Current Prevalence of Hyperinsulinemia and Impaired Glucose Tolerance among PCOS Women of Telangana Region- South India

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Abstract

Introduction: Polycystic ovary syndrome is the most usual endocrine disorder characterized by chronic anovulation and androgen excess. Insulin resistance, hyperinsulinemia, impaired glucose tolerance is often accompanied by PCOS and therefore must be studied to find out their prevalence and association in this condition.

Objectives: Our study is aimed towards finding out the association of elevated insulin and impaired glucose tolerance with PCOS and to study the current scenario among the population of Telangana, situated in the southern region of India.

Material and Methods: We conducted a community- based study covering Urban and Rural areas of Telangana state. A PCOS- based questionnaire was used to recruit patients and were enrolled in the study. Probable cases and healthy controls were further evaluated for clinical and biochemical parameters. Insulin, blood glucose, HOMA-IR, ultrasonography were assessed for outcomes apart from anthropometric data.

Results: Significant results were observed for fasting glucose, fasting insulin, presence of ≥ 8 subcapsular follicular cysts which measure ≤ 10nm in sonography, HOMA-IR when probable PCOS were compared to healthy controls. Prevalence of hyperinsulinemia was 31% in probable PCOS and 8.3% among controls whereas the prevalence of impaired glucose tolerance was 35% in probable PCOS and 10% in controls.

Conclusion: Our study suggested a strong association of PCOS with hyperinsulinemia and impaired glucose tolerance in the Telangana region of South India. We thereby conclude that glucose intolerance and insulin resistance are usual among women with PCOS in our county and its association with uncontrolled diabetes mellitus in the general population might stipulate prompt and early lifestyle modifications for those who have a known family history.

Keywords: Polycystic ovary syndrome; Glucose intolerance; Insulin resistance; Hyperinsulinemia

Abbreviatations: PCOS: Polycystic Ovary Syndrome; ESHRE: European Society For Human Reproduction And Embryology; ASRM: American Society For Reproductive Medicine; IR: Insulin Resistance; ELICA: Electrochemiluminescence Immunoassay; HOMA-IR: Homeostatic Model Assessment- Insulin Resistance

Introduction

Polycystic ovary syndrome (PCOS) is the most common condition of the endocrine which is observed in women of reproductive age group and is characterized by chronic unexplained hyperandrogenemia reporting around 95% of hyperandrogenism in women [1]. It consists of multifarious components such as reproductive, cardiovascular, metabolic, and long term health implications regarded as the leading cause of anovulatory infertility with complex genetic etiology. Apart from the reproductive defects, insulin resistance and hyperinsulinemia are the hallmark features of PCOS [2]. As per the European Society for Human Reproduction and Embryology (ESHRE) and American Society for Reproductive Medicine (ASRM) appearance of any two of the three criteria as follows can be useful for diagnosing PCOS: (i) presence of polycystic ovaries on ultrasound; (ii) oligo and/ or anovulation; and biochemical or clinical confirmation of hyperandrogenism on condition that other etiologies have been excluded like Cushing syndrome, congenital adrenal hyperplasia, androgen- secreting tumors, etc. Based on ultrasonography, the

presence of 12 or more follicles in each ovary which measures 2-9mm in diameter and increased ovarian volume (>10ml) is taken as the morphological diagnostic criteria [3]. One of the most notable disorders in PCOS is the manifestation of insulin resistance (IR) and associated hyperinsulinemia which is regarded as the crucial element in the pathogenesis of type 2 diabetes mellitus (T2DM) thereby having a greater risk of long-term complications like metabolic disorders and numerous cardiovascular diseases [3]. Our study aims to establish the relationship between elevated insulin and impaired glucose tolerance in PCOS subjects among Telangana's population which is situated in the southern region of India, current scenario. This study is multicentric, and the following manuscript shows results from selected regions of Telangana as per the study protocol.

Material and Methods

A cross- sectional community- based study was conducted in Maternal Health and Research Institute, Hyderabad, Telangana, India. Ethical approval had been obtained from the institution and subjects were recruited after taking written informed consent. The main objective of the study was to find out the prevalence of patients with hyperinsulinemia or abnormal (Oral Glucose Tolerance Test) OGTT who are probable for PCOS and compare them with healthy control subjects for the same parameters. This will enable us to find the link between PCOS and hyperinsulinemia. Our inclusion criteria were women of age between 18-40 years who were dwelling in that area for more than 10 years, who were non- pregnant and non- lactating, and willing to give informed consent. Subjects who had cognitive or physical abnormalities and couldn't respond to questionnaires, subjects who had a history of drug intake which interfered with glucose metabolism were excluded from the study. Diet, lifestyle, occupation, and other environmental factors of both cases and controls were the same. A total of 60 PCOS cases and an equal integer of matched control healthy females were taken into the study. A survey of the community was done using questionnaires and subjects were selected as probable and control after various clinical, biochemical, hormonal, and ultrasonographic evaluations.

Clinical and Biochemical Parameters

Anthropometric data like weight, height, body mass index, waist, the thickness of triceps and dorsum skin, and presence of hirsutism, acne, acanthosis, oligomenorrhea, primary infertility was obtained from all the subjects.10ml of venous blood was drawn in fasting from which 5ml was transferred to EDTA and the rest 5ml to a plain vial which was used to estimate insulin and sugar. Insulin was measured using electrochemiluminescence immunoassay (ELICA) on Cobas e 411 analyzers and sugar was measured spectrophotometrically by making use of glucose oxidase- peroxidase method. HOMA-IR (homeostatic model assessment- insulin resistance) for evaluating insulin resistance was calculated with the help of a formula [4].

HOMA-IR (in mass units) = [fasting glucose (in mg/dl) x fasting insulin (mIU/L)]/405

Impaired Glucose Tolerance was calculated as per 1999 WHO criteria : [5].

IGT= Fasting <126 and a 2hr post Glucose value in the range of 140-200mg/dl.

Ultrasonography

In ultrasonography, the polycystic ovaries are defined by the presence of ≥ 8 subcapsular follicular cysts which measure ≤ 10nm and escalated ovarian stroma [6].

Statistical Analysis

Unpaired t test was used to analyze all the continuous variables in cases and controls. Results are displayed as mean ± SD and $P < 0.05$ is taken as statistically significant.

Result

Table 1: Clinical and Biochemical parameters in PCOS subjects versus healthy control subjects.

Parameters	Probable PCOS Cases (n=60)	Healthy Controls (n=60)	P value
Age (years)	24.08 ± 4.45	24.89 ± 4.32	0.313
BMI (kg/m^2)	24.31 ± 4.89	22.57 ± 3.18	0.022*
Systolic Blood Pressure	112.81 ± 11.01	113.89 ± 8.87	0.555
Diastolic Blood Pressure	76.12 ± 8.69	76.15 ± 7.75	0.984
Fasting glucose (mg/dl)	87.51 ± 7.73	81.79 ± 8.65	0.0002*
2 hour Post Glucose (mg/dl)	128.69 ± 23.23	118.76 ± 21.45	0.01*
Fasting Insulin (mIU/L)	16.20 ± 8.63	12.93 ± 7.26	0.026*
HOMA-IR	3.46 ± 1.83	2.68 ± 1.54	0.012*
Ultrasonography-Polycystic ovaries	12.5 ± 3.25	6.0 ± 2.33	<0.0001*

P <0.05- Significant

Table 1 shows the results of various clinical and biochemical parameters assessed and it is noticed that BMI, fasting blood glucose, fasting insulin and HOMA-IR, follicles on ultrasound values are significantly higher in the probable PCOS group when compared to the healthy controls. Whereas no significant difference was observed in blood pressure. Probable PCOS subjects were selected based on Rotterdam 2003 Criteria. BMI is measured as weight in kg/ height in meter square. Polycystic ovaries on ultrasonography were taken for evaluation and were found to be significant for subjects with probable PCOS. Prevalence of impaired glucose tolerance was observed as 0.35 among probable PCOS and 0.1 in controls while the prevalence of hyperinsulinemia was found as 0.31 in probable PCOS cases and 0.083 among healthy controls (Figure 1).
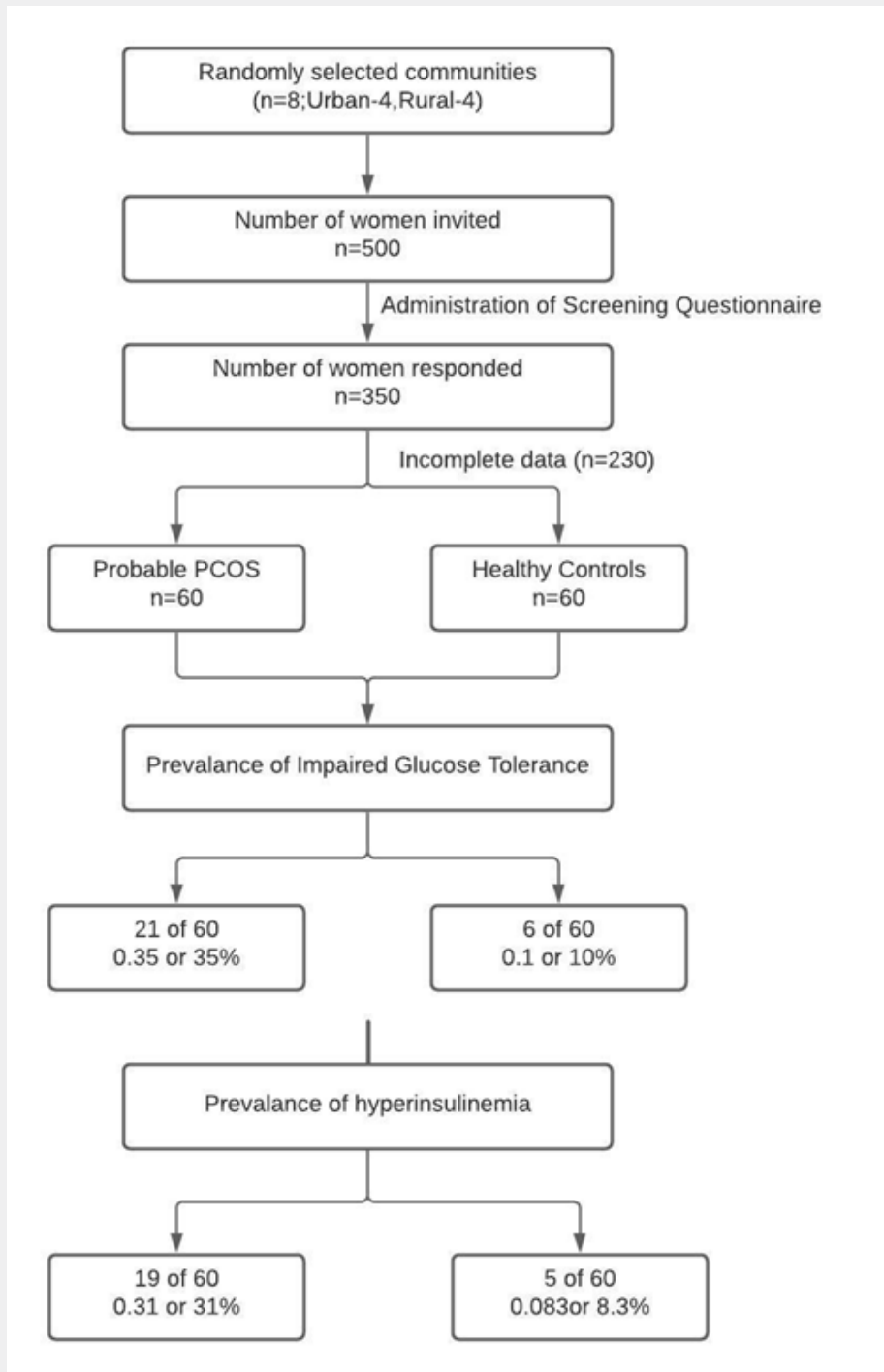

Figure 1: Availability of $MgSO_4$ at the facility as at the time of the study.

Discussion

Our study demonstrates that there is a strong alliance of PCOS with insulin resistance in Telangana, South India, and is the first study in this region to evaluate these parameters and has discussed the most current scenario. We have conducted a study on the population that is relatively young suffering from PCOS and mostly having low BMI. The mean age of our subjects was 24.08 ± 4.45 years. The majority of such studies conducted have included subjects with a higher mean age than ours [7,8]. Overall abnormalities of glucose intolerance observed in our cases were 35% and 10% in controls which shows a significant difference.

Insulin resistance has a very significant role in the pathophysiology of both type 2 diabetes mellitus and PCOS. Although numerous females with PCOS are at a high risk of insulin resistance, impaired glucose tolerance, and pancreatic beta- cell dysfunction, [2] the exact cause of an increase in insulin levels is not yet known but could be due to elevated phosphorylation of the insulin receptors which reduces the activity of protein tyrosine kinase resulting in insulin secretion abnormality [9,10]. Hyperinsulinemia seems to be a crucial factor in maintaining hyperandrogenemia which acts directly to promote androgen production, elevating the effect of augmented LH stimulus which can be observed in maximum patients of PCOS [11]. In our study, the prevalence of cases with hyperinsulinemia is 0.31 and 0.083 for controls (Figure 1). The probability of glucose intolerance in PCOS patients seems to be elevated equally in mixed ethnicities of the United States and Asian Populations [12-14]. The compensatory mechanism of insulin in the body during hyperinsulinemia changes the steroid hormone metabolism which leads to high production of ovarian androgens, resulting in manifestations of PCOS [2]. A strong link between irregularities in the menstrual cycle and insulin resistance in PCOS women was demonstrated by studies where anovulatory women of PCOS had shown insulin resistance and those with a regular cycle of menstruation haven't demonstrated resistance in insulin [9,10,15].

Insulin resistance in our study was assessed by calculating the values of HOMA-IR. Results were significantly high concerning glucose, insulin, HOMA-IR in the PCOS group when compared to control and, BMI was also observed more in cases. Insulin resistance is the cause of the excessive accumulation of fat associated with type 2DM and is the etiology of hyperinsulinemia [16]. Rarely, any literature is available in India on PCOS women regarding insulin resistance like the one in Delhi slums which showed a greater risk of severe insulin resistance (22%) using HOMA-IR criteria for calculating insulin resistance [17]. From our data, we observed that 75% of women with probable PCOS who had glucose intolerance were having a family history of known DM when compared with controls who had 12% of family history of known DM. Therefore, early modification in lifestyle for such subjects can delay the onset of the disease. We also evaluated the ultrasonography and found that Glucose intolerance among PCOS patients is observed mostly in the 3rd and 4th decade of life [3].

2 hours post glucose to calculate impaired glucose tolerance had been a bit challenging. Currently, in our Indian population, we observe the high prevalence of PCOS with the presence of glucose intolerance, hyperinsulinemia, family history of DM and the array starts at an early age.

Conclusion

Women suffering from PCOS have innumerable risk factors like obesity; elevated levels of glucose, hyperinsulinemia, family history of type 2DM, menstrual irregularities, elevated cardiovascular risk factors like dyslipidemia and hypertension. Our study suggested a strong association of PCOS with hyperinsulinemia and impaired glucose tolerance in the Telangana region of South India. We thereby conclude that glucose intolerance and insulin resistance are usual among women with PCOS in our county and its association with uncontrolled diabetes mellitus in the general population might stipulate prompt and early lifestyle modifications for those who have a known family history.

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