



**ORIGINAL RESEARCH PAPER**

**Radiodiagnosis**

**ROLE OF ULTRASONOGRAPHY IN EVALUATION OF POLYCYSTIC OVARIAN SYNDROME AND ITS CORRELATION WITH HORMONAL PROFILE : A PROSPECTIVE STUDY**

**KEY WORDS:** Polycystic Ovarian Syndrome, Hormonal, Ultrasonographic Features

<b>Dr J.S. Sikarwar</b>	Professor & Head, Department Of Radio-Diagnosis, Gajra Raja Medical College, Gwalior, Madhya Pradesh.
<b>Dr I.K. Batham</b>	Associate Professor, Department Of Radio-Diagnosis, Gajra Raja Medical College, Gwalior, Madhya Pradesh.
<b>Dr Nisha Bhatta*</b>	Resident Department Of Radio-Diagnosis, Gajra Raja Medical College, Gwalior, Madhya Pradesh. *Corresponding Author

**ABSTRACT**

**OBJECTIVE:-** The objective of this study was to assess the appearance of ovary and endometrium in patients of clinical features of PCOS and to correlate with hormonal profile of patients. **MATERIAL AND METHODS:-** This study included 100 patients of the age group 18-37 years who were clinically diagnosed with PCOS. All the patients were subjected to ultrasonography and hormonal profiling. **RESULTS:-** Among 100 patients with clinical features of PCOS 75% of the patients were under 27 years and 68% patients were unmarried. Amenorrhoea/ oligomenorrhoea was the most common complaint which was seen in 94% of patients. On Ultrasonography, peripheral arrangement of follicles was seen in all patients. 80% patients had  $\geq 12$  follicles per ovary, 2-9 mm size follicles were observed in 85% of patients, 71% of patients had ovarian volume  $\geq 10$  cc, echogenic stroma was noted in 91% of patients and 94% patients had endometrial thickness  $\leq 10$  mm. On hormonal profiling, 90% of patients had normal/low FSH levels, 82% of patients had increased LH levels, 63% of patients had LH/FSH level of  $>2$  and 72% of patients had increased free testosterone levels. The study showed statistically significant relationship between number of follicle & ovarian volume with LH, LH/FSH and free testosterone levels. The study also observed negative correlation between FSH levels and USG features like number of follicle and ovarian volume. **CONCLUSION:-** The ultrasonographic features in patients with PCOS correlated well with hormonal profile of patients.

**INTRODUCTION**

Polycystic ovary syndrome (PCOS) is a common heterogeneous endocrinological disorder of reproductive age group that occurs in 5% to 10% of women. It is one of most prevalent endocrinopathy and common cause of infertility.<sup>(1)</sup>

The clinical manifestations of PCOS includes menstrual irregularities, signs of androgen excess like acne, hirsutism and obesity. It is also associated with increased risk of dyslipidemia, diabetes mellitus, cardiovascular disease and endometrial carcinoma.<sup>(2-5)</sup>

PCOS is characterized by low follicle stimulating hormone (FSH) levels resulting in anovulation, elevated luteinizing hormone levels resulting in hyperandrogenism, and insulin-resistance symptoms which may range from simple cystic acne, cephalic hair loss or mild facial hirsutism to instances of oligomenorrhoea or amenorrhoea, sterility and severe generalized hirsutism. Chronic anovulation results in endometrial hyperplasia and heterogenous cystic endometrium due to unopposed estrogens.<sup>(6)</sup>

Classical Stein Leventhal syndrome which manifests as amenorrhoea, hirsutism, infertility and obesity is one extreme form in the broad spectrum of clinical manifestations of PCOS. The goal of imaging in PCOS is to properly identify and document the presence of polycystic ovaries. However, because PCOS is by definition a syndrome, the presence of polycystic ovaries alone is insufficient for diagnosis. The women with incidentally discovered polycystic ovaries should not be considered to have PCOS until further workup.<sup>(7)</sup>

The classic sonographic features of polycystic ovaries are enlarged ovaries, with multiple 2 to 6 mm cysts, absence of cysts greater than 1.5 cm in diameter and presence of hyperechoic ovarian stroma. The small cysts may be peripherally located or dispersed throughout the ovarian parenchyma.<sup>(8-11)</sup>

**AIMS AND OBJECTIVES**

1. To assess the appearance of ovaries on sonography in patients with clinical features of PCOS.
2. To assess the endometrium appearance on sonography in patients with clinical features of PCOS.
3. To assess the hormonal profile of patients with clinical features of PCOS.
4. To correlate the sonological features of ovary and endometrium with hormonal profile of patients.

**MATERIAL AND METHODS**

**STUDY SETTINGS:-** Department of Radiodiagnosis, G.R. Medical college and JA group of Hospitals, Gwalior. Clinically diagnosed patients of PCOS were included in study after informed consent. Sonographic features of ovary and endometrium in these patients were correlated with hormonal profile of patients. Ethical clearance was taken from ethical committee of G.R Medical college, Gwalior

**SOURCE OF DATA:-** Patients with clinical symptoms of PCOS who were referred to Department of Radiodiagnosis, GRMC, Gwalior for diagnosis and evaluation were subjected to ultrasonography (Transabdominal/Transvaginal) and hormonal profiling.

**METHOD OF COLLECTION OF DATA:-** A prospective study was performed in 100 women and women of age group 18-37 yrs were included in the study. This study was done for duration of 1.5 year.

**EQUIPMENT AND PROTOCOL:** Transabdominal and transvaginal ultrasonography was performed using ultrasound scanners using convex probes of frequency ranging from 3 to 5 MHz and curved probes of frequency ranging from 5 to 7.5 MHz. using ALOKA IPF-1701B, ESAOTE MODEL5 6400 LC185EXN and MINDRAY DC-30 ultrasound scanners.

**INCLUSION CRITERIA**

- All cases of clinically diagnosed PCOS referred from Obstetrics and Gynaecology Department of GRMC Gwalior and then presenting to department of Radiodiagnosis,

GRMC, Gwalior  
 • Female patients in reproductive age (18-37yrs)group.

**EXCLUSION CRITERIA**

- Women <18 and >37 yrs of age
- Cushing syndrome
- Congenital adrenal hyperplasia
- Androgen Secreting tumors
- Patient not giving consent

**OBSERVATION AND RESULTS**

The age range in our study of 100 patients with clinically suspected PCOS was 18 to 37years. The median age distribution was 25 years. Maximum cases were seen in group of 23 to 27 years. Majority (75%) of the patients were below 27 years. Most (68%) of the patients were unmarried.

Majority of the patients had oligomenorrhoea /amenorrhoea (94%) and other main complaints were obesity 63%, hirsutism 38% and infertility 24%

Trans abdominal USG examination was performed in all patients and TVS along with TAS was also performed in 17 patients. Peripheral arrangement of the follicles was observed in all patients. More than 12 follicles per ovary was observed in most (80%) of patients. Follicles of size 2-9 mm were observed in maximum (85%) patients. Most (71%) of the patients showed ovarian volume ≥10 cc. Ovarian stroma appeared echogenic in most( 91 %) of the patients. Most(94%) of the patients showed normal endometrial thickness.

Most (90%) of the patients showed normal or low levels of FSH values. Elevated LH levels was observed in 82% of patients. Increased LH/FSH ratio was seen in 63% of the patients. TSH levels were normal or low in most (97%) of the patients. Normal or low level of prolactin was observed in most(95%)of the patients. Elevated free testosterone levels was noted in most(72%)of patients. Most (72%) patients had normal 2hr blood sugar levels.

**TABLE 1 :1DISTRIBUTION OF PATIENTS ACCORDING TO ULTRASONOGRAPHIC FEATURES OF PATIENTS**

Follicle distribution	Number of patients	Percentage (%)
Peripheral	100	100
Irregular	0	0
<b>Number of follicles</b>		
< 12	20	20
> 12	80	80
<b>Follicle size (in mm)</b>		
<2	0	0
2-9	85	85
>9	15	15
<b>Volume of ovary (in cc)</b>		
<10	29	29
>10	71	71
<b>Stromal character</b>		
Echogenic	91	91
Non echogenic	9	9
<b>Endometrial thickness</b>		
<10	94	94
>10	6	6

**TABLE 2: DISTRIBUTION OF PATIENTS ACCORDING TO HORMONES**

FSH	Number of patients	Percentage (%)	Reference value
<11 mIU/ml	90	90	2.5-10.2 mIU/ml
>11 mIU/ml	10	10	

<b>LH</b>			
<13 mIU/ml	18	18	1.9-12.5 mIU/ml
>13 mIU/ml	82	82	
<b>LH/FSH</b>			
<2:1	37	37	2:1
>2:1	63	63	
<b>TSH</b>			
<6.5 uIU/ml	97	97	0.7-6.4 uIU/ml
>6.5 uIU/ml	3	3	
<b>Prolactin</b>			
<30 ng/ml	95	95	2.8-29.2 ng/ml
>30 ng/ml	5	5	
<b>FreeTestosterone</b>			
<3.5 pg/ml	28	28	0.45-3.17pg/ml
≥3.5 pg/ml	72	72	
<b>2hr Blood Sugar Level</b>			
<140 mg/dl	72	72	70-140 mg/dl
> 140 mg/dl	28	28	



**Fig 1: USG image of both ovaries showing peripherally arranged multiple follicles.**

**DISCUSSION**

100 patients who were clinically suspected of having PCOS were included in the present study. The study was conducted for a period of 1.5 year. Patients were studied by pelvic ultrasonography in the department of Radiodiagnosis, GRMC Gwalior and were followed up for hormonal profiling. The observations of the study were as follows.

**AGEWISE DISTRIBUTION OF THE PATIENTS**

The median age of presentation was 25 years. The age range observed was between 18 years to 37 years. Maximum number of patients were in the age group of 23-27 years (42%). Majority (75%) of the patients were below 27 years.

Similar results were observed in a prospective study of 214 patients of polycystic ovarian syndrome by S. Jonard, Y. Robert<sup>12</sup>, the age range was 21 to 34 years with a median age of 27 years.

**MARITAL STATUS OF THE PATIENTS**

In the present study out of 100 patients with suspected PCOS most (68%) of them were unmarried compared to the married (32%).

Similar result was seen in a study of 102 patients of PCOS conducted by Haque Riyazul Aqbalul Nazma Begum and K Ashoka Reddy<sup>13</sup> in 2018 , 83(81.6%) of them were unmarried

compared to married 19(19.4%).

### CHIEF COMPLAINTS OF THE PATIENTS

In present study of 100 patients, most (94%) of the patients had amenorrhoea/oligomenorrhoea. Other main complaints of the patients were obesity(63%), hirsutism(38%) and infertility (24%).

These observations were similar to the study by Adams et al<sup>14</sup>. In this study along with oligomenorrhoea (100%), infertility (85%) and hirsutism (65%) were the main complaints.

### TYPE OF SONOLOGICAL PROCEDURE PERFORMED

In present study transabdominal ultrasonography was done in all 100 patients. 13% of the patients also underwent transvaginal ultrasonography in addition to transabdominal sonography. Most of the patients opted for transabdominal examination as they were unmarried.

Similar result was seen in a study of 102 patients of PCOS conducted by Haque Riyazul Aqbalul Nazma Begum and K Ashoka Reddy<sup>13</sup> in which all the patients underwent transabdominal ultrasound as most of them were unmarried.

### ENDOMETRIAL THICKNESS

94% of the patients has endometrial thickness of 3mm to 9mm in present study of 100 patients with clinical suspicion of polycystic ovarian syndrome. In 6% of the patients it was more than 10mm. Overall, the thickness of the endometrium ranged between 3mm to 16mm.

This observation is comparable with the study by Nagamani Periet. Al<sup>8</sup>, in which out of 245 patients with polycystic ovarian syndrome, about 93% had homogenous endometrium with thickening ranging from 1mm to 17mm and the rest about 7% had heterogenous endometrium with thickness ranges from 4mm to 23mm.

### NUMBER OF FOLLICLES PER OVARY

Maximum numbers of patients (80%) were in the group of  $\geq 12$  follicles in present study. 20% showed  $< 12$  follicles. The range of follicle number observed in the present study was between 9 and 20.

This cut off point was taken as per the Rotterdam consensus definition of polycystic ovarian syndrome.

### FOLLICLE DISTRIBUTION

Present study showed peripheral distribution of follicles in 100% of the patients.

This observation was similar to study conducted by Vandana Yadav, Kanti Maurya<sup>15</sup> in 2016 in which 100% showed peripheral arrangement of follicles

### FOLLICLE SIZE

Most common size range observed in this study was 2-9mm which was seen in 85% of the patients. The range of follicle size in this study was between 3 to 10mm.

Similar observation was also seen in other studies like Hannet al<sup>16</sup> in which most common follicular size observed was 2-9mm (80%) with range 2 to 12mm.

### STROMAL CHARACTER

Evaluation of stroma in this study showed echogenic stroma in 91% of the patients.

In the study by Pacheet al<sup>11</sup> increase in stromal echogenicity was found in 55%.

### VOLUME OF THE OVARY

In this study most (71%) of the patients have ovarian volume

$\geq 10$ cc. The volume range observed in the present study was between 8 to 18cc.

In study by Adams et al<sup>14</sup>, 70% of the PCOS patients showed ovarian volume  $\geq 10$ cc. In another study by Hannet. al<sup>16</sup>, 71% patients have ovarian volume  $\geq 10$ cc.

### DISTRIBUTION ACCORDING TO HORMONAL PROFILE

In this present study of 100 patients of clinically suspected PCOS:- 90% of the patients showed normal or low levels of FSH. Increased LH levels is seen in 82% of the patients. 63% of the patients showed raised LH/FSH ratio. The testosterone levels were raised in most (72%) of the patients. 95% of the patients showed normal prolactin levels. 97% of the patients showed normal thyroid levels. 72% of the patients have normal 2 hr blood sugar levels after OGTT. These results are comparable to other studies by Miguel Dolz and Van Der Westhuitzen<sup>17</sup>.

### CORRELATION BETWEEN USG FEATURES AND HORMONAL PROFILE

Number of follicles and ovarian volume showed negative correlation with FSH values. FSH was low to normal in patients with more than 12 follicles (94%) and ovarian volume more than 10cc. (94%) which was statistically significant.

FSH was also low to normal in patients with follicular size 2-9mm (89%) which was not statistically significant. There is significant rise in LH levels in patients with more than 12 follicles (86%) and with volume of ovary more than 10cc (92%). LH/FSH ratio was significantly greater in patients with more than 12 follicles (73%) and volume of ovary more than 10cc (76%). Rise in LH/FSH was also seen in patients with ET less than 10mm (62%), but this was not statistically significant. Number of follicles and follicular size showed negative correlation with rise of TSH which was not statistically significant. There is significant rise in free testosterone levels seen in patients with more than 12 follicles (83%) and volume of ovary more than 10cc (85%). Pache et al<sup>11</sup> found positive correlation between testosterone and LH with number of follicles  $> 2$ mm. In the study by Luciano G. Nardo<sup>18</sup>, the total ovarian volume, total follicular volume and follicular number correlated well with the LH and FSH. Takahashi et al<sup>19</sup> and Battaglia et al<sup>20</sup> noted a positive correlation between number of small follicles (2-8mm) and LH/FSH ratio. Ludmila et al<sup>21</sup> noted a negative correlation between FSH level and antral follicle count.

### CONCLUSION

This study concludes that the ovarian features on ultrasonography like follicular number and ovarian volume shows positive correlation with LH, LH/FSH ratio and testosterone and negative correlation with FSH. Transabdominal sonography proved to be optimally efficient and effective in identifying all the sonological features of PCOS, however transvaginal sonography is known to be more sensitive and accurate. Transabdominal sonography can be recommended as a convenient and effective imaging tool to identify ovarian morphology. However, this study suggests that for identifying endometrial and stromal changes further studies involving larger sample population are required.

### REFERENCES

1. A.H. Zargar, V.K. Gupta, A. I. Wani, S. R. Masoodi, M. I. Bashir, B. A. Laway, M. A. Ganie and M. Salahudin, "Prevalence of Ultrasonically Proved Polycystic Ovaries in North Indian Women with Type 2 Diabetes Mellitus," *Reproductive Biology & Endocrinology*, Vol. 3, No. 35, 2005. doi:10.1186/1477-7827-3-35
2. Ovalle F, Azziz R. Insulin resistance, polycystic ovary syndrome, and type 2 diabetes mellitus. *Fertil Steril* 2002;77(6):1095-105.
3. Wild RA. Long-term health consequences of PCOS. *Hum Reprod Update* 2002;8(3):231-41.
4. Legro RS. Polycystic ovary syndrome and cardiovascular disease: a premature association? *Endocr Rev*. 2003;24(3):302-12.
5. Hardiman P, Pillay OC, Atiomo W. Polycystic ovary syndrome and endometrial carcinoma. *Lancet* 2003;361(9389):1810-2.
6. Nagamani Peri, Deborah Levine. Sonographic evaluation of the endometrium in patients with a history or an appearance of polycystic

- ovarian syndrome. *J Ultrasound Med* 2007;26:55-58.
7. Dewailly D. Definition and significance of polycystic ovaries. *Baillieres Clin Obstet Gynaecol* 1997;11(2):349-368.
  8. Mendelson EB, Friedman H, Neiman HL, et al. The role of imaging in infertility management. *AJR AM J Roentgenol* 1985;144(2):415-20.
  9. El Tabbakh CH, Lofty I, Azab I, et al. Correlation of sonographic ovarian disease and the clinical, hormonal, and laparoscopic findings. *Am J Obstet Gynecol* 1986;154(3):892-95.
  10. Yeh H-C, Futterweit W, Thornton JC. Polycystic ovarian disease: US features in 104 patients. *Radiology* 1987;163(6):111-16.
  11. Pache TD, Wladimiroff JW, Hop WCJ, et al. How to discriminate between normal and polycystic ovaries: Transvaginal US study. *Radiology* 1992;183(3):421-23
  12. Jonard S, Robert Y, Cortet-Rudelli C, Pigny P, Decanter C, Dewailly D. Ultrasound examination of polycystic ovaries: is it worth counting the follicles? *Human reproduction* 2003;18:598-603
  13. Haque Riyajul Aqbalul Nazma Begum, K Ashoka Reddy, Md. Kaleemullah. Polycystic ovarian syndrome: a hormonal and radiological correlation. *International Journal of Contemporary Medicine Surgery and Radiology*. 2018;3(4):C1-C5
  14. Adams J, Polson DW, Abdul wahid N, Morris DV, Franks S, Mason HD, et al. Multifollicular ovaries: clinical and endocrine features and response to pulsatile gonadotropin releasing hormone. *Lancet* 1985;2:1375-1379
  15. Vandana Maurya, Kanti Yadav. Clinicoradiological Profile of Patients with PCOS and its Association with Biochemical Parameters. *Int J Med Res Prof*. 2016;2(4):72-75
  16. Hann LE, Hall DA, Mc Ardle CR, Seibel M. Polycystic ovarian disease: sonographic spectrum. *Radiology* 1984;150(2):531-534.
  17. Miguel Dolz, Newton G, Osborne, Javier Blanes, Francisco Raga, Lorenzo Abad-Velasco et al. Polycystic ovarian syndrome: Assessment with color Doppler angiography and three dimensional ultrasonography. *J Ultrasound Med* 1999;18:303-313.
  18. Luciano GN, William Buckest M, Daviana White, Alessandro Digesu G, Stephen Franks, Vik Khullar. Three dimensional assessment of ultrasound features in women with Clomiphene citrate-resistant polycystic ovarian syndrome (PCOS): ovarian stromal volume does not correlate with biochemical indices. *Human reproduction* 2002;17:1052-1055
  19. Takahashi K, Eda Y, Abu Musa A, Okada S, Yoshino K, Kitao M. Transvaginal ultrasound imaging, histopathology and endocrinopathy in patients with polycystic ovarian syndrome. *Human Reproduction* 1994; 9:1231-1236.
  20. Cesare Battaglia, Nicola Persico, Pierandrea de Iaco, Fulvia Mancini, Paolo Busacchi, Domenico de Aloysio. The ultrasound review of Obstetrics & gynecology 2005;5:316-324.
  21. Ludmila Barbakadze, Jenara Kristesashvili, Natalia Khonelidze, and Gia Tsagareishvili, The Correlations of Anti-Mullerian Hormone, Follicle-Stimulating Hormone and Antral Follicle Count in Different Age Groups of Infertile Women, *Int J Fertil Steril*. 2015 Jan-Mar; 8(4):393-398.