Research Article

Accuracy of Transperineal Ultrasound Examination in Predicting Vaginal Delivery

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Abstract

Objective: To determine the accuracy of transperineal ultrasonography (HPD and AoP) in predicting vaginal delivery.

Methods: A cohort study was conducted using a consecutive sampling method on pregnant women in the active phase of labor at Fatimah Maternity Hospital, Pertiwi Maternity Hospital, and Syekh Yusuf Gowa Hospital.

Results: Out of 150 participants, 95 underwent vaginal delivery, 55 cesarean section. AoP and HPD parameters were found to be significantly different in both groups. The study found that an AoP value greater than 110.45 had a sensitivity of 90.53%, specificity of 70.91%, PPV of 84.31, NPV of 81.25, and P <0.001. In contrast, the HPD value of less than 3.54 predicted vaginal success with a sensitivity of 94.54%, specificity of 83.16%, PPV of 85.87, NPV of 89.66, and P <0.001.

Conclusion: AoP and HPD parameters on transperineal ultrasound can be considered to predict successful vaginal delivery.

Keywords: angle of progression, head perineum distance, transperineal ultrasound.

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INTRODUCTION

Vaginal delivery is a physiological and natural process. Between 1990 and 2018, the average cesarean section rate increased by 19 percentage points globally, including poor labor progress.[1] In Indonesia, the alternative of cesarean delivery compared to vaginal delivery increased from 12% in 2012 to 17% in 2017.[2] Maternal and neonatal morbidity rates are higher in cases of delayed labor. Hence, strategies to reduce the risk of complications for both the mother and the fetus include early prediction and decision-making about the mode of delivery in cases of delayed or arrested first or second stages of labor.[3] Detection of the mode of delivery preceding labor onset is beneficial since the emergency cesarean section during active labor leads to both maternal and fetal complications.[4] Transperineal ultrasound can be applied in real-time monitoring of labor progress, helping predict the possibility of vaginal delivery during labor, and further research in this area is warranted.[5]

Non-invasive transperineal ultrasonography has been utilized to detect fetal head descent by measuring the Head-Perineum Distance (HPD). The HPD is defined as the shortest distance from the fetal head to the perineum. Additionally, the Angle of Progression (AoP) is the angle between a line through the midline of the pubic symphysis and a line from the inferior crest of the symphysis to the front of the fetal skull.[6]

It has been demonstrated in multiple studies that in women with prolonged first stage, measurements of the Angle of Progression and Head-Perineum Distance are more reliable predictors of vaginal delivery. Researchers looked at 150 women in a multicenter trial that was carried out in 2012 in Cambridge and Norway. According to the study, there was a 7% chance of a cesarean section if the

head-perineal distance was less than 40 mm and an 82% chance if the distance was greater than 50 mm. According to the same study, the likelihood of a cesarean section is 12% if the angle of descent is greater than 110° and rises to 62% if the angle of descent is less than 100°.[7]

This research aimed to assess the predictive usefulness of transperineal ultrasound, using Head-Perineum Distance and Angle of Progression, in predicting the delivery method during the first stage of the active phase of labor.

METHODS

This study was conducted using a cohort research design. It was conducted for six months, from November 2022 to April 2023, at Fatimah Maternity Hospital, Pertiwi Maternity Hospital, and Syekh Yusuf Gowa Hospital. Researchers obtained Ethical Clearance with recommendation number 154/UN4.6.4.5.31/PP36/ 2022.

The inclusion criteria were Pregnant women in the first stage of labor in the active phase, gestational age from 37 - 42 weeks, and vertex presentation. The exclusion criteria were Malpresentation, pelvic organ disorders, macrosomia, and pregnant women with comorbidities.

The ultrasound examination was performed by one examiner, supervised and confirmed by two ultrasound professionals from the Maternal-Fetal Medicine Consultant, each with over 20 years of expertise. The ultrasound scans were conducted with 2 type Ultrasounds (Mindray DP-10 portable ultrasound and Mindray DC-8 ultrasound), which standardization is considered to have been equated by the same manufacturer.

A hundred fifty subjects of pregnant women in the active phase of labor were obtained through consecutive sampling. Data collection in this study utilized primary data obtained through a questionnaire and transperineal ultrasound examination to measure the size of AoP and HPD. An experienced Obstetrician Gynecologist conducted a transperineal ultrasound. To obtain the progression angle, the transducer should be placed in the sagittal plane translabially. Anatomic landmarks, such as pubic symphysis and the outer edge of the fetal skull, are used in this plane. Imaginary lines are drawn from the pubic symphysis long axis through the point of infra pubic, then end at the outer edge of the fetal skull. Head Perineum Distance is then achieved by placing the transducer transperineally with the transverse plane. Slight pressure is applied to display the fetal skull's perineal skin edge and outer edge (Figure 1). The measurements between the two calipers are then recorded (Figure 2) [8].

All data in this study were processed using IBM SPSS 24.0 with Mann-Whitney and chi-square analysis. The ROC (Receiver-Operating Characteristic) curve was used in this study to assess the predictive value of the Angle of Progression and Head Perineum Distance concerning the sensitivity and specificity of variables in predicting successful vaginal delivery.

RESULTS

This study was conducted on pregnant women in active phase 1 who underwent labor at the Teaching Hospital Network Hospital of Department of Obstetrics and Gynecology, Universitas Hasanuddin Faculty of Medicine, with 73 samples from Fatimah Maternity Hospital, 56 samples from Syekh Yusuf Gowa Hospital, and 21 samples from Pertiwi Maternity Hospital. The sample comprised 150 individuals who satisfied the inclusion criteria.

Table 1 displays the characteristics of the study subjects. Most study subjects were 20-35 years old, multigravida, high school education, and normal BMI. In this study, 95 (63.33%) participants had vaginal delivery, while 55 (36.67%) had Caesarean Section.

Table 2 shows that the parameters of age and BMI had a significant relationship ($p<0.05$). In terms of AoP, there was a significant difference between patients who had a vaginal delivery and the control group. The average AoP for patients with vaginal delivery was 122.02° (±15.86), while the control group had an average AoP of 107.27° (±7.23). HPD parameters were also found to be significantly different. In

the sample of vaginal deliveries, the mean HPD was 3.05 cm (±0.49), whereas in the control group, the mean HPD was 4.07 cm (±0.46).

The results of this study's sensitivity and specificity tests were based on tranperineal ultrasound parameters. Cut-off points for the Head-Perineum Distance and Angle of Progression were found, which have diagnostic value for vaginal delivery success, as demonstrated by the ROC (Receiver Operating Characteristic) Curve.

The Area Under Curve (AUC) value for the Angle of Progression was 0.881, and the Head-Perineum Distance was 0.955. This test obtained a cut-off point of ≥110.45o for the Angle of Progression, with a specificity of 70.91%, a sensitivity of 84.09%, PPV of 84.31, NPV of 81.25, and P < 0.001. The Head-Perineum Distance value obtained a cut-off point of <3.53 cm, with a specificity of 85.87%, a sensitivity of 83.16%, PPV of 85.87, NPV of 89.66 and P < 0.001.

DISCUSSION

The transperineal ultrasound technique can predict the success of vaginal delivery by measuring AoP and HPD. In this study, the cut-off value of AoP was ≥110.45, with a specificity of 70.91% and a sensitivity of 84.09%. Ultrasound techniques are more reliable than vaginal touche assessment for predicting whether spontaneous vaginal delivery is successful or requires a cesarean section. In previous study One hundred ten and one hundred fifty pregnant nulliparous women participated. The results showed 87% and 58% VD rates were noted in AoP ≥110°. It can be concluded that a higher vaginal delivery success rate is positively correlated with an increase in the AoP.[9] A study carried out in Indonesia discovered that a vaginal birth can be predicted with an AoP value of 107o with a sensitivity of 80% and specificity of 97%.[10]

Based on the ROC curve analysis, the AoP measurement in this study can predict vaginal delivery with an accuracy of 88.1%. Another study found that the optimal value of the angle of progression (AoP) is 116°, as this value optimizes the curve. No patient had a cesarean section with an AoP greater than 116°; instead, all patients had vaginal births. The 116° AoP demonstrated a sensitivity of 96.49% and specificity of 96.43% for a cut-off value of 116° in vaginally delivered cases, a value that was greater than that of cesarean section cases. With an AUC of 0.989, this difference had high statistical significance. [11]

In addition to assessing AoP, it was demonstrated in this study that the Head-Perineum Distance parameter, with a cut-off point value of <3.53 cm, could also accurately predict the success of vaginal birth, with a specificity of 85.87% and a sensitivity of 83.16%. The head-perineum distance is 4.2 cm as a cut-off value, 84% delivered vaginally (sensitivity 80%, specificity 84%, PPV 85%, NPV 78%, positive LR 5.2, and negative LR 0.24).[6]

The advantage of this research is that one person carried out the ultrasound assessment to avoid interobserver bias. This research was also the first to be conducted with a population of pregnant women in Makassar, with a reasonably balanced comparison between primiparas and multiparas by incorporating multiple parameters that evaluate both the head-perineum distance and the angle of development. This study provides more comprehensive evidence of the capacity for the prediction of transperineal ultrasonography to vaginal delivery.

The limitation of this study is that we employed two distinct Ultrasound devices to evaluate the Angle of Progression and Head-Perineum Distance. This approach potentially introduces reporting bias. Nevertheless, employing standardized machines sourced from the same factory helps reduce variability and uphold reliability. The limited sample size used in this study only partially guarantees the accuracy of this method in predicting successful delivery. Therefore, more research on a larger scale with more robust methods is still necessary.

CONCLUSION

The Angle of Progression and Head-Perineum Distance in transperineal

ultrasound have the potential to serve as additional modalities for predicting the likelihood of successful vaginal birth, and researchers should conduct further studies to develop these methods.

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CONFLICT OF INTERESTS

The authors declare that they have no competing interests.

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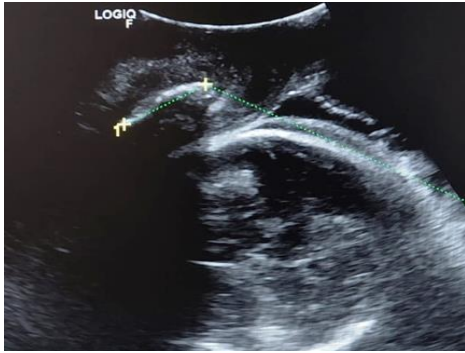
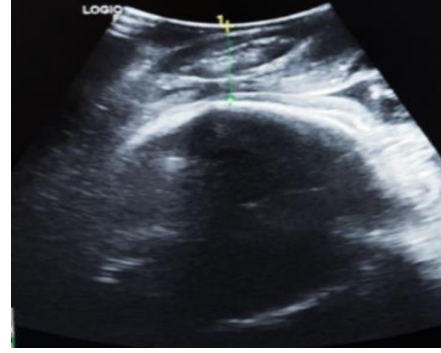**Figure 1.** Transperineal Ultrasound. Measurement of Angle of Progression

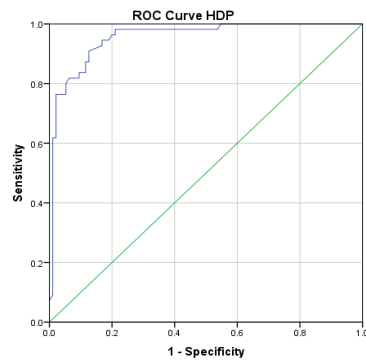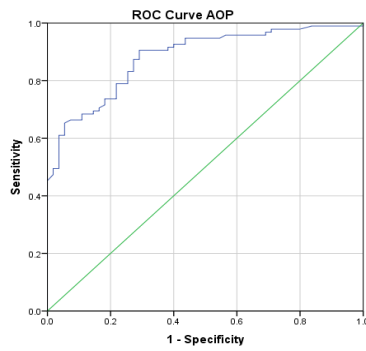**Figure 2.** Transperineal Ultrasound. Measurement of Head-Perineum Distance

Figure 3. Receiver Operating Characteristic Curve

Table 1. Frequency Distribution of Respondent Characteristics by Group

Category	Frequency	(%)
Age (y o)		
< 20	13	8.67
20-35	121	80.66
> 35	16	10.67
Parity		
Primigravida	71	47.33
Multigravida	79	52.67
Education		
Junior High School	19	12.67
Senior High School	101	67.33
College	30	20.00
Pre-pregnancy Body Mass Index		
Normal	116	77.33
Overweight	33	22.00
Obesity	1	0.67
Labor Methods		
Vaginal Delivery	95	63.33
Cesarean Section	55	36.67

*Chi-square test

Table 2. Subject Characteristics Based on Delivery Method

Parameters		P-value	Sensitivity	Specificity	PPV	NPV	Accuracy	AUC*
AoP	≥ 110.45	<0.001	90.53	70.91	84.31	81.25	83.33	0.881
	< 110.45							
HPD	< 3.53	<0.001	94.54	83.16	85.87	89.66	87.33	0.955
	≥ 3.53							

*Mann-whitney test

Table 3. Sensitivity and Specificity of Angle of Progression (AoP) and Head-perineum Distance (HPD)

Category	Labor				P-value
	Vaginal		Cesarean Section		
	n	%	n	%	
Age					
Low risk	82	86.32	39	70.91	0.021
High risk	13	13.68	16	29.09	
Parity					
Primigravida	42	44.21	29	52.73	0.695
Multigravida	53	55.79	26	47.27	
Education					
Low education	11	11.58	8	14.55	0.599
Higher education	84	88.42	47	85.45	
Pre-pregnancy Body Mass Index					
Normal	80	84.21	36	65.45	0.008
Abnormal	15	15.79	19	34.55	
AoP (Mean ± SE)	122.02 ± 15.86		107.27 ± 7.23		< 0.001
HPD (Mean ± SE)	3.05 ± 0.49		4.07 ± 0.46		< 0.001

*From ROC Curve