

Sonographic Quantification of Ovarian Volumes in an adult Nigeria population

Mr. Eze Joseph MSc, Mr. Ugwu Anthony Chukwuka MSc and Dr. Nzotta Christian PhD

Department of Medical Radiography and Radiological Science, Faculty of Health Science and Technology, Nnamdi Azikiwe University, Anambra State, Nigeria

(Received 29 February 2008 and accepted 30 April 2008)

ABSTRACT: This study was conducted to establish the normal values of ovarian volumes in this locality. A convenience sample of 141 apparently and gynecologically healthy and non pregnant females was studied using transabdominal sonography. The length, width and anteroposterior dimensions of both the right and left ovaries were measured. Volumes of the ovaries were determined using the prolate ellipsoid formula. The mean ovarian volumes were found to be a 9.5cm^3 and $10.\text{cm}^3$ for the right and left ovaries respectively. A mean ovarian volume (Right and left) was 9.9cm^3 . A mean (right and left) range of 5.3cm^3 to 13.9cm^3 was also established. Significant correlations were noted between ovarian volumes and age ($r=0.93$, $p<0.05$) and between ovarian volumes and body weight ($r=0.73$, $p<0.05$). This study has established a nomogram for ovarian sizes in this locality which would offer a valid method of evaluating ovarian volumes in clinical practice.

KEYWORDS: Ovarian volume; Sonography; Nigeria

INTRODUCTION

Ultrasonography has proven clinically useful to characterize adnexal masses, evaluate abnormal bleeding, and assess infertility, monitor follicle growth, and aid in the localization of transvaginal needle aspiration and biopsy. Both transabdominal and transvaginal sonography are important in these evaluations. Transabdominal imaging furnishes a global survey of anatomy, whereas transvaginal imaging provides improved texture determination and characterization of internal architecture of the ovary, vascular anatomy and adnexal area¹.

The ovaries are typically described as oval structures measuring some $4\times 2\times 1$ cm. They vary in size and morphology with both the age and physiological status of the female.² Ovarian volume is relatively constant from birth to five years but over five years, there is an age related increase in volume.³ At puberty, the ovary

enlarges rapidly under hormonal stimulation.⁴ Post-pubertal ovarian size is approximately 2 cm long, 2cm wide and 3 to 4cm thick. The normal ovary is ellipsoid in shape and may vary in configuration. In practice, ovarian shapes vary widely from spherical to linear in addition to the striking functional alterations associated with ovulation⁵.

Ovarian size is better evaluated as volume because of its variation in shape and configuration.² Its volume may be estimated by using the approximate formula for an ellipsoid: length \times breath \times width \times 0.523. The normal volume ranges up to 12cm^3 at or soon after puberty and then progressively decreases to about 2.5cm^3 at menopause and 0.5cm^3 by 10 years post menopause. No lower limit has been offered in literature but failure to identify the ovary does not necessarily imply agenesis or dysgenesis.^{6,7}

(Corresponding Author: Mr. Ugwu Anthony Chukwuka, Department of Medical Radiography, Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria, Email: tonybullng@yahoo.ca)

The importance of ovarian size and morphology as critical diagnostic parameters in certain disease conditions affecting the ovary is not controversial. Literature is replete with the diagnostic relevance of ovarian menstrual disorders. Ovarian torsion produces an enlarged edematous ovary, usually greater than 4cm in diameter.⁸ The sizes of ovaries could also be used as grading tools in ovarian hyperstimulation syndrome (OHSS) and to assess the existence of polycystic ovary syndrome (PCOS). The consistent evidence that ovarian size varies in certain disorders of the ovary necessitated the present study in this environment as published data have so far been based on the Caucasian population. The aim of this study was to establish a nomogram for ovarian volumes in this locality.

MATERIAL AND METHOD

This study includes a convenience sample of 141 non pregnant females from the age range of 16 to 45 years. The selection was based on clinical history, sonographic findings and age. All cases with clinical indications of ovarian pathology and menstrual disorders were excluded from the study. Those without indication of ovarian disorders or pelvic abnormalities but who in the course of scanning revealed pathology were also excluded based on the sonographic findings. All were apparently gynecologically healthy and were not taking oral contraceptives or any other drug known to influence the ovarian size.

The study was carried out at the University of Nigeria Teaching Hospital (UNTH), Enugu, which has the south east Nigeria (Ibo tribe) as its major catchment's area. The equipment used for this study was a simens sonoline – 2 (SL -2) machine with a sector transducer of 3.5MHZ frequency for transabdominal sonography.

The ultrasound scans were performed using the full bladder technique. The subjects were scanned in the supine position in both longitudinal and transverse planes. The pelvic vasculature was the useful landmark in identifying the site of the ovary. The subjects were scanned and the date of the menstrual cycles noted. Measurements of the greatest length, transverse dimension (width) and antero-

posterior (AP) thickness were obtained. The greatest length and the AP measurements were obtained in the longitudinal plane while the width was obtained in the transverse plane. The weight and age of all the subjects were recorded. Ovaries were categorized as right and left and mean values obtained. Mean value of all the measured ovaries (right and left) was also obtained. T-test was used to assess the mean difference between the right and left ovaries while Pearson's correlation was used to assess the relationship between age, body weight and mean (right and left) ovarian volume. Summary statistics and inferential statistics were generated using SPSS 11.0 software. $P < 0.05$ was considered statistically significant.

RESULTS

The mean age of the sample population studies was 27.8 years. The mean ovarian volume was 9.9cm^3 with mean values of 9.5cm^3 and 10.0cm^3 for right and left ovaries respectively. Mean ovarian volume (right and left) ranged from 5.3cm^3 to 13.9cm^3 . No statistically significant difference was noted in the mean volumes of left and right ovaries. A strong and significant correlation ($r=0.73$, $p < 0.05$) was established between body weight and mean (right and left) ovarian volumes in this population. A positive correlation between mean ovarian volume and age was noted in the study population ($r = 0.93$, $P < 0.05$).

Table 1 shows mean (standard deviation) of right (R) and left (L) ovarian volumes by age group.

Table 2 shows body weight and mean ovarian volume distribution. A positive relationship between ovarian volume and body weight is shown by this table.

Table 3 shows ovarian volume distribution at different periods of the menstrual cycle. It reveals that the lowest values were recorded during the menstrual phase and the late secretory phase. The highest value was however observed during the ovulation phase. A weak correlation ($r=0.31$) occurred as the volume is seen to rise and decrease with the cycle.

Figure 1 is a graphical representation of ovarian volume according to days of the menstrual cycle.

Table 1: Mean (Standard deviation) of right and left ovarian volume by age group

Age (Years)	Right (cm ³)	Left (cm ³)
16-18	5.3 (1.1)	6.6 (1.5)
19-21	5.3 (1.1)	6.6 (1.5)
22-24	6.7 (1.8)	8.0 (1.9)
25-27	7.7 (2.9)	9.7 (3.4)
28-30	9.2 (4.0)	10.1 (2.5)
31-33	10.3 (3.0)	9.5 (2.8)
34-36	11.5 (2.8)	9.4 (3.1)
37-39	10.5 (2.8)	12.4 (3.8)
40-42	12.9 (3.5)	10.9 (1.5)
43-45	12.6 (0.6)	12.4 (0.8)

Table 2: Body weight and mean ovarian volume distribution

Weight (Kg)	Right (cm ³)	Left (cm ³)
50-52	9	7.0
53-55	17	9.5
56-58	33	8.4
59-61	30	8.0
62-64	20	10.1
65-67	16	11.1
68-70	14	10.2
71-73	1	9.4
74-76	1	13.9

Table 3: Mean ovarian volume distribution at different menstrual periods of the menstrual

Parameters	Number	Days	Volume (cm ³)
Menstrual Phase	24	1-5	4.6
Early proliferative Phase	25	6-10	7.7
Late proliferative Phase	23	11-13	9.7
Ovulation Phase	24	14	11.7
Early Secretory Phase	22	15-22	10.0
Late Secretory Phase	23	23-28	6.4

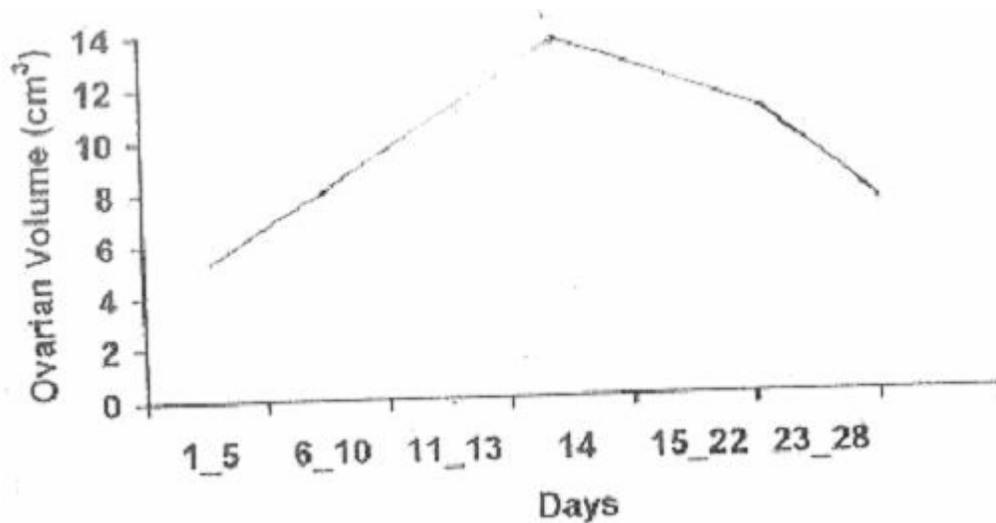


Figure 1: Graphical Representation of Ovarian Volume According to days of menstrual cycle

DISCUSSION

The result of the present study shows that the mean ovarian volume in this locality is 9.9 cm³. This value is in agreement with the study by **Cohen et al**⁹ which reported a mean ovarian volume of 9.8 cm³. This appears to suggest that geographical and racial influences may not have significant impacts on ovarian volumes. The normal range of ovarian volume in this locality,

from this study was 5.3cm³ to 13.9 cm³. This agrees with a previous study by **van-Nagell et al**¹⁰ which recommended that ovarian volume greater than or equal to 20cm³ should be considered abnormal. A positive and strong correlation (r = 0.93, p< 0.05) between ovarian volume and age (**Table 1**) in this study is similar to a previous studies.^{11,12}

In this study, the ovarian volume was noted to increase with body weight. This could possibly be due to increase in the layers of fat around the meso-ovarian with increasing weight. The ovarian volume invariably measured could be a composite mass of the true ovary and the surrounding fat. From the present study, an interesting but expected pattern of change in ovarian volumes with the menstrual cycle periods was observed. The ovarian volume increased steadily from day one to day fourteen (**figure 1**). After day fourteen, the volume decreases. This result is congruent with the well known changes in the ovary during a 28 day menstrual cycle. This conformity authenticates the author's claim that the sample size was made up of gynecologically normal subjects.

Abdominal ultrasound is much less sensitive than trans-vaginal scans.¹³ Trans-vaginal sonography (TVS) provides improved texture determination and characterization of the architecture of the ovary. Further studies in this locality using TVS is hence, recommended.

In conclusion, we have presented a novel data, showing normal range of values of ovarian volumes in this locality. This could be used in the assessment of pathological conditions which affect ovarian sizes.

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