



## Original Article

## Diagnostic Accuracy of Sonographic Transvaginal Ovarian Biophysical Profile as A Predictor of Infertility Taking Transvaginal Ultrasound as A Gold Standard

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## ABSTRACT

Infertility is a common occurrence and a serious medical, societal, and global health issue that affects 10-15 % of couples at some point in their lives. Pakistan, one of the world's most populated countries with a population growth rate of roughly 2%, has a 22 % prevalence of infertility, with 4.0 % of primary infertility and 18.0 % of secondary infertility. In cases where the problem of infertility may be handled with therapeutic or surgical operations, there are still hurdles to treatment, which can be divided into three categories: accessibility, economic cost, and cultural/societal considerations. All three exist in Pakistan at the same time. **Objective:** To determine the diagnostic accuracy of sonographic transvaginal ovarian biophysical profile as a predictor of infertility taking transvaginal ultrasound as a gold standard. **Methods:** In this cross-sectional validation study, women visited the gynecologist for treatment of infertility for a period of two years. A total of 550 cycles were inducted primarily referred for ovarian assessment by ultrasound with patent tubes and normal uterine morphology. Baseline transvaginal sonography was performed at the proliferative phase by TVS. On an individual basis, the following parameters, that is, follicle size, ovarian volume, and ovarian artery Doppler Pulsatility and Resistive index were studied. **Results:** The Ovarian biophysical profile was determined by applying the ovarian scoring system for reproduction (OSSR). In this research, we compared the infertile females with fertile. Out of 550, 243 (44.18%) patients were infertile and 307 (55.82%) were normal, as for as the primary infertile females were 99 (18.00%) and secondary infertile were 144 (26.18%). Out of 550 females, 331 women had a perfect ovarian biophysical profile (OBP) score of 10. The mean score for fertile was  $9.39 \pm 1.56$  and in infertile females  $7.05 \pm 2.55$ . The p-values  $< 0.001$ . The sensitivity and specificity of OBP at cut-off value 10 is 100% and 0.04%. The sensitivity and specificity of OBP at cut-off value 8 can be considered to rule-out in the future with 85.3% and 63.8% respectively. Follicle size and ovarian artery Doppler flow were highly significant for pregnancy. **Conclusions:** In normal and childless females, we found substantial variations in mature follicles, ovarian volume, and ovarian artery blood flow resistive and Pulsatility index. In the fertile females, the diameter of the follicles was larger, whereas infertile females had smaller follicles. The ovarian scoring system for reproduction (OSSR) can prove to be a simple, diagnostic and authentic score to predict the ovarian environment and thereby help in the prediction of the outcome of infertility. Six out of the nine parameters were found to be the high score to predict a pregnancy all by themselves, but these parameters needed expertise and better instrumentation for evaluation. Of the remaining three parameters, two were the same or equal on an individual basis and one was found to be not significant.

## INTRODUCTION

The World Health Organization has defined infertility as a twelve-month period of unsuccessful attempts to conceive. According to research conducted by the World

Health Organization (WHO), 48.5 million couples globally were unable to conceive in 2010. After five years of struggling, 1.9 percent of women aged 20 to 44 who desired

a child were unable to have their first live birth, and 10.5 percent of women who had previously given birth were unable to have another baby. It was a 0.1 percent and 0.4 percent decline, respectively, from 1990 [1,2]. According to one estimate, anxiety, depression, and obesity are the primary causes of infertility, with about 86.8% of infertile women suffering from anxiety and 40.8 percent suffering from depression [4]. In today's infertility diagnosis, transvaginal ultrasonography is crucial [3]. The follicle should be smooth, anechoic, and at maximal size, which should be less than 30mm, during the proliferative phase of the cycle [4]. When it comes to ovulation, this trait is desired. The cyclic alterations and episodic assessment of follicle function, size, and responsiveness during the cycle allows for the evaluation of their function, size, and receptivity [5]. The ovaries are typically shown as rectangular entities with a 3x2x1 cm. Premenopausal females' ovarian volume ranges from 10 to 12 cm<sup>3</sup>, with volume accounting for up to 2-4 cm<sup>3</sup> depending on the existence of a mature follicle [6]. The diameter of the ovaries is proportional to the patient's age and follicular stage of development. The number of small antral follicles (AFC) in a baseline scan indicates the likelihood of success [7]. Another notable feature of ultrasound is that it can indicate the pattern and quantity of blood flow in infertile females, and spectral Doppler methods can describe the flow in greater detail [8]. The presence or absence of blood flow is indicated by the pattern, which can aid in the correct diagnosis [9].

**METHODS**

By using the ovarian points system for reproduction, the OBP was developed. Infertile females with an empty bladder had transvaginal ultrasonography as a baseline exam to assess the size of follicles, the volume of the ovaries, & ovarian vascularity. The background, clinical examination, and exploration findings were recorded after receiving written informed permission from couples who wanted to partake in the research. These investigations were recorded. Male factor infertility was excluded. The mean follicular diameter was calculated as well as ovarian volume. Doppler imaging with 7-12 MHz transvaginal transducer was used to assess ovarian stromal vascularization. A minimum of 3 clear waveforms were acquired for evaluation. The resistive index & pulsatility index were recorded.

**RESULTS**

A score of 9-10 on the OBP was extremely significant for a pregnancy, whereas a score of 7-8 was also significant. A score of 6 can be effectively to prospect of becoming pregnant. There were 307 normal females, 243 infertile women included in this study (Table 1). Mean OBP of normal

women was 9.39±1.56 while for infertile women (Figure 1A,B; 2A,B), it was 7.05±2.55 (Table 1). Fertile females had a mean age of 29.14 ±2.81 years and infertile females had a mean age of 31.36 ±5.26 years. The mean age of healthy and childless women was statistically significant. There was a single female (0.2%) with a score of "0" 6 (1.1%) females with a score of "2," 12 (2.2%) females with score of "3" 54 (9.8%) females with a score of "4" 21 (3.8%) females with a score of "5" 29 (5.3%) females with a score of "6" 44 (8.0%) Women with a "7" score 33 (6.0%), "8," 19 (3.5%) "9," and 331 (60.2%) women who received a "10" (Table 2). For this OBP, the maximum score is 0-10. The sensitivity and specificity of OBP at cut off value '1' is 100% and 0.04%. The sensitivity and specificity of OBP at cut off value 7 is 85% and 63%. It can be considered to rule out the sensitivity and specificity at cut off value 8 in future with 85.3% and 63.8% respectively (Table 3).

	Groups	Mean	S.D	Median	IQR	Z*	p-value
Ovarian biophysical profile Total Score	Normal (n=307)	9.39	1.56	10.00	0.00	-12.200	<0.001
	Infertility (n=243)	7.05	2.55	7.00	6.00		
	Total (N=550)	8.35	2.36	10.00	3.00		

**Table 1:** Comparison of Total in both study groups (Normal versus Infertility)

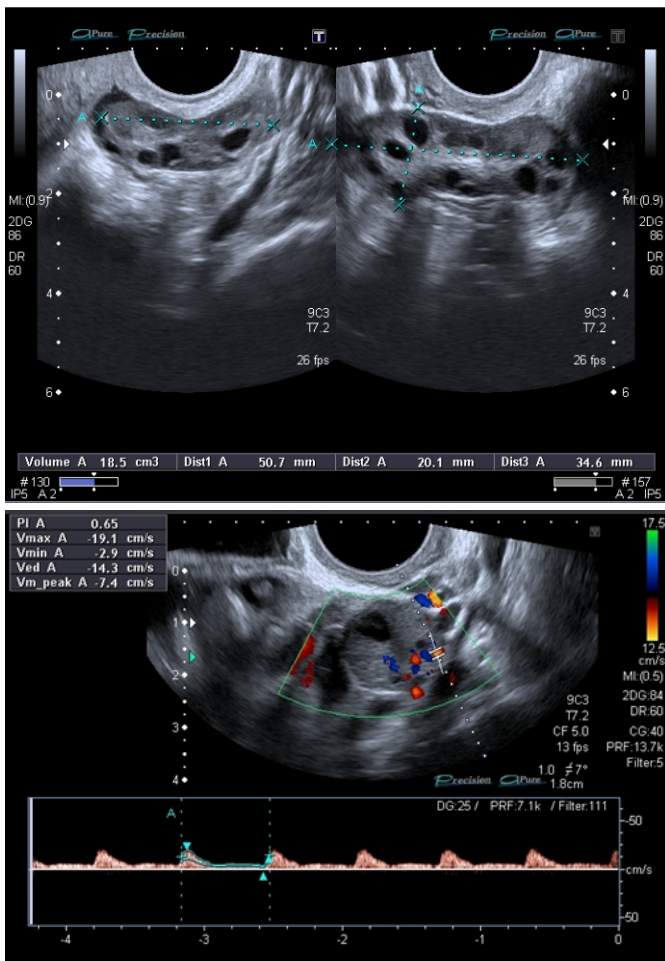
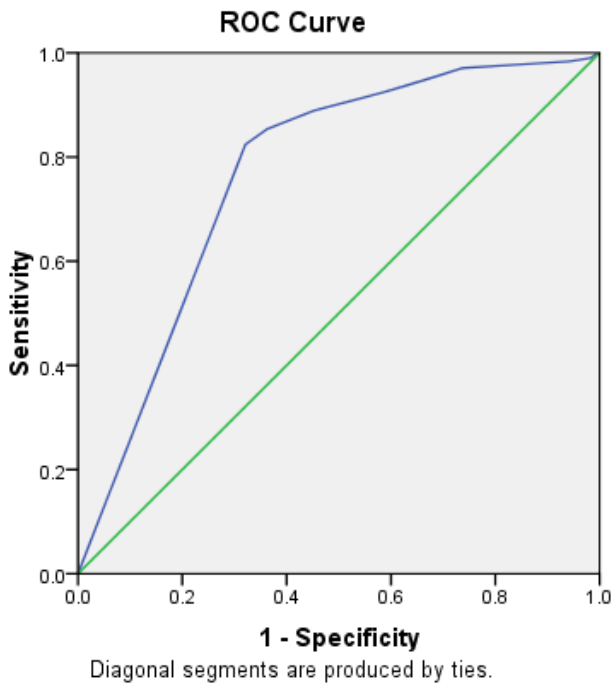
a: Mann-Whitney Test was applied

Score	Frequency	Percent
.00	1	.2
2.00	6	1.1
3.00	12	2.2
4.00	54	9.8
5.00	21	3.8
6.00	29	5.3
7.00	44	8.0
8.00	33	6.0
9.00	19	3.5
10.00	331	60.2
Total	550	100.0

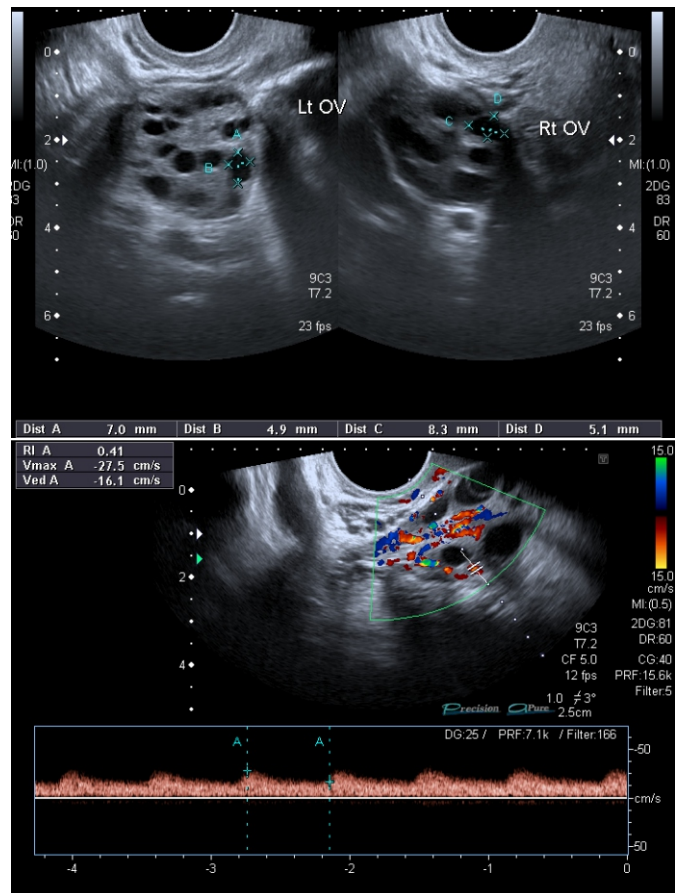
**Table 2:** Ovarian biophysical profile Scoring and frequency distribution with the percentage

Test Result Variables : Total		
Positive If Greater Than or Equal To*	Sensitivity	Specificity
1	1.000	0.004
2	0.990	0.016
3	0.984	0.058
4	0.971	0.263
5	0.951	0.325
6	0.925	0.412
7	0.889	0.547
8	0.853	0.638
9	0.824	0.679
10	0.000	1

**Table 3:** Test Result Variables



**Figure 1A:** Shows the enlarged ovary with 18.5cm<sup>3</sup> volume and immature follicles at periphery with central echogenic stroma.  
**Figure 1B:** Shows the ovarian artery vascularity PI=0.65.



**Figure 2A:** Shows the immature follicles with average size follicles measuring 0.7x0.4cm in left ovary and in right ovary average size of follicles was 0.8x0.5cm with primary infertility.  
**Figure 2B:** Shows the ovarian artery Doppler vascularization RI=0.41 in fertile female..

## DISCUSSION

Anovulation due to follicular atresia, empty follicle syndrome, luteinized un-ruptured follicle syndrome, and chronic anovulation syndromes are the most common ovarian illnesses that cause infertility. Color Doppler and Grayscale Sonography are the first high-quality tools for ovarian cycle monitoring that can characterize potential alterations in the cycle's physiologic sequence. Ovaries with small follicles of 3mm or less and early disappearance of the principal follicle are seen in follicular atresia. The absence of oocytes within the main follicle is known as empty follicular syndrome. The lack of oocyte exclusion from the main follicle persists in the luteinized un-ruptured follicle condition [10]. The follicular size inter-activeness plays an important role in embryo implantation, as well as estimating follicular size receptivity is a difficult task in clinical practice [11]. Poor gamete quality has been implicated as a cause of infertility in polycystic ovarian illness, luteal deficit, and certain cases of idiopathic infertility. According to our findings which are the same as

Andrews's findings, the average follicular size of normal women was bigger than the average follicle size of infertile women. The difference in mean follicle size between research groups was statistically significant. In 2010, Shaheen R et al., performed study in Pakistan and found that there are 118 cases of ovulatory failure in Pakistan 22.09% [11]. Insufficient follicular might be considered a primary fertility deciding factor, according to a study done by Severi et al., in 2012. The size of the follicles was reviewed in his research, mature follicles normally measure 17 to 25 mm in average inner dimension [6]. Neeta Singh et al. reported in 2013 that in spontaneous ovulation, developing follicles that are destined to ovulate grow in size by 2 - 3mm every day and achieve maximum size of 16 - 33mm before ovulation in spontaneous cycles of 222 women. On days 8 - 10 of the cycle, Doppler can identify a dominant follicle in the ovary, and the follicle grows to roughly 20 to 24mm in size [13]. In 1991, Asim Kurjeck shows the results of Doppler study in infertile women examining ovarian and uterine arteries. 111 women were infertile, with eight of them suffering from primary infertility [14]. Whenever the dominant follicle exceeds 12 to 15 mm, the ovarian artery flow velocity is recorded. The resistance index is  $0.54 \pm 0.04$  on the day before ovulation, and it also drops. 4 to 5 days later, a nadir of  $0.44 \pm 0.04$  is attained, followed by a gradual increase to  $0.050 \pm 0.04$  before menstruation. The PI of the right and left ovaries showed no significant differences. The PI, on the other hand, was linked to follicles count [15]. Our study also relates with these results. According to Richard Fleming in 2015, vaginal sonography can be used to image and manually measure the diameter of all small antral follicles, counting those between 2 and 10 mm in diameter [16]. Females with a low ovarian reserve are more likely to respond to ovarian stimulation with a moderate degree of follicular growth, making them "poor responders" who may require more attention to their chances of success. Increased age is linked to a reduction in ovarian volume. Reduction in the volume of ovaries & less in the number of antral follicles are signs of ovarian aging that may manifest before an increase in FSH levels [17]. In a study published in 2016, Akmal El-Mazny et al., found that the PI of ovarian arteries in the control group was  $(1.6 \pm 0.4)$  and the ovarian artery RI was  $0.85 \pm 0.11$  in normal fertile females [18]. Increased uterine artery blood flow resistance, according to Steer et al., can induce infertility without explanation [19]. Hyperprolactinemia showed a vasoconstrictor impact and was linked to increased blood flow resistance, according to Temizkan et al., [20]. However, according to a research done by Ranko Kutlesi in 2008, at the age of 35, It was diagnosed with Resistive index of the left ovary  $(0.60 \pm 0.11)$  right ovary is  $(0.64 \pm 0.10)$  RI of the left ovarian artery is

$(0.66 \pm 0.12)$  and RI of the right ovarian artery is  $(0.60 \pm 0.11)$  in control and fertile groups [21]. Their findings are comparable to ours. In polycystic ovaries, Doppler analysis appears to be greater than in normal ovaries [22].

## CONCLUSIONS

In the diagnosis and treatment of infertility, ultrasound has become the most widely used and essential technology. The greatest indicators for determining OBP are antral follicle count, ovarian volume, and ovarian artery Doppler. This first ultrasound examination will have an immediate impact on the patient's care and will aid in the prediction of the ovarian response to gonadotropins. Low OSS in infertile females who failed to conceive showed lower follicular size, ovarian volume (reduction or increase), ovarian artery Doppler RI, and PI receptivity. OBP parameters and scoring can help to predict whether or not a pregnancy can be successful. OBP has the potential to be a simple, quick, and non-invasive method for predicting ovarian environment and, as a result, pregnancy outcome.

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