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Ovarian Volume by Transvaginal Sonography in the Prediction of Ovarian Response to Induction of Ovulation

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Summary

This prospective study was done to evaluate the ability of ovarian volume, measured by transvaginal sonography, to predict ovarian response in induction protocols. A total of 75 women presenting with primary/secondary infertility, at manipal Assisted Reproduction Centre, Department of Obstetrics and Gynaecology, Kasturba Medical College, Manipal were included in the study. They were divided into 3 groups. Group-I -<30 years (n=45), Group II 31-35 years (n=23) and Group III 36-40 years (n=7). It was found that the mean volumes of smaller ovaries were 3.9 ± 2.6 cm^3 in Group-II and 2.7 ± 0.80 cm^3 in Group III. The mean total ovarian volume also decreased as age increased, from 10.1 ± 5.9 cm^3 to 8.3 ± 3.0 cm^3. All were induced with clomiphene citrate 50mg from Day 2 to Day 6 of the menstrual cycle. The mean number of follicles increased with the increase in volume of smaller ovary (3.2 ± 1.9 in ovaries measuring < 3cm^3 to 4.0 ± 1.4 in ovaries measuring > 9 cm^3). As the total volume was < 8.6 cm^3, 4.8 ± 2.5 when the volume was > 22.2 cm^3). Size of follicles and endometrial response to ovulation induction did not vary with the ovarian volume.

Introduction

At present a limited number of factors predict ovarian responsiveness and the occurrence of pregnancy before a cycle of assisted reproduction technology (ART). Advanced maternal age is associated with reductions in successful stimulation, clinical pregnancy and live birth rates in women pursuing ART. We need some easy predictors to predict ovarian response to ovulation induction, which are easy and cheap before starting these time consuming and expensive (ART) procedures.

It has been stated that, some women with small ovarian size on ultrasound demonstrated poor response to subsequent controlled ovarian stimulation. To substantiate this observation we undertook a prospective study to evaluate the ability of ovarian volume measured by transvaginal sonography, obtained preceding treatment, to predict ovarian response.

Materials and Methods

A total of 75 women presenting with primary/secondary infertility, at Manipal Assisted Reproduction Centre, Department of Obstetrics & Gynaecology, Kasturba Medical College, Manipal, were included in the study. They were divided into 3 groups. Group-I -<30 years (n=45), Group-II 31-35 years (n=23) and Group III 36-40 years (n=7). All were induced with clomiphene citrate 50mg from Day 2 to Day 6 of the menstrual cycle. Ovarian response was observed in the first cycle of ovulation induction.

Transvaginal ultrasonographic evaluation was done using Ultra mark 4 machine with 5mhz probe after emptying the bladder. Transverse and longitudinal scans are done and ovarian size was noted. Ovarian volume was then calculated by the Ellipsoid formula.

D1 x D2 x D3 x 0.523 = Volume of the Ellipsoid.

Where D1 is the maximum transverse diameter and D2 is the anterior-posterior diameter and D3 is the longitudinal diameter of each ovary. Following terms were used for analysis of ovarian volumes.

Volume of the smaller ovary – Volume of the smaller of the two ovaries

Total ovarian volume – The sum of right and left ovarian volume

The ovarian volume thus obtained was taken to correlate with the ovarian response in terms of number of follicles, size of the follicles and the endometrial response.

The data was fed into computer in D-base and analysed using the statistical package SPSS. Means of different groups were compared by one-way analysis of variants followed by Duncans multiple range test. Percentages were compared using chi-square test. p value < 0.05, was considered statistically significant, graphs were drawn using the Harvard Graphics.

Results

Our study showed that as the maternal age was increasing, the mean volumes of the smaller ovaries as well as mean total ovarian volumes were decreasing (Table I). However, this was not statistically significant ($p<0.05$).

To examine the correlation between ovarian volume and the ovarian response in terms of numbers of follicles, the size of follicles (mm) and the endometrial response (mm) the volumes of the smaller ovary were categorized into 3 categories:

Category I < 3cm³, number of subjects were 35,
Category II 3 to 9 cm³, number of subjects were 36,
Category III > 9 cm³, we had 4 subjects.
Similarly the total ovarian volumes were also categorized into 3 categories:
Category I < 8.6 cm³, we had 40 subjects.
Category II 8.6 to 22.2cm³, we had 31 subjects.
Category III > 22.2 cm³, we had 4 subjects.

It was observed that as the volume of the smaller ovary and total ovarian volumes were increasing the mean number of follicles was increasing. However there was not much of difference in the size of follicles or the endometrial response (Table II to V).

Discussion

A limited number of factors predict ovarian responsiveness and occurrence of pregnancy. Ovarian volume has been used as one of the indicators of ovarian reserve and predictors of ovarian response. In our study we found that the mean ovarian volume was decreasing

Table I The Relationship of Ovarian Volume to Maternal Age (n=75)

Age	No. of Subjects	Mean Volume of Smaller Ovary (cm³)	Mean Total Ovarian Volume (cm³)
< 30	45	3.9 ± 2.6	10.1 ± 5.9
31-35	23	3.9 ± 4.7	10.2 ± 10.2
36-40	7	2.7 ± 0.80	8.3 ± 3.0
p value		0.67	0.82

Table II Ovarian Volumes and the Ovarian Response (n=75)

Ovarian Volume cm³	No. of Subjects	No. of* Follicles	Size of* Follicles	Endometrial* Response mm
Vol of Smaller Ovary				
< 3	35	3.2 ± 1.9	21.6 ± 5.8	9.3 ± 2.5
3-9	36	4.1 ± 2.0	21.5 ± 6.6	9.2 ± 2.2
> 9	4	4.0 ± 1.4	18.5 ± 9.3	6.0 ± 1.8
p value		0.19	0.64	0.03
Total Ovarian Vol				
< 8.6	40	3.4 ± 2.0	21.1 ± 5.9	9.5 ± 2.4
8.6-22.2	31	3.9 ± 1.9	22.0 ± 6.5	8.9 ± 2.2
> 22.2	4	4.8 ± 2.5	19.2 ± 9.7	6.0 ± 1.8
p value		0.32	0.66	0.02

* = Values are Mean ± SD

Table III The Ovarian Volumes and the Ovarian Response (size of follicles) n=75

Ovarian Volume cm^3	No. of Subject	Ovarian Response Size of follicles – mm > 14	15-18	> 18	p value
Volume of Smaller Ovary					
< 3	35 (46.7%)	5 (14.3%)	3 (8.6%)	27 (77.1%)	0.77
3-9	36 (48%)	5 (13.9%)	3 (8.3%)	28 (77.8%)	
> 9	4 (5.3%)	1 (25%)	1 (25%)	2 (50%)	
Total	75(100%)	11 (14.7%)	7 (9.3%)	57 (76%)	
Total Ovarian Volume					
< 8.6	40 (53.3%)	7 (17.5%)	2 (5%)	31 (77.5%)	0.44
8.6-22.2	31 (41.3%)	3 (9.7%)	4 (12.9%)	24 (77.4%)	
> 22.2	4 (5.3%)	1 (25%)	1 (25%)	2 (50%)	
Total	75(100%)	11 (14.7%)	7 (9.3%)	57 (76%)	

Table IV The Ovarian volumes and the Ovarian response (Number of follicles) n=75

Ovarian Volume cm^3	No. of Subjects	Ovarian Response No. of follicles – mm < 3	>3 - <8	p value
Volume of Smaller Ovary				
< 3	35 (46.7%)	21 (60%)	14 (40%)	0.13
3-9	36 (48%)	14 (38.9%)	22 (61.1%)	
> 9	4 (5.3%)	1 (25%)	3 (75%)	
Total	75 (100%)	36 (48%)	39 (52%)	
Total Ovarian Volume				
< 8.6	40 (53.3%)	22 (55%)	18 (45%)	0.35
8.6-22.2	31 (41.3%)	13 (41.9%)	18 (58.1%)	
> 22.2	4 (5.3%)	1 (25%)	3 (75%)	
Total	75 (100%)	36 (48%)	39 (52%)	

Table V: The Ovarian Volumes and the Endometrial Response n=75

Ovarian Volume cm^3	No. of Subjects	Endometrial Response Poor < 8mm	Good > 8mm	p value
Volume of Smaller Ovary				
< 3	35 (46.7%)	9 (25.7%)	26 (74.3%)	0.01
3-9	36 (48%)	5 (13.9%)	31 (86.1%)	
> 9	4 (5.3%)	3 (75%)	1 (25%)	
Total	75(100%)	17 (22.7%)	58 (77.3%)	
Total Ovarian Volume				
< 8.6	40 (53.3%)	8 (20%)	32 (80%)	0.03
8.6-22.2	31 (41.3%)	6 (19.4%)	25 (80.6%)	
> 22.2	4 (5.3%)	3 (75%)	1 (25%)	
Total	75(100%)	17 (22.7%)	58 (77.3%)	

as the maternal age was increasing. Andolf et al (1997) had measured ovarian volume by ultrasound in the age group of 40-70 years and have found that the ovarian size decreases with age in all women. Santiago and Jairo (1989) have studied 512 patients who underwent oocyte retrievals for in vitro fertilization and concluded that women's age had a negative effect on (IVF) success that is more pronounced after the age of 36. Syrop et al (1995) studied 188 women initiating their first cycle of assisted reproduction. In this study ovarian volume was correlated poorly with age (r=0.073) and did not change significantly with age in their patient population. Total ovarian volume was a significant variable beyond age in predicting cycle cancellation, peak E2 concentration, number of oocytes retrieved and number of embryos resulting from a cycle. However, it was not predictive of clinical pregnancy rate (PR). Volume of the smaller ovary was a significant predictor beyond age in predicting peak E2 concentration, number of oocytes retrieved, number of embryos from a cycle and clinical PR.

Mensah et al (1996) have proven that three-dimensional ovarian volume measurement were not significantly different from ovarian volume calculated from 3 dimension. So in our study we calculated the ovarian volume by measuring the 3 diameters and using the formula of volume of the Ellipsiod = D1 x D2 x D3 x 0.523. Higgins et al (1990) have proved that inter observer variation in ovarian volume measurements is extremely low as determined by TVS. So in any infertility workup the basal ovarian volume can be done by anyone. Wittmaack et al (1994) have conducted that follicular size is a useful indicator of oocyte recovery and fertilization for optimal results volume of >1 ml which corresponds to follicle diameter of > 12mm and not larger than 7ml (24 mm). For during hCG administration the number of adequate size follicles is more important than size of leading follicle.

Amir et al (1997) have tested the hypothesis that small ovaries measured on transvaginal sonography are associated with a poor response to ovulation induction by human menopausal gonadotropins for IVF. The patients were divided into 2 categories, ovarian volume less than < 3 cm³ and > 5cm³. They found that there was strong association between ovarian volume and ovarian reserve. Small ovaries were associated with poor response to hMG and a very high cancellation rate. The smaller ovaries needed higher dose of hMG to get a good response to ovulation induction.

In the present study it was found that when the volumes of smaller ovaries and total ovarian volume increased there was increase in the mean number of follicles.

The above discussion would lead to the conclusion that smaller the ovarian volume, poorer would be the response to ovulation induction. Hence we would recommend measurement of basal ovarian volume prior to ovulation induction and if the mean volume of smaller ovary was found less than 3 cm³ one could step up ovulation induction by using human menopausal gonadotrophins along with clomiphene citrate for getting better ovarian response.

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