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Pelvic floor muscle thickness in women with polycystic ovary syndrome

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Summary

Objective: To evaluate pelvic floor muscle (PFM) thickness in women with polycystic ovary syndrome (PCOS) group and compare it to those with normal menstrual cycle (control group). *Materials and Methods:* Transperineal ultrasound examination was used to evaluate the thickness of the bilateral pelvic floor muscles *Results:* The mean age was 25.1 ± 2.1 and 24.2 ± 1.9 years in PCOS and control groups, respectively ($p > 0.05$). Body mass index averaged 22.5 ± 0.9 in the control group and 27.8 ± 2.6 in the PCOS group ($p = 0.03$). There was no difference between the thickness of the pelvic floor muscles (PCOS group: right 1.12 ± 0.5, left 1.0 ± 0.6 and control group: right 0.89 ± 0.6 and left 0.94 ± 0.4. *Conclusions:* There was no differences in pelvic floor muscle thickness identified by ultrasound. However, the PCOS group exhibited a tendency to greater thickness. This may be due to the state of hyperandrogenism or abdominal overload.

Key words: Hyperandrogenism; Pelvic floor; Polycystic ovary syndrome; Muscle.

Introduction

The pelvic floor muscles (PFM) are a set of skeletal muscles. The primary component of this complex, the *levator ani*, is composed of three muscles: *pubococcygeus*, *iliococcygeus*, and *puborectalis*. They are responsible for static and dynamic support of pelvic organs and contribute to fecal and urinary continence [1]. Moreover, these muscles can neutralize excessive abdominal pressure, by voluntary muscle contraction that reduces the urethral and anal canal [1, 2].

Skeletal muscles contain androgenic and estrogenic receptors. It is believed that variations in these hormones can affect muscle strength and endurance [3]. An increase in the level of these hormones in blood could contribute to improving the performance of these variables [4-6]. There is a direct association between testosterone levels and an increase in perineal muscle mass [7]. In women, however, the action of testosterone in skeletal muscles in general remains unclear [8].

Hyperandrogenism in women is observed in several abnormal situations, the polycystic ovary syndrome (PCOS) being the most frequent. This disorder has a prevalence of 5-10% in women of reproductive age. The main characteristics of PCOS are menstrual irregularity, changes in the ultrasonographic pattern of the ovaries, as well as clinical and/or biochemical signs of hyperandrogenism [9].

Considering that PCOS is a clinical model of high androgen levels in women, it is necessary to investigate the relationship between muscle morphology and different parts of the body, including the PFM. Of the different techniques to assess PFM, the International Continence Society (ICS) [10] recommends ultrasound to obtain additional information on muscle function. A number of studies [11, 12] have used ultrasound to analyze PFM, primarily to prove the effectiveness of conservative treatments. It is an easy-to-apply, reproducible, non-invasive, and validated method [3]. Studies have demonstrated a strong correlation between assessment of the cross-section area and muscle strength [13].

It is known that PFM lesions are responsible for several dysfunctions, especially urinary incontinence due to its high prevalence in women. Urinary loss has a large social and economic impact, with significant repercussions on feminine hygiene and emotional aspects. Thus, it is increasingly important to investigate the function of pelvic floor muscles in different situations, both physiological and pathological, of a woman's vital cycle, emphasizing new validated tools with high reproducibility that can be used in this assessment.

Accordingly, the aim of this study was to assess pelvic floor muscle thickness using ultrasound imaging in women

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with PCOS and compare it to those with normal menstrual cycle.

Materials and Methods

This is a descriptive study that intentionally recruited 20 women treated at the Maternity Hospital of the Federal University of Rio Grande do Norte, Natal, Brazil. The sample was composed of ten women with PCOS, and ten women with normal menstrual cycle and no clinical, laboratory or ultrasound evidence of PCOS, all aged between 20 and 30 years. All the patients were informed about the purpose of the study, and those that agreed to take part gave their informed consent. The study was approved by the Research Ethics Committee of the Federal University of Rio Grande do Norte under protocol number 574067.

The women with PCOS were diagnosed according to the Rotterdam criteria [9]. The control group included women with ovulatory menstrual cycle confirmed by progesterone blood levels above 5 ng/ml on the 21st day of the menstrual cycle. All the patients were nulliparous and had not undergone gynecological surgery. All the women with other endocrine disorders and those who had used medication that affected reproductive function or altered the metabolism (oral contraceptives, antiandrogenic drugs, treatment for diabetes or corticoids) within the previous 90 days were excluded.

All the women were submitted to a clinical examination to measure weight, height, and waist and hip circumference. Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared (kg/m^2) [14]. Gynecological assessment was performed, excluding those with inflammatory processes and/or local infections, in addition to vaginal dystopias and prolapses. In the physical examination, especially in the group with PCOS, the presence of acne, acanthosis nigricans in the neck folds, axillae, elbow, and inner surface of the thigh, as well as the amount of body hair were investigated. The Ferriman and Gallwey [15] semi-quantitative method was used to assess body hair, defining it as abnormal for a score less than or equal to 8.

PFM thickness was assessed by transperineal 3D ultrasound using a variable frequency volumetric transducer (4-8 Hz) and Minitab 11.0 software. The transducer was covered with a sterile glove and placed in the subclitoral region with the patient in the lithotomy position. The mid-sagittal plane was assessed, using a right to left scan to visualize the bladder neck, urethra, vaginal length, and the distal portion of the rectum with the anorectal junction and the proximal portion of the anal canal. The open angle was standardized at 70º in the sagittal plane and 75º in the axial plane. After automatic digitization (four seconds), the image was displayed on the screen in the multiplanal (axial, sagittal, and coronal) and rendering modes. The sagittal mode was selected as reference to obtain levator ani muscle thickness. The green line (corresponding to the region of interest) was placed on the upper portion of the sagittal plane, to ensure that all the pelvic floor structures were acquired for each patient. To analyze thickness, three images were captured and recorded for subsequent measurement by the assessor. The best image, as defined by the assessor, was used.

The data were tabulated using SPSS 20.0 software, and the Shapiro-Wilk test was used to test normality. Measures of central tendency were applied to describe gynecological and obstetric information and the Student's *t*-test to compare the groups. Thickness with an error difference above 0.5 and ICC of 95% were considered for statistical power. Thus, a study power of 75% was achieved.

Table 1. — *Clinical characteristics of patients with polycystic ovary syndrome (PCOS) and controls.*

	PCOS	CONTROL	p-value
Age (years)	25.3±4.5	26.2±4.0	>0.05
Age at menarche (years)	14.4±2.6	14.9±3.2	>0.05
Body mass index (kg/m2)	27.80±2.6	22.5±0.9	0,02*
Weight (Kg)	69.39±7.6	57.6±5.0	0.001*
Height (m)	1.58±0.08	1.60±0.05	0.05
Waist circumference (cm)	85.3±3.8	68.1±6.7	<0.001*
Hip circumference (cm)	107.8±6.7	87.7±5.5	<0.001*

*Student's t-test applied with a 5% significance level (p <0.05).

Results

The control group had a mean age of 25.3 ± 4.5 years with menarche at 14.4 ± 2.6 years, while in the control group it was 26.2 ± 4.0 years and menarche at 14.9 ± 3.2 years ($p > 0.05$). The PCOS group showed menstrual irregularity, seven (70%) were amenorrheic and three (30%) were oligomenorrheic; ovarian morphology was identified in all patients at the ultrasound examination. Signs of clinical hyperandrogenism included the Ferriman-Gallwey index, with a mean of 14.1 ± 3.2 points. Acne was present in eight (80%) patients, and acanthosis nigricans in four (40 %).

With respect to the physical examination, the PCOS group exhibited BMI of 27.8 ±2.6 kg/m^2 and the control group 22.5 ±0.9 kg/m^2: a statistical difference of $p = 0.02$. Table I shows the clinical characteristics of the PCOS group and control group.

Ultrasound assessment of PFM showed that the mean on the right side was 1.2 ± 0.5 cm and 0.89 ± 0.6 cm in the PCOS and control group, respectively. On the left side, the PCOS group exhibited a mean of 1.8 ± 0.6 cm and the control of 0.94 ± 0.4 cm. There was no intergroup difference.

Discussion

The results of the present study showed no significant difference in pelvic floor muscle thickness between women

with PCOS and normal women. It is important to underscore that this is the first study to assess PFM thickness in women with PCOS.

Ultrasound assessment of perineal muscles has been conducted in a number of clinical tests, primarily after surgery. This method makes it possible to measure/compare the thickness of the muscle complex at different phases of a woman's life, such as pregnancy, puerperium, and climacterium [13].

Microscopically, the skeletal muscle system contains a large number of type α and β estrogen receptors, as well as androgen receptors [16, 17]. These hormones exert direct hormonal action on a specific receptor and induce the transcription of specific genes in the intracelular environment [17, 18]. A series of investigations showed hormonal effects as a function of PFM when pre- and postmenopausal women were compared [19].

Testosterone stimulates protein synthesis and recruits satellite cells via the anabolic effect, in addition to having the ability to inhibit protein degradation [20, 21]. Satellite cells are undifferentiated mononuclear cells involved in the increase in myonuclei due to the post-mitotic characteristic of muscle fiber nuclei. In response to testosterone, these cells proliferate and bond to muscle fibers, resulting in an increase in muscle fiber hypertrophy. Despite the known presence of androgenic receptors and their stimulation in satellite cells, the direct mechanism that involves this action is uncertain in women [5].

Studies that relate skeletal muscles and hormone levels assess muscle performance by measuring isometric strength or maximum voluntary contraction. By assessing strength, a number of studies that investigated skeletal muscles during the menstrual cycle phases using a dynamometer found that the ability to generate strength was positively related to an increase in sex hormones [20-22]. One study that assessed hand grip strength and testosterone in women with PCOS and normal women showed no statistical difference in this relationship, explained by the low plasma testosterone levels [23].

It is believed that the higher the serum testosterone level, the larger the number of androgenic receptors, and in turn, the better the skeletal muscle quality, in terms of volume, strength and endurance [5]. This information corroborates other studies that assessed the quadriceps, abductors, and palmar interossi muscles [20-22].

Given that PCOS is one of the most frequent endocrine dysfunctions in young women and may cause systemic compromise, this study sought to assess the repercussions on PFM. It is important to underscore that due to comorbidities, women with PCOS are overweight or obese. Excess weight on PFM may favor pelvic floor dysfunctions such as urinary incontinence and vaginal prolapse, among others. These are caused by the increase in intra-abdominal pressure and shrinkage of pelvic support structures, such as ligaments and muscles, which was not observed in the present study group [24].

This study exhibited some limitations. The small number of patients in each group is due to the inclusion criteria established to homogenize the group and avoid distortions in ultrasound analyses. However, statistical analysis showed that the confidence intervals were small and data distribution was normal.

Conclusion

No difference in PFM thickness was initially observed between normal women and those with PCOS-related hyperandrogenism. However, it is important to underscore that the data obtained here show a tendency for women with PCOS to exhibit greater pelvic floor muscle thickness. It is suggested that new studies be carried out with a larger number of women or another population to confirm this tendency.

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