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BRIEF REVIEW

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Polycystic Ovarian Morphology: Diagnostic Criteria and Prevalence

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Abstract

The purpose of this brief review was to systematize the current information on the diagnosis, prevalence, and ethnic aspects of polycystic ovarian morphology (PCOM). The information search was conducted using Internet resources (Medline, Pubmed, Cochrane Library, and Google Scholar) and literature sources for the period from January 1999 to August 2021. The review includes only full-text articles. Based on the analysis of the literature, we demonstrated that the diagnostic value of PCOM has changed since the moment of the first description of polycystic ovarian syndrome (PCOS). Currently, ovarian size, ovarian volume and antral follicle count are key criteria for most PCOS phenotypes and complications. The diagnostic value of PCOM depends on age and racial characteristics, which requires large-scale epidemiological studies to determine PCOM characteristics in different populations. Standardizing PCOM diagnostic criteria is the key to PCOS effective diagnosis and, consequently, to preventing complications and comorbidities associated with PCOS.(**International Journal of Biomedicine. 2021;11(4):100-103.**)

Key Words: PCOM • PCOS • insulin resistance • hyperandrogenism • ultrasound criteria

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Abbreviations

AMH, anti-müllerian hormone; **FNPO**, follicle number per ovary; **FSH**, follicle-stimulating hormone; **IR**, insulin resistance; **OV**, ovarian volume; **PCOM**, polycystic ovarian morphology; **PCOS**, polycystic ovarian syndrome; **SHBG**, sex hormone binding globulin.

Introduction

Polycystic ovarian syndrome (PCOS) takes a leading position among endocrine diseases and is associated with a wide range of reproductive[1-4] and metabolic disorders.[4-7] Currently, polycystic ovarian morphology (PCOM) is a key criterion for PCOS in most cases. The definition of PCOS symptoms has significantly changed since the first description [8] of this syndrome in 1935 and remains a subject of debate among clinicians and scientits around the world. In 1990, a panel of experts from the National Institutes of Health (NIH) defined this condition as a combination of hyperandrogenism and chronic anovulation after excluding other causes of anovulation.[8] Subsequently, the NIH criteria were criticized because they did not include ultrasound (US) signs of PCOM, which was considered to be a significant marker of PCOS by many scientists.

In 2003, ESHRE/ASRM experts in Rotterdam adopted updated criteria for PCOS,[9] which represented an extended version of the 1990 NIH consensus and included polycystic ovarian changes as one of the criteria for diagnosing PCOS.[8,9] Parameters providing sufficient sensitivity and specificity of PCOM were approved. They included the presence in at least one ovary with follicle number per ovary (FNPO) of ≥12 with a diameter of 2–9mm and/or ovarian volume (OV) of ≥10 cm^3. It was noted that the number of follicles should be assessed both in longitudinal and anteroposterior sections of the ovaries, and follicles with a size of 10mm should denominate the average value of the diameters measured in two sections. To calculate the volume of the ovary, a formula was proposed for an elongated ellipsoid (0.523×length×width×thickness). For sexually active women, transvaginal access was recognized as a priority, especially in obese patients. Women with regular menstruation were advised to undergo a pelvic ultrasound

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on the early follicular phase of the natural cycle, or, if oligo-amenorrhea occurs, regardless of the day of the cycle or after withdrawal bleeding caused by pharmaceuticals. In case of the follicle/cyst diameter more than 10mm or corpus luteum presence, a repeat US was recommended.

The unacceptability of the criteria for the diagnosis of PCOM in women taking oral contraceptives (both healthy and with a diagnosis of PCOS) was noted due to changes in the structure of the ovary during intake of these medicines. It was recommended not to overestimate the distribution of follicles in the ovary, the increase in echogenicity, and the stroma volume as the parameters of polycystic morphology, due to the presence of a more sensitive marker - OV. The role of pelvic ultrasound estimates in the prognosis of hyperstimulation and in response to ovarian stimulation and the outcomes of in vitro oocyte maturation was demonstrated as significant, as was the use of modern equipment. In addition, the importance of appropriate training of specialists and the inadmissibility of replacing measurements according to the protocol with a subjective assessment was emphasized.[9]

The introduction of these criteria naturally led to an increase in the frequency of PCOS detection due to the so-called "non-androgenic" and "ovulatory" phenotypes. Possible combinations of components of the Rotterdam criteria have allowed identifying four PCOS phenotypes:[6,10] phenotype A (oligo-/anovulation (OA), clinical and/or biochemical hyperandrogenism (HA), and PCOM), phenotype B (HA+OA), phenotype C (HA+PCOM), and phenotype D (OA+PCOM).[9-12]

In 2006, the AE-PCOS experts proposed their version of the PCOS diagnostic criteria. These criteria focused on the manifestations of hyperandrogenism, which was recognized as a necessary symptom of PCOS. According to the AE-PCOS consensus, PCOS should have been diagnosed with the obligatory presence of hyperandrogenism in combination with menstrual dysfunction and/or a polycystic ovarian structure, according to ultrasound data.[10,13] The Rotterdam 2003 PCOM ultrasound diagnostic criteria (presence of at least one ovary with 12 follicles of 2–9 mm in size or OV>10 mL, in the absence of a dominant follicle >0 mm) were supported in this document as well. However, the working group noted the likelihood of a high incidence of false-positive PCOM results and suggested that hyperandrogenism and oligo/anovulation should be considered priority criteria for PCOS.

In 2013, the experts from the Endocrine Society Working Group [14] published a document in which they recommended the criteria proposed in Rotterdam in 2003 for the diagnosis of PCOM (the presence of at least one ovary with 12 follicles 2-9 mm in size or >10mL, in the absence of a dominant follicle of >10 mm), the preference for the transvaginal approach to imaging was also supported. At the same time, the need to standardize the ultrasound characteristics of PCOS was pronounced, considering the age and possible limitations of the method associated with the technical characteristics of the equipment and ethical aspects.[14]

The improvement in the technical capabilities of ultrasound diagnostic devices has led to a clearer visualization of the ovarian structure and requests for a revision of the ultrasound criteria for PCOS. In this regard, it was proposed to increase the threshold value of the number of follicles or ovarian volume.[4,14]

The latest guideline on the diagnosis and management of PCOS, published in 2018,[4] proposes to consider the provisions adopted in Rotterdam as the basis for the diagnosis of PCOS.[4] However, the need to take into account racial and age characteristics was noted. This document establishes the standard protocol for clinical assessment of polycystic ovarian structure for sexually active women, including a transvaginal ultrasound examination in the early follicular phase of the natural cycle or after withdrawal of bleeding caused by pharmaceutical drugs. The 2018 ESHRE PCOS guideline group suggested a threshold of >20 FNPO with or without an OV ≥10 mL, without any dominant follicles, cysts, or corpus luteum in either ovary using transvaginal ultrasound transducers with a frequency bandwidth of 8MHz to diagnose PCOM in women aged 18-35.[4,15] It has been emphasized that a cut-off OV value of ≥10 mL is much more reliable than the number of follicles for the diagnosis of PCOM.[4,15] This parameter is especially useful when utilizing outdated ultrasound equipment or transabdominal imaging[15] in sexually inactive women.[4] The above-mentioned approach to determining PCOM is also used in the Russian national clinical guidelines for the management of women with PCOS.

It should be noted that in patients with hyperandrogenism and irregular menstrual cycles, ultrasound examination of the pelvic organs is not necessary for the diagnosis of PCOS; however, it is important to clarify the clinical phenotype.[4] Also, the latest international guidelines do not recommend using PCOM as a diagnostic criterion for PCOS within 8 years after menarche.[4]

The ovarian stroma was considered by researchers as a tool to improve the quality of PCOM diagnostics.[16] However, due to the technical features of the implementation and the high correlation between stromal volume and the size of the ovaries, this approach is not used in clinical practice.[4,15] There is also no reliable data on the diagnostic value of measuring blood flow in the ovaries to detect PCOM, nor are there threshold values for differentiating the blood flow of polycystic and normal ovaries.[4,15]

Ethnic differences in the number of follicles and/or volume of the ovaries are being actively studied. For example, in Chinese women, the lower OV and FNPO, compared to women in the European population (≥6.3 cm^3 and ≥10), are considered as sufficient criteria for determining PCOM.[17] Turkish women also showed lower values than the Western population. The threshold PCOM criteria for them are OV of 6.43 cm^3 and FNPO of >8.[18] In the population of Korean patients, FNPO is considered to be a more significant criterion for polycystic disease than the OV, due to the smaller volume of ovaries specific for the Asian race.

The OV and FNPO change during the woman's reproductive period, reaching a maximum in adolescence with a gradual decrease in adulthood and a fast decrease in the age of menopause. For example, in women over age 35, the prevalence of PCOM is 7.8%, compared with 21% in younger women.[19] Moreover, a decrease in FNPO happens faster than

in OV.[20] Age-related processes in women suggest a reduction in the number of growing antral follicles.[20] A progressive decrease in the number of antral follicles leads to significant changes in typical ultrasound signs of PCOS, associated with a decrease in inhibin B and AMH levels,[20,21] and an increase in FSH levels.[20] FSH contributes a temporary more complete maturation of follicles with a reduction in the duration of the menstrual cycle,[20,21] and a decrease in the level of androgens in the blood serum. In this regard, aging in women with PCOS is associated with an improvement in the main characteristics of PCOS: a decrease in the prevalence of PCOM and a rise in the proportion of women with regular menstrual cycles.[20]

The use of various criteria for polycystic ovarian transformation also determines the inconsistency of information about the prevalence of PCOM. In general, the prevalence of polycystic morphology in a non-selective population, according to several authors, ranges from 33% to 22%.[22] At the same time, PCOM, according to the results of the ultrasound examination, is a common condition that can occur in 16%-25% of healthy women with regular menstrual cycles.[19] According to a few studies, the polycystic ovarian structure was detected in 92% of women with hirsutism with regular menstrual cycles, in 87% of women with oligomenorrhea, in 57% of women with anovulation, and in 26% of women with amenorrhea.[19,23] Interestingly, 25% of women with signs of PCOM had no other PCOS symptoms. Of women with anovulation and regular menstruation, 91% showed polycystic ovarian changes.[19]

The incidence of polycystic ovaries in Japanese women was comparable to that in women from the United States and Italy and was detected in 68%-80% of patients diagnosed with PCOS.[23] The prevalence of polycystic morphology in English women aged 20-25 years is 22%-33%, in Finnish women <36 years –21.6%, in New Zealand – 21%, and in Australia – 23%.[19] The prevalence of polycystic ovaries may be less if the study had been conducted using a transabdominal approach.[4]

Insulin resistance (IR) and hyperandrogenism are closely interrelated, exacerbating the pathogenesis of PCOS. Hyperandrogenemia favors the development of IR by directly altering the action of insulin in skeletal muscle and adipocytes and decreasing the secretion of adiponectin. IR also enhances hyperandrogenemia due to the induction of steroidogenesis in the ovaries and adrenal glands and a decrease in the synthesis of SHBG. In addition, hyperandrogenism correlates with follicular excess in PCOS.[4,24] According to a cross-sectional study, PCOS patients with IR and hyperinsulinemia had a larger OV than patients without abnormal biochemical markers.[4,25,26] However, there was no correlation between laboratory parameters of IR and FNPO.[25] Therefore, the authors consider OV as an important risk factor for metabolic disorders in patients with PCOS.[4,25] Even in women with normal menstrual function and without clinical signs of hyperandrogenism, PCOM is associated with higher androgen and insulin levels and lower SHBG levels.[27] On the other hand, hirsutism, oligomenorrhea, and irregular cycles were equally present in patients with normal OV and enlarged ovaries.[4]

There is a positive correlation between the FNPO and AMH levels. Some authors have proposed the use of AMH as an alternative marker of ovarian dysfunction and PCOM, especially in cases with an ambiguous assessment of PCOM, as well as when it is impossible to use a transvaginal approach (for example, in virgins, in the absence of equipment of a certain class, and in obese patients). However, a single threshold for AMH as a diagnostic criterion has not been determined yet.[4,28]

Conclusion

Thus, the results of the conducted literature review emphasize the importance of assessing PCOM, which is an independent criterion for diagnosing PCOS and determining its clinical phenotype. The review illustrates the role of PCOM, not only as an indicator of ovarian dysfunction but also as a marker of disease severity and a factor in assessing metabolic risks. The diagnostic significance of PCOM varies with age and race, requiring large-scale epidemiological studies to determine the PCOM characteristics for different populations. Standardization of PCOM diagnostic criteria is the key to the effective diagnosis of PCOS and, accordingly, to the prevention of complications and comorbidities associated with PCOS.

Competing Interests

The authors declare that they have no competing interests.

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