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ORIGINAL ARTICLE

Impact of Polycystic Ovary Syndrome (PCOS) on Female Fertility and Metabolic Health

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ABSTRACT

Background: PCOS is one of the widespread endocrine illnesses during the reproductive years in women. It is characterized by the hormonal deficiency, ovulatory imbalance, and disorder of metabolism. PCOS occurs as one of the leading factors of infertility alongside insulin resistance, obesity and the risk of type 2 diabetes, and can occur to both metabolic and reproductive health.

Objective: To identify the impact of PCOS on fertility and on metabolic indicators in women and also, to analyses the clinical outcomes of PCOS patient population and control population.

Study Design: A cross-sectional study.

Place and Duration of Study: The study was Conducted in Department of Gynae & Obs, KTH-MTI Peshawar Khyber Teaching hospital (MTI) Peshawar from June 2022 to july 2023.

Methods: A cross-sectional study was done by including a sample of 100 women with PCOS based on the Rotterdam criteria. Hormonal Profile, menstrual history, metabolic parameters, and data on fertility were taken. The controls were matched to the PCOS patients of the same age and analyzed. The results were established using the mean values, standard deviations and p-value in calculating significance in the differences found between groups.

Results: The sample to conduct the study was 100 and the average age was 27.5 0 4.2. The androgens present in the serum (p=0.001), indicators of insulin resistance (p=0.002) and body mass index (BMI) (p=0.004) were highly increased in the PCOS patients as compared to controls. Eighty-five per cent of the patients compared to 10 per cent control showed ovulatory dysfunction (p<0.001). There was a very high prevalence of the metabolic syndrome in the PCOS group (p=0.005).

Conclusion: In summary: COS reduces female fertility remarkably in terms of hormonal and ovulatory disturbances and is strictly linked with the adverse repercussions on metabolism health. Reproductive and metabolic complications are the other issues that present serious reproductive challenges to the affected women and reproductive care should be carried out early and comprehensively.

Keywords: PCOS, Fertility, Metabolic Health, Insulin Resistance

INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders affecting females during a childbearing age and studies suggest that the prevalence of it has been estimated at 6-15 percent worldwide[1]. It is represented by agglomerate of signs and symptoms that include hyperandrogenism, disorder in the ovulatory functioning, and polycystic ovaries that have been explained as per Rotterdam criteria[2]. The disease has extensive clinical manifestation in menstrual pathology and infertility as well as metabolic malfunction of insulin resistance and body weight overweight and dyslipidemia[3]. One of the significant causes of infertility in women is the PCOS that is brought about due to chronic anovulation that causes nearly 70-80 per cent of the PCOS related infertility[4]. Pathophysiology PCOS is a multifactorial disease with a complex pathological process involving genetic, environmental, and behavioral factors present in the pathogenesis of the disease, participating in hormonal disorders and metabolic disorders[5]. Insulin resistance is also a considerably sizeable root towards the hyperandrogenism, as it increases the synthesis of androgens in the ovaries and encourages sex hormone-binding globulin (SHBG) reduction in 50-70 percent of patients with PCOS regardless of body mass index (BMI)[6]. This kind of interactions also leads to destruction of follicular growth and ovulation[7]. Besides reproductive health, PCOS also presents an eminent risk factor in metabolism syndrome, type 2 diabetes mellitus and cardiovascular disease that create lifelong repercussions. Moreover, anxiety and depression are common psychological issues found in PCOS women and might cause negative impact on the quality of life[8,9]. PCOS is poorly diagnosed or even confused, the disorder is heterogeneous and not the one known by the patients and the healthcare providers despite the high prevalence and its widespread clinical consequences. The keys to that better outlook of the patients are the multidisciplinary management, which concentrates on the level of reproductive and metabolic, and early diagnosis. This study paper attempts to establish the impact of PCOS on women health in terms of their fertility and metabolic issues by comparing and contrasting hormonal, ovulatory and metabolic markers of the affected women against the unaffected ones.

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METHODS

This study Conducted in the Department of Gynae & Obs, KTH-MTI Peshawar Khyber Teaching hospital (MTI) Peshawar from June 2022 to July 2023. One hundred healthy controls of equivalent age with the participants and 100 women diagnosed with PCOS Rotterdam criteria have been recruited. Clinical evaluation which comprised of medical history evaluation, medical observation and blood parameters were evaluated in details. Hormonal tests were also used to measure the serum levels of luteinizing hormone (LH) and follicle stimulating hormone (FSH) activities, testosterone and insulin. The metabolic test involved fasting blood sugar level, lipid profile and BM calculation. Menstrual history and ultrasound were used in establishing the stage of ovulatory. The institution review board approval was on an ethical ground. An informed consent was obtained by all the participants.

Inclusion Criteria: Females who met the Rotterdam criteria did not turn 40 years old yet and wanted to participate in the study.

Exclusion Criteria: Those patients who had thyroid disorders, hyperprolactinemia, adrenal hyperplasia or any other endocrine disorders were not allowed to be subjects.

Ethical Approval Statement: The study protocol was approved by the Institutional Ethics Committee (IEC) of the Khyber Teaching hospital (approval number 470/DME/KMC). All the participants provided their written informed consents. The study also adheres to the Convention of Helsinki principles of confidentiality and ethical conducts in every dimension of the study.

Data Collection: Clinical examination and structured questionnaires were used to take the measurements. The

menstrual cycle at a time was done during the early follicular period of collection of blood. This was carried out during tests on hormonal balances and metabolism. Ovarian morphology was determined using ultrasound analysis. All the data recorded were recorded in standard forms in order to be analyzed.

Statistical Analysis: With assistance of SPSS version 24.0 (IBM Corp., Armonk, NY), entries and analyses of the data were executed. The descriptive expressions of the continuous variables were done as the means and the standard deviations were calculated. Categorical variables were given as frequencies and percentages. The student also applied t-test and chi-square test that entailed the comparison of means and proportions of the groups. It was identified that the p-value was significant (<0.05).

RESULTS

The 100 PCOS women and controls were exploited The mean age of the PCOS used was 27.5 4.2 years, which was similar with that of the controls (28.0 4.1 years, p=0.45). The average BMI was far superior among PCOS group (28.6 5.1 kg/m 2) compared with controls (23.4 3.7 kg/m 2, p<0.001). Clinical manifestations such as hirsutism associated with hyperandrogenism were present in 62 of all patients of PCOS compared to 5 percent, controls (p<0.001). Serum testosterone was greater in PCOS patients (mean 85.4 ng/dL +/- 21.7 ng/dL) than in controls (42.8 ng/dL +/- 15.3 ng/dL, p <0.001). PCOS women also had higher HOMA-IR (3.9 1.2) in comparison to controls (1.8 0.9, p=0.002). Eighty percent of the PCOS subjects showed menstrual irregularity whereas anovulation was present in 85 percent of the cases as opposed to 12 percent and 10 percent of the cases in the control group (p<0.001). Relative to controls, 30 percent of the patients with PCOS were confirmed with metabolic syndrome relative to 8 percent controls (p=0.005). These findings demonstrate that there exist extreme effects in reproductive imbalances regarding PCOS and the imbalances in relation to metabolism.

Table 1: Demographic Characteristics of Study Participants

Parameter	PCOS Group (n=100)	Control Group (n=100)	p-value
Mean Age (years)	27.5 ± 4.2	28.0 ± 4.1	0.45
BMI (kg/m²)	28.6 ± 5.1	23.4 ± 3.7	<0.001

Table 2: Clinical Features of Participants

Feature	PCOS Group (n=100)	Control Group (n=100)	p-value
Hirsutism (%)	62	5	<0.001
Menstrual Irregularity (%)	80	12	<0.001
Anovulation (%)	85	10	<0.001

Table 3: Hormonal Profile

Hormone	PCOS Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Serum Testosterone (ng/dL)	85.4 ± 21.7	42.8 ± 15.3	<0.001
LH (IU/L)	12.2 ± 4.5	6.8 ± 2.3	<0.001
FSH (IU/L)	5.8 ± 2.1	6.1 ± 1.9	0.34

Table 4: Metabolic Parameters

Parameter	PCOS Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Fasting Blood Glucose (mg/dL)	102.3 ± 12.8	89.5 ± 10.4	<0.001
HOMA-IR (Insulin Resistance)	3.9 ± 1.2	1.8 ± 0.9	0.002
Total Cholesterol (mg/dL)	210.5 ± 38.6	185.2 ± 29.1	0.01
Triglycerides (mg/dL)	165.3 ± 45.7	120.7 ± 30.4	<0.001

Table 5: Fertility Outcomes

Outcome	PCOS Group (n=100)	Control Group (n=100)	p-value
Infertility (%)	58	15	<0.001
Pregnancy Rate (%)	30	75	<0.001
Miscarriage Rate (%)	20	8	0.03

DISCUSSION

This paper has established the effects of Poly Cyclic Ovary Syndrome (PCOS) on the fertility of females and the metabolic health and the results revealed that there were serious alterations (hormonal, metabolic and reproductive) as compared to healthy participants. The enormous literature would probably be covered in our outcome showing the close correlation between metabolic and reproductive disfunction in PCOS[10]. Marked hyperandrogenism in the serum as well as clinical evidence of hyperandrogenism such as hirsutism as observed in 62 percent of our PCOS patients lends credence to the dominance of androgen excess in PCOS pathology. It is in line with findings presented by Azziz et al[11], which showed that one of the classical symptoms of PCOS is hyperandrogenism, and as much as 80 percent of all PCOS patients may have hyperandrogenism, which presents a great challenge to ovulatory dysfunction and infertility. Coupled with this, the elevated LH levels in our patients further evokes situations of a third imbalanced hypothalamic-pituitary-ovarian axis, a state that has been described by the Fauser et al[12] who have alluded that this mechanism is indeed of cardinal importance in PCOS pathogenesis, halting of follicular development and anovulation. Also significant is the prevalence of menstrual irregularity (80 percent) and anovulation (85 percent) that are some of the biggest causes of infertility witnessed in 58 percent of the cohort[13]. These results have been replicated by a large cohort study done by Franks et al. who showed that chronic anovulation is indeed the common denominator in infertility in PCOS with as high an incidence as 70-80%. The reduced ARTE and elevated miscarriage risk additionally share the same issues with the Palomba et al[14] who heightened the likelihood of hormonal no balance and metabolism-disharmonized metabolism to adversely impact the endometrial receptivity and embryo implantation[15]. A major reason in our metabolic data was that the PCOS patients were determined to have had a greater BMI, insulin resistance (calculated through HOMA-IR), fasting sugar content, and lipid disorders as compared to the control. These findings agree with those of the study conducted by Legro and others[16], which concluded that insulin resistance was essentially a universal trait among PCOS with and without obesity. It is not a novelty that hyperinsulinemia contributes to enhanced hyperandrogenism as a result of over secretion of androgens in ovaries[17] and this lies at the foundation of the conjunction of metabolic and reproductive impairment in PCOS. Here, we could also confirm that the prevalence of metabolic syndrome (30%) is greater in PCOS women as well as is the same as in the study of Teide et al.[18], and that the PCOS women should be screened on metabolic parameters at an early age. Correlations between obesity and the intensity of PCOS were also found in our findings whereby higher BMI was correlated with the elevated insulin resistance and androgen excess. This coincides with the evidence presented by Goodarzi et al.[19], who stated that the obesity augments the metabolic and reproductive phenotype of PCOS, most likely caused by the inflammation of adipose tissue and altered profiles of adipokines. Weight management is a crucial component in the delivery of PCOS treatment since the decrease in weight by any amount improves ovulatory status and metabolic scores[20]. The idea that we should develop is that cardiovascular risk increases in PCOS. Hypertriglyceridemia, elevated total cholesterol levels and insulin resistance indicators above normal seen in PCOS group are in line with meta-analysis of Wild et al that affirmed the predisposition rate of dyslipidemia and endothelial dysfunction of PCOS because of which the risk of cardiovascular disease is increased throughout life.

CONCLUSION

PCOS has a significant impact on the fertility of women leading to hormonal imbalance and ovulatory dysfunction. It also exposes affected women to risks of changes in their metabolism such as insulin resistance and dyslipidemia predisposing them to chronic

illnesses and diseases. The only solution here is proper diagnosis and combined management on both reproductive and metabolism levels of patients, resulting in successful results.

Limitations: This study is cross-sectional, so the results do not permit causal inference. The sample size was adequate but it only consisted of a sole center, thus it may be generalizing. Also, no psyche effects and long-term follow-up outcomes were measured, thereby inhibiting the general understanding of PCOS total universe and development.

Future Findings: It is argued that study that is further needed to be done needs to target longitudinal study in the direction of the exploration of personalized intervention which constitutes an amalgamated support by way of lifestyle, pharmacological and psychological support. The presence of novel infertile genetic and epigenetic influences on PCOS phenotypes would contribute to enhancing their diagnosis and treatment. Furthermore, the study concerning the effectiveness of the new treatments on both metabolism and fertility health ought to be conducted.

Abbreviations

1. **PCOS**: Polycystic Ovary Syndrome
2. **BMI**: Body Mass Index
3. **LH**: Luteinizing Hormone
4. **FSH**: Follicle-Stimulating Hormone
5. **SHBG**: Sex Hormone-Binding Globulin
6. **HOMA-IR**: Homeostatic Model Assessment for Insulin Resistance
7. **IEC**: Institutional Ethics Committee
8. **SPSS**: Statistical Package for the Social Sciences

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