

**COMPARATIVE ANALYSIS OF OVARIAN VOLUME AND ANTRAL FOLLICLE COUNT ASSESSED BY MRI AND TRANSVAGINAL ULTRASONOGRAPHY IN WOMEN WITH PCOS**Bulabai Karpagam<sup>1</sup>, Prem Kumar<sup>2</sup>, V. Vadanika<sup>3</sup>**HOW TO CITE THIS ARTICLE:**

Bulabai Karpagam, Prem Kumar, V. Vadanika. "Comparative Analysis of Ovarian Volume and Antral Follicle Count Assessed by MRI and Transvaginal Ultrasonography in Women with PCOS". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 87, October 29; Page: 15110-15117, DOI: 10.14260/jemds/2015/2146

**ABSTRACT: AIM :** Ovarian volume and antral follicle count are of clinical importance as diagnostic features of polycystic ovarian syndrome (PCOS). The aim of this study is an comparative analysis of antral follicular count (AFC) and ovarian volume assessment by transvaginal ultrasound (TVS) versus Magnetic Resonance Imaging (MRI). **MATERIALS AND METHODS:** TVS Study was performed on Seimens usg Acuson x300, probe- EC9-4 4.0–9.0MHz 2D9 (C, D, M Urology, Obstetrics, Early Obstetrics, Gynecology) and MRI by Seimens 1.5 Tesla magneto Essenza. Standard protocols have to applied for each patients while performing scan. Average number of follicles in both ovaries were taken as AFC and Ovarian volume was measured by taking all the three dimensions (Length, AP and width). MRI was done in Siemens 1.5 Tesla magnetom Essenza. AFC, ovarian volume and follicle size were assessed in both the ovaries by T2 FS axial, sagittal, T1 axial and T2 coronal series. **RESULT:** There is age related decline in AFC of patients with PCOS whereas the ovarian volume appears to be stable after the age of 35. More over MRI is more sensitive (82.6%) for AFC as compared with TVS and no significant difference noted on ovarian volume by TVS versus MRI. **CONCLUSION:** In our study there is evidence of increase in AFC count until age of 35 years and then declines as the age progresses, whereas the ovarian volume remains static after 38-42 years. MRI is more sensitive than TVS for AFC, whereas no significant change noted for ovarian volume by TVS and MRI. Unlike US, the results have demonstrated that MR uniformly provided clarity in follicle number and distribution, as well as distinction between ovarian antral follicle, and stroma.

**KEYWORDS:** Bulabai karpagam, Pcos, Antral follicular count, AFC by MRI and TVS, Ovarian volume in PCOS.

**INTRODUCTION:** Polycystic ovary syndrome (PCOS), is a complex disease also called hyperandrogenic anovulation (HA), or Stein-Leventhal syndrome, is one of the most common endocrine disorders among women. PCOS has a diverse range of causes that are not entirely understood, but there is evidence that it is largely a genetic disease. Others say it is generally a metabolic dysfunction, since it is reversible.<sup>1</sup>

The name PCOD is used when there is ultrasonographic evidence. Ultrasonographic measurements of ovarian volume and antral follicle count are of clinical importance as diagnostic features of polycystic ovarian syndrome (PCOS), and as a parameter in estimation of ovarian follicular reserve in infertility care. Antral follicle count (AFC) has been a reliable marker for ovarian reserve. Antral follicle (Or Graafian follicle) is an ovarian follicle during a later stage of folliculogenesis. It is a resting follicle and appears as a small fluid filled sac that contains the immature egg.

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These follicles can be measured and counted on cycle days 2, 3 and 5. These follicles can be measured and counted on cycle days 2-5, and 3 to 8 follicles per ovary of size from 2-10mm.<sup>2,3</sup> PCOS produces symptoms in approximately 5% to 10% of women of reproductive age (Approximately 12 to 45 years old). It is thought to be one of the leading causes of female sub fertility and the most frequent endocrine problem in women of reproductive age. Finding that the ovaries appear multicystic on ultrasound is common, but it is not an absolute requirement in all definitions of the disorder.

The estimated prevalence is at around 4-2%. Trans abdominal and/or transvaginal ultrasound have become the most commonly used diagnostic methods for the identification of polycystic ovaries. The characteristic features are accepted as being an increase in the size (Volume) of the ovary due to a greater number of follicles and volume of stroma as compared with normal ovaries. Transabdominal ultrasound is preferred to the transvaginal approach in adolescent girls, but this approach may be technically limited in overweight and obese individuals. These challenges to ultrasound evaluation make this diagnostic criterion much less useful in the adolescent. Hence recent studies have suggested MRI as a potentially more accurate modality to evaluate the ovaries<sup>4</sup>. More over Study also observed on correlative analysis for ovarian aging by AFC on TVS versus MRI.

**MATERIALS AND METHODS:** Descriptive cross sectional study was conducted in 92 cases of women with irregular periods/PCOS from August 2014 to March 2016 of age group between 18to 45 in married women. It was a simple random sampling using descriptive analysis by SPSS software, not applying test data analysis.

Exclusion criteria includes patients who are pregnant, patient refusal/Inability to understand the information provided, Patients associated with any other ovarian pathology, Patients on hormonal therapy and patients who have metallic implants/cardiac pacemakers. Study was performed on Seimens usg Acuson x300, probe-EC9-4 4.0–9.0 MHz 2D9(C, D, M Urology, Obstetrics, Early Obstetrics, Gynecology) and Seimens 1.5 Tesla magneto Essenza. Standard protocols was applied for each patients with T1, T2 axial and coronal sequences. Sonographic examinations were done with an empty bladder, the patient was lying in a supine position and the buttocks elevated with pillows.

The transducer was advanced about 6 to 8cm into the vagina angling laterally until the ovary was seen. Examination of the ovary was established by scanning from the outer margin to the inner margin. All follicles having adequate morphology as described for a healthy follicle i.e., 2-9mm size range of well-defined anechoic cysts with smooth margins and absence of internal septations.

### **USG criteria-Bilateral enlarged ovaries with multiple small follicles: 50%**

- Increased ovarian size (>10cc).
- 12 or more follicles measuring 2-9mm.
- Follicles of similar size.
- Peripheral location of follicles: which can give a string of pearl appearance.
- Hyperechoic central stroma.
- The ovarian outline may be slightly irregular.

MRI criteria may show most or all of the above sonographic features. Sequences and Signal characteristics include AFC, ovarian volume and follicle size were assessed in both the ovaries in T2 FS axial, T1-the small uniform follicles are low in signal while the central stroma is of intermediate

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signal (e.g., compared with normal myometrium), on T2-follicles have high signal while the central stroma is of low signal Fig1. Follicular size is measured using the internal diameters of the ovary. Average number of follicles in both ovaries were taken as AFC. Ovarian volume was measured by taking all the three dimensions (Length, AP and width) (Fig. 2). The length and Antero-Posterior (AP) measurements were obtained in the longitudinal plane, while the transverse plane was used to measure the width. Patients satisfying USG criteria for PCOS were subjected to MRI.

**RESULT ANALYSIS:** Comparison of AFC and ovarian volume between TVS and MRI was done using Paired t-test. Follicle size was compared between TVS and MRI using Correlation co-efficient.

Correlation co efficient tool was used to see whether transverse diameter (D2) of the ovary is a predilector of ovarian volume. Stromal echogenicity is done using frequency table. A total of 135 women were evaluated, of which 92 women fitted the criteria for PCOS. Compared to TVS, follicles were better assessed by MRI (In view of AFC count-72cases, and volume-36 cases).

Graph 1 showing correlation between AFC measured in TVS and MRI is done using Pearson Correlation. P value was calculated  $<0.001$  i.e. statistically strongly significant and correlation was 0.9. Similarly P value was calculated for ovarian volume TVS and MRI (Graph 2), value was  $<0.001$  i.e. strongly significant and correlation ratio was 0.9. Ovarian width (D2) was compared with ovarian volume in MRI (Graph 3) using Pearson Correlation and the correlation ratio was 0.7 and P value was derived 0.001 i.e. there is positive correlation. Out of 92 PCOS patients 45.7% had echogenic stroma and 54.3% did not have stromal echogenicity represented in Graph 4.

A total of 135 women were evaluated, of which 92 women fitted the criteria for PCOS. Compared to TVS, follicles were better assessed by MRI (In view of AFC count-72 cases, and volume-36 cases). Study showed decline in number of antral follicle count as the age progresses, whereas ovarian volume after the age of 35 remained the same. Table 1 showing correlation between AFC measured in TVS and MRI is done using Pearson Correlation. P value was calculated  $<0.001$  i.e. statistically strongly significant and correlation was 0.9. Similarly P value was calculated for ovarian volume TVS and MRI (Table 2), value was  $<0.001$  i.e. strongly significant and correlation ratio was 0.9.

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		AFC_MRI
AFC_TVVS	Pearson Correlation	0.989
	P-value	$<0.001$
	N	92

**Table 1: Pearson Correlation between AFC\_TVVS and AFC\_MRI**

Pearson Correlation ratio is calculated and ratio is 0.98, which shows strong correlation between AFC\_TVVS and AFC\_MRI.

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		Volume MRI.
Volume TVS	Pearson Correlation	0.901
	P-value	<0.001
	N	92
<b><i>Table 2: Pearson Correlation between Ovarian Volume TVS and Volume MRI</i></b>		

The Pearson Correlation ratio is calculated and ratio is 0.9, which shows strong correlation between Ovarian Volume\_TV S and Volume\_MRI.

**DISCUSSION:** Our study was conducted to assess the utility of MR as an imaging technique to define ovarian morphology compared with that of transvaginal US in patients with PCOS. The current diagnostic criteria for PCOS include distinctive features of ovarian morphology as defined by the 2003 Rotterdam consensus.<sup>5</sup> namely, the number of antral follicles measuring 2–9 mm in diameter are equal to or greater than 12 and/or an increased ovarian volume of greater than 10 ml. These criteria were based primarily on ultrasonographic findings in adult women with PCOS. In our study totally 92 patients underwent TVS. Out of 92 PCOS women about 44.5% of women belong to the age group 26-30yrs as represented in Graph 5. In these patients AFC ranged from 12-32 follicle per ovary with an average of 18 follicles. The ovarian volume ranged from 10.8-52.5 ml with average of 19 ml. The average antral follicle size was found to be 3-5mm.

Our results confirmed previous study reports of age-related decrease in AFC among women with or without PCOS.<sup>6,7,8</sup> showed that women with PCOS maintain a stable oocyte count across the age range of 22–41 years Graph 6. The age related ovarian volume remains static after 38-42 years in our study. This result confirm the previous reports of that there was no major changes in ovarian volume in reproduction. Similarly, our finding of higher follicle counts may reflect the greater resolving capability of MRI compared to TVS with sensitivity of 82.6%.

The sensitivity and specificity of transvaginal ultrasonography in assessing the antral follicle >14 is 82% but the sensitivity decreases to 30% for antral follicle >18.<sup>9</sup> by Janet Kwee et al. Unlike USG (Figure 3a), advantage of MR is that it uniformly provides clarity in follicle number and distribution, as well as distinction between ovarian antral follicle, and stroma within the ovaries (Fig 3b). Vassiliadi et al. found that a threshold of 12 ovarian follicles is appropriate for detection of PCOS using MRI, however several subjects in that series had greater than 35 follicles seen within a single ovary.<sup>10</sup>

In our study maximum number of AFC was 34, which could be explained by various theories proposed to explain the high AFC in PCOS patients, besides high ovarian reserve. Webber et al suggested that: (i) there are more primordial follicles to start within the polycystic ovary than in the normal ovary; (ii) there is reduced loss of follicles by atresia during folliculogenesis; and (iii) the dynamics of follicle growth are different from normal and polycystic ovaries.<sup>11</sup>

Our data support a higher threshold, which may prove higher delineation of individual follicles by MRI compared to ultrasound as noted in Hauth EA et al study.<sup>12</sup> In our study out of 92 patients, 76 patients had higher number of AFC in MRI compared to TVS. The latter explanation supported by our finding of slightly higher follicle counts using 2 mm slices. The independent t test using Pearson's correlation was used in comparison of ovarian volume assessed by TVS and MRI and it showed that there was no significant difference between the values (p value<0.001) as noted in Graph 3.

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Out of 92 PCOS patients 54.3% had central echogenic stroma (Fig. 4) and 45.7% did not have stromal echogenicity shown in graph 4. Whereas in MRI only 38 patients (41%) had T2 hypo intense (In comparison with muscle) central stroma. Thus for assessing the ovarian volume and central stroma MRI does not provide any extra information in comparison to TVS in our study as similar results had been noted in various articles.<sup>13,14</sup>

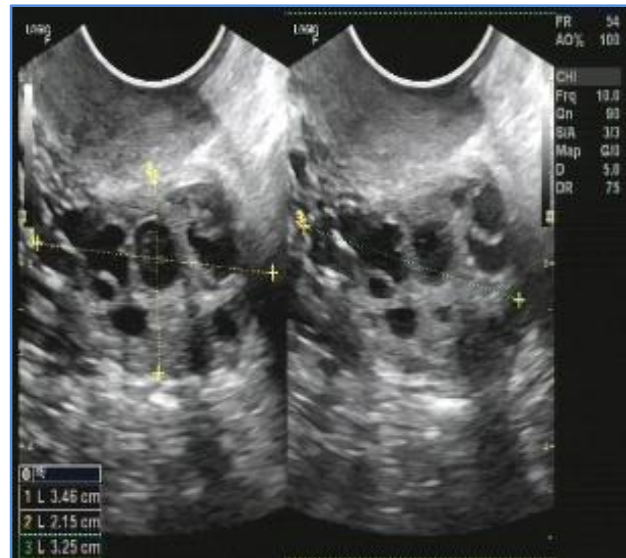
A review of the literature,<sup>15</sup> has yielded two published reports addressing a simpler ovarian morphometric assessment utilizing the mean ovarian diameter as a prognosticator of ovarian volume. In our study the ovarian width (D2) is correlated with ovarian volume and P value was statistically significant (0.001).

**CONCLUSION:** This study concluded that age-related ovarian volume remains stable and AFC declines in women with PCOS after age of 35. Compared to TVS the AFC were better assessed by MRI in view of number and follicle size.

Where as in assessing the ovarian volume and stroma both MRI and TVS play an equal role. One limitation of this study is that it was a cross sectional study and it did not have a long-term follow up on the individual patients to enable the effect of age on AFC to be evaluated longitudinally. Moreover, threshold values based on previous ultrasound data may not be appropriate for MRI. Clearly, additional studies are needed to corroborate the current findings and potentially to re-consider morphological criteria for polycystic ovaries assessment in MRI.



**Fig. 1: MRI coronal plane T2 weighted coronal plane Images showing antral follicles of hyperintense signal.**

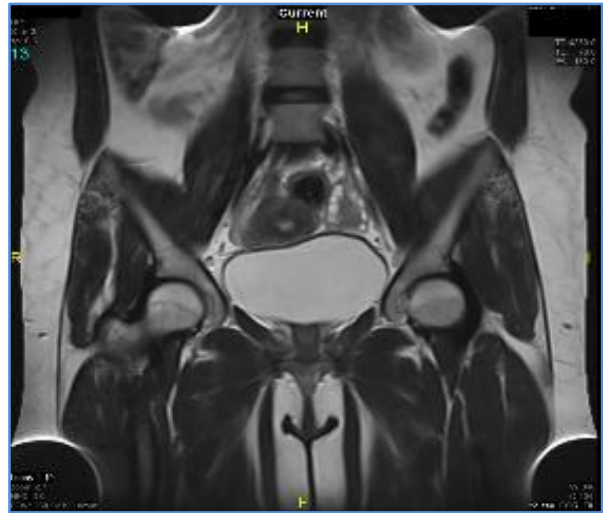


**Fig. 2: Transvaginal ultrasound**

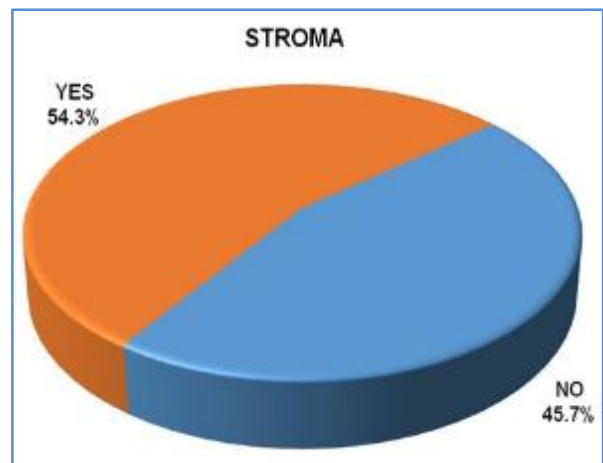
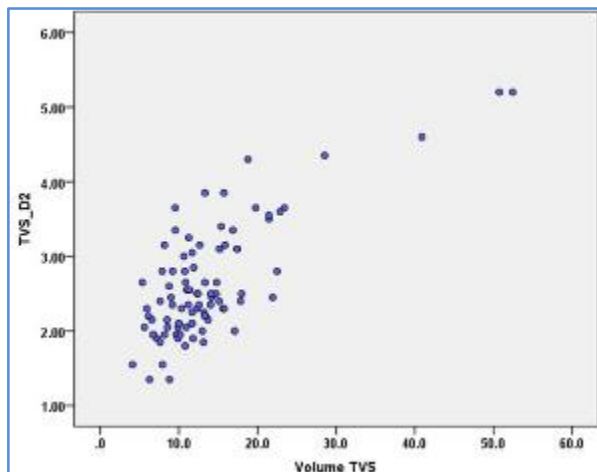
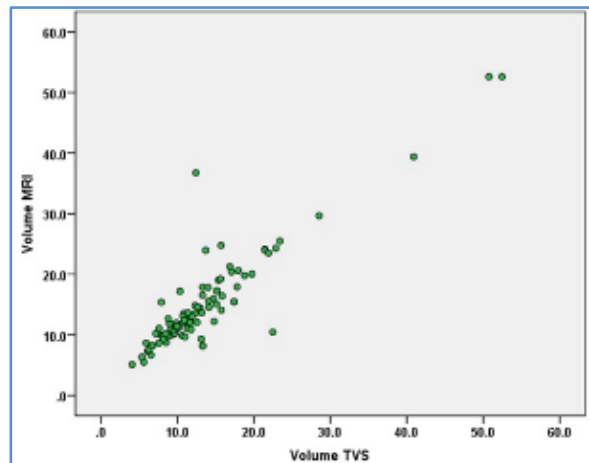
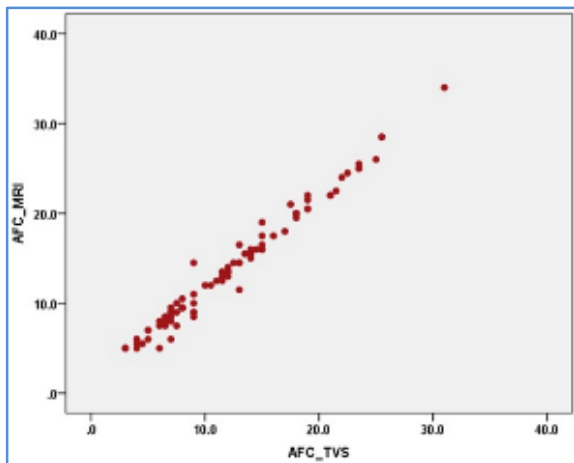
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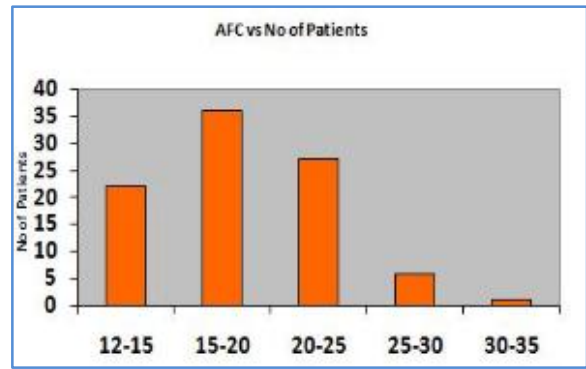
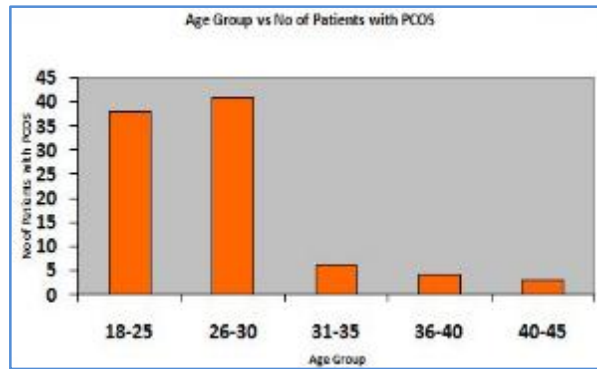
**Fig. 3a:** Transvaginal sonography image Showing PCOS with echogenic stroma.



**Fig. 3b:** MRI multiplanar imaging as noted on T2 coronal series shows clarity in follicle number and distribution, as well as distinction between ovarian antral follicle, and stroma within the ovaries.



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