Prospective Estimation of Duration of Pregnancy in Women Attending Antenatal Care at the University of Nigeria Teaching Hospital, Enugu, Nigeria

T. C. Okeke[1*], J. O. Enwereji[1], H. U. Ezegwui[1], A. C. Adiuku-Brown[1], C. O. Adiri[1] and O. A. Okezie[1]

[1]*Department of Obstetrics and Gynaecology, University of Nigeria Teaching Hospital, (UNTH), Enugu, Nigeria.*

Authors' contributions

This work was carried out in collaboration between all authors. Authors TCO, JOE and ACAB designed the study, performed the data acquisition, data analysis, statistical analysis, wrote the protocol, wrote the first draft of the manuscript and manuscript review. Authors HUE, COA and OAO managed the analyses of the study, manuscript editing and review. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Background: Accurate estimation of gestational age is of paramount importance in obstetric care. The most commonly used principle for determining gestational age and duration of pregnancy is Naegele's rule, which is supplemented by ultrasound estimation of gestational age.
Aim: This study was to assess the accuracy of Naegele's rule in pregnancy and comparison with ultrasound biometry.
Study Design: Hospital based prospective study.
Place and Duration of Study: Department of Obstetrics and Gynaecology University of Nigeria Teaching Hospital (UNTH), Enugu, Nigeria: a 2-year study.
Methods: This was a prospective study of pregnant women selected at random with normal 28day cycle, who knew their last menstrual period (LMP) and were delivered in the labour ward of the UNTH Enugu, Nigeria between January 1, 2007 and December 31, 2008. The total number of respondents studied was 326 women. The respondents were

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Corresponding author: Email: tcokeke2014@yahoo.com;

divided into 2 groups: 163 for each group. Group A were those whose estimated date of delivery was based on Naegele's rule and group B were those whose expected date of delivery (EDD) was based on ultrasound (USS). Data was analyzed with SPSS Version 15.0 (SPSS Inc. Chicago, IL, USA), using Chi-square and T-test. The significant level was taken if $P < 0.05$ at 95% Confidence level.

Results: The mean age of the population was 29.8years. The mean duration of pregnancy for the two groups was 280 days. There was no statistical difference between the two groups in the age of the respondents p=0.832. There was no statistical difference also between the two groups in the parity of the respondents p=0.894.

The gestational age (GA) at delivery for DLMP was 280 days with (standard deviation [SD] 8.3 days) while the GA at delivery for DUSS was 280 days with SD 7.9 days.

Conclusion: The duration of 280days instead of 282days appears more applicable in our environment.

1. INTRODUCTION

It is generally accepted that safe obstetric care is largely dependent on the ability to rightly determine gestational age. Correct assessment of pregnancy duration and fetal growth is essential for optimal obstetric management [1]. Accurate estimation of gestational age early in pregnancy is paramount for obstetric care decisions and for determining fetal growth and other conditions that may necessitate timing the iatrogenic intervention or delivery[2]. This determines when interventions in problematic pregnancies can be instituted with avoidable iatrogenic prematurity or prolonged pregnancies. It will equally avoid unnecessary obstetric interventions at the time of delivery [1,2].

The length of pregnancies is generally calculated to be an average of 280 days according to the Naegele's rule [3] in a regular 28day cycle and where hormonal contraceptives were not used prior to the index pregnancy. It is however, known that most cycle lengths are not 28days and that adjustments need to be made depending on the exact duration of the menstrual cycle. Currently, obstetricians simply use a gestation calculator to calculate the expected date of delivery by adding 280 days to the first day of the last menstrual period (LMP) irrespective of the actual cycle length in individual patients[1]. Controversy remains about the measurement of choice and the optimal gestational age (GA) for assessment [4].

Current evidence suggests that ultrasound dating in the first trimester using measurements of the biparietal diameter (BPD), femoral length (FL) and crown-rump length (CRL) are more accurate in estimating the gestational age (GA) and estimated date of delivery (EDD) than those based on the first day of the last menstrual period [5-8]. This may be due to the fact that some women are not sure of their last menstrual periods. When discrepancies greater than 7 days arise between these two methods, the ultrasound estimates of GA are preferred over the former [6,7]. Many sonographers estimates a composite estimate of the gestational age using two or more of the parameters discussed earlier. It has been shown however, that this does not improve the accuracy in estimating the date of delivery over estimates based on a single parameter [6]. Both the last menstrual period method (Naegele's rule) and

ultrasound (USS) biometric estimation of the expected date of delivery assume duration of 280 days from the last menstrual period to the delivery date.

A large study from Sweden which included more than 400,000 singleton births showed that the mode and median of time span between the first day of a reliable LMP (D_{LMP}) and the day of spontaneous delivery was 282 days [9]. Since the duration of pregnancy is simply assumed to be 280 days by the Naegele's rule and ultrasound biometry, both methods may present a systematic error of 2 days in the current prediction of the date of delivery. The hypothesis of the present study was therefore that a change of the duration of pregnancy from 280 days to 282 days might improve the prediction of the date of delivery from the LMP and thereby optimize the determination of true pre and post term deliveries.

The aim of this study was to determine the proportion of women in our environment who deliver on their expected dates of delivery according to the Naegeles rule and to see if the recommendation of adjusting the duration of pregnancy from 280days to 282 days will improve our precision in determining the expected dates of delivery in our patients. Other objectives were to compare the accuracy of ultrasound estimation of expected dates of delivery with the estimates based on the last menstrual period.

2. METHODS

This prospective study was conducted between January 1, 2007 and December 31, 2008 and included 326 women. The women were randomly selected from UNTH antenatal clinic attendees at the UNTH Enugu, Nigeria by simple random sampling using table of random numbers. Following individual counseling of eligible participants, self administered, structured departmental protocol was distributed to the consenting selected women by trained medical interns. The total number of respondents studied was 326. The respondents were divided into 2 groups: 163 for each group. Group A were those whose estimated date of delivery was based on Naegele's rule and group B were those whose expected date of delivery (EDD) was based on ultrasound (USS).

The inclusion criteria were all the eligible participants who have a regular 28 day cycle, must know her LMP and an early ultrasound scan of the pregnancy must be available for the group B.

The exclusion criteria were multiple pregnancies, pre-term births, elective caesarean sections and emergency caesarean sections not preceded by established labour, induced pregnancies and those with unsure of dates. Ultrasound scans done at a gestational age > 12 weeks were excluded.

The gestational age (GA_{USS} and GA_{LMP}) was calculated by use of ultrasound (USS) and the date of the first day of the last menstrual period (LMP) according to Persson's equation and Naegele's rule (DLMP + 280), respectively. The D_{USS}, corresponding to the DLMP, was calculated by subtracting D_{USS} and D_{LMP}, respectively, from the date of spontaneous delivery. Expected dates of delivery (EDD) were calculated from 4 different models: D_{LMP} + 280, D_{USS} + 280, D_{LMP}+ 282, D_{USS} + 282. The error of each model (the discrepancy between EDD and date of spontaneous delivery was expected as absolute error. The mean absolute error of each model was compared with that of EDD predicted by D_{LMP} + 280 as the chosen standard. The date of menstrual period (DOP_{LMP}) as a measure of the duration of pregnancy was derived by calculating the duration between the actual date of spontaneous delivery and the first day of the last menstrual period.

2.1 Ultrasound Protocol

To assess gestational age by ultrasound, the trained research staff worked in pairs to obtain at least two images of the three biometric parameters (biparietal diameter, femur length, and abdominal circumference). An absolute value for each biometric measurement was recorded as was the corresponding gestational age generated by the SonoSite™ package software pre-programmed with specific nomograms for the biparietal diameter. The gestational age was averaged for each parameter. The means of each biometric parameter were then averaged to generate an overall gestational age by ultrasound.

2.2 Statistical Methods

Sample size was calculated according to this formula:

$$(U+V)^2 \, (\delta_1^{\,2} + \delta_0^{\,2}) / \, (\mu_1 - \mu_0)^2$$

Where U is a one sided percentage point of the normal distribution=100%-power, here power is 90%. Hence U=1.28.

V=Percentage point of the normal distribution corresponding to the (two-sided) significance level i.e. for 15%=1.96

δ_1 and δ_0 = Standard deviations= 14days and 12 days $\mu_1 - \mu_0$ = difference between the means= 280days and 282days.

Therefore, $(1.28+1.96)2(142+122)/(42-40)2 = (10.5)^2(196+144)/4=110+340/4=112.5$.

Minimum sample size acceptable=113 for each group.

Group A were those whose estimated date of delivery was based on Naegele's rule and group B were those whose expected date of delivery (EDD) was based on ultrasound (USS).

Statistical analysis of this study was both descriptive and inferential at 95% confidence level using Statistical Package for Social Sciences (SPSS) computer software version 15 (SPSS Inc. Chicago, IL,USA). Frequency tables were generated for relevant variables. Continous variables were analyzed using T-test while the discrete variables were analyzed using Chi-square test. P-value <0.05 was considered statistically significant.

3. RESULTS

The mean age of the respondent was 29.8 years. The mean duration of pregnancy for the two groups was 280 days. The age and parity distributions are shown in Tables 1 and 2. There was no statistical difference between the two groups in the age of the respondents p=0.832. There was also no statistical difference between the two groups in the parity of the respondents p=0.894.

The gestational age at delivery for DLMP was 280 days with (standard deviation [SD] 8.3 days) while the GA at delivery for DUSS was 280 days with SD 7.9 days as shown in Tables 3 and 4.

A comparison of the means of the duration of pregnancy from ultrasound scan and from the last menstrual period using the t-test had a p-value of 1.00 which was not statistically significant. Using the Chi-square test, there was no statistical difference between the 2 groups (t=0.00, p=1.00, 95% confidence interval, -1.77 to 1.77). This is shown in Table 5.

Table 1. Age distribution of Patients

Age Range	No of patients(DLMP)	No of patients(DUSS)
<20	18	20
21-30	50	48
31-40	75	70
>40	20	25
Total	**163**	**163**

X^2=0.874, P=0.832. There was no statistical difference between the two groups.

Table 2. Parity distribution of patients

Parity	No of patients(DLMP)	No of patients(DUSS)
P1-P4	83	87
P5-P8	72	69
>P8	8	7
Total	**163**	**163**

X^2=0.225, P=0.894. There was no statistical difference between the two groups.

Table 3. Gestational age at delivery and mean deviation of DUSS

GA at delivery	Frequency(X_1)	X_1^2
262	20	400
263	20	400
267	10	100
268	10	100
269	10	100
270	20	400
272	10	100
278	10	100
280	10	100
281	10	100
287	13	169
289	10	100
292	10	100

Total ΣX_1=163, ΣX_1^2=2269, Mean Deviation= 7.9, Gestational age at delivery= 280±7.9 days.

Table 4. Gestational age at delivery and mean deviation of DLMP

GA at delivery	Frequency(X_1)	X_1^2
266	10	100
267	11	121
268	15	225
270	7	49
272	9	81
274	5	64
276	8	25
278	8	64
280	20	400
282	30	900
285	10	100
287	13	169
288	9	81
290	5	25
292	3	9

Total ΣX_1=163, ΣX_1^2=2413 Mean Deviation=8.3 Mean gestational age = 280±8.3 days.

Table 5. Comparison of mean gestational age of DLMP and DUSS using student t-test

	Mean	Deviation	t	p-value	95% Confidence interval
DLMP	280	8.3	0.00	1.00	-1.77 to 1.77
DUSS	280	7.9			

There was no statistically significant difference between the 2 groups (p=1.00).

4. DISCUSSION

The duration of pregnancy among various populations, ethnic groups, and tribes are fraught with controversy [9,10]. Some authorities do not regard the mode alone to be sufficiently robust, and therefore prefer to use the median and mean for comparison [9,11]. In this study, the mean pregnancy duration in these respondents is 280 days which is comparable and very close to Naegele's traditional pregnancy duration commonly used in obstetric calculations [3]. This is higher than an earlier study done by Gini and Chilaka (273.8 days) in this centre about 22 years ago [12]. It is at the extreme of previous studies reported on black women [10,13,14]. It is also higher than the mean pregnancy duration reported among South Asian women [14,15]. It is about 2-3 days less than what has been documented in Caucasians [9,13,16]. The reasons for these variations are still poorly understood, but it is likely due to physiological reasons. However, different inclusion criteria of these women in these studies are paramount. It is also known that even with large sample sizes, these parameters change with time in a given population [9]. More work needs to be done, to ascertain the significance of this findings in our environment.

This study agrees with conclusions made from other studies on several points and for several reasons. Firstly, the most widely accepted reference for estimating the delivery date is the D_{BPD} + 280 [17-20] which is compatible with this study. From this study, DBPD is better than other parameters and was used because it is widely accepted. Thus, DBPD was

elected because it is widely used. Secondly, accuracy of pregnancy duration in any defined obstetric population is still based on DBPD+280. This study agrees with this concept. Thirdly, wide-spread availability of ultrasound assessment of fetal gestational age is common and cheap even in the developing countries like Nigeria. This is to support the use of DBPD+280 even in low resource setting.

We observed also that modal duration of pregnancy has slightly shorter standard deviation with DOP_{BPD} than DOP_{LMP}. This supports the finding that ultrasound estimation of gestational age tends to underestimate the gestational age [5,21,22]. Findings in other large studies [9,13,16] that suggest that $D_{LMP} + 282$ will give a more accurate prediction of delivery date were not supported by this study.

The limitation of this study was the restriction of sample population to the UNTH Enugu, Nigeria. The women who received care in other health institutions outside UNTH and those who received no care at all were not included in the study. Furthermore, the cross sectional nature of the study allowed for finding associations but did not allow for definitive conclusions on cause and effect. However, this is a stepping stone towards further research on pregnancy duration among Nigerian women.

5. CONCLUSION

The duration of 280 days instead of 282 days appears more applicable in our environment. A prospective study with early dating ultrasound scans done in all the subjects is suggested.

ETHICAL APPROVAL

Approval of the study was passed from the institutional review board of the UNTH, Enugu. (20: 12: 2006, item no 6).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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