Original Research Article

Evaluation of the anterior cervical angle of the uterus to predict spontaneous preterm birth

Bijay Sur, Sujata Misra*, Sanghamitra Dash

Department of Obstetrics and Gynecology, SCB Medical College, Cuttack, Odisha, India

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*Correspondence:
Dr. Sujata Misra,
E-mail: drsujatamisra@gmail.com

ABSTRACT

Background: This prospective observational study was conducted to evaluate the anterior cervical angle (ACA) of the uterus by transvaginal sonography (TVS) and to determine the feasibility to predict spontaneous preterm birth (PTB). The duration of the study was from December 2014-December 2016.The participants included 100 pregnant women with singleton pregnancy who were asymptomatic. They were enrolled after excluding all known risk factors of preterm birth.

Methods: The ACA and cervical length were measured in all cases by transvaginal sonography either in the 1st trimester or 2nd trimester. All cases were followed and well documented with respect to the gestational age at delivery.

Results: There was a significant risk of preterm labour in women with cervical length <2.5cm in the 2nd trimester with Odds Ratio 3.625, P value=0.001, sensitivity 75% and specificity 79.31%. The positive predictive value was 33.33% and negative predictive value 95.83%. The false positive rate was 20.65% and false negative rate 25%. The difference of mean cervical angle in women who delivered preterm and that of those who delivered at term, in the 1st trimester (preterm group 114.2°Vs term group 93.0°, P<0.001) and in the 2nd trimester (preterm group 127.66° Vs term group 103.65°, P <0.001) was significant. An ACA of 114.2° in the 1st trimester was associated with a risk of spontaneous preterm birth (P value 0.0065, sensitivity 90% and specificity 80%). An ACA of 127.66° in 2nd trimester was associated with a risk of spontaneous preterm birth (P value 0.0004, sensitivity 80%and specificity 88.23%).

Conclusions: Despite the limitations of a small sample size, the results suggest that the anterior cervical angle has potential as a new predictor of spontaneous preterm birth especially when measured in the 1st trimester.

Keywords: Anterior cervical angle, Preterm birth, Transvaginal sonography

INTRODUCTION

Preterm birth is the leading cause of neonatal morbidity and mortality worldwide. It accounts for 75% of neonatal deaths and 50% of long-term morbidity which is inversely related to the gestational age at birth.[1] According to WHO, 2016 (Nov), an estimated 15 million babies are born too early every year and almost 1 million children die each year due to complications of preterm birth.[2] In India, out of 27 million babies born every year (2010 data), 3.5 million babies born are premature. The effects of PTB extend beyond early infancy with substantial long-term consequences in late childhood and adult life.[3]

Current prenatal screening protocols during the first and second trimesters, identify only approximately 55% to 69% of cases of spontaneous preterm birth (PTB), respectively.[4] The concept of an ultrasonic measurement of the anterior cervical angle (ACA) can be an additional predictor of spontaneous PTB. The patho-physiological principle is purely physical and follows the rules of

gravity and trigonometry. With advancing pregnancy, the force of the pregnant uterus is shifted towards the cervix and depending on the angle of inclination, the cervical canal is either pressed shut in case of an acute angle or pressed open in case of an obtuse angle. This shift in cervical angle is used by one of the most effective interventions in preventing spontaneous PTB.[4] This is a prospective observational study to evaluate the anterior cervical angle (ACA) measured by Transvaginal sonography (TVS) for the prediction of spontaneous preterm birth

METHODS

This prospective observational study was conducted on women with singleton pregnancy in the 1st and 2nd trimesters attending the OPD or admitted to Obstetrics and Gynecology Department, S.C.B. Medical College and Hospital, Cuttack.

Exclusion criteria

Multiple pregnancy, polyhydramnios, uterine anomalies, fibroids, h/o cervical excision treatment, rupture of membrane, uterine specific infections (chorioamnitis, bacterirua etc), cigarette smoking, illicit drug abuse, physical abuse, all other systemic illnesses. Number of cases were 100.

All pregnant women with singleton pregnancy, recruited in this study, underwent transvaginal sonography to measure the anterior cervical angle and cervical length in the 1st and 2nd trimesters. (Anterior uterine wall was imaged, the internal and external cervical ora including the isthmus were identified and a line between them was

drawn. A second line was drawn parallel to the lower aspect of the anterior uterine wall passing through the internal cervical os. The angle created by the two lines at the internal os was measured). They were followed up and the pregnancy outcome was documented. The co relation of preterm birth and term birth and its relation to the cervical angle was analyzed.

RESULTS

During the two years period (December 2014-Dececember 2016) of this prospective study, 63 women of the 100 cases enrolled, delivered at term; while 37 women had preterm delivery. Of the women who delivered preterm, 50% were of the high socioeconomic group, 28.3% in the low socioeconomic group and 38.9% in the middle socioeconomic group. On analysing the relationship of maternal age to the incidence of preterm labour, it was seen that the highest incidence of preterm labour in the age group 25-30 years (45.7%); while it was 26.4% in the 20-25 age group and 25% in the 30-35 years age group. The relationship of maternal height to preterm labour was analysed and it was inferred that the incidence of preterm labour was highest (35.7%) in the group with a maternal height between 140cm-150cm.It was 31.6% in the height group >150cm and 18.2% in height <140 cm.

The relation of history of preterm delivery to the risk of preterm labour was analysed.

It was seen that in 81.25% of the cases with history of prior preterm birth had preterm labour. Statistical analysis further showed the P value to be <0.001 and the Odds Ratio was 3.15. The 95% Confidence interval was 1.9574-5.0693and χ^2 was 20.056 (Table 1).

Table 1: Risk of preterm labour in relation to H/O preterm birth.

History of preterm birth	Preterm labour				Total
	No	%	Yes	%	
No	64	76.2	20	23.8	84
Yes	3	18.75	13	81.25	16
Total	67	67	33	33	100
	Value	df	Asymp Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	20.056	1	0.000		
Continuity Correction	17.542	1	0.000		
Likelihood Ratio	19.182	1	0.000		
Fisher's Exact Test				0.000	0.000
Relative risk 3.1500	95% CI 1.9574-5.0693	P value <0.001	Odds Ratio 3.15		

Table 2 represents the relationship of cervical length measured in 2nd trimester by TVS scan of subjects with preterm labour. For the estimation of risks by cervical length in preterm labour, measured cervical length was

divided into 2 groups i.e. cases (those whose CL <2.5cm) and controls (those whose CL ≥2.5cm). There was a higher incidence of preterm labour (75%) in cervical length <2.5cm than incidence (20.68%) in cervical length ≥2.5cm.

Table 2: Relation between 2nd trimester cervical length and preterm labour.

2nd trimester cervical length	Preterm Labour					Total
	No	%	Yes	%		
Less than 2.5cm	2	25	6	75		8
More than equals to 2.5cm	46	79.3	12	20.7		58
Total	48	72.7	18	27.3		66
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)		Exact Sig. (1-sided)
Pearson Chi-square	10.455	1	0.001			
Continuity Correction	7.896	1	0.005			
Likelihood Ratio	9.210	1	0.002			
Fisher's Exact Test				0.004		0.004

Odds Ratio 3.625, 95% Confidence Interval(CI) 1.905-6.898, Pearson Chi-square ($\chi2$) 10.455, 'P' Value 0.001, Relative risk 3.6250.

Statistical analysis was done by Chi-Square tests which showed there was significant risk of preterm labour in subjects with CL <2.5cm with Odds Ratio 3.625 (i.e. more than 3 times higher risk), P value 0.001, Chi-Square (χ^2) = 10.455, Confidence Interval (CI) 1.905-6.898 and Relative risk 3.6250.

2nd trimester cervical length cut-off level <2.5cm was predictor of spontaneous preterm birth with sensitivity 75% and specificity 79.31%. Positive predictive value 33.33% and negative predictive value 95.83%. The False positive rate was 20.65% and false negative rate 25%.

Table 3: Relation between ACA in 1st trimester and preterm labour.

		Number	Mean	Std. deviation	Std. Error Mean
ACA in 1st trimester	No	16	93.038°	10.3589	2.5897
	Yes	15	114.213°	2.4089	0.6220
ACA in 1st trimester	s PTL		No s PTL		P value =0.0065
	N	%	N	%	Total	95% Confidence Interval (CI)
<114.2°	2	20	8	80	10	2.7210-476.2989
≥114.2°	9	90	1	10	10	Odds ratio (OR) 36.00

Table 4: Relation between ACA in 2nd trimester and preterm labour.

Preterm labour		Number	Mean	Std. deviation	Std. Error Mean
ACA in 2nd trimester	No	51	103.649°	14.0096	1.9617
	Yes	18	127.661°	6.6117	1.5584
ACA in 2nd trimester	sPTL		No s PTL		P' value =0.0004
	N	%	N	%	Total	
<127.66°	4	11.8	30	88.2	34	95% Confidence Interval (CI) 4.6329-194.2615
≥127.66°	8	80	2	20	10	Odds ratio (OR) 30.00

There was significant difference of mean ACA between peterm group and term group, (114.2° vs 93.0°). The incidence of spontaneous preterm birth was more in 1st trimester ACA ≥114.2° (i.e. 90%) and statistical analysis shows this angle was associated with risk of spontaneous PTL with P value =0.0065, 95% Confidence Interval(CI) 2.7210-476.2989andOdds Ratio 36.00 (Table 3).

There was significant difference of mean ACA between peterm group and term group, (127.66° vs 103.65°). The incidence of spontaneous preterm birth was more in ACA ≥127.66° (80%).On further analysing the data it was found that the 2nd trimester ACA ≥127.66° was associated with significant risk of spontaneous PTL with 'P' value 0.0004, 95% Confidence Interval (CI) 4.6329-194.2615andOdds Ratio 30.00 (Table 4).

DISCUSSION

Across 184 countries, the rate of preterm birth ranges from 5% to 18% of babies born.[2] Globally it is estimated that 11.1% of births are preterm and being born preterm is the direct cause of 27% of the neonatal deaths.[3] During

the study period, (December 2014-December 2016), the institutional incidence of preterm births was 28.02% and the incidence of preterm births in our study group was 37%. There was an increased incidence of preterm births in high socio-economic groups but statistically no significant causal association between preterm birth and socio-economic status. There was higher incidence of preterm labour (81.25%) in subjects with history of preterm birth as compared to lower incidence (23.80%) in subjects without history of preterm birth. Chi-Square Tests of independence revealed the Pearson Chi-Square (χ^2) 20.056; 95% Confidence interval (CI) 1.9574-5.0693, and P value <0.001 which signified that there was a significant causal effect of history of prior preterm birth with preterm labour in the subsequent pregnancies with Odds Ratio (OR) 3.1500.

From statistical analysis, it concluded that the history of prior preterm birth is a risk factor for preterm labour in subsequent pregnancies with P value <0.001, sensitivity 81.25% and specificity 76.19%. Bloom SL et al, observed that the risk of recurrent preterm delivery for those whose 1st delivery was preterm, is increased by three-fold, compared with women whose 1st delivery reached term. Almost 1/3rd of women whose first two deliveries were preterm, delivered preterm in their 3rd pregnancies.[5] Yamashita M et al , have reported that the risk factors for recurrence included multiple previous spontaneous PTB (adjusted odds ratio (aOR): 2.26; 95% confidence interval (CI): 1.19-4.30; P = 0.013), as compared to no previous term birth (aOR: 2.08; 95% CI: 1.24-3.49; P = 0.005).[6] Mazaki-Tovi S et al have opined that patients with a history of an indicated preterm birth are at risk not only for recurrence of this subtype, but also for spontaneous preterm birth.[7]

In the study, the second trimester cervical length cut-off level < 2.5cm was predictor of spontaneous preterm birth with sensitivity 75% and specificity 79.31%. Positive predictive value 33.33% and negative predictive value 95.83%. The False positive rate was 20.65% and false negative rate 25%. According to Banicevic AC et al, the incidence of high premature birth (defined as birth before 36.6 weeks) was 50% in patients with cervical length bellow 15mm. In the group of patients with cervical length up to 25mm the premature risk incidence was 10.52±0.05.[8]

According to Boelig RC et al, women with a short CL did not differ from women with normal CL with respect to demographic variables or mean number of risk factors (4.20±2.11 versus 3.52±1.97, p =0.23), but they did deliver at a significantly earlier gestational age (25.0±1.1 versus 34.6±3.1 weeks, p <0.01). The distribution of the presentation of sPTB was different in women with a short versus normal CL (p <0.01).[9] Iams JD, Goldenberg RL, Meis PJ, et al have reported that when the length is below 20 mm there is increased risk and treatment should be considered. Cervical length <20 mm at 24 weeks has sensitivity of 23%, specificity of 97% and positive predictive value of 26% for PTB before 35 weeks in a population with a PTB rate of 4.3%.[10]

There was significant difference of mean angle between women who delivered preterm and that of those who delivered at term (preterm group 114.2° Vs term group 93.0°) and a significance association between ACA and spontaneous preterm birth. The ACA of 114.2° in 1st trimester yielded a risk of spontaneous preterm birth with P=0.0065, false positive rate 18.18%. According to N. Sochacki-W´ojcicka et al, there was a significant difference between the median ACA in the first trimester of women who delivered preterm and that of those who delivered at term (preterm group, 115.5◦ vs controls, 85◦; P=0.0002). A linear regression analysis suggested that the ACA increased with advancing gestation (P=0.0001). As an isolated marker, the ACA yielded an estimated detection rate for spontaneous PTB of 61.1% in the first trimester with a false-positive rate of 10%.[11]

The study showed a significant difference of mean ACA in 2nd trimester between women who delivered preterm and that of those who delivered at term (preterm group 127.66° Vs term group 103.65°) and a significant association between ACA and spontaneous preterm birth. According to N. Sochacki-W´ojcicka et al, there was a significant difference between the median ACA in the second trimester of women who delivered preterm and that of those who delivered at term (preterm group, 126° vs controls, 91.5°; P <0.0001). A linear regression analysis suggested that the ACA increased with advancing gestation (P=0.0001). As an isolated marker, the ACA yielded an estimated detection rate for spontaneous PTB of 66.7% in the second trimester with a false-positive rate of 10%.[11] Dziadosz M et al too have reported that in gestations between 16 0/7-23 6/7 weeks, the uterocervical angle of ≥95 degrees was significantly associated with spontaneous preterm birth <37 weeks with sensitivity of 80% (P <0.001; confidence interval, 0.70-0.81; negative predictive value, 95%). Uterocervical angle of ≥105 degrees predicted spontaneous preterm birth <34 weeks with sensitivity of 81% (P <0.001; confidence interval, 0.72-0.86; negative predictive value, 99%).[12]

CONCLUSION

100 asymptomatic women with a single term pregnancy without any risk factors for preterm birth were included in the study. The anterior cervical angle and cervical length were measured in all cases by transvaginal sonography either in the 1st trimester or 2nd trimester. All cases were followed and all documents were recorded specially focusing on preterm labour (spontaneous/indicated) and other causes of preterm birth developed later causing late exclusion from the study. Statistical analysis showed that there was no significant risk associations of maternal age, maternal height and socio-economic status with preterm birth. There was a significant risk of preterm labour in women with cervical

length <2.5cm in the 2nd trimester. A significant difference of mean angle between women who delivered preterm and that of those who delivered at term in both 1st trimester (preterm group 114.2° Vs term group 93.0°) and 2nd trimester (preterm group 127.66° Vs term group 103.65°) was noted. The ACA of 114.2° in 1st trimester was associated with a risk of spontaneous preterm birth and an ACA of 127.66° in 2nd trimester was associated with a risk of spontaneous preterm birth.

The results suggest that the anterior cervical angle has potential as a new predictor of spontaneous preterm birth especially when measured in the 1st trimester. Detection rates may be improved if combined with other parameters such as cervical length, maternal characteristics and obstetric history. This would be of great help and importance in the prediction and hence prevention of PTB.

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