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Original Article

Radiology Section

Sonographic Evaluation of Uterine Dimensions in Postpartum Women of Reproductive Age-Study from Enugu, Southeast Nigeria

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ABSTRACT

Introduction: Uterine involution, a physiological process in which the uterus reverts to prepregnant size, occurs during puerperium. The latter is a time of substantial maternal risk. Ultrasound is considered the most appropriate tool in monitoring the progression of uterine involution because it is cheap, convenient and repeatable with no radiation risk.

Aim: To sonographically evaluate the involution of the uterus and uterine cavity in postpartum women in Enugu, Nigeria.

Materials and Methods: This was a prospective longitudinal cohort study on 400 postpartum women at the University of Nigeria Teaching Hospital, Enugu, Nigeria. Transabdominal ultrasonography to measure uterine dimensions was done on day 1, day 3 and day 42 of puerperium using a 3.5-5 MHz curvilinear probe of a portable ALOKA ultrasound machine. Statistical analysis was done with the Statistical Package for Social Sciences (SPSS) software version 20.0. The uterine dimensions were expressed as mean±standard deviation and student's t-test analysis was used to compare the values for day 1, day 3 and day 42 of puerperium. Regression analysis was carried out to measure the relationship between uterine measurements on days 1, 3 and 42. A p-value of <0.05 was considered statistically significant.

Results: The mean longitudinal, anteroposterior and transverse diameters of the uterus at day 1 were 14.51 cm, 8.54 cm and 10.97 cm, respectively. The corresponding values for day 42 were 8.27 cm, 4.78 cm, and 6.22 cm. The uterine diameters decreased significantly as puerperium advanced (p<0.001). The mean uterine cavity diameters also decreased significantly as puerperium advanced (p<0.001). There was significant regression between longitudinal diameters of both uterus and uterine cavity on days 1 and 3 but not between days 3 and 42.

Conclusion: This study has established a normal range of diameters for the uterus and uterine cavity on day 1, day 3 and day 42 of puerperium. It can serve as reference data for further studies in the study area.

Keywords: Puerperium, Uterine involution, Uterus

INTRODUCTION

Puerperium is the period from the delivery of the placenta and time when most of the changes that have occurred during pregnancy in the uterus returns to its prepregnant state and it usually last for six weeks duration [1]. It is a time of substantial maternal risk. Uterine involution is a physiologic process by which the uterus returns to its normal prepregnant state by which time most of the changes of pregnancy, labour and delivery have resolved [1]. Maternal deaths commonly occur during and after delivery [2]. Globally more than 60% of maternal deaths occur in the postpartum period [3] and it is high in Nigeria and other developing countries [4,5].

The gradual decrease in the size of the uterus during involution results from a decrease in size and not due to a decrease in the number of uterine muscles. It was observed that size of the uterus decrease at the rate of 1.25 cm per 24 hours during the first 14 days of postpartum [6]. Facts on postpartum changes in the uterus have mostly been based on clinical examinations as well as on histological studies from the end of the 19th century and the early part of the 20th century when maternal death during the puerperium was common [7]. The involution of the uterus, a main characteristic of the normal puerperium was previously assessed by palpation of the fundal height, which can be imprecise in obese women and women with uterine myoma. This method has been linked with increased morbidity and mortality during puerperium [7]. Ultrasound has become the first imaging modality as well as the gold standard for evaluating normal puerperium because it is cheap, available, uses non-ionizing radiation and is a valuable tool especially in monitoring the progression of uterine involution and investigating the different causes of puerperal complications [8].

Progression of uterine involution is assessed sonographically by measurement of the longitudinal, anteroposterior and transverse diameters of the uterus. Though many studies have been done on the sonographic evaluation of uterine involution in the United States of America and England [9-11] but very few studies have been done in Nigeria [12]. The main aim of this study therefore was to sonographically evaluate uterine involution in postpartum women in Enugu, Southeast Nigeria.

MATERIALS AND METHODS

This was a prospective longitudinal study. The subjects were women who gave birth at the University of Nigeria Teaching Hospital, Ituku Ozalla, Enugu State, the foremost tertiary health institution in Southeast Nigeria, between November 2012 and May 2013. Ethical approval (NHREC/05/01/20088B-FWA00002458-IRB00002323) for the proposed study was obtained from the Health Research Ethics Committee of the University of Nigeria Teaching Hospital, Ituku Ozalla, Enugu State before the commencement of the study.

Sample size calculation: The minimum sample size was calculated using Cochrane's formula: $n=Z^2\ p\ (1-p)/d^2$

for a population greater than 10,000 at 95% confidence interval (z=1.96), 50% prevalence level (p), and absolute precision (d) of 5%. The calculated minimum sample size was approximated to 400 participants.

Inclusion and Exclusion criteria: All women who had uncomplicated singleton pregnancies that were carried to term with uneventful deliveries and puerperium were recruited for this study. Women with morbidities during pregnancy and delivery were excluded from the study. Women

with pre-pregnancy pathologies (leiomyoma uteri, adenomyosis, etc.), scars from surgeries (Caesarean section, myomectomy, etc.), and those that did not complete the study were excluded from the study. If any abnormality was noted the patient was referred for the appropriate management and excluded from the study.

Recruitment of Participants and Data Collection

Before enlistment into the study, informed consent was sought and obtained from each subject and the procedure was properly explained. The age, parity, breastfeeding pattern, type of delivery and past medical history was obtained by direct questioning and proper history taking.

Transabdominal sonography was carried out on each subject using a portable ALOKA ultrasound machine {made in Japan by ALOKA Ltd., model IPC-1530(u); SN model 7292} with a 3.5-5. MHz curvilinear electronic transducer. The ultrasound examinations were done on a postpartum day 1, day 3 and day 42. Day 1 and day 3 were chosen to assess uterine involution in the early puerperium. Day 42 was chosen for assessment of uterine involution at late puerperium and also because postpartum women come for their routine six weeks visit on that day which reduces the number to be lost to follow-up. The subjects were made to lie in a comfortable supine position and with the bladder moderately filled with urine which served as an effective acoustic window especially for day 42 examination. This helped to visualize the uterus and endometrium better as bowel loops containing gas were displaced upwards away from the pelvis. The subjects were usually asked to drink about 2.5 liters of potable water to get the bladder moderately filled.

Coupling inert gel was used to eliminate air between the probe surface and the skin. Gentle compression with the probe was used and the measurements were taken between uterine contractions especially on day 1 and day 3. On day 42 there are usually no contractions so the measurements were taken without emphasis on uterine contractions. The uterus and uterine cavity were assessed in longitudinal and transverse sections. In the sagittal scan, longitudinal diameters (the length) and anteroposterior diameters (thickness) of the uterus and uterine cavity were measured with the anteroposterior diameters perpendicular to the length. The longitudinal diameter (length) of the uterus was taken from the highest fundal point in the midline to the external os of the cervix. The anteroposterior diameter was measured from the anterior to the posterior wall and perpendicular to the length. The transverse diameter (width) of the uterus was the widest diameter from right to left in the midline on a transverse scan [10,12]. The uterine cavity (endometrium) was critically assessed to rule out retained products of conception.

STATISTICAL ANALYSIS

The analysis was carried out using the SPSS software version 20.0 for descriptive statistics, central tendencies and cross-tabulation result display. The uterine dimensions were expressed as mean±standard deviation and student's t-test analysis was used to compare the values for day 1, day 3 and day 42 of puerperium. Regression analysis was carried out to measure the relationship between uterine measurements on days 1, 3 and 42. A p-value of <0.05 was considered statistically significant.

RESULTS

The mean age was 31.1±4.78 years. The highest proportion of the subjects, 156 (39%) were in the 30-34 year age category. Majority of them were multiparous 253 (63.2%), gave birth by vaginal delivery; 234 (58.5%) and practiced exclusive breastfeeding; 316 (79%) [Table/Fig-1].

The mean diameter of the uterus (longitudinal, anteroposterior and transverse) on day 1, day 3 and day 42 of puerperium is shown in [Table/Fig-2]. All diameters reduced with increasing days of puerperium.

Socio-demographic characteristic	Frequency	Percent (%)
Age category (years)		
20-24	27	6.7
25-29	122	30.5
30-34	156	39
35-39	80	20
40-44	13	3.3
45 and above	2	0.5
Parity		
Primiparous	147	36.8
Multiparous	253	63.2
Mode of delivery		
Spontaneous vertex delivery (SVD)	234	58.5
Caesarean section (CS)	166	41.5
Breastfeeding practice		
Exclusive breastfeeding	316	79.0
Nonexclusive breastfeeding	84	21.0

[Table/Fig-1]: Socio-demographic characteristics of respondents. N=400

Uterine measurements (cm)	Day 1 Mean±SD (cm)	Day 3 Mean±SD (cm)	Day 42 Mean±SD (cm)
Longitudinal diameter	14.51±1.27	12.96±1.22	8.27±1.02
Anteroposterior diameter	8.54±1.46	7.68±1.38	4.78±0.92
Transverse diameter	10.97±1.46	10.37±1.40	6.22±1.23

[Table/Fig-2]: Mean uterine diameters (uterus) at different days of puerperium.

There was a reduction in all three uterine diameters with increasing days of puerperium and were significant. The most rapid rate of reduction of all diameters occurred between days 1 and 3. There was a marked reduction in the rate of involution between days 1-3 and days 3-42 across all three diameters (7.54, 5.81 and 2.83 for Longitudinal, Anteroposterior and Transverse diameters, respectively) [Table/Fig-3].

Uterine diameters	p-value	Average daily reduction in diameter (cm)	Factor change in reduction rate between days 1-3 and 3-42
Longitudinal diameter			
Day 1 versus Day 3	<0.001	0.760	7.54
Day 1 versus Day 42	<0.001	0.143	
Day 3 versus Day 42	<0.001	0.120	
Anteroposterior diameter			
Day 1 versus Day 3	<0.001	0.430	5.81
Day 1 versus Day 42	<0.001	0.092	
Day 3 versus Day 42	<0.001	0.074	
Transverse diameter			
Day 1 versus Day 3	<0.001	0.300	2.83
Day 1 versus Day 42	<0.001	0.116	
Day 3 versus Day 42	<0.001	0.106	

[Table/Fig-3]: T-test of mean diameters of the uterus at different days of puerperium.

The mean diameters of the uterine cavity (longitudinal, anteroposterior and transverse diameters) showed a reduction with increasing days of puerperium [Table/Fig-4].

The most rapid rate of reduction of all diameters occurred between days 1 and 3. There was a marked reduction in the rate of involution between days 1-3 and days 3-42 across all 3 diameters (7.54, 26.67 and 10.00 for Longitudinal, Anteroposterior and Transverse diameters, respectively) [Table/Fig-5].

As shown in [Table/Fig-6], measurements of all three dimensions (longitudinal, anteroposterior and transverse) on day 1 can be used to predict what these dimensions will be on day 3. In the same way,

anteroposterior dimensions on day 1 and day 3 were predictive of day 42 dimensions.

Similarly, day 1 measurements of the uterine cavity (longitudinal, anteroposterior and transverse) can be used to predict day 3 measurements. Also, the longitudinal diameter on day 1 was found to be a predictor of the day 42 diameter.

Uterine cavity measurements (cm)	Day 1 Mean±SD (cm)	Day 3 Mean±SD (cm)	Day 42 Mean±SD (cm)
Longitudinal diameter	7.14±1.27	6.10±1.55	3.4±0.93
Anteroposterior diameter	0.77±0.54	0.62±0.36	0.52±0.43
Transverse diameter	1.54±0.25	1.46±0.20	1.31±0.26

[Table/Fig-4]: Mean diameters of the uterine cavity at different days of the puerperium.

Uterine cavity diameters	p-value	Average daily reduction in diameter (cm)	Factor change in reduction rate between days 1-3 and 3-42
Longitudinal diameter			
Day 1 versus Day 3	<0.001	0.520	7.54
Day 1 versus Day 42	<0.001	0.091	
Day 3 versus Day 42	<0.001	0.069	
Anteroposterior diameter			
Day 1 versus Day 3	<0.001	0.080	26.67
Day 1 versus Day 42	<0.001	0.069	
Day 3 versus Day 42	<0.001	0.003	
Transverse diameter			
Day 1 versus Day 3	<0.001	0.040	10.00
Day 1 versus Day 42	<0.001	0.006	
Day 3 versus Day 42	<0.001	0.004	

[Table/Fig-5]: T-test of mean diameters of the uterine cavity at different days of the puerperium.

DISCUSSION

The most rapid involution of the uterus occurs within the first week of puerperium [13]. Regeneration of the endometrium is complete by the third week postpartum but regeneration of placental site is not complete until 5-6 weeks [12]. In this present study, the mean age was 31.1±4.78 years and the predominant age group was 30-34 years. This is comparable to the study by Olayemi O et al., on 300 postpartum women in the southwestern part of Nigeria [12] and is in keeping with other studies in different parts of the world [7,14].

The mean uterine longitudinal diameter on day one was 14.5±1.27 cm. Although it was lower than in some other studies [12,15,16], it is still within the normal expected value for uterine length postpartum which ranges from 14.5 to 25 cm [17]. Olayemi O et al., in South West Nigeria [12] reported a value of 17.1 cm on day 1 while Middleton WD et al., and Sokol ER et al., reported 19.9 cm and 16.1 cm, respectively [15,16]. These were carried out in the United States of America and the differences noted in these various studies could be due to racial and anthropometric variations between the study populations. In this study, all diameters of the uterus reduced significantly as puerperium progressed. This is in keeping with what is expected in uterine involution; as puerperium progresses, the uterus contracts and reduces in size until the 6th week when it returns to its prepregnant size. Several studies have shown that uterine diameters, regardless of the particular diameter studied, reduces as puerperium progresses [12,14-16,18,19]. Galli D et al., stated that the reduction in the diameters and volume of the uterus was more evident during the first four days [18]. As observed in this study, It has also been reported that the length and anteroposterior diameters reduce more quickly than the transverse diameter [1]. However, controversy still exists on which diameter is the best for assessing uterine involution [7,14,19].

Mulic-Lutvica A et al., reported that the anteroposterior diameter of the uterus diminished substantially and progressively from 92.0 mm on day 1 postpartum to 38.9 mm on day 56 [7]. Their findings were similar to the 93.0 mm (day 1 postpartum) and 38.6 mm (day 56) reported by Abdel-Nabi A et al., both authors also reported that the anteroposterior diameter of the uterine cavity showed a progressive reduction until day 56 [14]; reducing from 15.8 mm on day 1 to 4.0 mm on day 56. On the other hand, the anteroposterior diameter of the uterine cavity measured 5 cm from the fundus, however, showed an increase on days 7 and 14 postpartum. Uniquely, during the normal puerperium the position, shape and cavity of the uterus undergo some changes.

Parameter	Odds ratio	t value	p-value	Confidence intervals	
Uterine dimensions				Upper limit	Lower limit
Longitudinal diameter day 1 vs 3	0.618	16.706	0.001	0.545	0.690
Longitudinal diameter day 1 vs 42	0.013	-0.249	0.803	-0.116	0.090
Longitudinal diameter day 3 vs 42	0.089	1.622	0.106	-0.019	0.196
Anteroposterior diameter day 1 vs 3	0.552	14.203	0.001	0.475	0.628
Anteroposterior diameter day 1 vs 42	0.104	2.745	0.006	0.029	0.178
Anteroposterior diameter day 3 vs 42	0.045	1.131	0.001	0.033	0.123
Transverse diameter day 1 vs 3	0.257	5.575	0.001	0.166	0.347
Transverse diameter day 1 vs 42	0.065	1.475	0.141	0.022	0.197
Transverse diameter day 3 vs 42	0.027	-0.586	0.558	-0.117	0.063
Uterine cavity					
Longitudinal diameter day 1 vs 3	0.424	8.807	0.001	0.330	0.519
Longitudinal diameter day 1 vs 42	0.086	2.502	0.013	0.018	0.154
Longitudinal diameter day 3 vs 42	0.029	-0.875	0.282	-0.093	0.036
Anteroposterior diameter day 1 vs 3	0.319	4.271	0.001	0.172	0.465
Anteroposterior diameter day 1 vs 42	0.050	-1.222	0.223	-0.131	0.031
Anteroposterior diameter day 3 vs 42	0.098	-1.567	0.118	-0.220	0.025
Transverse diameter day 1 vs 3	0.142	4.402	0.001	0.079	0.205
Transverse diameter day 1 vs 42	0.027	0.514	0.608	-0.078	0.132
Transverse diameter day 3 vs 42	0.082	1.224	0.222	-0.050	0.213

[Table/Fig-6]: Regression analysis of uterine parameters on days 1,3 and 42.

All diameters of the uterine cavity reduced significantly with increasing days of puerperium. This was an expected finding and could be explained by the fact that the process of the uterus contracting during involution also leads to gradual expulsion of the uterine cavity contents. Although the mean uterine cavity anteroposterior diameter of 0.77 cm on day 1 was smaller than a number of other studies [7,12,14]. It is still within normal diameter for postpartum uterine cavity involution which is less than 2 cm. The differences in these various studies could be due to the difference in the racial and anthropometric variables of the population studied.

Klug PW was of the opinion that an exact involution of the length of the uterus can be made only by sonography [20]. Middleton WD et al., reported that at mean times of 1.4 days, 2.7 weeks and 6.7 weeks after delivery, the uterus decreased in length from a mean of 19.9+2.1 cm to 11.2+2.0 cm and then to 8.7+1.2 cm, respectively [15]. They also noted that the endometrial cavity was usually empty as at first

week of puerperium and also on day 28. However, haematometra is usually seen on day 7 and give rise to no clinical signs.

Belachew J et al., studied uterine involution with three dimensional ultrasound by measuring uterine body and cavity volumes [21]. They reported a marked reduction in the median uterine body volume from 756 cm^3 on day 1 to 68 cm^3 on day 56 and in the median cavity volume from 22 cm^3 on day 1 to an insignificant volume on day 56.

In this present study, there was a significant relationship between day 1 and day 3 longitudinal and anteroposterior diameters. This implies that day 3 longitudinal and anteroposterior diameters can be predicted using day 1 diameter. As for day 42, the diameter cannot be accurately predicted because of the regression between day 1 and day 42 was not significant. The linear regression in the transverse diameter showed no significant relationship between day 1 and days 3 and 42. The diameters for day 3 and day 42 cannot be accurately predicted using day 1 diameter. In this study, the linear regression between longitudinal uterine cavity diameters showed significant relationship between day 1 and day 3 and day 1 and day 42. Conversely, the linear regression between anteroposterior and transverse uterine cavity diameters also showed no significant relationships for both days 3 and 42. This implies that ultrasonography in these women on day 3 can be predicted if day 1 parameters are stated (longitudinal) whereas the anteroposterior and transverse diameters cannot be accurately predicted and so must be measured and not estimated.

Limitation(s)

This study was an institution based; the participants selected for the study may not be true representation of the actual population of Southeastern Nigeria.

CONCLUSION(S)

This study has established a normal range of the diameters of the uterus and the uterine cavity on days 1, 3 and 42 of puerperium and there is reduction in these diameters with increasing days of puerperium. The study has served as a baseline for future studies through the provision of reference data. A study to compare the use of 2 and 3-dimensional sonography for the evaluation of uterine involution in puerperium is also recommended to ascertain if there is any advantage of volumetric measurements over numeric measurements.

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