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Ultrasonographic Cervical Length Measurement at 10-14- and 20-24-weeks' Gestation and Prediction of Preterm Delivery

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Abstract

Preterm labor is a regular occurrence in pregnancy; an estimated 15 million babies are born prematurely each year, with the number increasing. This was a prospective study of pregnant women who came to the Maternity Teaching Hospital in Erbil, Kurdistan Province, Iraq, for an outpatient clinic. On a manageable sample of 150 singleton pregnancies. In this study, one hundred fifty singleton asymptomatic pregnancies encountered the inclusion criteria during the study period, 69 primi gravid, 81 multi gravid. The correlation between the cervical length at 20–24 weeks and preterm delivery was moderately poor (r =0.715), and this correlation was highly significant (P < 0.001). In another word, a better correlation was found between preterm delivery and cervical length at 20–24 weeks than at 10–14 weeks in the prediction of preterm delivery. This study also points towards the importance of serial ultrasound scans to detect those who are at higher risk. There was no statistically significant effect of age, parity. Finally, the findings revealed that trans vaginal ultrasound is more accurate at 20-24weeks than 10-14weeks gestation for prediction of preterm labor, it can be used routinely to prevent preterm birth.

Keywords— Ultrasonographic Cervical, Gestation and Prediction of Preterm Delivery.

I. INTRODUCTION

Preterm labor is a common condition in pregnancy, an estimated 15 million babies are born preterm annually and this number is rising. 12% of babies are born preterm in low income countries compared with 9% in higher-income countries (Tesfalul et al. 2021). Preterm labor is the most frequent cause of neonatal deaths and the second leading cause of both neonatal and under-five mortality with many short and long-term health danger worldwide (Lawn et al. 2013). During the last 25 years, despite remarkable improvements in neonatal care leading to higher survival of very premature infants (Saigal & Doyle, 2008) still the estimates assuming that the average annual increase in the rate of preterm birth observed between 2005 and 2010 is maintained, predict that over 2 million babies will be born prematurely in 2025 (Matijevic et al. 2006). Preterm birth is categorized into two broad classes: iatrogenic compromising 30% of cases and spontaneous preterm labor, which accounts for about 70% of cases (Oskovi Kaplan & Ozgu-Erdinc, 2018). The introduction of a universal trans vaginal Ultrasonographic cervical length screening in women with singleton gestations without a history of spontaneous preterm birth is associated with a reduction in the frequency of threatened Preterm labor (Navathe et al. 2019). The Society for Maternal-Fetal Medicine demonstrated The role of routine cervical length screening in selected high- and low-risk women for preterm birth prevention with the sensitivity 44.7% using trans abdominal ultrasound to identify a (confirmed by trans vaginal ultrasound) short cervix < 25mm (McIntosh et al. 2016). The risk of spontaneous preterm birth is inversely proportional to the length of the cervix; those with the shortest cervical length have the highest risk of prematurity(McIntosh et al. 2016). Our study aims to compare the accuracy of cervical length measurement at first trimester and early second trimester for the prediction of preterm birth in 150 women at tertiary hospital Centre.

II. PATIENTS AND METHODS

Study design and sample:

This was a prospective study on pregnant women presented to in outpatient clinic at Maternity Teaching hospital, Erbil city, Kurdistan region, Iraq. On a convenient sample of 150 women with singleton pregnancies, started from January 2018 to June 2020.

Inclusion and exclusion criteria:

Asymptomatic, nulliparous and multiparous women, with uncomplicated singleton pregnancy attending the hospital in first trimester of pregnancy were regarded as inclusion criteria.

The exclusion criteria were: clinically and biochemically suspected infection(white cell count>14x/10^{12}/l, C reactive protein>/10 mg/l), developmental malformations of the Mullerian duct, history of surgical procedure on the cervix, cervical cerclage before participation; Any medical conditions that are risk factors for preterm labor (eg; hypertension, diabetes mellitus), major congenital fetal anomalies; missed abortion and intrauterine fetal death, Multiple pregnancies, preterm pre labor rupture of membrane, Placenta Previa, history of preterm labor and Smokers.

Data Collection:

Cervical length was measured by trans vaginal sonography At X-ray department of Maternity Teaching hospital, Erbil city, Kurdistan region, Iraq, using a real-time trans abdominal 3.5-5MHZ and 7 MHz curvilinear trans vaginal probe (Voluson E6,USA). In the beginning, trans abdominal ultrasonography was done, after that trans vaginal ultrasonography was done to measure cervical length. Gestational age was calculated from the date of the last reliable menstrual period and confirmed by assessing the crown-rump length at the 10-14 weeks gestation or calculated by the US alone if there was a difference between the LMP and us. (by ultrasound examination alone if the sonographic determination of gestational age was not consistent with menstrual dating by more than 1 week.)

Preparation of the participant

First, the women were requested to empty their bladder and were put in the lithotomy position. Second, the vaginal transducer .The vaginal probe was covered with a sterile condom with sterile gel applied both inside and outside and was introduced in the anterior fornix of the vagina and used to attain a sagittal view of the entire length of the cervical canal, which may be either translucent or echo dense. The canal is surrounded by the endo cervical mucosa, which is usually reduced but seldom of increased echogenicity compared to the nearby tissues. Third, the probe was withdrawn faintly till the image was blurry and then reinserted gently until the image was returned, devoid of exerting excessive pressure on the cervix so that cervical length was not modified. Fourth, the settings of the ultrasound device were improved to get the widest viewing angle and the magnification was increased with the purpose of most of the screen was occupied by the tissues between the external cervical os at one end of the picture and the gestational sac at the other end. Fifth, calipers were used to measure in series the linear distance between the two ends of the glandular area around the endo cervical canal (Kuusela et al. 2021). All the ultrasound measurements were conducted by the same operator who has experience in conducting this procedure. An adequate image was defined as presence of external cervical axis, endocervical canal and internal

cervical axis, which is the cranial end of the cervical canal adherent to the intrauterine cavity. Cervical length was measured with electronic calipers as linear distance between the external axis and the functional internal axis along a closed endo cervical canal(8). The shortest of the three measurements was recorded. Cervical length <2.5mm regarded as short cervix(6). BMI was also categorized into four groups according to the conventional WHO classification: underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese (≥30 kg/m^2)(9)

Ethical consideration:

The ethics and scientific committee of Kurdistani board for medical specialties approved the study on 2/2/2020 no 418. Written consent was obtained from the patients during the first interview and ensured that the information is kept confidential and it is for research purpose only.

Statistical Analysis

A receiver operating characteristic (ROC) curve was constructed for cervical lengths to test the effectiveness of various cutoff points in predicting premature delivery. The areas under the ROC curves were calculated and the sensitivity, specificity, and positive-predictive value (PPV) for the cervical length of the most appropriate cutoff point were calculated for predicting preterm delivery (Thain et al. 2021).

Cervical length measurements were expressed as the mean _ standard deviation (S.D.). The student's t-test was used to determine the differences in the cervical lengths at the first and second scans for the groups of patients who delivered either at term or preterm. A Pearson correlation test was used to test for independence between cervical length (at 10–14 and 20–24 weeks) and the gestational week at preterm delivery. A P-value < 0.05 was considered significant.

Analyses were performed using commercial software.

III. RESULTS

In this study, one hundred fifty singleton asymptomatic pregnancies encountered the inclusion criteria during the study period, 69 primi gravid, 81 multi gravid

Spontaneous preterm delivery before 37 weeks occurred in 30 women (20%). The mean age (+_S.D.) of the preterm and term groups was 29.2 +_ 7.1 and 28.60+_ 7.01 years (P = 0.536), respectively. The mean BMI for preterm was (28.43+_4.19) for the term was (27.20+_5.16). There were no statistically significant differences in education level, parity, or BMI among those that were delivered at term and the preterm group(Table 1) .The mean cervical lengths at 10–14 weeks were not statistically different between the group of women who delivered at term (41.51+ _ 4.37 mm) and the preterm group (38.56+_2.69 mm) (P 0.498). By contrast, the mean cervical lengths at 20–24 weeks were significantly different in the preterm (22.72+_3.24 mm) and term (35.96+ _ 6.25mm) groups.(P < 0.001; Table 3).

The correlation between cervical length at 10–14 weeks and the gestational week at preterm delivery was poor (r = 0.427), although this correlation was statistically significant (P =0.18). The correlation between the cervical

length at 20–24 weeks and preterm delivery was moderately poor (r =0.715), and this correlation was highly significant (P < 0.001). In another word, a better correlation was found between preterm delivery and cervical length at 20–24 weeks than at 10–14 weeks in the prediction of preterm delivery.

Based on the receiver operating characteristic curve, at 20-24wks a cervical length of 28.7 mm was the most appropriate cutoff point for predicting preterm delivery, with a sensitivity of 83.3%, specificity of 100%, and PPV of 100% , NPV 60%.(P < 0.001), AUC 0.944 ,95%CI(0.910-0.978). With a most appropriate cervical length of 39.2mm at 10–14 weeks for predicting preterm delivery, the respective values were 67.5%,56.7%,86.2%,30.4%.AUC 0.694. 95%CI(0.604-0.784). (P < 0.01; Fig. 1).

Table 1:

	Mean	Std. Deviation
Age (Preterm)	29.266	7.182
BMI(preterm)	28.436	4.195
CL at 10-14 wk(mm)(preterm)	38.566	2.699
CL at 20-24wk(mm)(preterm)	22.723	3.241
GA at delivery(wk)(ptreterm)	34.680	2.606
Age(term)	28.604	7.016
BMI (Term)	27.207	5.167
CL at 10-14 wk(mm) (term)	41.517	4.373
CL at 20-24wk(mm)(term)	35.960	6.529
GA at delivery(wk)(term)	39.060	1.516

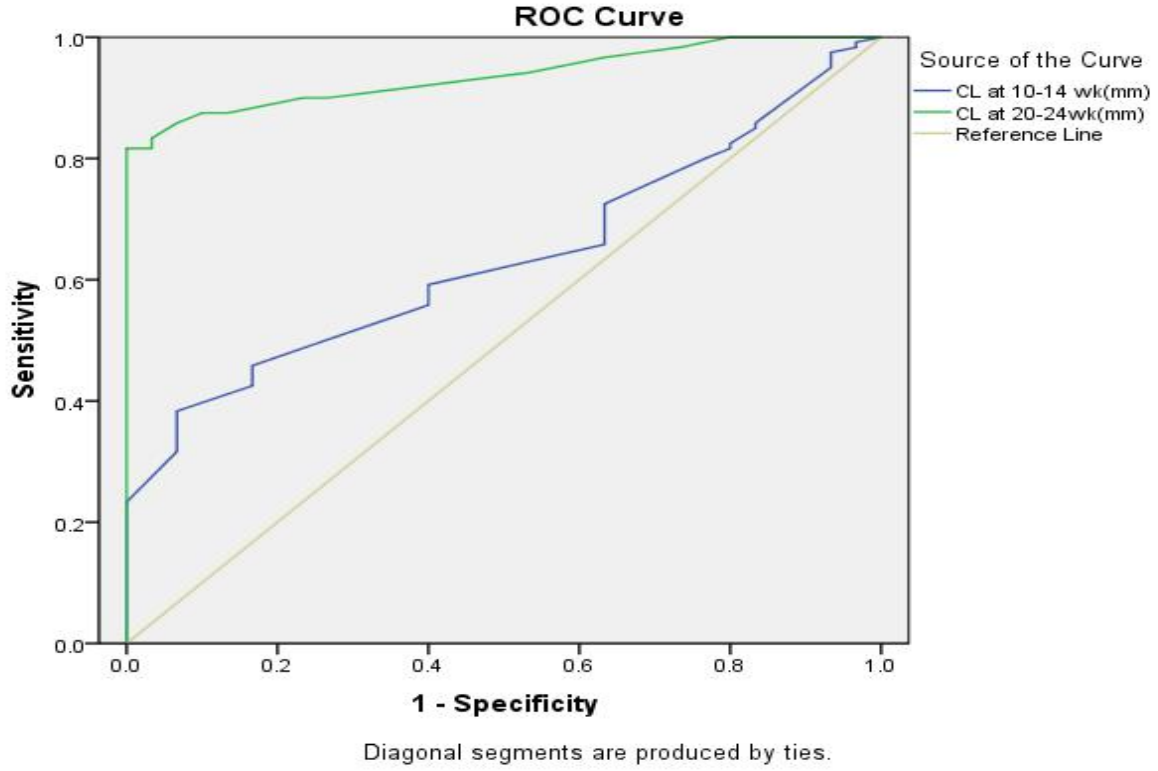
Table 2: Distribution of participants according to cervical length:

Cervical length (mm)	No of pregnant women with cervical length at 11-14 weeks	No of pregnant women with cervical length at 20-22 weeks
=<25	-	39
26-30	-	13
31-35	14	25
36-40	71	51
41-45	52	15
46-50	9	5
=>51	4	1

Table 3:

Gestational age and mean cervical length at 1st and 2nd-trimester scans				
	Total (n=150)	Preterm(n=30)	Term(n=120)	P Value
Cervical length at 10–14 weeks (mm)	40.04 +_ 4.57	38.56+_2.69	41.51+_4.37	>0.05
Cervical length at 20–24 weeks (mm)	35.37+_5.74	22.72+_3.24	35.96+_6.52	<0.001

Fig. 1. Receiver operating characteristic curve showing the relationship between sensitivity and false positives at various cutoff points of cervical length to predict delivery before 37 weeks gestation.



IV. DISCUSSION

Overall, this study suggests that trans vaginal cervical length measurement at mid gestation is more predictive than earlier scan for detection of premature birth, because most of the cases that are screened in our study had normal cervical length at 10-14 weeks, with progressive shortening towards 20-24wks scan. This study also points towards the importance of serial ultrasound scans to detect those who are at higher risk. There was no statistically significant effect of age, parity, BMI.

The mean age (+_S.D.) of the preterm and term groups was 29.2 +_ 7.1 and 28.60+_ 7.01 years (P = 0.536), respectively. The cervical lengths at 10–14weeks were not statistically different between the group of women who delivered at term (41.51+ _ 4.37 mm) and the preterm group (38.56+_2.69 mm) (P= 0.498). By contrast, the cervical lengths at 20–24 weeks were significantly different in the preterm (22.72+_3.24 mm) and term (35.96+ _ 6.25mm) groups. (P < 0.001). This was consistent with other studies that are done in asymptomatic pregnancies a study done by Ismail Ozdemir a,, Fuat Demirci a, Oguz Yucel a, et al,showed that the mean age (+_S.D.) of the preterm and term groups was 27.8 _ 6.9 and 26.0 _ 5.5 years (P = 0.184), respectively and The cervical lengths at 10–14 weeks were not statistically different between the group of women who delivered at term (40.9 _ 4.8 mm) and the preterm group (38.6 _ 6.3 mm) (P > 0.05). By contrast, the cervical lengths at 20–24 weeks were significantly different in the preterm (28.4 _ 7.1 mm) and term (37.8 _ 5.2 mm) groups (P < 0.001) (10).

Achour Radhouane1, Ben Jemaa Nadia2, Ksibi Imen3, et al, showed that The mean cervical length of women having a threat preterm delivery between 12 and 14 weeks of amenorrhea was equal to 32.3mm while it was equal to 40.7mm for those delivering at term, The mean cervical length between 22 and 24weeks for patients who presented

athreat of preterm delivery was 26.1mm with an opening of the internal os of 9mm. However, it reached 38.7mm for women delivering at term with an internal os of 2.3mm.(11).another study done by Serene Thain, George S. H. Yeo1, Kenneth Kwek2, et al demonstrates that There was a significantly shorter cervical length both in the 2nd trimester (18 to 22 weeks)

and the 3rd trimester (28 to 32 weeks) in the preterm birth group compared to the term birth group ($p = 0.028$ and $p < 0.001$ respectively). In the first trimester (11 to 14 weeks), there was no statistically significant difference in cervical length between the two groups ($p = 0.425$). ROC curve analysis for cervical length in the preterm birth group for 18 to 22 weeks and 28 to 32 weeks showed an AUC of 0.605 and 0.725 respectively. At 28 to 32 weeks of gestation, a cut-off level at 2.49 cm has a sensitivity of 54.8%, specificity of 82.5%, negative predictive value of 97.9% and positive predictive value of 11.1%.(12) In 2008, a systematic review showed that cervical length revealed a positive likelihood ratio of 11.30 (95% confidence interval:3.59–35.57) at <20 weeks and 2.86% (95% confidence interval: 2.12–3.87) at 20–24 weeks in women with a history of sPTB if cervical length<25mmwas used as a cutoff.(13)

By contrast another study done by E. VAISBUCH*†, R. ROMERO*‡#, O. EREZ*†, et al, demonstrates that the median gestational age at diagnosis of a short cervix before 20 weeks and at 20–24 weeks was 18.9 and 22.7 weeks, respectively. Women diagnosed before 20 weeks had a higher rate of PTD at <28 weeks (76.9% vs. 30.9%; $P < 0.001$) and at <32 weeks (80.8% vs. 48.1%; $P = 0.004$), and a shorter median diagnosis-to delivery interval (21 vs. 61.5 days, $P = 0.003$) than those diagnosed at 20–24 weeks.(14)

Strength and Limitations:

In our study we excluded all risk factors that lead to preterm labor so that cervical length was the only contributing factor for preterm birth, which was done in two appointments at first and second trimesters.

It would be better another appointment to be done at 28-30week

V. CONCLUSION

Trans vaginal ultrasound is more accurate at 20-24weeks than 10-14weeks gestation for prediction of preterm labor, it can be used routinely to prevent preterm birth. Preterm labor is a regular occurrence in pregnancy; an estimated 15 million babies are born prematurely each year, with the number increasing. This was a prospective study of pregnant women who came to the Maternity Teaching Hospital in Erbil, Kurdistan Province, Iraq, for an outpatient clinic. On a manageable sample of 150 singleton pregnancies. In this study, one hundred fifty singleton asymptomatic pregnancies encountered the inclusion criteria during the study period, 69 primi gravid, 81 multi gravid. The correlation between the cervical length at 20–24 weeks and preterm delivery was moderately poor ($r = 0.715$), and this correlation was highly significant ($P < 0.001$). In another word, a better correlation was found between preterm delivery and cervical length at 20–24 weeks than at 10–14 weeks in the prediction of preterm delivery. This study also points towards the importance of serial ultrasound scans to detect those who are at higher risk. There was no statistically significant effect of age, parity. Finally, the findings revealed that trans vaginal ultrasound is more accurate at 20-24weeks than 10-14weeks gestation for prediction of preterm labor, it can be used routinely to prevent preterm birth.

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