Sonographic evaluation of cervical length changes during normal pregnancy

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(Received 25 March 2008 and accepted 24 July 2008)

ABSTRACT: This study was aimed to establish reference values of cervical length in normal pregnancy. We studied a cross-sectional sample of 144 pregnant women by transabdominal sonography. The inclusion criteria were sonographic confirmation of gestational age, the absence of any risk factors for preterm birth, and uncomplicated pregnancy. Cervical length was measured in a straight line. Height, age and weight of patients were also obtained. There was a relationship between gestational age and cervical length, which could be described with a linear regression (R = 0.44; P<0.05). Our study shows an increase in cervical length with gestational age. Reference ranges constructed for the whole gestational period could be more clinically applicable and useful than a single cut off value for more efficient prevention and management of preterm birth.

KEYWORDS: Transabdominal sonography; cervical length; normal pregnancy; gestational age

INTRODUCTION
Sonographic evaluation of the gravid cervix is important for the assessment of cervical incompetence, preterm labor and placenta previa. Premature delivery affects 7% to 11% of all newborn infants and remains a major cause of perinatal morbidity and mortality. Despite the increasingly varied choice of therapies and treatments available to present day obstetricians for the management of pregnancy, no significant changes have been reported so far in preterm birth (PTB) rates, which of course, vary widely among different populations studied because of racial, social, economic, and environmental factors. The proportion of women at risk of PTB is about 7% in France and 8% to 9% in Italy. In the United States, where the rate has been unchanged for the last 3 decades, the PTB rate is 10% to 11%.

Detection of incompetence of the cervix is based on demonstration of a shortened and dilated Cervix less than 3.0cm. Establishment of this diagnosis early enough may lead to saving the pregnancy by circlage. Over the last few years, investigators have begun to study changes in cervical length by sonographic scanning, perhaps in an attempt to overcome the limitations inherent in the subjectivity of clinical examination of the cervix. The manual assessment of the cervical length is subjective and has a poor intra observer variability. The literature actually reports different cutoff values for cervical length measurements, which might theoretically enable identification of up to 100% of PTBs. Literature search did not reveal any previous study in this locality.

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The purpose of our study was to assess changes in cervical length during physiologic pregnancy, establish regression models and construct reference ranges that could be used at any gestational period for prompt identification of women with changes in cervical length.

**MATERIAL AND METHOD**

This study was carried out on a convenience sample of 144 pregnant women of Nigerian descent coming for obstetric sonography. The scans were done at the Radiology Department of the University of Nigeria Teaching Hospital (UNTH) and Hansa Clinics, Enugu. Patients were scanned with full bladder in supine position on examination. Aquasonic gel was applied to the anterior abdominal wall as a coupling agent to eliminate air interphase between the transducer and the anterior abdominal wall. The transducer was placed in position for sagittal scan with the symphysis pubis as the inferior border. A multifunction ultrasound scanning machine (Philips-sterling) was used at Hansa clinic while a Siemens sonoline SL-2 machine was used at UNTH. Both machines were equipped with 3.5 MHz curvilinear transducers. Prints of the images were obtained with an incorporated video camera.

The cervical canal and the external os were well visualized and displayed in profile during real time scanning before measurements were made\(^\text{19}\). The internal os was identified as flat or the apex of an isosceles triangle against a hypoechoic background of amniotic fluid. Cervical canal lengths (CCL) were measured from internal to external os\(^\text{20}\) in all subjects. Gestational ages (GA) by scan were determined by measuring the biparietal diameter (BPD) and the femur length (FL) or Gestational Sac (GS). The gestational ages corresponding to these biometric measurements were read out from prepared charts\(^\text{21,22}\). Heights, weights and ages of subjects were obtained.

As suggested by Burger et al\(^\text{23}\), the following four 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.
3. A symmetric image of the external os was to be obtainable.
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.

The inclusion criteria were sonographic confirmation of gestational age, absence of risk factors for PTB (Table 1)\(^\text{24}\), and uncomplicated pregnancy. Pearson’s correlation was used to assess the relationship between CCL and GA.

### Table 1: Risk factors for premature labor

- Cultural, behavioural, and economic
- Low socioeconomic status
- Poor health care attitudes
- No or inadequate prenatal care
- Cigarette, alcohol, and drug use
- Unmarried less than 1 y since last birth
- Heavy work
- Unemployment
- Biological, genetic, and medical
- Short stature
- Chronic medical illnesses
- Reproductive (multiple gestation and Parity > 5)
- Polyhydramnios
- Premature rupture of membranes
- Infections (systemic, amniotic, extra-amniotic, cervical)
- Pre eclampsia/Eclampsia
- Uterine bleeding (abruption placentae, placenta previa)
- Fetal disease
- Assisted reproduction
- Idiopathic premature labor
- Abdominal surgery

#### Data analysis:

Data was tested for normality using 3 sigma rule (Mean ± 3SD). Descriptive and inferential statistics were performed using SPSS software (SPSS Inc, Chicago, IL). Mean, standard deviation (SD) and range of values were obtained. A multiple regression analysis derived predictive formula for the calculation of cervical length. All statistical analyses were reviewed by a statistical consultant. \(P < 0.05\) was considered significant.

### RESULTS

Table 2 shows changes in cervical canal length with gestational age. It shows a progressive increase in the cervical canal length with increasing gestational age. The relationship between the CCL and gestational ages showed a statistically significant linear correlation (\(R = 0.44; p < 0.05\)).
Table 2: Cervical canal lengths in pregnant subjects according to gestational age

<table>
<thead>
<tr>
<th>Gestational Age (weeks)</th>
<th>Number (n=144)</th>
<th>Cervical Canal lengths (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (cm)</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>5 - 9</td>
<td>5</td>
<td>3.20</td>
</tr>
<tr>
<td>10 – 14</td>
<td>20</td>
<td>4.73</td>
</tr>
<tr>
<td>15 – 19</td>
<td>6</td>
<td>4.92</td>
</tr>
<tr>
<td>20 – 24</td>
<td>14</td>
<td>5.31</td>
</tr>
<tr>
<td>25 – 29</td>
<td>28</td>
<td>4.90</td>
</tr>
<tr>
<td>30 – 34</td>
<td>33</td>
<td>5.32</td>
</tr>
<tr>
<td>35 – 39</td>
<td>36</td>
<td>5.45</td>
</tr>
<tr>
<td>40+</td>
<td>2</td>
<td>5.50</td>
</tr>
</tbody>
</table>

Table 3 shows the mean cervical canal lengths in pregnant subjects stratified into groups according to trimesters. With this grouping, the mean CCL showed an increase from 4.41 cm in the first trimester to 5.30 cm in the third trimester. A multiple regression equation was also derived for prediction of cervical canal length:

\[
\text{CCL} = 0.370 \times (\text{GA}) - 0.629 \times (\text{weight}) + 0.086 \times (\text{Height}) + 28.96 --- (R=0.4; P<0.05)
\]

Table 3: The mean cervical canal lengths of pregnant subjects according to trimester

<table>
<thead>
<tr>
<th>Trimester</th>
<th>Number</th>
<th>Mean (cm)</th>
<th>Standard Deviation</th>
<th>Range (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st trimester (1 - 13 weeks)</td>
<td>22</td>
<td>4.41</td>
<td>1.07</td>
<td>2.90 – 5.90</td>
</tr>
<tr>
<td>2nd Trimester (14 - 26 weeks)</td>
<td>36</td>
<td>5.10</td>
<td>0.83</td>
<td>2.70 – 6.00</td>
</tr>
<tr>
<td>3rd trimester (27 - 40 weeks)</td>
<td>86</td>
<td>5.30</td>
<td>0.60</td>
<td>3.60 – 6.01</td>
</tr>
</tbody>
</table>

DISCUSSION

Preterm birth is the leading cause of perinatal mortality and morbidity\(^\text{25}\). Ultrasonographic evaluation of the cervix in pregnancy has provided some insight into premature delivery and pregnancy wastage. Its use has led to the development of cervical length nomograms in uncomplicated pregnancies and to the realization that varying degrees of cervical incompetence exist. Cervical length is normally distributed and remains relatively constant until the third trimester\(^\text{26}\). Cervical length is inversely related to preterm birth risk in asymptomatic women\(^\text{7,27}\). In some instances, the internal os has been observed to dilate and funnel in the early second trimester while in others these changes occur gradually into the third trimester. Transient cervical changes have been linked to premature delivery, and extended ultrasonographic inspection is required for their detection\(^\text{28}\).

The result of this study shows that mean values of cervical length in pregnancy vary from 3.2 cm to 5.5 cm. This range intercepts with mean values of 2.8 cm to 4.8 cm\(^\text{29,31}\) previously described in literature. This study has also shown that CCL increases up to 40 weeks. This contradicts earlier report by Brieger et al\(^\text{32}\) which established that CCL increases up to 34 weeks. Contrary to the result of this study, some authors\(^\text{20,30}\) found a decrease of CCL with increasing gestational age. Even though the values of the CCL from the present study are higher for the same gestational ages, when compared with the cervical canal length form the study by Hertzberge et al\(^\text{33}\) using transvaginal scan, there is an agreement with the trend of increase in cervical canal length as gestational age increase. The increase in CCL with increasing gestational ages compare favorably with the results of other researchers\(^\text{34}\). Beyond the gestational age of 35-39 weeks, there is a decline in the rate of increase of CCL. This is similar to the findings of Brieger and Coauthors\(^\text{32}\). The result from this study is similar to that of a previous study\(^\text{26}\) which
showed that cervical length follows a normal distribution. Lawson\textsuperscript{35} reported that in multiparous and also many primiparae of black descent, the fetal head does not usually engage in the pelvic brim until late in labor. This is attributed to racial factors and their physique of a steep angle of inclination of the pelvic brims. The non engagement of head until labor may therefore account for the late effacement and shortening of the cervix and the apparent longer cervical length seen in our study when compared to the Caucasian population.

Transabdominal ultrasound requires filling the bladder to assess the cervix adequately, but this may spuriously lengthen the cervix by opposing the anterior and posterior lower uterine segments\textsuperscript{34}, concealing cervical shortening or funneling. In contrast, transvaginal ultrasound is performed with the bladder empty\textsuperscript{36}. Transabdominal resolution is hampered significantly by maternal obesity, shadowing from fetal parts, and the need for lower frequency transducer\textsuperscript{36}. Transperineal ultrasound has been performed as less invasive than the transvaginal examination but most studies have found that both approaches are acceptable to women\textsuperscript{37,38}. Furthermore, the translabial or transperineal technique is not always successful because of reduced visualization secondary to bowel gas\textsuperscript{39}. Since the image resolution is better transvaginally, transperineal ultrasound should be reserved for and offered to women at increased risk of preterm birth for whom vaginal assessment is unacceptably invasive and uncomfortable\textsuperscript{40}. Hence, the use of both transvaginal and transperineal approach create further research directions in this environment.

Finally, it is important to consider that, as was pointed out by Leitich et al\textsuperscript{18}, mean cervical lengths are shown to differ in different populations; consequently, it may be more appropriate to define reference values of cervical lengths for the appropriate population. Although sonography may allow the identification of women who deliver prematurely, it has not demonstrated enough discriminatory power to recommend its routine use for this purpose\textsuperscript{38}. This study has established reference values and a gestation age based regression model for cervical length changes during normal pregnancy which could be used to monitor, predict, prevent and manage preterm birth in this locality.

REFERENCES

