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Utility of ultrasound in the diagnosis of polycystic ovary syndrome in adolescents

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Objective: To determine the utility of transabdominal pelvic ultrasound in the diagnosis of polycystic ovary syndrome (PCOS) during adolescence.
Design: Retrospective case-control study.
Setting: Academic tertiary care pediatric hospital.
Patient(s): A case group of 54 patients (mean age, 15.2 years) with PCOS based on the National Institutes of Health criteria and a comparison group of 98 patients (mean age, 14.6 years) with acute appendicitis.
Intervention(s): Transabdominal ultrasound (TAUS) images were evaluated in the two groups of adolescents, with data collected on quality of the images, ovarian volume, ovarian follicle count, and endometrial thickness.
Main Outcome Measure(s): Sonographic modified Rotterdam criteria (volume >10 mL and/or follicle number per section ≥ 10) for polycystic ovaries (PCO).
Result(s): Among the 54 patients with PCOS and 98 comparison subjects with usable images, the sonographic modified Rotterdam criteria for PCO morphology (PCOM) were met more frequently in the PCOS group than in the comparison group (65% vs. 11%). The vast majority of images were of adequate quality for diagnosis (PCOS = 94% and comparison = 91%), even in the presence of obesity.
Conclusion(s): The prevalence of ovarian morphology meeting the sonographic modified Rotterdam criteria by TAUS in girls with PCOS was markedly higher than in the adolescents serving as a comparison group. PCOM findings by the sonographic modified Rotterdam criteria were uncommon in the nongynecologic comparison group, in contrast to previous reports. TAUS may provide useful information in the evaluation of PCOS during adolescence, even in obese adolescents. (Fertil Steril® 2014;■:■–■. ©2014 by American Society for Reproductive Medicine.)
Key Words: Polycystic ovary syndrome, adolescents, transabdominal ultrasound, Rotterdam criteria, endometrial thickness

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Polycystic ovary syndrome (PCOS) is the most common endocrine disorder, affecting 6%–15% of women of reproductive age (1). Manifestations of PCOS include irregular menses, hyperandrogenism, and the presence of polycystic ovaries on pelvic ultrasound (US). Associated conditions include obesity, diabetes, cardiovascular disease, infertility, and increased risk of endometrial hyperplasia and cancer (2, 3). Early diagnosis is important, as awareness can promote lifestyle modifications or medical treatments to prevent at least part of the late sequelae (4).

Several criteria have been proposed in adults to make a diagnosis of PCOS with the concomitant exclusion of other disorders. The 1990 National Institutes of Health (NIH) criteria require menstrual irregularities and clinical or biochemical hyperandrogenism. The Rotterdam criteria (RC), the product of a consensus workshop held in 2003 by the European Society for Human Reproduction and Embryology (ESHRE) and the American Society for Reproductive Medicine (ASRM), broadened the definition to include two out of three of the following criteria: oligomenorrhea

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and/or anovulation, hyperandrogenism, and polycystic ovaries (PCO) by transvaginal US (5) (either ovarian volume >10 mL and/or ≥12 follicles measuring 2–9 mm) (6). The Androgen Excess-PCOS Society criteria require the presence of hyperandrogenism (clinical and/or biochemical) and ovarian dysfunction (oligoanovulation and/or PCO) (7).

The application of these diagnostic criteria for PCOS in the adolescent girl is more challenging, given the expected anovulatory menses and hormone changes characteristic of the early postmenarchal years. Menstrual and hormonal fluctuations that occur normally during adolescence may mimic the clinical characteristics included in the adult PCOS diagnostic criteria, making them less reliable as a diagnostic tool in this age group. After menarche, anovulatory cycles are common, may persist for several years (1, 8), and do not necessarily correspond to clinical or biochemical hyperandrogenism (9). Clinical hyperandrogenism is defined primarily by the degree of hirsutism in adolescents because acne is common in this age group and is usually transient (10, 11). Although some studies suggest relying primarily on biochemical markers when making the diagnosis of PCOS (12, 13), measurements of serum androgens can be challenging to interpret owing to the variability among laboratories and the use of different methods of determining free and total T (14).

The usefulness of pelvic US in supporting the suspected diagnosis of PCOS has been controversial. The finding of PCO on US has been reported to be nonspecific, overlapping with image findings seen in up to 40% of the normal population (9, 15–17). In addition, most pelvic US exams in adolescents are performed transabdominally rather than transvaginally, resulting in lower resolution and thus less accurate observation of ovarian morphology (6). The prevalence of obesity in the PCOS population may potentially make the transabdominal US (TAUS) even less ideal to define ovarian morphology. Furthermore, the multifollicular appearance characteristically seen during puberty as a result of follicular growth without consistent recruitment of a dominant follicle may also be a source of confusion and misdiagnosis of PCO in this age group (6). As a result, some investigators have proposed replacing ovarian sonographic imaging with ovarian magnetic resonance imaging or serum antimüllerian hormone (AMH) levels, especially in the adolescent population (18–21). The most recent Endocrine Society guidelines cautioned against the use of PCO morphology (PCOM) as a diagnostic criteria for adolescents (22).

Given the controversies and questions regarding the use of US in an adolescent PCOS population, we analyzed pelvic US images obtained in a cohort of adolescents with PCOS and a comparison adolescent population to assess the prevalence of PCOM by a modified version of the Rotterdam US criteria and to examine whether there were differences in endometrial thickness.

MATERIALS AND METHODS

We performed a retrospective, case-control cohort study. The protocol was approved by the Boston Children's Hospital Committee on Clinical Investigation.

Study Populations

US images were evaluated in two cohorts: [1] a sample of adolescent girls who all were diagnosed with PCOS by the 1990 NIH criteria (menstrual irregularities and clinical and/or biochemical hyperandrogenism) between 2006 and 2008 at the Boston Children's Hospital's Reproductive Endocrine Clinic in the Division of Adolescent/Young Adult Medicine; and [2] a comparison group of adolescents with surgically confirmed appendicitis who had a pelvic TAUS in the Emergency Department (ED) (2005–2013) before the operative procedure. Patients with PCOS taking hormonal medications (such as birth control pills) that could affect ovarian morphology were excluded. Hormonal and physical characteristics of PCOS patients were assessed (Table 1). Hirsutism was considered clinically significant if the Ferriman-Gallwey score was >7. None of the girls had acne as the only sign of hyperandrogenism. The biochemical evaluation included serum concentrations of total T (high-performance liquid chromatography tandem mass spectrometry, Esoterix, Inc.; the upper limit of the normal values ranged between 32 and 55 ng/dL, depending on Tanner stage) and free T (equilibrium dialysis, Esoterix, Inc.; normal <6.3 pg/mL). The comparison group was identified using an institutional database. Medical charts were reviewed including the initial ED visit and subsequent clinic visits in our hospital. In total, 398 patients were initially identified. Patients were excluded if they were premenarchal or if they had a past medical history suggesting a diagnosis of PCOS or potentially affecting ovarian morphology (e.g., endocrinopathies, use of hormonal medications, known adnexal pathology; Fig. 1). The data collected included weight and last menstrual period (LMP) before the US.

US Data

All examinations were performed on one of three units, with multiple, size-appropriate, 2–5 MHz transducers: Siemens,

TABLE 1

Menstrual and hormonal characteristics of girls with PCOS (n = 54).

	n (%[a])	Mean value[b] (SD)
Age at menarche (y)		12.0 (1.6)
Gynecologic age		3.5 (2)
Oligoanovulation		
Primary amenorrhea	1 (2)	
Secondary amenorrhea	7 (12)	
Oligomenorrhea	45 (84)	
Polymenorrhea	1 (2)	
Hirsutism (n = 54)	46 (85)	
Acne (n = 54)	37 (69)	
Total T (ng/dL) (n = 49)		46.7 (25.3)
Elevated total T (n = 53)	17 (32)	
Free T (pg/mL) (n = 45)		9.6 (8.2)
Elevated free T (n = 47)	17 (36)	
DHEAS (μg/dL) (n = 45)		296.2 (138)
Elevated DHEAS (n = 48)	19 (40)	

[a] Percentages are from those patients with complete data on a given variable.
[b] Mean is calculated for patients with laboratory values obtained at our institution. Patients whose labs were performed before the initial visit (at facilities that used different laboratory methods with a variable range and cutoff) were included in calculations of the frequency of elevated androgen concentrations.

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