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ROLE OF TRANSVAGINAL ULTRASOUND IN CERVICAL LENGTH CHANGES DURING NORMAL PREGNANCY

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ABSTRACT
The objectives of this study was to examine the relationship between cervical length and gestational age in normal pregnancy in nulliparous versus parous women. We studied a cross-sectional sample of 321 pregnant women, including 185 nulliparous and 136 multiparous women. The inclusion criteria were sonographic confirmation of gestational age within the 12th week, the absence of any risk factors for preterm birth, and uncomplicated pregnancy with expected delivery during the 38th to 42nd weeks. Cervical length was measured in a straight line if the cervix did not show any curvature; in the presence of cervical curvature, the measurement was broken down into 2 or more segments. It was found that there was a relationship between gestational age and cervical length, which could be described with a linear function (R = 0.92; $R2$ = 0.85; P < .001). Moreover, there was no statistically significant difference between multiparous and nulliparous women.

Conclusions: Our study shows that cervical length is comparable in nulliparous and multiparous women throughout pregnancy. In both groups, it actually shows a progressive, linear reduction between the 10th and 40th weeks. Reference ranges constructed for the whole gestational period might be more useful than a single cut off value for more efficient prevention and management of preterm birth.

Key words: Vaginal sonography; cervical length; normal pregnancy, PTB (Preterm Birth.

INTRODUCTION

Labor that begins between 20 and 37 weeks gestation is appropriately termed preterm. Some of the precipitating factors of preterm labor are changes in cervical status including dilatation and effacement. Until recently, a digital pelvic examination was considered the gold standard for evaluating cervical changes. Current research promotes the use of sonography for the prediction of preterm labor. It is essential for sonographers to become familiar with the various methods of cervical imaging including transabdominal, translabial, and transvaginal approaches. Each technique has its costs and benefits; however, a review of the current literature will show that the transvaginal method of cervical measurement is the most reliable. Preterm labor affects 5% to 10% of all pregnancies and is a major cause of perinatal morbidity and mortality[1]. Every year in the United States, more than 70% of fetal and neonatal deaths in babies without anomalies are caused by complications of preterm birth[2]. Newborns were once considered premature if they weighed less than 2500 g at birth; however, regardless of birth weight, preterm birth is the delivery of an infant before 37 gestational weeks[3]. The diagnosis of preterm labor is made when contractions and cervical shortening occur early in gestation. Several studies promote sonography as a means of identifying cervical shortening and thus predicting preterm labor[4,5]. Sonography is regarded as superior to the traditional method of digital evaluation of cervical effacement and dilatation. Assessing the cervix with sonography can take place using one of two approaches: transabdominal and transvaginal sonography. Depending on the clinical situation, one method may be preferred over another; therefore, it is important for sonographers to become familiar with each of the two techniques and their benefits and limitations.

The proportion of pregnant women at risk of PTB is about 6% in France and 8% to 9% in Italy[1]. In the United States, where the rate has been unchanged for the last 3 decades, the PTB rate is 10% to 11%.[2] Identification of risk factors is still critical to the management of PTB. In particular, assessment of cervical maturation by vaginal examination has always played a prominent role. However, after a broad review of reports 3–7 published so far on this subject, Schrevel et al have come to the conclusion that routine digital cervical examination is not justified for identification of women at risk of PTB or for its prevention[8]. However, because of great differences in the populations studied, in gestational age at the time of the sonographic scan, and in the cervical parameters themselves, it is not yet clear at which gestational period and with what measuring technique the cervical canal should be assessed by sonography for its assessment to be clinically helpful in identifying pregnant women at risk of PTB. The purpose of our study was to assess any changes in cervical length during physiologic pregnancy and to construct reference ranges that could be used at any gestational period for prompt identification of women with significant changes in cervical length.

MATERIAL AND METHOD

Of all patients who received a sonographic scan, 321 were included in the study: 185 nulliparous and 136 multiparous women between the 10th and 40th weeks of gestation. The inclusion criteria were sonographic confirmation of gestational age between the 9th and 12th weeks by crown-rump length measurement, absence of risk factors for PTB and uncomplicated pregnancy with expected delivery between the 38th and 42nd weeks.

From January 2008 to January 2009, all women attending the Alnoor Diagnostic Centre Lahore were offered a sonographic scan, which included examination of the fetus and the option of a transvaginal scan to measure cervical length. Informed consent was obtained from the patients. The women were asked to empty their bladder and transvaginal sonography using a phased RIC (5-9 MHz) probe with a 180° aperture angle (Voluson 730 Expert General Electrical) was carried out by a single experienced consultant. The intraobserver variance of cervical sonographic measurements was 2.9%. As suggested by Burger et al, 4 guidelines were followed to obtain reproducible cervical length measurements:

(1) The internal os was to be either flat or an isosceles triangle.
(2) The whole length of the cervical canal was to be observable (Fig. 1).
(3) A symmetric image of the external OS was to be obtainable.

These guidelines made it possible to improve the inter observer coefficient of variation from 7.1% to 3.3%[10]. In addition, when curvature of the cervix was present, the measurement was broken down into 2 or more segments, making it easier to correctly estimate the whole length of the cervical canal (Fig. 2). In all cases, the measurement was the mean of 3 different measurements taken in quick succession.

(4) The distance from the surface of the posterior lip to the cervical canal was to be equal to the distance from the anterior lip to the cervical canal[10].

STATISTICAL ANALYSIS

General statistical analysis, consisting of analysis of variance and *t* tests, and regression analysis were

Fig. 1: *TVS the whole length of the cervix (4 cm) measured in early pregnancy.*

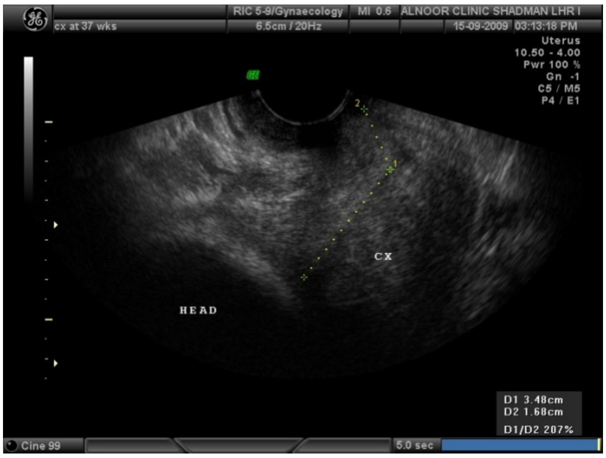

Fig. 2: *TVS – Two measurements of the entire cervical length (total 51 mm) are taken due to curved cervix.*

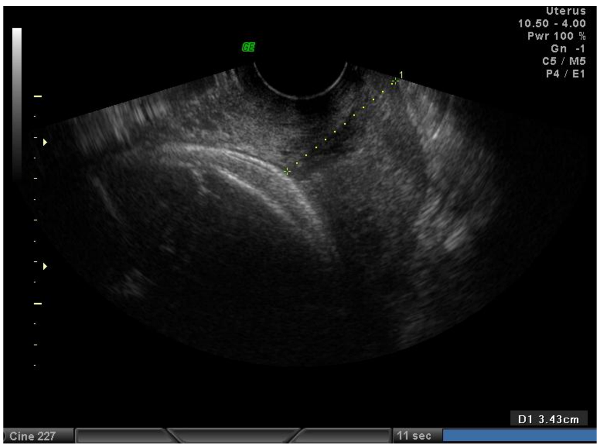

Fig. 3: *TVS – The cervical length has slightly decreaed (3.4 cm) in 38 wks of pregnancy.*

carried out using SPSS software (SPSS Inc, Chicago, IL). All statistical analyses were reviewed by a statistical consultant. $P < .05$ was considered significant.

RESULTS

In the first stage of the study, the 321 cervical length measurements taken on the 185 nulliparous and 136 multiparous women were divided into 6 groups on the basis of gestational age at the time of the sonographic scan. Each group corresponded to a gestational period, which included 4 weeks in early pregnancy (10th–13th weeks) and 4 weeks in late pregnancy (37th–40th weeks) as well as 5 weeks in each of the 4 periods in between (14th–19th, 20th–25th, 26th–31st, and 32nd–36th weeks). Means, SDs, and 95% confidence limits were reported for each group. Although mean values for cervical length appeared higher in multiparous women, statistical analysis of cervical length measurements by the *t* test within the 6 periods in nulliparous versus multiparous women did not show any statistically significant difference ($P > .05$) between the 2 groups for any of the periods considered. In other words, gestational age being the same, cervical length was basically comparable in nulliparous and multiparous women. By contrast, the analysis of variance test on cervical length measurements of nulliparous women grouped according to the 6 gestational periods showed a statistically significant difference ($F = 7.69$; $P < .001$). The same statistical evidence was found among multiparous women ($F = 5.88$; $P < .001$). Therefore, in both groups, cervical length appeared to decrease significantly in relation to gestational age (Fig. 3). Because no statistically significant differences could be found in cervical length measurements between nulliparous and multiparous women, we proceeded with the second stage of our study, which consisted of combining all biometric data to study the correlation existing between cervical length and gestational age. The data collected were presented in graphic form: The cervical length measurement was plotted on the y-axis of the graph, and the gestational age at which the measurement was obtained was plotted on the x-axis. Then, by regression analysis, the best fit curve was calculated using the least squares technique. The linear model was the one that best described the relationship between the 2 variables ($R = 0.92$; $R2 = 0.85$; $F = 122.34$; $P < .001$). The normal curve and the reference intervals for each week were then calculated by taking the gestational age–specific mean ± 1.28 SD and back-transforming (10th and 90th percentiles).

DISCUSSION

Most investigators currently agree on the need of having cervical length measurements performed by sonographic scanning to overcome the limitations inherent in the subjectivity of clinical examination of the cervix. However, the reference biometric values reported in the literature vary greatly, and there does not seem to be a large consensus, either, on what changes in cervical length should be considered normal during pregnancy. A few authors think that cervical length remains unchanged up to the third quarter and from then on becomes progressively shorter[10,12]. Other authors[13-16] maintain that cervical length starts to decrease in the second quarter. Two longitudinal studies conducted between the 12th and 39th weeks did not show any changes in cervical length throughout the period considered.[17,18] There is even a report that points to an actual increase in cervical length between the 8th and 31st weeks, followed by a progressive decrease to term[19]. It is not clear whether there is a difference between nulliparous and multiparous women; indeed, a few authors deny the existence of any such difference, whereas others confirm it, indicating increased cervical length in multiparous women compared with nulliparous women.[10,20,21,17,18] The results of our study seem to indicate that cervical length is basically comparable in nulliparous and multiparous women. By contrast, cervical length undergoes a linear reduction between the 10th and 40th weeks, the variability of the reference ranges becoming increasingly wider as the term of pregnancy draws near (although the correlation coefficient remains very high: $r = -0.92$). Strict compliance with standard conditions during cervical length measurement was essential for us to obtain a far better correlation coefficient than those reported by Murokawa et al ($r = -0.40$) and Hasegawa et al ($r = -0.50$) in comparable studies[16,22]. In the study by Murokawa et al, the control population, which was comparable with the control population in our study, was made up of 177 healthy women who gave birth at term, but the only criterion followed in measuring cervical length was the possibility of viewing the whole length of the cervical canal[16]. By contrast, in the study by Hasegawa et al, data were collected from an "apparently normal population" made up of 729 pregnant women at 15 to 34 weeks' gestation, without excluding from the study women who were at risk of PTB or who actually gave birth before the 38th week[16]. It is likely that differences in the measuring techniques used by the different authors, together with the lack of standard conditions for cervical length measurement, may lead not only to differences in the reference ranges but also to the inability to show changes in cervical length during pregnancy. It should be noted, however, that the reference ranges obtained in our study were on average higher than those found by other research groups.[20,21] A tentative explanation of this phenolmenon might be that the vaginal probe used by the sonographer at our ultrasound clinic, with an aperture angle of greater than 160°, makes it possible to easily view the whole length of the cervical canal. Far from allowing a consistent view of the whole cervix, a probe with a lesser angle would force the sonographer to execute maneuvers or other pressing movements that might alter the accuracy of the measurement, providing falsely decreased length readings. A further explanation might lie in the special cervical length measurement technique used in our study in the presence of cervical curvature. By breaking down the measurement into 2 or more segments and then combining these segments together, we obtained biometric data that were certainly higher than those provided by a single straight-line measurement, as is usually done in most other studies, which underestimates the actual length of the cervical canal in the event of curvature. According to To et al, curvature of the cervix was observed in 48% of 301 women and increased with cervical length from 0% at less than 16 mm to 25% at 16 to 25 mm and 51% at 26 to 55 mm.[23]

Finally, it is also important to consider that, as was pointed out by Leitich et al, mean cervical lengths are shown to differ in different populations; consequently, it may be more appropriate to define reference values of cervical length for the appropriate population[9]. In our opinion, the construction of reference ranges between the 10th and 40th weeks using strict reference criteria may have 2 significant advantages. The first is that it makes biometric data more reproducible, and the second is that reference intervals are available for longer gestational periods than using a single cutoff value. It will then be possible to also study the longitudinal behavior of patients at high risk of PTB by identifying the exact moment at which the cervical canal begins to become shorter than normal.

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