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ORIGINAL ARTICLE

Physiological and Biochemical Changes Associated with Hormonal Imbalance in Polycystic Ovarian Syndrome

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ABSTRACT

Background: Polycystic ovarian syndrome is among the most prevalent endocrine diseases in women of reproductive age group. It is also typified by menstrual disorder, hyperandrogenism, anovulation, and polycystic ovarian structure. One of its pathogenesis is hormonal imbalance, which is a leading factor in reproductive, metabolic and cosmetic manifestataion.

Objective: To evaluate hormonal imbalance associated with polycystic ovarian syndrome among women presenting to Mardan Medical Complex.

Methods: The study was a descriptive cross-sectional study conducted in Mardan Medical Complex, Mardan, between January 2022 and June 2022. There were 78 women with polycystic ovarian syndrome. The information on demographic profile, clinical presentation, menstrual history, and findings of ultrasonographic was entered on a structured proforma. Hormonal analysis of blood (luteinizing hormone, follicle-stimulating hormone, LH/FSH ratio, testosterone, prolactin, thyroid-stimulating hormone, estradiol, and progesterone) was performed. The analysis of data was performed through the use of SPSS version 26. Quantitative variables were displayed in the form of mean ± SD whereas qualitative variables were shown using frequency and percentage. The tests of the associations were performed with chi-square test, and the p was accepted as significant (p=0.05).

Results: The mean age of participants was 24.8 ± 4.6 years and the mean body mass index was 28.6 ± 4.9 kg/m². Menstrual irregularity was observed in 78.2% of women, while hirsutism, acne, and acanthosis nigricans were present in 59.0%, 50.0%, and 41.0%, respectively. Bilateral polycystic ovaries were found in 62.8% of cases. The most frequent hormonal abnormalities were raised luteinizing hormone in 56.4%, raised LH/FSH ratio in 52.6%, and elevated testosterone in 48.7% of participants. Significant associations were found between hormonal imbalance and obesity, menstrual irregularity, and hirsutism.

Conclusion: Hormonal imbalance is a prominent feature of polycystic ovarian syndrome, with raised LH, elevated LH/FSH ratio, and increased testosterone being the most common abnormalities. Early hormonal assessment in women with PCOS is essential for timely diagnosis and better management of reproductive and metabolic complications.

Keywords: Polycystic ovarian syndrome, hormonal imbalance, luteinizing hormone, testosterone, menstrual irregularity, hyperandrogenism

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a widespread endocrine and metabolic disease in women of reproductive age and is one of the major causes of menstrual, anovulatory infertility and hyperandrogenism. It is a heterogeneous disorder, which has fluctuating clinical manifestations, such as oligomenorrhea, amenorrhea, hirsutism, acne, obesity and subfertility. Besides its gynecological manifestations, PCOS is being identified as a multisystem disorder, in relation to insulin resistance, dyslipidemia, impaired glucose tolerance, and cardiovascular risk after a prolonged period[1-3].

PCOS is a multifactorial, and its etiology is a complex and multifactorial condition and it is associated with genetic predisposition, environmental issues, insulin resistance, and malfunctioning neuroendocrine factors. Its pathophysiology involves hormonal imbalance. The contribution of abnormal follicular development and persistent anovulation lies in altered gonadotropin secretion especially higher levels of luteinizing hormone secretion and relatively normal or low levels of follicle-stimulating hormone. Further elevation of androgen production by ovarian theca cells leads to the clinical signs of hyperandrogenism including hirsutism, acne and alopecia. Such endocrine imbalances also play with obesity and insulin resistance and increase the severity of the condition[4-6].

Ultrasonography is also a valuable auxiliary in the diagnosis of PCOS as it reveals increased ovarian volume and multiple small peripheral follicles. Imaging is however not used to diagnose it on its own and biochemical and clinical examination equally play an important role. Hormonal testing is useful in determining the key endocrine dysfunctions related to the syndrome and distinguishing between PCOS and other endocrine disease conditions such as thyroid dysfunction,hyperprolactinemia, and adrenal sources of androgen excess. As a result, reproductive hormone and related endocrine tests play a vital role in the diagnosis and treatment of the affected women[7-9].

In Pakistan and other developing nations, PCOS is becoming a significant health issue due to the shifting lifestyle trends, rising obesity, late onset and little understanding about the health of menstruation and endocrine. Most women only resort to medical care when they become infertile, experience severe menstrual problems, or dislike their appearance, and it is not always timely enough to diagnose and treat them. There is a dearth of local data on the hormonal profile of women having PCOS especially in tertiary care where numerous clinical presentations are observed.

This study was conducted to evaluate hormonal imbalance associated with polycystic ovarian syndrome among women presenting to Mardan Medical Complex. The objective was to determine the pattern of hormonal abnormalities and their association with major clinical features in women diagnosed with PCOS.

METHODOLOGY

The research was carried out at Mardan Medical Complex, Mardan, between six months, between January 2022 and June 2022. The aim of the study was to assess hormonal imbalance due to polycystic ovarian syndrome in women who were presenting to the gynecology and outpatient units of the hospital. The study involved 78 women who were diagnosed with polycystic ovarian syndrome. The sample size was made up of patients who qualified the selection criteria within the study period.

The study included women of reproductive age who were diagnosed with polycystic ovarian syndrome based on clinical observations, menstrual aberrations and ultrasonographic results. Exclusion was done on patients with known thyroid diseases,

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hyperprolactinemia, congenital adrenal hyperplasia, Cushing syndrome, ovarian tumor, and patients already receiving hormonal therapy to avoid confounding of hormonal assessment. All the subjects gave informed consent after the aim of the study was explained and patient information kept confidential during the research process.

The structured proforma was used in data collection. Age, marital status, weight, height, and body mass index were taken. Menstrual history such as irregularity, infertility, hirsutism, acne, alopecia and family history of polycystic ovarian syndrome/ diabetes was recorded. All participants were examined in terms of general physical and related clinical examination. Ultrasonography of the pelvis was done to determine the morphology of the ovaries, the volume of ovaries, the number of follicles, and other characteristics that indicate the presence of polycystic ovaries.

For hormonal evaluation, venous blood samples were collected under aseptic conditions and sent to the hospital laboratory for analysis. The hormonal profile included luteinizing hormone (LH), follicle-stimulating hormone (FSH), LH/FSH ratio, total testosterone, prolactin, thyroid-stimulating hormone (TSH), estradiol, and progesterone. Standard laboratory methods were used for biochemical assessment according to the protocol of the institutional laboratory. The collected data were entered and analyzed using SPSS version 26. Quantitative variables were presented as mean and standard deviation, while qualitative variables were expressed as frequency and percentage. Associations between hormonal imbalance and clinical variables were assessed using the chi-square test**,** and a p-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 78 women diagnosed with polycystic ovarian syndrome (PCOS) were included in the study. The results are presented in terms of demographic profile, clinical characteristics, ultrasound findings, hormonal profile, and the association of hormonal imbalance with major clinical features. The findings showed that menstrual irregularity, obesity, hyperandrogenic features, and altered reproductive hormones were common among the study participants.

Table 1 illustrates the demographic and anthropometric characteristics of the participants in the study. Most of the women were in the younger reproductive age with the mean age of 24.8 ± 4.6 years. Findings were common in increased body weight and central obesity which were expressed through the increased mean BMI and mean waist circumference.

Table 2 shows the menstrual pattern and major clinical manifestations among women with PCOS. Menstrual irregularity was the most common complaint, with oligomenorrhea being more frequent than amenorrhea. Clinical signs of hyperandrogenism, especially hirsutism and acne, were also observed in a substantial proportion of participants.

Table 3 illustrates ultrasonographic features of the ovaries of the study group. Most of the participants were observed to have bilateral polycystic ovarian morphology which supports clinical diagnosis of PCOS. There was a mild increase in the mean ovarian volume, and that several peripheral follicles were observed in high percentage of cases.

Table 4 summarizes hormonal profile of the PCOS diagnosed women. The most prominent abnormalities included raised LH, high LH/FSH ratio and higher levels of testosterone. Some subjects also had mild increases in prolactin and TSH indicating related endocrine disorders.

Table 5 presents the relationship that exists between significant hormonal abnormalities and the chosen clinical characteristics among PCOS women. High LH /FS ratio and high testosterone were more common between obese participants, menstrual irregularity, and hirsutism in women. These results show that hyperandrogenicity and hyperandrogenicity are strongly associated with hormonal imbalance in PCOS.

Table 1: Demographic and Anthropometric Characteristics of Study Participants (n=78)

Variable	Frequency (%) / Mean ± SD
Age (years)	24.8 ± 4.6
18–24 years	36 (46.2%)
25–30 years	28 (35.9%)
31–35 years	14 (17.9%)
Marital status – Married	42 (53.8%)
Marital status – Unmarried	36 (46.2%)
Weight (kg)	71.5 ± 11.2
Height (m)	1.58 ± 0.07
Body Mass Index (kg/m²)	28.6 ± 4.9
Normal BMI (<25)	20 (25.6%)
Overweight (25–29.9)	31 (39.7%)
Obese (≥30)	27 (34.6%)
Waist circumference (cm)	90.8 ± 9.4
Hip circumference (cm)	101.7 ± 8.6
Waist-to-hip ratio	0.89 ± 0.06

Table 2: Menstrual and Clinical Characteristics of Study Participants (n=78)

Variable	Frequency (%)
Menstrual irregularity	61 (78.2%)
Regular menstrual cycle	17 (21.8%)
Oligomenorrhea	43 (55.1%)
Amenorrhea	18 (23.1%)
Infertility	29 (37.2%)
Primary infertility	18 (23.1%)
Secondary infertility	11 (14.1%)
Hirsutism	46 (59.0%)
Acne	39 (50.0%)
Alopecia	21 (26.9%)
Acanthosis nigricans	32 (41.0%)
Family history of PCOS	19 (24.4%)
Family history of diabetes	27 (34.6%)
Family history of obesity	24 (30.8%)

Table 3: Ultrasound Findings in Women with PCOS (n=78)

Variable	Frequency (%) / Mean ± SD
Bilateral polycystic ovaries	49 (62.8%)
Unilateral polycystic ovaries	29 (37.2%)
Increased ovarian volume	52 (66.7%)
Peripheral follicles present	57 (73.1%)
Endometrial thickness (mm)	7.1 ± 1.8
Right ovarian volume (mL)	11.4 ± 2.7
Left ovarian volume (mL)	10.9 ± 2.5
Follicle number per ovary	12.8 ± 3.1

Table 4: Hormonal Profile of Study Participants (n=78)

Hormonal Variable	Mean ± SD	Abnormal n (%)
Luteinizing Hormone (LH) (mIU/mL)	11.8 ± 4.2	44 (56.4%)
Follicle-Stimulating Hormone (FSH) (mIU/mL)	5.9 ± 1.8	9 (11.5%)
LH/FSH ratio	2.1 ± 0.8	41 (52.6%)
Total Testosterone (ng/mL)	0.82 ± 0.29	38 (48.7%)
Prolactin (ng/mL)	21.4 ± 8.1	17 (21.8%)
Thyroid-Stimulating Hormone (TSH) (mIU/L)	3.8 ± 1.7	15 (19.2%)
Estradiol (pg/mL)	58.6 ± 18.4	12 (15.4%)
Progesterone (ng/mL)	1.9 ± 0.8	28 (35.9%)

Table 5: Association of Hormonal Imbalance with Major Clinical Features (n=78)

Clinical Variable	Total n	Raised LH/FSH Ratio n (%)	Raised Testosterone n (%)	p-value
BMI <25 kg/m²	20	6 (30.0%)	5 (25.0%)	
BMI ≥25 kg/m²	58	35 (60.3%)	33 (56.9%)	0.021
Menstrual irregularity present	61	37 (60.7%)	34 (55.7%)	
Menstrual irregularity absent	17	4 (23.5%)	4 (23.5%)	0.014
Hirsutism present	46	30 (65.2%)	31 (67.4%)	
Hirsutism absent	32	11 (34.4%)	7 (21.9%)	0.008
Infertility present	29	19 (65.5%)	17 (58.6%)	
Infertility absent	49	22 (44.9%)	21 (42.9%)	0.096

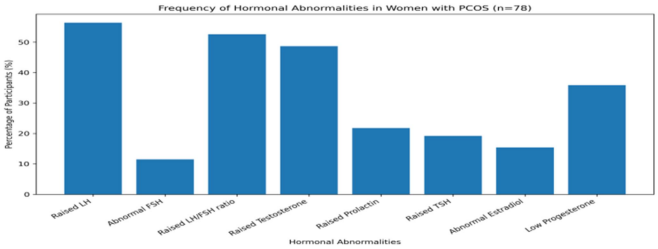

Figure 1: Frequency of hormonal abnormalities in women with polycystic ovarian syndrome (n=78).

DISCUSSION

The present study evaluated hormonal imbalance associated with polycystic ovarian syndrome in 78 women presenting to Mardan Medical Complex. The findings showed that most participants were young women in the reproductive age group, and a substantial proportion were either overweight or obese. This pattern supports the well-established clinical observation that PCOS commonly affects young women and is frequently associated with excess body weight and central adiposity, both of which may aggravate endocrine and metabolic dysfunction[10, 11].

Menstrual irregularity was the most common clinical presentation in this study, oligomenorrhea being common than amenorrhea. This observation is in line with the pathophysiology of PCOS, in which chronic anovulation and abnormal follicular maturation lead to abnormal menstrual cycles[12, 13] Quite a large number of patients also experienced infertility which again is a manifestation of the reproductive burden of the disorder. Hirsutism, acne, and acanthosis nigricans were very common in the current study, which is a strong indication that hyperandrogenism and insulin resistance were also significant clinical variables in these women[14, 15].

Ultrasonographic evaluation revealed that bilateral polycystic ovarian morphology, increased ovarian volume, and multiple peripheral follicles were present in most participants. These imaging findings are in agreement with the recognized sonographic features of PCOS and support the diagnosis in combination with clinical and biochemical abnormalities[16, 17]. The high proportion of bilateral ovarian involvement in this study suggests that structural ovarian changes were well established in the studied populationn[18].

The hormonal profile revealed most common abnormalities were elevated LH, high LH/FSH ratio and high testosterone. Such results are supported by biological realities, with the change in secretion of gonadotropins and hyperproduction of androgens being the key characteristics of PCOS. High LH increases stimulation of ovarian theca cells and production of androgen and a high LH/FSH ratio is associated with disordered ovarian folliculogenesis and anovulation. The high levels of testosterone among most of the participants can be used to explain the prevalent clinical presentation of alopecia, acne, and hirsutism found in this study. Mild prolactin and TSH abnormalities were also present in less percent of patients indicating that endocrine disturbances may accompany PCOS in women[19].

A significant discovery of this research was that the high ratio of LH/FSH and high levels of testosterone showed a high correlation with obesity, menstrual aberration, and hirsutism. This implies that hormonal imbalance is augmented in women exhibiting negative metabolic profile and an overt clinical hyperandrogenism. Obesity can increase insulin resistance and provoke androgen surplus, so it exacerbates the endocrine impairment of PCOS. Biochemical changes are also confirmed by the association of hirsutism and menstrual irregularity with the disease as well as a clinical manifestation of the disorder[20].

There are some limitations to this study. The study was carried out in single center and the sample size was small which could restrict the generalizability of the results. Moreover, insulin levels, anti-Mullerian hormone and long-term metabolic outcomes were not evaluated which would have given a more detailed endocrine and metabolic profile. Despite these limitations, the study provide a useful local information on clinical, ultrasonographic, and hormonal peculiarities of PCOS women as well as demonstrates the necessity of the early endocrine evaluation of the patients.

CONCLUSION

In conclusion, polycystic ovarian syndrome was commonly associated with significant hormonal imbalance in women of reproductive age. The most frequent abnormalities were raised LH, increased LH/FSH ratio, and elevated testosterone, while menstrual irregularity, hirsutism, acne, and obesity were the dominant clinical features. Hormonal disturbances were significantly associated with obesity, menstrual dysfunction, and hirsutism, indicating that endocrine imbalance is closely linked with the severity of clinical presentation. Early recognition and hormonal evaluation of women with PCOS can help in timely diagnosis, better clinical management, and prevention of long-term reproductive and metabolic complications.

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