Research Article

The Role of Intrapartum Ultrasound to Predict Outcome of Delivery

Penggunaan Ultrasonografi Intrapartum untuk Memprediksi Luaran Persalinan

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Abstract

Objective: To predict outcome of delivery by using ultrasound measurements consisting angle of progression, and head perineum distance.

Methods: Sixty two parturients assigned in cohort prospective study. Ultrasound examination begin with identifying the cephalic position by placement of transducer on suprapubic region. The angle of progression is obtained trans-labially, head perineum distance and cervical dilation trans-perineally. Ultrasound findings of Nuchal cord, caput, moulding, occiput posterior position then compared with conventional findings. Labour is observed, outcomes are grouped into vaginal delivery and cesarean section.

Results: Thirty-six women went for vaginal delivery, 26 underwent cesarean section. Independent T-test showed significant differences of the angle of progression (121.11° vs 88.85°) and head perineum distance (5.15 cm vs 7.26 cm) between the two groups. Linear regression test found a negative correlation on how the angle of progression affecting head perineum distance p-value <0.05 , R^2 0.684, (r) – 0.827. Cervical dilation measurements both ultrasound and digital examination were assessed with the Bland-Altman reliability test with level of agreement (-1.0 cm) – (1.2 cm). Receiver Operating Characteristic curve showed cut-off value >101° angle of progression predicts vaginal delivery, area under curve 0.902 and positive likelihood ratio 4.4. Kappa reliability testing for nuchal cord, caput, moulding, and occiput posterior are 0.919, 0.938, 0.384, 0.681 respectively.

Conclusions: Intrapartum ultrasound able to predict the outcome of delivery, digital examination of cervical dilation is the mainstay of measurement. Ultrasound able to rule out the presence of nuchal cord, caput, and occiput posterior.

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

Abstrak

Tujuan: *Mengetahui besar sudut penurunan kepala dan jarak kepala ke perineum dengan ultrasonografi intrapartum dalam memprediksi luaran persalinan.*

Metode: *Enam puluh dua ibu bersalin dilakukan pemeriksaan ultrasonografi intrapartum. Identifikasi posisi kepala dengan meletakan transduser di suprapubik, sudut penurunan kepala secara translabial, jarak kepala ke perineum dan nilai dilatasi serviks secara transperineal. Lilitan tali pusat, kaput, molase, dan oksiput posterior pada temuan ulstrasonografi dibandingkan dengan hasil pemeriksaan konvensional. Observasi persalinan dilakukan, di kelompokan untuk persalinan pervaginam dan seksio sesarea.*

Hasil: *Didapatkan 36 persalinan pervaginam dan 26 seksio sesarea. Uji – t secara signifikan berbeda, nilai sudut penurunan kepala (121,11° vs 88,85°), jarak kepala ke perineum (5,15 cm vs 7,26 cm) pada kedua kelompok. Uji regresi linier sudut penurunan kepala dan pengaruhnya terhadap jarak kepala ke perineum berkorelasi negatif p <0.05, R^2 0.684, (r) – 0.827. Batas kesepakatan nilai dilatasi serviks kedua metode diuji dengan uji reliabilitas Bland-Altman dengan batas kesepakatan sebesar (-1.0) cm – (1.2) cm. Sudut penurunan kepala memprediksi persalinan pervaginam sebesar >101°, uji diagnostik dengan kurva Receiver Operating Characteristic didapatkan area dibawah kurva 0.902, rasio kemungkinan positif 4,4. Uji reliabilitas Kappa lilitan tali pusat, kaput ,molase, dan oksiput posterior berturut-turut (k) = 0.919, 0.938, 0.384, dan 0.681.*

Kesimpulan: *Penggunaan ultrasonografi intrapartum dapat memprediksi luaran persalinan, pemriksaan dalam tetap menjadi pemeriksaan utama dalam menilai dilatasi serviks, ultrasnografi mampu mendeteksi lilitan tali pusat, kaput, dan posisi oksiput posterior.*

Kata kunci: *Jarak kepala ke perineum, sudut penurunan kepala, Ultrasonografi intrapartum.*

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INTRODUCTION

Progression and outcome of labour are assessed through conventional methods comprise history taking and physical examination. The pelvic digital examination usually performs to gather useful information of cervical dilation, head position, and descent of presenting part through pelvis with Station or Hodge plane. Labour dystocia with presence of caput succedaneum and severe moulding make digital examination to determine head descent and denominator position are proven difficult[1]. Intrapartum ultrasound compared with conventional method provides objective value with several anatomic landmarks related to labour progression [2].

The International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) released guideline states that several parameters trough sonographic imaging can be achieved during labour to determine station and head position. Producing an ultrasound image consisting Angle of Progression/Angle of Descent (AOP), Head Perineum Distance (HPD), Fetal Head Direction, Midline Angle (MLA), Progression Distance (PD), and Head Symphysis Distance (HSD) provide useful values and prediction models on how labour will progress[3]. Each of these techniques aid in identifying anatomical landmarks and increase the success rate of operative vaginal delivery[4,5]. Intrapartum ultrasound can aid preemptive measure to foresee labour dystocia requiring further intervention[6].

Pelvic digital examination remains as the main choice to assess progression of labour in labour and delivery unit. This study aims to verify the value of angle of progression and head perineum distance predict the future outcome of labour. Cervical dilation, denominator position, caput succedaneum and moulding will be compared between ultrasound and digital examination findings. The presence of nuchal cord during ultrasound examination will also be compared soon after delivery.

METHODS

This study was performed from May 2019 – January 2020. Samples were gathered at RSUD Besuki, Situbondo, East Java. It uses cohort prospective model with the consecutive sampling method. The inclusion criteria are women who in the 1st stage of labour, singleton pregnancy, cephalic presentation, agreed on informed consent. Meanwhile, those whose sexual transmitted disease and other blood born disease prove to be positive are excluded from this study.

We begin the examination by having the midwife to perform a routine pelvic digital examination to obtain cervical dilation, head position, and to rule out the presence of caput succedaneum and moulding. Soon after it is followed by series of ultrasonographic examinations operated by Obstetrician using GE LOGIQ C5 Premium in the obstetric emergency ward and Mindray DC-N3I in the delivery ward.

Placing of the transducer in the transverse plane in suprapubic region will achieve imaging of fetal orbits opposite to its occiput and transthalamic plane with choroid plexuses toward occiput[7-15] (Figure 1). Then in the same region placing the transducer in sagittal plane will achieve an image of fetal vertebrae long axis and the posterior nuchal region relates to fetal occiput[16].

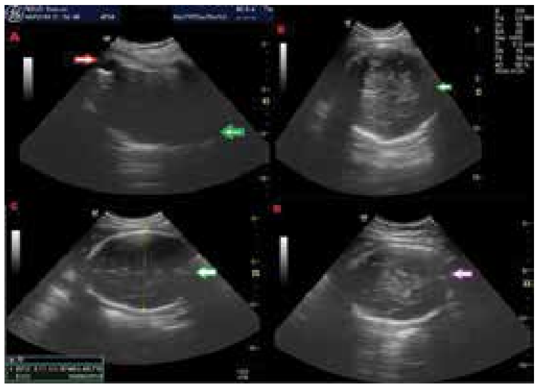

Figure 1. Fetal orbit (red arrow) opposite to fetal occiput. A.OP 4:00 (green arrow). **B&C.** Transthalamic plane LOT 9:00,D. LOA 2:30

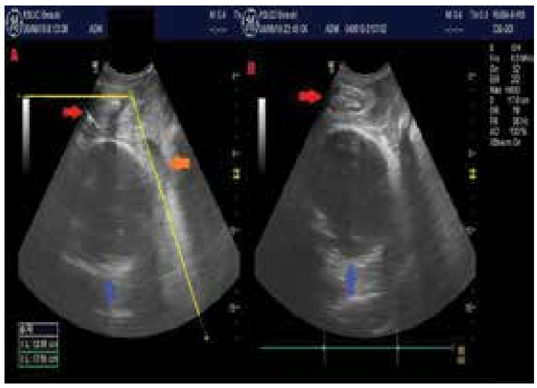

Figure 2. A. AOP 110°. Pubic Symphysis (red arrow), fetal head (blue arrow), forewaters (orange arrow).

Additional *colour flow Doppler* in the same plane will visualized cord vessels to raise nuchal cord suspicion. Divot sign can also be identified in B-Mode imaging as a result of nuchal cord entanglement pressure on fetal skin[17,18]. ISUOG guideline stated that fetal occiput to be illustrated as a clock direction.

To obtain angle of progression, placement of the transducer should be in sagittal plane translabially. Anatomic landmarks are used in this plane which are pubic symphysis and outer edge of fetal skull. Imaginary lines are drawn from pubic symphysis long axis through the point of infrapubic then ends at the outer edge of fetal skull[19,20] **(Figure 2)**. The presence of caput and moulding can also be identified in this plane[21,22].

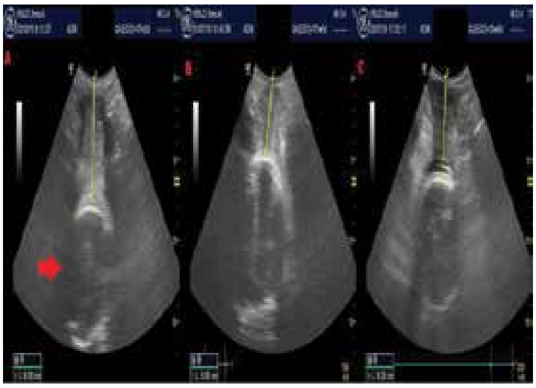

Figure 3. HPD **A**. 8 cm, **B**. 5.06 cm, dan **C**. 6.36 cm.

Figure 4. Cervical Dilation **B**. 5.73 cm cervical dilation.

Head perineum distance then achieved by placing the transducer transperineally with transverse plane. Slight pressure is applied to display perineal skin edge and the outer edge of fetal skull. The measurement between two callipers are then recorded[23,24] **(Figure 3**).

In the same plane, slight angling to upward pressure manoeuvre will expect that the sound beam to produce an image of dilating external cervical os, transverse diameter between the two calipers in the projected area are then recorded[25,26] **(Figure 4)**.

Samples are observed and grouped into vaginal delivery and cesarean section group. Statistical analysis then performed, Independent T-test is used to compare the angle of progression and head perineum distance between two groups. Linear regression with Pearson correlation then used to find the influence between the angle of progression and head perineum distance. All numerical data are processed through the Kolmogorov-Smirnov normality test. Inter-rater reliability test Kappa is used for comparing nuchal cord, caput succedaneum, moulding, and denominator position between ultrasound and conventional method. Bland-Altman reliability testing is also used to find the level of agreement between cervical dilation based on ultrasound finding compared with digital examination. Level of agreement not exceeding 0.5 cm are set as the threshold. Area Under Curve (AUC) on Receiver Operating Characteristics (ROC) curve will be used as diagnostic testing on how well angle of progression and head premium distance predict the outcome of labour. All statistical analyses were performed with IBM SPSS Statistics 23.

RESULTS

Samples Characteristic

Table 1. Gravidity and Outcome of Parturients.

Variable	Mode of Delivery		Total
	Vaginal	Cesarean	
Primigravid	14	18	32
Multigravid	22	8	30
Outcome	36	26	62

From labour observation 36 labouring mother successfully deliver vaginally, and 26 underwent cesarean delivery. Most of labouring mother presenting in this study are primigravid.

Table 2. Distribution of Minimal, Maximal and Mean Values among Samples.

Characteristics	Value		
	Minimal	Maximal	Mean
AOP	59°	165°	107°
HPD	1.03 cm	10.7 cm	6.0 cm
CDUS	0.0 cm	10.8 cm	5.4 cm
CDPE	0 cm	10 cm	5.3 cm
Birth Weight	2100 gr	4050 gr	3115 gr
Gestational Age	34 weeks	43 weeks	38 weeks
Maternal Age	17 years old	39 years old	25 years old

From all samples, the value of each characteristic can be described. the angle of progression 59° being the smallest angle and 165° is the largest angle, with an average of 107°. Head perineum distance found to be 1.03 cm being the smallest and 10.7 cm being the largest distance. Ultrasound (CDUS) and conventional cervical dilation (CDPE) values obtained a minimum value of 0 cm, a maximum value of 10.8 cm on ultrasonography and 10 cm on conventional examination, with no significant difference of mean between the two measurements (One sample T-test p 0.139). Birth weight average is 3115 gr, the smallest 2100 gr, and the largest 4050 gr. The youngest age of mothers in this study is 17 years old and the oldest being 39 years old.

Table 3. Independent *T-test.*

T-Test					
Variable	**Outcome**		**Outcome**		***P-value***
	Cesarean	**Vaginal**	**Cesarean**	**Vaginal**	
Angle of progression	26	36	88.85°	121.11°	0.001
Head perineum distance	26	36	7.26 cm	5.15 cm	0.001

Independent T-test Shows significant difference of angle of progression and head perineum distance values between vaginal and cesarean group.

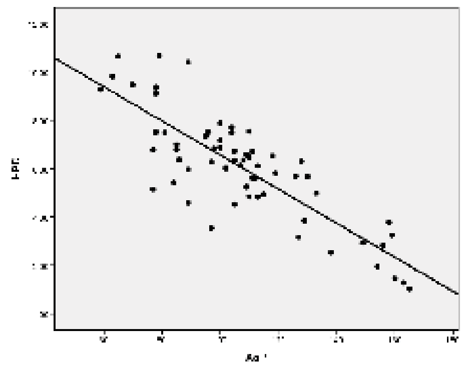

Chart 1. Linear regression scatter plot.

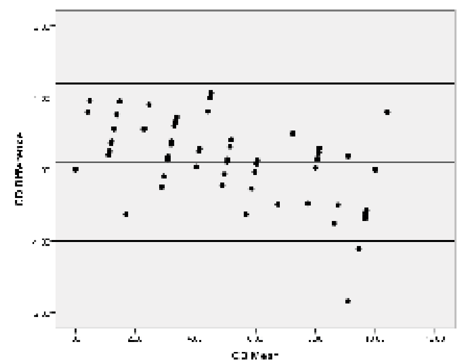

Chart 2. *Bland-Altman* scatter plot.

Scatter plot showing a negative correlation on how AOP affecting HPD. p value 0.001 with R2 0.684 meaning that 68.4% HPD data variation are affected by AOP in this regression model, Pearson correlation p value <0.05 (r = -0.827) **(Chart 1).**

Bland Altman scatter plot showing a mean difference and level of agreement between the two measurements (middle line). Although there is no significant difference between cervical dilation value obtained from pelvic exam and ultrasonography, the level of agreement between the two disagree, with mean difference 0.1 cm (SD 0.56) , upper limit of agreement 1.2 cm and lower limit of agreement -1.0 cm. This equation proves that cervical dilation value measured from ultrasonography will be between 1.2 cm more and 1 cm less compared with pelvic examination. Thus the 0.5 cm threshold for limit of agreement does not meet. CD (Cervical Dilation), SD (Standard Deviation) **(Chart 2).**

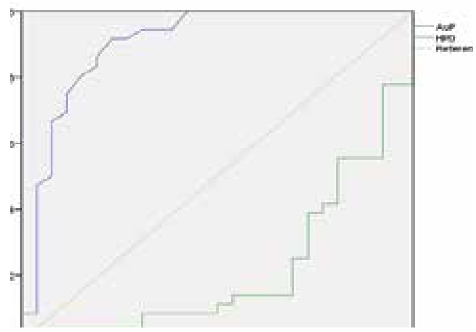

Chart 3. ROC Curve.

ROC (Receiver Operating Characteristics) curve showing how intrapartum ultrasound predicting outcome of labor. AOP proven to be better predictor of labor outcome compared to HPD. With AUC (Area Under Curve) 0.902 (90.2%) for AOP compared to HPD 0.213 (21.3%). According to the curve from 62 samples value of AOP greater than 101° predicts vaginal delivery. This proven to be true in our study as 86% of laboring women in >101° group deliver vaginally, only 14% of them are assigned for cesarean. From 101° cut off value, this model has 86.1% sensitivity and positive predictive value, 80.7% specificity and negative predictive value, 4.4 positive likelihood ratio and 0.1 negative likelihood ratio. Thus concludes angle of progression greater than 101° is 4.4 times likely to result in vaginal delivery with 83.8% accuracy **(Chart 3)**.

Kappa coefficient to predict accuracy between ultrasound and conventional method on assessing nuchal cord, caput succedaneum, moulding, and occiput position are k = 0.919, 0.938, 0.384, 0.681 respectively. It shows that nuchal cord, caput, and occiput position are acceptable in both method in contrast with molding it appears ultrasound is more reliable.

DISCUSSION

Our findings in this research are supported with the previous result from other similar studies. Determined the cut off value in angle of progression >110° (OR 3.1 & ROC/AUC 72%) and head perineum distance <4 cm (OR 4.9 & ROC/AUC 81%) as predictive to vaginal delivery outcome.[27] Were able to predict vaginal delivery during 1st stage of labour dystocia with angle of progression <100° (76% ROC/AUC) and head perineum distance >5 cm (81% ROC/AUC) increase the chance of cesarean section.[28] Determined the predictive value of vaginal delivery are with angle of progression >105° (87.7% ROC/AUC) and head perineum distance < 4 cm (86.5% ROC/AUC)[29].

Meta-analysis showed that cervical dilation value through sonographic imaging compared with digital examination had good agreement based on Pearson's correlation test and linear regression.[30] This differs with our findings as our Bland Altman reliability testing show no level of agreement, which exceeds 0.5 cm. A review found that ultrasonography is superior compared with conventional method in to distinct every denominator positions and we find so in our research.[31,32]

CONCLUSION

Intrapartum ultrasound predicts labour outcome, angle of progression is good parameter to predict the success of vaginal delivery. Nuchal cord, caput succedaneum, moulding, head position can be identified with intrapartum ultrasound. Cervical dilation obtained from ultrasound does not have agreement with digital examination.

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