polycystic ovary) [2].

Early postmenarchal years are characterized by ovulatory menstruations and hormone modifications. Menstrual and hormonal abnormalities in adolescence may resemble the adult PCOS confirmation criteria.

Post-menarche, anovulatory cycles continue frequently for years [2] and do not match hyperandrogenism [5]. Clinical hyperandrogenism is defined by hirsutism, as acne is frequent and temporary [1]. For confirmation of PCOS, biochemical markers (serum androgens) are important [6].

Use of pelvic ultrasound in doubtful cases of PCOS has been shown to be questionable. A polycystic ovary is nonspecific on ultrasound, overlapping with findings in 40% of people who do not have the syndrome [5, 7]. Most pelvic ultrasounds are transabdominal and not transvaginal, with less resolution and precision of ovarian morphology [4, 8]. Obesity in PCOS patients can make transabdominal ultrasound less effective at defining ovarian morphology. Multifollicular aspects in puberty because of follicular growth with no dominant follicle are an origin of uncertainty of PCOS [4, 9]. Ovarian ultrasound was replaced with ovarian magnetic resonance imaging or serum anti-Müllerian hormone levels [10]. The use of polycystic ovary morphology (PCOM) as confirmation criteria is questionable [11].

This investigation aimed to assess the advantages of transabdominal pelvic ultrasound in the confirmation of PCOS in a group of adolescents with PCOS, by comparing them with a group of adolescents without, to determine the incidence of PCOM by modified Rotterdam criteria (mRC).

METHODS

This prospective investigation included 45 female participants with PCOS (menstrual abnormalities and hyperandrogenism), average age of 14.9 years (group I) compared with 82 participants with operatively ascertained acute appendicitis, average age 14.3 years (group II), at Hashim Bin Al-hussein Military Hospital, Zarqa, Jordan, during the period 2018-2020. Written informed consent was obtained from all subjects and approval was granted by the ethical and research board review committee of the Jordanian Royal Medical Services. Participants with PCOS receiving hormonal drugs or who were premenarchal were excluded.

Transabdominal pelvic ultrasound was assessed in the two groups. Ovarian volume and follicle numbers were followed up. The mRC (volume more than 10 ml and/or number of follicles more than 10 in every section) for polycystic ovaries were used. Hormonal and hormonal related features of PCOS are shown in Table II. Abnormal hirsutism was confirmed if the Ferriman-Gallwey score was more than 7. Serum total T (upper normal was 32- 55 ng/dl) and free T (normal <6.3 pg/mL) were recorded.

Pelvic transabdominal ultrasound was performed in patients with doubtful appendicitis, with longitudinal and transverse images of the two ovaries and uterus (and endometrial stripe). Ultrasound was excluded if there was a dominant follicle larger than 1 cm. Ovarian volume was measured (0.5 x length x width x thickness) [(4)]. The number of antral follicles (3–10 mm) in a single plane (follicle number per section [FNPS]) for each ovary was determined. The RC specifies an ovary volume of more than 10 ml and a follicle number per ovary (FNPO) of more than 12 follicles. PCOM was labelled using mRC, with an ovary volume of more than 10 ml and FNPS of 10 follicles [(12)]. In group II, patients were subdivided into those receiving ultrasound within the first two weeks of the cycle (follicular phase) or within four weeks of last menstrual period (LMP; luteal phase).

Statistics

Correlations between continuous variables were calculated via nonparametric Wilcoxon tests and between categorical variables using Fisher's exact test. In the PCOS group, associations between age and weight and the number of follicles more than 10 were calculated using nonlinear models. In the comparison group, the associations between age and weight and number of follicles were calculated using linear models. A P-value of less than 0.05 was considered statistically significant.

RESULTS

In group I (average weight, 68 kg), 30 participants (66.7%) were positively identified using mRC for PCOM during transabdominal ultrasound; 12 of these (40%) by number of follicles more than 10, four of these (13.3%) by volume and 14 of these (46.7%) by number and volume (Table I). Seventeen subjects were positive for ovary volume (OV) criteria, 11/17 (64.7%) had bilateral enlargement of ovaries and 6/17 (35.3%) had unilateral enlargement of one ovary. There was no correlation between age and OV (P > 0.05) or mRC (P >0.05). Increased age was not correlated with a decreased incidence of having more than 10 follicles (>0.05). There was no association between weight and ultrasound criteria (P>0.05). Weight was also not correlated with having more than 10 follicles (P>0.05) or with OV (P>0.05).

In group II (average weight, 45.3 kg), nine participants (10.97%) were positively identified for PCOM: three by follicle criteria, two by volume and four by volume and number of follicles. The increased OV was unilateral in total. The subjects positive for ultrasound mRC for PCOM were older (P< 0.05) and older subjects had larger OV (P<0.05). Age was not significantly correlated with an increased number of follicles (P>0.05). Increased weight was correlated with increased OV (P<0.05) but not with increased follicle number (P>0.05) or with mRC for PCOM (P>0.05).

Most ultrasounds were accurate for confirmation (PCOS = 93.3% and comparison = 91.5%; P>0.05). The mRC for PCOM was significantly higher

in the PCOS group than in the comparison group (66.7% and 10.97%, respectively; P<0.05). OV was higher in the PCOS group (P<0.05). Average weight in the PCOS group was higher than in the comparison group (68 kg and 45.3 kg, respectively; P<0.05). There was no significant correlation between weight and ultrasound in both groups (P>0.05 in the PCOS group and P>0.05 in the comparison group).

Table I: Participant demographics and ultrasound features

	Group I	**Group II**	**P**
n=	**45**	**82**	
Age (years) (range)	14.9(10-18)	14.3(9-16)	>0.05
Weight (kg) (range)	68(40-85)	45.3(40-75)	<0.05
mRC for PCOM (%)	30(66.7)	9(10.97)	<0.05
Volume (%)	4/30(13.3)	2/9(22.2)	
Follicles (%)	12/30(40)	3/9(33.3)	
Volume and follicles (%)	14/30(46.7)	4/9(44.5)	
Total mRC by volume (%)	18/30(60)	6/9(66.7)	
Total mRC by follicles (%)	26/30(86.7)	7/9(77.8)	
Ovaries > 10 ml (%)	11/30(36.7)	1/9(11.1)	
Ovary volume (ml)	9.5(2.7-19.7)	6.9(1.6-13)	<0.05

Table II: Menstrual and hormonal features of group I

Variable	
Average age at menarche (years)	11
Oligoanovulation (n, %) Primary-amenorrhea Secondary- Oligo- Poly-	 1(2.2) 5(11.1) 38(84.4) 1(2.2)
Hirsutism (54) (n, %)	39(86.7)
Increased total T (53) (n, %)	15(33.3)
Increased free T (47) (n, %)	16(35.6)

DISCUSSION

In our investigation, most subjects with PCOS were positively identified via the mRC for PCOM using transabdominal ultrasound. The comparison group experienced a lower incidence of PCOM, as has been shown in other work [7, 9]. The frequency of PCOM was significantly higher in participants with PCOS than in the comparison group. Ovarian morphology is part of the confirmation criteria for adults. OV more than 10 ml and a follicle number more than 10 with FNPS can be recorded using transabdominal ultrasound even in obese patients. For the evaluation and treatment of PCOS, some authors have indicated against using ultrasound as a first-step confirmation [13], others have indicated confirmation of PCOS in adult females via the RC and in younger females via hyperandrogenism and amenorrhea, limiting use of ultrasound [11].

Limiting the use of ultrasound for confirmation of PCOS is based on three theories: the incidence of PCOM in the general population; the evolution of ovarian morphology and the character of transabdominal ultrasound in obese patients. PCOM is recorded in 40% of the healthy population [7, 14]. PCOM of 35% in subjects aged 14–16 years was attributed to increased OV rather than an increased number of follicles [5]. Females with isolated PCOM have higher levels of anti-Müllerian hormone than with controls, indicating a granulosa cell pathology in PCOS [15]. In the comparison group with an operative confirmation and no irregular menses or hyperandrogenism, there was an 11% incidence of PCO in the general population [3]. Ovarian multifollicular morphology may progress within early adulthood [1]. There was no correlation between age and PCOM in subjects with PCOS. In the comparison group, older age was correlated with PCOM, because of the increase in OV and not because of an increase in the number of follicles. There was no correlation between older age and decreased number of follicles. An absence of signs of PCO in early adolescence via ultrasound must be followed up by later reassessment. If PCOM is present based on OV, this is unlikely to regress [16].

The ovarian and endometrial measurements in most of our participants were recorded as in previous studies, whatever the weight [5, 7]. If the ovaries are properly seen, OV can be evaluated [2]. There was comparability between the incidence of PCOM in our group and others [8]. Transvaginal ultrasound with FNPO count can detect antral follicles [12, 17]. There is a highly comparable threshold for OV and FNPS using a single cross-sectional view of the ovary [12, 18]. A mixture of FNPS (a cut-off of nine to 10 follicles) with OV gives significant predictive detection of PCOS compared to use of FNPO only [12]. If the image

character is poor, the volume can be used on its own (with a sensitivity of 81% and specificity of 84% in differentiating between PCOS and non-PCOS) [18]. Transabdominal ultrasound in obese patients has a significant predictive ability in the confirmation of PCOS using the OV and FNPS.

The comparison group consisted of adolescents with acute abdominal pain as a main complaint, assessed for nongynecological confirmation to rule out any ovarian abnormality. More ultrasounds were ruled out in cases with a dominant follicle of more than 10 mm. menstrual history and contraceptives have implications for differential confirmation of abdominal pain. Obesity is common among patients with PCOS and in our study; the average weight was higher in the PCOS group than in the comparison group. Some findings of PCOS, such as hirsutism or high androgen, might have been present, but were not recorded in the nine participants with PCOM in the comparison group. Excluding any subject would have reduced the incidence of PCOM in the comparison group. FNPO via transvaginal ultrasound with a higher threshold was used as the most precise confirmation criteria for PCOM [19] but with older ultrasound patients, the volume criteria are used. Assessment according to a mixed metric of FNPS and OV may achieve predictive detection rates of PCOM comparable with that of FNPO only [12]. Most pelvic ultrasounds are conducted with a reduced resolution TA transducer and FNPS counts. In our study, a mixed metric of FNPS and OV measured transabdominally was used.

CONCLUSION

The incidence of ovarian morphology via mRC by transabdominal ultrasound in participants with PCOS was significantly higher than in the comparison group. The incidence of PCOM using an ultrasound mRC in a nongynecological group was lower. Transabdominal ultrasound can assess PCOM in obese patients. Adolescence is the most suitable period to manage PCOS.

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