

Prediction of Delivery Mode in pregnant Women using Angle of Progression before Onset of Labor

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Abstract: Objectives: Prediction of delivery mode using angle of progression in the primigravida between 37 and 40 weeks of gestation. **Background:** Prediction of delivery mode, particularly identification of pregnant women at risk for Cesarean delivery has the potential to improve pregnancy outcome. Trans-labial ultrasound has been suggested to be useful for predicting the delivery mode. **Methods:** The study included one hundred nulliparous women with gestational age of 37 to 40 weeks, singleton fetus, cephalic with intact membranes. All women were not in labor. We excluded women scheduled for elective cesarean section (CS) for a variety of indications. After taking history and physical examination patients were submitted for trans-labial Ultrasound imaging to measure the angle of progression and the delivery mode was followed to test the ability of the measured angle to predict the delivery mode. **Results:** For a cut off 92.5 °, angle of progression correctly identified cases planned to deliver vaginally with a sensitivity of about 97.4% and a specificity of 79.2%. A statistically significant correlation was found between the angle of progression measured in the antenatal period and the delivery mode ($p < 0.0001$). **Conclusion:** Trans-labial ultrasound converted images to measure the angle of progression in antenatal period accurately predicted the mode of delivery providing a more scientific basis for assessing labor.

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Key Words: Angle of progression - Caesarian Section - Trans-labial ultrasound - Vaginal Delivery.

1. Introduction

Prediction of delivery mode, particularly identification of pregnant women at risk for CS has the potential to improve pregnancy outcomes and women's satisfaction with their childbirth experience¹.

There is clinical significance of an unengaged fetal head (as determined by digital examination) before the onset of labor in the prediction of CS due to abnormal labor progress².

But there is a controversy about the limited accuracy of assessment of fetal head station by digital examination, especially before labor, when the presenting part is palpated through a closed cervix³.

Indeed, several studies have shown that digital determination of fetal head station and position in laboring women is imprecise and poorly reproducible even in the hands of experienced examiners⁴.

Ultrasound has been used extensively in the late third trimester and before the onset of labor as a more objective tool with which to predict the delivery mode⁵.

Using trans-labial ultrasound, described a method that measured the angle between the long axis of the symphysis pubis and a line extending from its most inferior edge tangentially to the fetal skull, suggesting that this angle can predict delivery mode among laboring women. This method, termed the "angle of

progression" (AOP) has been demonstrated to be an objective, reliable and reproducible method for assessing fetal head descent in laboring women⁶.

This work aimed to measure the ability of measured angle of progression using trans-labial ultrasound to accurately predict the delivery mode.

2. Patients & Methods

This study was carried out in the department of Obstetrics and Gynecology at Al-Hussein Hospital between June 2017 to February 2018 and included one hundred nulliparous women. An informed consent was taken from all participants. The ultrasound studies were done by two different operators and the managing obstetricians were blinded to the results of antenatal ultrasound.

The inclusion criteria were: Gestational age from 37 to 40wk, Singleton fetus, intact membrane, Cephalic presentation, attending at antenatal care clinic in Al-Hussein Hospital and not in labor.

The exclusion criteria were: Multiple pregnancies, fetal presentation other than cephalic presentation, Women scheduled for induction of labor, Women scheduled for elective cesarean section for a variety of indications and Women with previous Cesarean delivery. All patients were submitted to detailed history including patient age, present, past

history, obstetric history, general examination, obstetric and local examination.

Technique used to measure angle of progress

All women were assessed by the physician on duty and if they were found not in labor, trans-labial ultrasound examination was done. The ultrasound assessment was performed by two different experienced operators. The examination was conducted with General Electric P80, 2005. The abdominal probe was enclosed in a latex glove covered with ultrasound gel and then placed between the labia below the pubic symphysis.

The sagittal view, in which the long axis of the pubic symphysis could be ascertained. While in this same plane, the leading portion of the fetal head could easily be discerned. A line was drawn on the screen between calipers placed at the two points identifying the long axis of the pubic symphysis. A second caliper line then was created on the frozen image that extend from the most inferior portion of the pubic symphysis tangentially to the fetal skull contour. The angle between the constructed lines was measured electronically. (Figure 1).

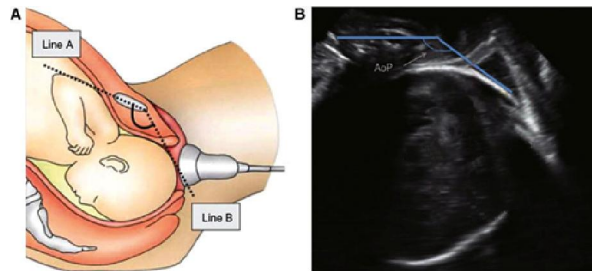


Fig. (1): Ultrasound image and diagram demonstrating the angle of progression of the fetal head.

Data recorded by Ultrasound scan included gestational age during angle measurement, fetal presentation, Fetal Position (occipito-anterior/occipitoposterior), fetal head circumference measured in cm and Angle of progression.

Statistical analysis

Data was collected and entered to the computer using SPSS (Statistical Package for Social Science) program for statistical analysis, (SPSS version 20; Inc., Chicago. IL, USA). Quantitative data were described using mean and standard deviation (SD). Qualitative data were described using number and percent. Comparison of quantitative variables in two groups was conducted using independent t-tests. Association between two qualitative variables (2-2) was done using Chisquare test. Correlation between two quantitative variables was done using Pearson correlation test.

U-test was used Compare the distributions of scores on a quantitative variable obtained from 2 independent groups. ROC curve analysis was done to test the diagnostic performance of certain markers to predict the onset of vaginal birth. Sensitivity was defined as the fraction of parturients who delivered vaginally that the marker correctly identified as positive. On the other hand, specificity was defined as the fraction of people who delivered by cesarean section that the test correctly identified as negative. The area under a ROC curve (AUC) quantifies the overall ability of the test to discriminate between those individuals destined to deliver vaginally and those who didn't. In all statistical tests, a level of significance of.05 was used, below which the results were considered to be statistically significant.

3. Results

The current study included 100 pregnant women in the antenatal care clinic at Al-Hussein hospital, Cairo, Egypt. All cases were primigravida.

Patient's characteristics:

The mean patient age in the studied population was 23.38 ± 4.57 years. The mean gestational age based on the U/S scan was 38.40 ± 0.752 weeks ranging from 37 to 40 weeks of gestation. The mean fetal birth weight was 3360 ± 444.9 gm with a mean head circumference of 35.96 ± 1.17 cm. Nearly 76% of patients delivered vaginally as compared to 24% who delivered by CS. Using transabdominal ultrasound 90% of all fetuses were in occipito-anterior position and 10% were in occipito-posterior.

Correlations and associations:

Table (1): Relation between age, anthropometric measurements, angle of progression, fetal characteristics and mode of delivery.

Anthropometric Measurement	Vaginal Delivery N = 76	Cesarean Section N = 24	Test	P- Value
	(Mean± SD)	(Mean± SD)		
Age	23.08 ± 4.78	24.33 ± 3.738	1.832	0.067
Weight	88.18±9.08	87.92 ± 7.92	0.291	0.771
Height	160.2 ± 5.83	159.50 ± 4.67	0.551	0.582
BMI	34.1 ± 2.81	34.45 ± 2.52	0.695	0.487
Angle of progression	104.88 ± 7.10	86.58 ± 11.212	5.723	0.0001
Head circumference (cm)	35.71 ± 1.105	36.75±1.03	3.571	0.0001
Birth weight (gm)	3328.9 ±435.6	3458.33 ±468.9	1.329	0.184

Regarding anthropometric measurements there was no significant statistical difference between both groups as regard age, weight, height and body mass index (BMI), table 1.

Regarding the fetus there was no significant statistical difference between both groups as regard birth weight and head circumference, table 1.

Females who delivered vaginally showed a statistical significance higher mean of the angle of progression (104.88 ± 7.10)° versus (86.58 ± 11.212)° with a P-value <0.0001 which indicate very high statistical significance between the angle of progress measurement in cases with normal vaginal delivery versus those who delivered by C.S, table 1.

Females admitted were classified according to angle of progression measurement into two groups, the first group with angle measurement < 92.5 compared to the second group with Angle >93.5. The first group included 21 Women with angle of progress measurement less than 92.5°, 2 cases (9.5%) had normal vaginal delivery while the rest 19 cases (90%) delivered by CS. while in the second group with angle >93.5, 74 case delivered with VD (93.7%) and only 5 cases delivered by CS (6.3%) with P-value =0.0001 which indicate a very high statistical significance between both group, table 2.

Table (2): Relation between cut off point (angle 92.5) and mode of delivery.

	Vaginal Delivery	Cesarean Section
Angle < 92.5	2 (9.5 %)	19 (90%)
Angle > 92.5	74 (93.7%)	5 (6.3%)
Test used X ²	64.402	
P - Value	0.0001	

The Pearson correlation test showed a weak correlation between Bishop Score and the angle of progression (figure.2).

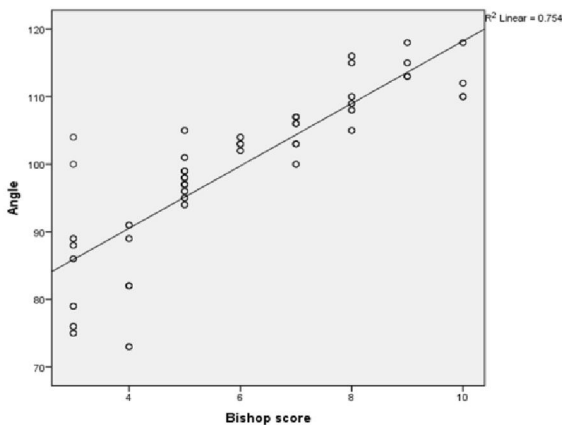


Fig. (2): Pearson correlation between Bishop Score and the angle of progression.

Testing the angle of progression to identify patients who will deliver vaginally showed a ROC curve having an AUC of 0.888 with a strong statistical

significance ($p < 0.0001$). For a cut-off value of 92.5°, such a test will have a sensitivity of 97.4% and a specificity of nearly 79.2% (Figure. 3).

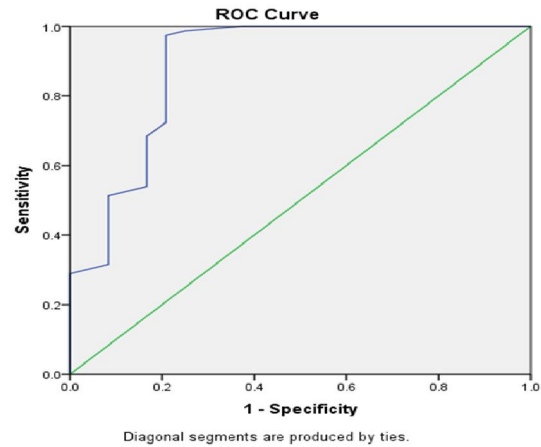


Fig. (3): ROC curve show that cut off value of angle of progression 92.5°.

4. Discussion

This study was done to assess the accuracy of measuring the angle of progression using ultrasound in predicting delivery mode in nulliparous women.

Regarding anthropometric measurements there was no significant statistical difference between both groups as regard age, weight, height and body mass index (BMI). Regarding the fetuses there were no significant statistical difference between both groups as regard birth weight and head circumference. Angle of progression differed significantly between patients who delivered vaginally from those by CS. For a cut-off angle of 92.5°, angle of progression showed a sensitivity of 97.4 % and specificity of 79.2 % in prediction of the occurrence of normal vaginal delivery with a p-value < 0.0001.

Barbera et al. studied the same angle and described a good intra- and inter observer variability that was less than 3°. Their data showed that an angle of at least 120° was always associated with subsequent spontaneous vaginal delivery. All cases were recruited in the labor ward at onset of labor, 51 cases were multiparous and only 37 cases were primigravida compared to our 100 subjects who were all a primigravida and recruited in antenatal care clinic⁷. These differences may be the cause of higher cut off point of the angle of progression (120°) compared to the (92.5°) of our study.

Tutschek et al. concluded that for a dynamic value of >135°, 94% of parturient will deliver vaginally. The study included 50 cases at second stage of labor and Use of intravenous oxytocin to augment labor was documented in 94% of cases⁸.

Torkildsen et al. defined an angle of progression of 110° as a cut-off to predict vaginal delivery which

occurred in 87% of patients. These figures are greater than dynamic cut-off values of the current work (92.5°)⁹.

The study included 110 cases at labor. Induction of labor was done in 17 cases. Augmentation during labor was done in 108 cases. Mode of delivery was 25.5% (28/ 110) Cesarean section, 41.8% (46/ 110) operative vaginal delivery and 32.7% (36/ 110) spontaneous vaginal delivery. Indications for Cesarean section were prolonged first stage (n = 20), prolonged second stage (n = 4) and fetal distress (n = 4). Indications for operative vaginal delivery were prolonged second stage (n = 25) and fetal distress (n = 21). In our study we haven't recorded the causes of cesarean section and operative vaginal delivery. Also we haven't recorded any induction or augmentation of labor.

Levy *et al.* concluded that An AOP $\geq 95^\circ$ measured before onset of labor had a sensitivity of 85%, a specificity of 89%, a positive predictive value of 98.7%, a negative predictive value of 36.3%, and a positive likelihood ratio of 7.7 and a negative likelihood ratio of 0.17 for the prediction of vaginal delivery at term in nulliparous women. These figures are close to the dynamic cut-off values of our current work (92.5°)¹⁰.

Among the 171 women who met the inclusion criteria, 100 were nulliparous and 71 were parous. Nine (9%) nulliparous women and one (1.4%) parous woman had Cesarean delivery.

The fact that the angle of progression in this study was measured before the onset of labor unlike others study may be the reason why this measurements is close to our study results.

Limitation of this study: We only measured the angle of progression before onset of labor if another measurement was done in the active labor we would be able to compare between both reading to determine the best time for measuring the angle to predict the delivery mode with higher sensitivity and specificity.

Also we measured the angle of progression only in primigravida, if other studies included both primigravida and multigravida patients so another study on multiparous group will be beneficial for comparison between the Angle of Progression in both groups.

We recommend that more studies should be held to test the role of AOP in the prediction of the delivery mode. Another study design should be held to test the role of AOP in the prediction of the delivery mode in multiparous patients and patients in active labor.

5. Conclusion

Birth represents one of the most important of all the experiences of the human kind. It is important to remember the simple objective of every pregnancy, namely the delivery of a healthy baby to a healthy mother. Current obstetric practice strives to avoid difficult vaginal deliveries and identify patients at risk of cesarean delivery. Our study proved that measuring the angle of progression in antenatal visits between 37 - 40 weeks of gestation using trans-labial ultrasound can predict the delivery mode with high sensitivity and specificity, and provides a more scientific basis for assessing labor.

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