Original Article

Evaluation of Luteinizing Hormone, Follicle Stimulating Hormone and LH/FSH Ratio in Polycystic Ovary Syndrome of Reproductive Women

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Abstract
Background: *Polycystic Ovary Syndrome (PCOS) is an endocrine disorder that affects women of reproductive age. Disturbances in luteinizing hormone (LH), follicle stimulating hormone (FSH), and the LH/FSH ratio are pivotal pathophysiological features of PCOS. The objective of this study is to assess the concentrations of various hormones (LH, FSH and LH/FSH ratio) in patients with PCOS.* ***Materials and Methods:*** *This cross-sectional comparative study was conducted in Chittagong Medical College & Hospital. The sample size was 100 comprising 80 individuals in the PCOS group (Group A) and 20 healthy reproductive women in the control group (Group B). The sampling technique was non-probability consecutive sampling.* ***Results:*** *Serum LH levels were increased in 22.5% of PCOS cases. The mean serum LH and LH/FSH ratios were significantly different between PCOS group and healthy group (7.54 ± 0.51 vs. 5.77 ± 0.63 mIU/ml) and (2.05 ± 0.18 vs. 1.25 ± 0.18 mIU/ml) respectively. Mean serum FSH levels did not show significant difference between the PCOS and healthy groups. Distribution of menstrual history, hirsutism and family history of PCOS between group A and group B has statistical difference.* ***Conclusion:*** *Serum LH levels were significantly associated with polycystic ovarian syndrome (PCOS) in reproductive women. Therefore, assessing LH levels in PCOS may provide foundational information for early diagnosis and management of infertility associated with the syndrome.*

Introduction

Polycystic ovary syndrome (PCOS) is a prevalent endocrine disorder affecting 5-10% of women of reproductive age globally[1]. For many years, an elevated luteinizing hormone to follicle stimulating hormone (LH/FSH) ratio has been used as a diagnostic test for PCOS[2,3]. The syndrome is primarily diagnosed using the revised Rotterdam criteria, which require the presence of two out of three conditions: ovulatory dysfunction, hyperandrogenism/hyperandrogenemia and polycystic ovarian morphology (PCOM) observed on ultrasonography. These criteria have recently been endorsed by an international evidence-based guideline for PCOS[4,5].

Although the pathophysiology of PCOS is not completely understood yet, PCOS is considered a multifactorial disorder with various genetic, metabolic, endocrine and environmental abnormalities[6]. Gonadotropin-releasing hormone (GnRH), synthesized by the hypothalamus, binds to its receptors on adenohypophyseal secretory cells, stimulating the release of luteinizing hormone (LH) and follicle-stimulating hormone (FSH)[7,8]. LH and FSH play critical roles in the body's development, growth, pubertal maturation and reproductive processes. In females, these hormones activate the ovaries to produce estrogen and inhibin, which regulate the menstrual cycle. Estrogen, via negative feedback, inhibits GnRH production by the hypothalamus[9].

Ultrasound scanning for polycystic ovaries lacks clinical impact; however, irregular menstrual cycles - characterized by prolonged or heavy menstruation and oligomenorrhea - are primary indicators of PCOS[10]. Evaluation of disease severity often involves assessing levels of LH and FSH, particularly noting irregularities such as elevated LH or abnormal LH/FSH ratios during routine medical

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examinations[11]. Abnormal patterns of gonadotropin secretion, including elevated LH concentrations, low-to-normal FSH levels, and increased LH/FSH ratios, are common in PCOS[12]. Hyperandrogenism in PCOS is frequently associated with obesity, affecting around 35% of women with the condition[13]. A body mass index (BMI) more than 25 is considered a significant contributing factor to the endocrinological and metabolic disturbances observed in PCOS[14].

Materials and Methods
This study was conducted over a one-year period from July 2020 to June 2021 at the Department of Biochemistry, Chittagong Medical College, the Outpatient Department of Obstetrics and Gynaecology and the Institute of Nuclear Medicine and Allied Sciences at Chittagong Medical College Hospital. Permission for the study was obtained from the ethical review committee of CMC (ref: CMC/PG/2020/674) and relevant departments. All included patients were fully informed about the study's nature and objectives. The study focused on reproductive women aged 15-40 diagnosed with Polycystic Ovary Syndrome (PCOS) through ultrasonography, employing a non-probability consecutive sampling method. The sample size was restricted to 100 comprising 80 individuals in the PCOS group (Group A) and 20 healthy reproductive women in the control group (Group B). Group A participants met inclusion criteria based on the revised Rotterdam consensus 2003, while Group B consisted of reproductive women without PCOS, ensuring exclusion criteria such as age outliers, thyroid disorder, hyperprolactinemia, congenital adrenal hyperplasia, type 2 diabetes mellitus, hypertension, chronic liver and renal disease and Cushing syndrome.

The data underwent processing and analysis utilizing Microsoft Excel and IBM-SPSS v22.0 for Windows. Statistical analysis utilized a 95% confidence interval, with significance set at a p-value of <0.05. Variables were reported as means±standard error of means (SEM) and distributions were depicted in percentages. Summarized findings were presented in tables and figures.

Results
Among the 100 participants 80 were diagnosed as PCOS (Group A) and 20 were healthy reproductive women as the control group (Group B) (Figure-1). Table-I represents the percentage distribution of baseline socio-demographic characteristics among the study groups. In this study the majority of patients (61.2%) in group A are between 20 and 30 years of age. Concerning socio-economic status, most patients in both group A and group B belong to middle-class families. Regarding marital status, 53.8% of patients in group A are married. Table-II demonstrates that the distribution of menstrual history, hirsutism and family history of PCOS between group A and group B has statistical difference.

There was significant association of serum LH between group A and group B but there was no significant association of serum FSH & LH/FSH between 2 groups (Table-III). Table-IV demonstrates that serum LH and LH/FSH ratio was significantly higher in group A compared to group B. But the mean serum FSH level was not statistically significant between the two groups.
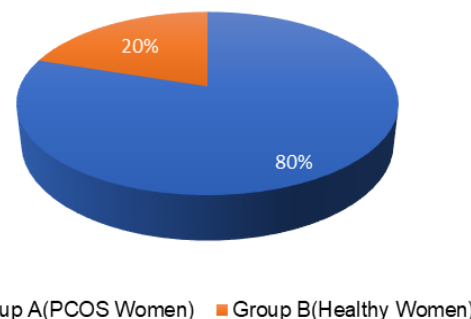

Figure-1: The pie chart illustrates the distribution of the study groups (n = 100)

Table-I: Baseline socio-demographic characteristics distribution among the study groups (n = 100)

Socio-demographic Variables		Study Groups				Total (n = 100)	
		Group A (n = 80)		Group B (n = 20)			
		n	%	n	%	n	%
Age in Groups	<20 Years	22	27.5	0	0.0	22	22.0
	20 – 30 Years	49	61.2	10	50.0	59	59.0
	>30 Years	9	11.2	10	50.0	19	19.0
Socio-Economic Status	Upper class	20	25.0	5	25.0	25	25.0
	Middle class	35	43.8	8	40.0	43	43.0
	Lower class	25	31.2	7	35.0	32	32.0
Marital Status	Married	43	53.8	18	90.0	61	61.0
	Unmarried	37	46.2	2	10.0	39	39.0

Table-II: Distribution of clinical variables among the study groups (n = 100)

Risk Factors		Study Groups		Total (n = 100)	p-value
		Group A (n = 80)	Group B (n = 20)		
Menstrual History	Regular	0 (0.0)	20 (100.0)	20 (20.0)	p<0.001 Significant
	Oligomenorrhea	42 (52.5)	0 (0.0)	42 (42.0)	
	Amenorrhea	38 (47.5)	0 (0.0)	38 (38.0)	
Hirsutism	Present	17 (21.2)	0 (0.0)	17 (17.0)	p<0.05 Significant
	Absent	63 (78.8)	20 (100.0)	83 (83.0)	
Family History of PCOS	Yes	14 (17.5)	0 (0.0)	14 (14.0)	p<0.05 Significant
	No	66 (82.5)	20 (100.0)	86 (86.0)	

Table-III: Distribution of hormone status among the study groups (n = 100)

Hormonal Status		Study Groups		Total (n = 100)	p-value
		Group A (n = 80)	Group B (n = 20)		
Serum LH Status	Increased	18 (22.5)	0 (0.0)	18 (18.0)	p<0.05 Significant
	Normal	62 (77.5)	20 (100.0)	82 (82.0)	
Serum FSH Status	Increased	3 (3.8)	1 (5.0)	4 (4.0)	p>0.05 Not Significant
	Normal	77 (96.2)	19 (95.0)	96 (96.0)	
Serum LH/FSH Status	Increased	26 (32.5)	4 (20.0)	30 (30.0)	p>0.05 Not Significant
	Normal	54 (67.5)	16 (80.0)	70 (70.0)	

*Figures within parentheses indicate percentages **p-value obtained from χ2 test*

Table-IV: Comparison of Hormone Levels between the Study Groups with independent samples t - test (n = 100)

Variables	Study Groups	n	Mean±SEM	Range	p-value
Serum LH (mIU/ml)	Group A	80	7.54±0.51	2.33 –16.40	p<0.01 Significant
	Group B	20	5.77±0.63	2.60 – 11.40	
	Total	100	7.19±0.43	2.33 –16.40	
Serum FSH (mIU/ml)	Group A	80	4.65±0.37	1.23 – 13.15	p>0.05 Not Significant
	Group B	20	5.74±0.72	2.32 – 12.60	
	Total	100	4.87±0.33	1.23 – 13.15	
Serum LH/FSH	Group A	80	2.05±0.18	0.47 – 9.03	p<0.05 Significant
	Group B	20	1.25±0.18	0.28 – 3.17	
	Total	100	1.89±0.15	0.28 – 9.03	

***p-value obtained from χ2 test*

Discussion

In this study, a significant association was found between serum LH levels and Polycystic Ovary Syndrome (PCOS) of reproductive women. This research aimed to assess the concentrations of various hormones (Luteinizing hormone-LH, Follicular stimulating hormone-FSH and LH/FSH ratio) among a group of 80 (eighty) PCOS patients compared to 20 (twenty) healthy reproductive women. Serum LH levels were elevated in 22.5% of cases and were significantly higher in group A compared to group B. Legro, et al.[15] also reported elevated LH levels in PCOS cases, indicating that increased LH levels in PCOS patients contribute to elevated androgen production by ovarian cells. Additionally, it was observed that the levels of FSH and LH in PCOS patients are generally elevated by more than 2-4.5%. PCOS is frequently associated with obesity and hyperinsulinemia. A significant subset of these patients experiences elevated LH levels and hyperandrogenism, resulting from increased androgenic activity[16]. Conversely, the FSH/LH ratio in PCOS patients has a minimal role in the diagnosis of PCOS as well as in control cases[17].

In this study, we analyzed various gonadotropin-releasing hormones, including FSH and LH, which are highly relevant to PCOS and play a crucial role in its pathophysiology[18]. While serum LH/FSH levels were not significantly different between group A and group B, the mean serum LH and LH/FSH levels were significantly higher in group A compared to group B. Banaszewska, et al.[16], Anlakesh, et al.[19] and Sinha, et al.[20] also reported elevated LH/FSH ratios greater than 2, although

their findings indicated higher levels than those observed in this study. Elevated levels of LH in women's blood can indicate primary ovarian failure, which may contribute to the development of PCOS[18].

Conclusion
The study concluded that serum LH levels were significantly associated with patients with polycystic ovarian syndrome (PCOS). However, serum FSH and LH/FSH ratio did not show significant associations with PCOS. Therefore, assessing LH levels in PCOS may provide foundational information for early diagnosis and management of infertility associated with the syndrome.

Limitations of the study
This study has certain limitations like small sample size, single center study and cross-sectional study design.

Conflict of interest
The authors declared that they have no conflict of interest.

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