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Role of Ultrasonographic Evaluation of Cervical Features and Myometrial Thickness in Prediction of Preterm Birth

Obstetrics & Gynecology

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Abstract

Background: Spontaneous preterm birth is the leading cause of neonatal mortality as more than one million die because of pre-term birth. Premature neonates who survive have significantly higher risk of developing serious complications such as cardiovascular, respiratory dysfunction, motor and intellectual deficiencies. The aim of our study is to evaluate the role of ultrasonographic measurement of myometrial thickness, cervical length, presence of funneling and cervical position in prediction of preterm labor.

Patient and Methods: Our prospective observational study included a sample of 100 pregnant women divided into 2 groups, group A (50 pregnant women who had previous preterm labor) and group B (50 low risk pregnant women).The myometrium thickness was measured by tansabdominal ultrasound at 4 different sites low anterior, mid anterior, fundal and posterior. Transvaginal ultrasound was performed to assess cervical length, presence of funneling and cervical position.

Results: The incidence of preterm labor was 18%. There was a statistically significant association between the presence of positive history of previous abortion and the risk of preterm birth. The cervical length measured at 20-24 weeks was significantly shorter in spontaneous preterm birth women in comparison to women who delivered at full term.

Conclusion: At 20-24 weeks of gestation, transvaginal cervical length measurement is the best predictor. A posterior uterine thickness ≤6.0 (mm) had highest diagnostic characteristics in predicting preterm delivery among risky group. Cervical position was found insignificant in prediction of preterm birth.

Key words: Cervical length; preterm birth; myometrial thickness; cervical position.

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INTRODUCTION

Spontaneous preterm delivery accounts for approximately 72% of preterm deliveries and several factors can increase the risk of this type of preterm delivery. Some of them are early threatened abortion in the current pregnancy, genetic factors, demographic features and behavior.[1]

The human cervix is a dynamic organ as its structure and shape change throughout the pregnancy period. It softens, shortens, dilates and becomes thinner as pregnancy progresses and term approaches. If these changes occur early, the risk of preterm morbidity increases.[2] Therefore cervical length assessment has become a widely used clinical measure for identifying women at high risk for preterm birth as the risk of spontaneous pre-term birth is greater in women with a short cervix than women with a longer cervix.[3]

Correct and appropriate evaluation of cervical status has become important in predicting spontaneous onset of labor with widespread use of ultrasonography in obstetrical practice, investigators have begun to study the changes of cervical morphology by sonographic scanning and they have advocated that trans vaginal ultrasonography is a reliable method to assess the cervix uteri and lower uterine segment.[2]

Myometrial thickness has undergone sonographic evaluation during normal pregnancy, labor and postpartum and in certain situations such as twin pregnancy, polyhydramnios and PPROM.[4] Some studies showed the decrease of myometrial thickness in the 2nd and 3rd trimesters compared with the 1st trimester and also in specific pregnancies which are associated with preterm labor such as twin pregnancy and polyhydramnios.[3]

The aim of this thesis is to investigate whether myometrial thickness, cervical length, the presence of funneling and cervical position are useful predictors for preterm delivery.

PATIENTS AND METHODS

This observational prospective study included a sample of 100 pregnant women attending Damanhour Teaching Hospital Obstetrics and Gynecology department.

Inclusion criteria were women aged from 16 to 45, in 20-24 weeks of gestation, and with viable fetus. The study participates were divided into 2 groups: Group included 50 pregnant women had previous history of preterm birth with or without other risk factor including: 1-Threatened abortion in the current pregnancy,2-Interpregnancy interval less than eighteen months,3-Maternal age < twenty years or >thirty five years old for the first pregnancy,4-Maternal weight less than forty five kilograms,5-Smoking,6-Uterine structure abnormalities (ex. fibroid),7-Accidental hemorrhage with mild bleeding, 8-Polyhydraminous, 9-Oligohydraminos, 10-Premature rupture of membranes, and 11-Medical diseases (as anemia, diabetes and hypertension) and fetal anomalies. Group B included 50 pregnant women with or without risk factors for preterm birth and with prior normal labor.

We excluded following patients**:** women less than 20 weeks of gestation, primigravida, multiple gestation, unsure gestational age, suspected IUGR and fetal macrosomia, BMI > 40, bad medical condition that may lead to termination of pregnancy, accidental hemorrhage with moderate or severe bleeding, polyhydramnios, and oligohydramnios.

All participants in group will received prophylactic tocolytic drug in the form of progesterone 400 mg vaginal suppository once daily at night**.** History was taken including: Personal history. Menstrual history. Obstetric history. Present history included: "Gynecological symptoms and Urinary symptoms". And past history included history of medical diseases**.** Examination including: General examination included general condition, height, weight, gait and vital signs. Abdominal examination included: Inspection, palpation, Auscultation of fetal heart sounds, and vaginal examination. Investigations: Routine investigations and Ultrasounds scan to assess the gestational age and to detect any abnormality.

Gestational age was determined by last menstrual period or ultrasound in the first trimester. The ultrasound was done at 20-24 weeks gestational age. Abdominal ultrasound will use a 2.5 - 7.5 MHz transabdominal probe with the women in the recumbent position. We assessed the fetal condition, gestational age, the presence of any fetal or uterine anomalies, the placenta and the amniotic fluid. The myometrium was sonographically identified as the echo homogeneous layer between the serosa and the decidua. The myometrium thickness was measured at 4 different sites: 1-Fundus, 2-Low anterior, 3-Mid anterior and 4-Posterior. Each measure was made from a separate scan image. At least three measurements were taken and the mean value of the three measures was considered as the current thickness. To assess cervical length, the probe was placed gently in anterior vaginal fornix, then it was withdrawn slowly until a sagittal view of the full cervix, including the internal os, external os and endocervical canal, was obtained. At least three measurements were taken and the mean value of the three measures was considered as the current cervical length.

Presence of funneling was considered when the endocervical canal was dilated 5 mm or more with or without extrusion of fetal membranes. The cervical position was defined as primarily horizontal. A cervix will be classified as vertical if the endocervical canal appeared to have an angle greater than 45° in relation to the horizontal plane (axis of the maternal abdomen)**.** The participants in the study was followed up till delivery, gestational age and mode of delivery was recorded by direct contact with the patient or from hospital records.

Statistical analysis:

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version 18.0, IBM Corp., Chicago, USA, 2009. Descriptive statistics were done for quantitative data as minimum& maximum of the range as well as mean±SD (standard deviation) for quantitative normally distributed data, while it was done for qualitative data as number and percentage. Inferential analyses were done for quantitative variables using Shapiro-Wilk test for normality testing, independent t-test in cases of two independent groups with normally distributed data. In qualitative data, inferential analyses for independent variables were done using Chi square test for differences between proportions and Fisher's Exact test for variables with small expected numbers. ROC curve was used to evaluate the performance of different tests differentiate between certain groups. The level of significance was taken at P value < 0.050 is significant, otherwise is non-significant.

Depending on the finding of Mean±SD of Cervical length in preterm and term was 22.2±2.8 and 26.0±2.9 mm respectively, with finding the difference was significant at p-value <0.050 and by using PASS 11th release the power = 0.979 and depending on the finding of Mean±SD of low anterior thickness in preterm and term was 5.0±0.8 and 5.9±0.8 mm respectively, with finding the difference was significant at p-value <0.050 and by using PASS 11th release the power = 0.915.

RESULTS

Table 1 shows that: group A significantly had higher gravidity, parity and abortion. Table 2 shows that: Group A significantly had more frequent vaginal discharge and previous abortion. Table 3 shows that: Preterm cases significantly had higher abortion and preterm. Table 4 shows that: Preterm cases significantly had lower cervical length and myometrial thickness. Table5 shows that: Cervical length ≤26.0 (mm) and posterior uterine thickness ≤6.0 (mm) had highest diagnostic characteristics in

predicting preterm delivery among group A; they hd high sensitivity but low specificity. Figure 1: Cervical length and thickness had significant moderate diagnostic performance in predicting preterm delivery among group A. Figure 2: Only Cervical length and Fundal thickness had significant moderate diagnostic performance in predicting preterm delivery among group B.

Variables	Group A (N=50)	Group B (N=50)	P
Age (years)	28.3±4.6	27.8±3.7	^0.582
BMI (kg/m2)	28.1±2.1	27.7±2.2	^0.293
GA (week)	22.2±1.0	22.3±0.9	^0.682
Gravidity	3.9±1.5	2.1±1.2	^**<0.001***
Parity	1.9±0.8	1.3±1.0	^**<0.001***
Abortion	1.1±1.1	0.7±1.0	^**0.045***
Preterm	1.6±0.7	--	--
HTN	7 (14.0%)	4 (8.0%)	#0.338
DM	3 (6.0%)	2 (4.0%)	§1.000

^Independent t-test. #Chi square test. §Fisher's Exact test. *Significant

Table 1: Comparison between the studied groups regarding demographic and clinical characteristics.

Variables	Group A (N=50)	Group B (N=50)	P
Vaginal discharge	36 (72.0%)	21 (42.0%)	**#0.002***
Previous abortion	29 (58.0%)	19 (38.0%)	**#0.045***
Threatened abortion	9 (18.0%)	5 (10.0%)	#0.249
Interval ≤18.0 month	15 (30.0%)	8 (16.0%)	#0.096
Age <20.0 years	4 (8.0%)	1 (2.0%)	§0.362
Smoking	4 (8.0%)	3 (6.0%)	§1.000

Table 2: Comparison between the studied groups regarding risk factors.

Variables	Preterm (N=13)	Term (N=37)	P
Age (years)	29.6±4.8	27.8±4.5	^0.228
BMI (kg/m2)	28.8±2.5	27.9±2.0	^0.211
GA (week)	22.1±1.3	22.2±0.9	^0.671
Gravidity	3.7±1.4	3.9±1.5	^0.641
Parity	1.8±0.7	2.0±0.8	^0.625
Abortion	1.7±1.3	0.9±1.0	^**0.032***
Preterm	2.5±0.5	1.5±0.6	^**0.001***
HTN	3 (23.1%)	4 (10.8%)	§0.357
DM	2 (15.4%)	1 (2.7%)	§0.162

Table 3: Comparison according to delivery time in group A regarding demographic and clinical characteristics.

Characteristics		Preterm (N=13)	Term (N=37)	P
Position	**H**	10 (76.9%)	26 (70.3%)	§0.734
	V	3 (23.1%)	11 (29.7%)	
Funneling		1 (7.7%)	1 (2.7%)	§0.456
Cervical length (mm)		22.2±2.8	26.0±2.9	^**<0.001***
Low Anterior thickness (mm)		5.0±0.8	5.9±0.8	^**<0.001***
Mid Anterior thickness (mm)		5.2±0.9	6.0±0.7	^**0.004***
Fundal thickness (mm)		5.2±0.8	6.1±0.9	^**<0.001***
Posterior thickness (mm)		5.7±0.9	6.7±0.7	**<0.001***

Table 4: Comparison according to delivery time in group A regarding US findings.

Characters	Cervical length ≤26.0	Low anterior ≤5.0	Mid anterior ≤5.0	Fundal ≤6.0	Posterior ≤6.0	H position
Sensitivity	100.0%	69.2%	61.5%	100.0%	84.6%	76.9%
Specificity	45.9%	70.3%	78.4%	40.5%	62.2%	29.7%
DA	60.0%	70.0%	74.0%	56.0%	68.0%	42.0%
YI	**45.9%**	39.5%	39.9%	40.5%	**46.8%**	6.7%
PPV	39.4%	45.0%	50.0%	37.1%	44.0%	27.8%
NPV	100.0%	86.7%	85.3%	100.0%	92.0%	78.6%
LR+	1.85	2.33	2.85	1.68	2.24	1.09
LR-	0.00	0.44	0.49	0.00	0.25	0.78
LR	>100.0	5.32	5.80	>100.0	9.04	1.41
Kappa	0.307	0.336	0.371	0.262	0.360	0.042

CI: Confidence interval, DA: Diagnostic accuracy, YI: Youden's index PPV: Positive Predictive value, NPV: Negative Predictive value, LR+: Positive likelihood ratio, LR-: Negative likelihood ratio, LR: Diagnostic odd ratio

Table 5: Diagnostic characteristics of US in predicting preterm delivery among group A

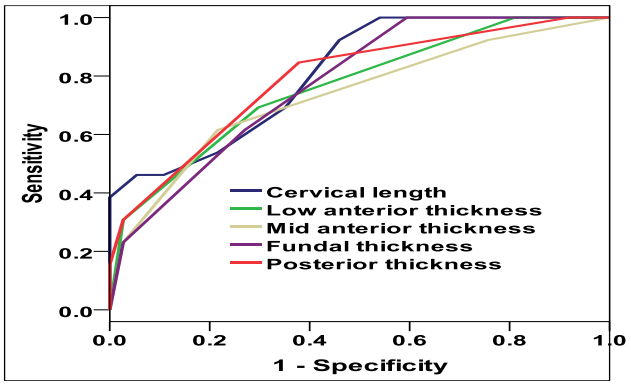

Figure 1: ROC curve for cervical length and thickness in predicting preterm delivery among group A.

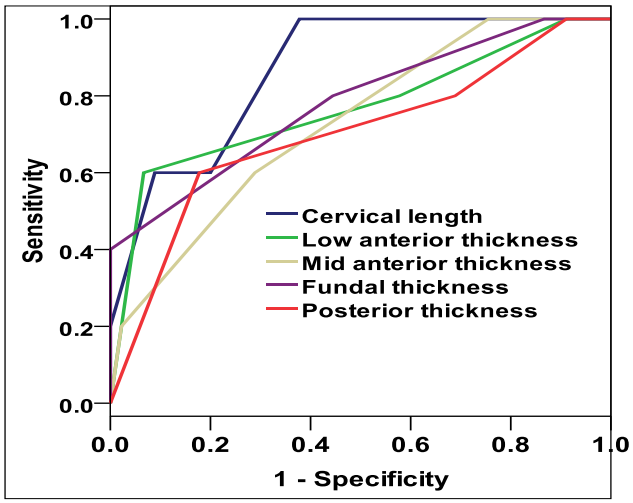

Figure 2: ROC curve for cervical length and thickness in predicting preterm delivery among group B.

DISCUSSION

This observational prospective study evaluated the role of ultra sonographic measurement of myometrial thickness, cervical length, presence of funneling and cervical position in prediction of preterm labor. The incidence of preterm birth according to our result was 18%which is consistence with the WHO[5] report in 2017. It reported that across 184 countries, the rate of preterm birth ranges from 5% in some northern European countries to 18%in some countries in sub-Saharan Africa and Asia.

We observed a statistically significant difference in the incidence of preterm birth between high risk group A and low risk group B (5%, 13% respectively). Similar results were obtained by Iams et al.,[6] who found that the rate of recurrent spontaneous preterm birth was 15%, while the rate of spontaneous preterm birth among parous women with a previous uncomplicated term delivery was 3%.

In addition, there was a statistically significant association between the presence of positive history of previous abortion and the risk of preterm birth. The same result was noted by Ancel et al.[7] in the EUROPOP study. They found that previous induced abortions were significantly associated with preterm birth and the risk of preterm birth increased with the number of abortions.

The cervical length measured at 20-24 weeks in group A was significantly shorter in spontaneous preterm birth women in comparison to women who delivered at full term. McFarlin et al.[8] found that cervical length was significantly shorter at 22–26 weeks in the spontaneous preterm birth women than in the women delivering at full term .In a study by Tanvir et al.[9] , the mean cervical length was 33.16 mm. Almost 80% of women who had cervical length <25 mm at mid trimesters had spontaneous preterm delivery and the relative risk of preterm delivery increased as the length of the cervix decreased.

In our study, the predictive role of cervical length measurement in mm was evaluated by ROC curve in group B between 20 to 24 weeks cervical length < 26 mm has sensitivity 100%, specificity 48.9%, PPV 17.9% and the NPV 100% with 54% accuracy. The sensitivity and specificity of cervical length measurement of 25 mm in low risk women was calculated in Dalili et al.[1] study, they were 55.5% and 93.6% respectively. Barber et al.[10] found that a cervical length of ≤25mm at 24 weeks had a sensitivity of 37%, a specificity of 92%,a positive predictive value 18%, and a negative predictive value 97 % in the prediction of spontaneous preterm labor at <35weeks' gestation. Arisoy and Yayla[11] concluded that, although low sensitivity and low positive predictive value of cervical length measurement, it has high negative predictive values so it can be used in screening of preterm labor in pregnant women.

In Dalili et al.[1] study, 12% of spontaneous preterm birth women had positive funneling. Duration of pregnancy and cervical length significantly differed between women with and without funneling. Yost et al.[12] found that cervical canal dilation of 2–4 mm was a significant predictor of spontaneous preterm birth of less than 35 weeks in univariate analyses.

Regarding the cervical position, 10 out of 13 women in high risk group who had horizontal position of the cervix between 20-24 weeks had a preterm birth. This incidence was statistically insignificant. In literature there are conflicting results, Chhabra et al.[13] , found that the incidence of preterm birth was significantly higher in women with vertical position of cervix (80%) than that with horizontal position (20%). However Yost et al.[12] reported that horizontal position of the cervix was found in 59% and it was insignificant in prediction of preterm birth.

Our study showed that there are no significant differences in myometrial thickness in different sites between group A and group B. Using ROC curve to evaluate the role of measurement of myometrial thickness in prediction of preterm labor between 20-24 weeks in group A posterior uterine thickness ≤6.0 (mm) had highest diagnostic characteristics in predicting preterm delivery among risky group; they had high sensitivity but low specificity. Posterior uterine segment <6mm had sensitivity 84.6%, specificity 62.2%, PPV 44% and the NPV 92% with 68% accuracy.

Similar results were found in Buhimschi et al.[14] study as there was a significant thickening of the fundal wall of the uterus follows PPROM. Different result was obtained by Durnwald and Mercer[15] , myometrial thickness of the fundus was significantly lesser than anterior, posterior, right and left side uterine walls. In Sfakianaki et al.[16] study, they found no significant changes in measurements at the anterior and fundal site over time throughout pregnancy but there was a significant and gradual thinning of the lower uterine segment myometrium during gestation. Hamdi et al.[17] found that myometrial thickness of the upper uterine segment remains fairly constant in the first and second trimesters of pregnancy, whereas a significant linear trend was found between thinning of the lower uterine segment and advancing gestational age.

CONCLUSION

Our study showed that the role of ultrasound in the prediction of preterm birth is: At 20-24 weeks of gestation, transvaginal cervical length measurement is the best predictor. A posterior uterine thickness ≤6.0 (mm) had highest diagnostic characteristics in predicting preterm delivery among risky group. Cervical position was found insignificant in prediction of preterm birth.

Conflicts of interest: no conflicts of interest were encountered.

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