Comparative evaluation of ovarian volume in women of reproductive and post menopausal age groups using transvaginal ultrasound scan in Jos, North-Central, Nigeria

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Abstract

The purpose of this study was to comparatively evaluate the ovarian volume in women of reproductive and post menopausal age groups using transvaginal ultrasound scan in normal Nigerian adults at the Jos University Teaching Hospital, with the aim of assessing the relationship between ovarian volume and age, body mass index (BMI) and parity.

A hospital-based cross-sectional descriptive study that involved 400 selected clinically and sonographically healthy women. Ultrasound scans were performed with a LOGIC 5 machine fitted with a 7.5MHz endovaginal transducer, The maximum longitudinal (D1), antero-posterior (D2) and transverse (D3) diameters of the right and left ovaries were measured in millimeters (mm). Ovarian volume was calculated using the Prollate ellipse formula

The mean ovarian volume for women in reproductive age was 7.7 ± 2.1cm^3 while that of postmenopausal women was 3.4 ± 2.2 cm^3. The mean right ovarian volume for the reproductive and postmenopausal women were 7.4 ± 2.0 cm^3 and 3.4 ± 2.2 cm^3 respectively. The mean left ovarian volume for the reproductive and postmenopausal women were 7.8 ± 2.0 cm^3 and 3.5 ± 2.4 cm^3 respectively.

Parity showed a statistically significant negative correlation with ovarian volume in both reproductive age and postmenopausal women (P = 0.00), while BMI showed a negative correlation which is not statistically significant in both the reproductive age (p= 0.22) and postmenopausal women (p=0.32).

The ovarian volume of the postmenopausal women was statistically smaller when compared with that of women in their reproductive age. The study also demonstrated a decreasing ovarian volume with parity and BMI.

Keywords:

Transvaginal sonography, reproductive - postmenopause, ovarian volume.

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Introduction

The ovaries are part of the female reproductive system. They are paired pelvic organs located inferior to the infundibulum of the fallopian tubes, lateral to the uterus, medial to the pelvic wall and superior to the iliac vessels. They have dual functions which are production of ova that is very important in reproduction and production of hormones principally estrogens and progesterones. The estrogens mainly promote proliferation and growth of specific cells in the body that are responsible for the development of most secondary sexual characteristics in the female. The progesterones function mainly to prepare the uterus for pregnancy and the breasts for lactation. The function of the ovaries is controlled by gonadotrophic hormones follicle stimulating hormone (FSH) and leitenising hormone (LH) secreted by anterior pituitary gland.[1]

Ultrasonography is the most common and most useful method to image the ovary. It is cheap, non-

invasive, easy to perform and readily available. Other imaging modality is Magnetic Resonance Imaging (MRI) which gives information on size, shape, and site.[3] Apart from being more expensive and not readily available in this environment, MRI takes relatively longer time to acquire images than ultrasonography. Therefore giving sonography an edge in imaging the pelvis.[3] Transvaginal ultrasound is fundamental to any screening program as a single modality or in conjunction to serum tumor markers for detection of ovarian cancer.[4,5] Furthermore, the qualities of the ultrasound images are comparable to that of MRI. Little attention has been paid on the influence of menopausal transition on ovarian volume. During reproductive and postmenopausal years, important hormonal changes occur which could be associated with ovarian morphology at least during the transition from reproductive to menopause. Therefore, the aim of this study is to carry out a sonographic investigation to assess the relationship between ovarian volume and age, body mass index and parity in reproductive and postmenopausal women.

Methods

The research was a hospital-based cross-sectional descriptive study that was carried out over the period of 16 months (from January 2012 to May 2013) at the Radiology Department of Jos University Teaching Hospital (JUTH), a tertiary health institution situated in the central part of Jos, Plateau state of Nigeria. 400 women who met the criteria were consecutively recruited. Inclusion criteria included all non pregnant females who clinically and sonographically had healthy pelvic organs referred for abdomino-pelvic ultrasound scan. Patients on contraceptives or ovulation induction drugs, patients who have had ovarian surgery or who had recent pelvic inflammatory disease were excluded. Also excluded were virgins, females who were unwilling to participate and those who were menstruating.

A questionnaire was used to collect data about demographic, gynecological history, climacteric characteristics and contraceptive use. Weight and height of each women were measured without shoes or heavy clothes. The body mass index (BMI) in Kilogram/meter square (Kg/m^2) [6] was then calculated from the weight and height[2].

Transvaginal ultrasound was performed with a LOGIC 5 ultrasound machine a product of General Electric (GE) fitted with a 7.5MHz transvaginal transducer. With an empty bladder, the client lay in a supine position. The transducer was gently advanced into the vagina angling laterally until the ovary was seen. The length was obtained on the longitudinal plane, while the width and the Antero-Posterior (AP) dimensions were taken on the transverse plane using electronic calipers (Figure 1). The ovarian volume was then automatically calculated by the machine and displayed on the monitor. The right and left ovarian volume was measured and recorded for each participant.

The study protocol was approved by the local Ethics Committee, and informed consent was obtained from every participant.

Statistical analysis:

The data obtained were entered into an excel sheet and analyzed using Epi Info version 3.5.1 CDC Atlanta, USA, 2008. Age group in years was broken down into eight groups: (≤19), (20-29), (30-39), (40-49), (50-59), (60-69), (70-79) and (80-89). BMI in Kg/m^2 was classified into four; underweight (<18.5), normal (18.5-24.9), overweight (≥25.0-29.9) and obese (≥30.0). Parity was grouped into three; Nulliparous, multiparous and grand multiparous. 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, BMI and parity. Analysis of variance (ANOVA) was used to compare mean volumes according to age groups, parity and BMI. The results describe independent associations between age, BMI, parity and ovarian volume. P value of <0.05 was considered statistically significant. The results were presented in the form of tables and charts.

Results

A total of 400 women were studied comprising of 242 (60%) and 158 (40%) reproductive and postmenopausal age group respectively. (Figure 2).

Figure 1: Transvaginal sonogram in longitudinal plane (A) and transverse plane (B), showing the length, height and the width of the ovary.

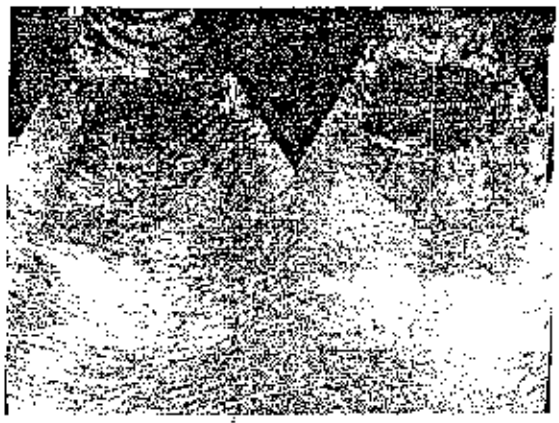

Figure 2: Pie chart showing distribution pattern of the study population for women of reproductive age and postmenopausal age respectively.

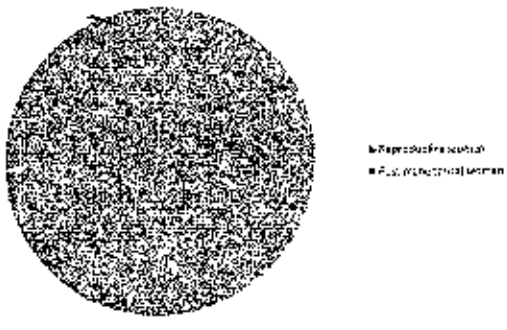

Table 1 demonstrates the means of their demographic characteristic of the study population. The total mean age for the participants was 32.8 ± 11.2 years with a mean age for women in their reproductive age of 30.2 ± 7.6 years (range of 15-55 years) and for postmenopausal women of 59.0 ± 9.4 years (range 45-80 years) (Table I). The mean age for the postmenopausal women was higher than the reproductive age group.

The total mean body mass index (BMI) was 25.9 ± 4.8 (range 14.5-40.7) whereas the mean BMI for women in reproductive and postmenopausal age were 26.1 ± 4.7 and 25.6 ± 5.0 respectively (Table 1). The mean BMI was greater in women of reproductive age group than postmenopausal women.

The total mean parity was 2.9 ± 2.8 (range 0-11) and the mean parity for women in reproductive age and postmenopausal age were 1.9 ± 2.2 and 2.9 ± 2.8 (Table I).

Table 1: *Demographic characteristics of study population*

Parameter	Subjects					
	Reproductive Age Women (n=242) Mean±SD	Range	Post menopausal Women (n=158) Mean±SD	Range	Total (N=400) Mean±SD	Range
Age(yrs)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BMI	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Parity	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 2: *Means and SD of ovarian volume (both right and left sides) for reproductive age and post menopausal women*

Subject	Mean±S.D (cm³)	Range (cm³)	P
Reproductive age women	[illegible]	[illegible]	[illegible]
Postmenopausal women	[illegible]	[illegible]	
Total	[illegible]	[illegible]	

The mean parity for women in their postmenopausal age was greater than that of women in their reproductive age group.

The total mean ovarian volume of the study population (Table 2) was 7.3 ± 2.5 cm³ (range 0.7-15.9 cm³). The mean ovarian volume for the reproductive age women was 7.7 ± 2.1 cm³ (range 4.2-15.9 cm³), while that for the postmenopausal women was 3.4 ± 2.2 cm³ (range 0.7-11.0 cm³). The mean ovarian volume was greater in women of reproductive age than postmenopausal women. This difference was statistically significant (p=0.00).

The mean right ovarian volume (ROV) for the

reproductive age and postmenopausal women was 7.4 ± 2.0 cm³ and 3.4 ±2.2 cm³ respectively, while the mean left ovarian volume (LOV) for the reproductive age and postmenopausal women was 7.8 ± 2.0 cm³ and 3.5 + 2.4 cm³.

The mean LOV was greater than the mean ROV in both women of reproductive and postmenopausal age groups. The difference was statistically significant in women of reproductive age (P= 0.00), however, for the postmenopausal women, the difference was not statistically significant (p= 0.54) as shown in Table 3.

Table 3: Means and SD of ovarian volume in cm3 of reproductive age and post menopausal women

Subject	ROV		LOV		
	Mean±SD	Range	Mean±SD	Range	P
Reproductive age women	7.4±2.01	2.31-19.[illegible]	7.80±1.9[illegible]	[illegible]-15.33	0.003
Post menopausal women	[illegible]	[illegible]-11.70	[illegible]	1.04-10.56	0.541
Total	7.34±2.51	0.7[illegible]-11.60	[illegible]	1.06-15.58	[illegible]

The study showed that age has statistical significant and independent strong negative correlation with ovarian volume in the reproductive age ® -0.305,p= 0.00) and postmenopausal women (r= -0.489, p= 0.00). Similarly, parity was negatively correlated with ovarian volume in both the reproductive (r= -0.252, p= 0.00) and postmenopausal women (r= -0.326, p=0.00).

Table 4: Correlation of ovarian volume with age, parity and BMI in reproductive age and postmenopausal women

	Reproductive age women		Postmenopausal Women	
Parameters	Coefficient (r)	P value	Coefficient (r)	P value
Age	-0.31	0.00	[illegible]	0.00
Parity	[illegible]	0.00	[illegible]	0.00
BMI	-0.10	0.22	-0.02	0.32

The analysis also aimed at ruling out the influence of obesity as a possible confounding factor in both reproductive and postmenopausal women; therefore, BMI was used as an independent variable which showed a weak negative correlation with ovarian volume which was not statistically significant ® -0.095, p=0.22) and (r= -0.021, p=0.32) for the reproductive and postmenopausal women respectively (Table 4).

Discussion

Transvaginal ultrasonographic study is extensively used for assessment of the female pelvis in all age groups including reproductive and postmenopausal women. This technique seems more promising for studying the ovaries than transabdominal technique, due to the fact that the image resolution is increased and morphologic details are clearly seen because the transducer is in close contact with the pelvic viscera.[7,8]

Our result showed the mean ovarian volume of the study population to be 7.3 ± 2.5 cm³. This value is similar to that reported by Oppermann *et al.*[9] Our value is lower than the values recorded in south east and south south Nigeria by Eze *et al*[10] and Nwankwo *et al*[11] respectively and also in North America by Cohen *et al*.[12] Our value is however, higher than the values recorded by Eddy *et al*[13] (5.2cm³) and Pavlik *et al*[14] (4.9cm³) from other parts of the world. This shows that there is geographical and racial difference in values of ovarian volume. This assertion is supported by Pongsatha *et al*[15] who showed that there is a racial difference between ovarian volume of Thai women and western women.

A statistically significant difference (p=0.01) was noted in the mean volumes of the left (7.8±2.0 cm³) and right (7.4±2.0cm³) in women of reproductive age. Similar was also reported by Nwankwo *et al*[11]. The significant difference observed might be due to the fact that more dominant follicles were present in the left ovaries than the right ovaries. While in the postmenopausal women, the difference between the mean volumes of the left and right ovaries was not statistically significant (p=0.54). This finding is similar to that reported by other studies.[15,16-18] This implies that there is significant decrease or absent ovarian folliculogenesis in the postmenopausal age group,[16] hence, the insignificant different

between the left and the right mean ovarian volume.

As it was described by other studies[8,10,19] and also in the current study, ovarian volume gradually increases with age and reaches its peak in the second and third decades of life, it then declines with increase in age. This reduction in volume is said to be due to decrease in the number of follicles associated with menopausal transition,[14,17] changes in local blood supply, and ovarian aging[9] This negative significant correlation (p =0.00) between ovarian volume and age was noted in our study in both the reproductive and postmenopausal age groups. However, Christensen et al[9] and Merz et al[20] found no correlation between ovarian volume and age.

Similarly, our study has demonstrated a negative correlation between ovarian volume and parity which was statistically significant in both the reproductive (r= -0.252, p=0.00) and postmenopausal women (r= -0.326, p= 0.00). This could be due to the fact that with increasing parity, there is advancement in age which consequently led to a waning ovarian function.[21] This finding supports the study by Goswamy et al.[22] In contrast, Merz et al[20] reported that parity had no effect on ovarian volume.

There was decrease in ovarian volume with increase in body mass index (BMI) with a negative correlation which was not statistically significant in both the reproductive (r= -0.095, p=0.22) and postmenopausal women (r= -0.021, p= 0.32). This was at variance with studies done by other researchers,[9,12,19] who observed no significant correlation between ovarian volume and BMI. The negative correlation observed between ovarian volume and BMI in the present study could probably be due to the fact that most of the postmenopausal women involved in this study were either overweight or obese.

Conclusion

Our data indicate that age and parity exert influence on ovarian volume in both reproductive age and postmenopausal women. BMI on the other hand, has a negative significant correlation with ovarian volume in the cycling women , while this negative correlation is not significant in the postmenopausal women. According to our results, postmenopausal women have a smaller ovarian volume than cycling women. We suggest that the current standard measurements of ovarian volume by transvaginal ultrasound should be reevaluated for cycling women and to establish the changes that takes place at each decades of life and also to measure the ovarian volume at each phase of the menstrual cycle for every woman. Considering the population-based design of the present study, the results reported herein may be used as reference for ovarian volume in women in their reproductive and postmenopausal years.

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Table 3: Computed tomography findings against assaulting agents

	Soft tissue swelling	Skull fracture	Subdural hematoma	Subarachnoid hemorrhage	Intracerebral contusion	Intracerebral hematoma	Intraventricular hemorrhage	Cerebellar contusion	Intracranial foreign body	Extracranial foreign body	Aerocele	Midline shift	Scalp emphysema
Machine gunshot	+	+		+	+				+		+	+	+
Cane/local gunshot	+	+	+	+	+				+		+	+	+
Matchet	+	+	+	+	+	+	+	+	+		+	+	+
Club	+	+	+		+			+					
IED	+	+	+										
Knife	+								+	+	+		+

IED=Improvised explosive device

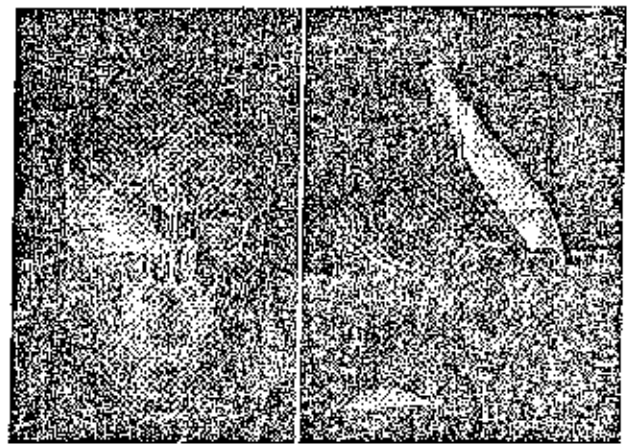

Figure 1: Scanograms of a patient assaulted with Jackknife

Subarachnoid and intra-ventricular hemorrhage were seen in 5 (11.6%) and 4 (9.3%) of the victims, respectively. They were associated with firearm injuries and are perhaps also an indicator of the severity of the force of impact on the cranium and its content.[10] Also associated with firearms are metallic artefacts, constituting intra-cranial foreign bodies and aeroceles following on the trajectory of the penetrating gun pellets or scattered within an area of brain contusion. These have been previously reported as frequent findings on CT following gunshot head injury.[6]

CT was not remarkable in six of the patients (13.9%). This finding was not unexpected in crises situation where there would be patients in whom it was pertinent to do a CT scan to exclude head injury especially in the event of the cost of acquiring one being already taken care of. These included victims with facial blood stains and/or lacerations or who were brought alongside other head injured patients. One victim had a jack knife impaled through the right temporal area with the cranial CT scan revealing a normal cranium and its contents [Figure 1].

Blunt attack of mild to moderate force to the head and face as with a club may also lead to diffuse axonal injury with the finding of an apparently normal CT scan. Repeat CT scan of the victims which may have revealed earlier missed diagnosis or later events and progression was not routinely done or followed up in this study. The outcome of events was however not within the objectives of this study.

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