Original Article

The Use of Angle of Progression, Cervical Length and Bishop Score Before Onset of Labor to Predict Termed Mothers into Normal Delivery

Mokkongphai S, MD[1], Nanthakomon T, MD[1], Somprasit C, MD[1], Tanprasertkul C, MD[1], Bhamarapravatana K, PhD[2], Suwannarurk K, MD[1]

[1] Department of Obstetrics and Gynecology, Faculty of Medicine, Thammasat University, Pathum Thani, Thailand

[2] Department of Preclinical Science, Faculty of Medicine, Thammasat University, Pathum Thani, Thailand

Objective: To assess the angle of progression (AOP) cervical length and bishop score before onset of labor as a tool in the prediction of normal delivery.

Materials and Methods: The present study was a prospective study of singleton cephalic term pregnant women. AOP was measured at more than 38 weeks of gestation by transperineal ultrasound examinations before the onset of labor. Pelvic examination for bishop score and transvaginal ultrasound for cervical length were obtained at the same time. All women were followed until delivery to evaluate the mode of delivery.

Results: One hundred eighty-six patients were included in the analysis. One hundred forty-four (77.4%) women had vaginal delivery and median AOP for the study group was 100 degrees. The adjusted risk ratio (aRR) of vaginal delivery in those patients who had an AOP of more than 100 degree was 1.48 (95% CI 0.71 to 3.07; p=0.292). A cervical length (CL) of more than 25.0 mm. had decreased chance of vaginal delivery at aRR 0.71 (95% CI 0.35 to 1.45; p=0.354). While Bishop score (BS) of more than 5 had increased chance of vaginal delivery at aRR 1.14 (95% CI 0.51 to 2.55; p=0.737). However, a statistically significant correlation was not found in AOP, cervical length, and Bishop score at before onset of labor for the prediction vaginal delivery.

Conclusion: A larger angle of AOP of more than 100 degrees at term, cervical length of less than 25 mm. and bishop score of more than 5 before onset of labor were not statistically significant to predict vaginal delivery.

Keywords: Angle of progression, Bishop score, Cervical length

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Post-term pregnancy is known to be associated with an increased risk of fetal and neonatal mortality and morbidity, as well as an increase in maternal morbidity[1-3]. These risks are not understood by the public in Thailand. Problems associated with post-term pregnancy could be prevented by the induction of labor (IOL) at term. However, the risk of IOL such as uterine hyper-stimulation, failed induction, and increased cesarean section (CS) rates had to be weighted carefully by attending physicians.

Post-term pregnancy can be a source of significant anxiety for pregnant women[4]. These mothers are normally very anxious. When their labor progressions are slow, the tending physicians often request labor induction for the fear of any post-term fetal complication. As a result, the number of CS cases is on a rise.

It is known that CS during labor increases the risk of complications in both mother and her fetus[5]. In Thailand, when pregnant women reach more than 40 weeks gestation period, they are usually very anxious and mostly request planned CS. Physicians normally grant these pregnant mothers wishes as requested because there is no good tool to predict and ensure normal labor (NL) in these cases. On top

Correspondence to:

Nanthakomon T.

Department of Obstetrics and Gynecology, Faculty of Medicine, Thammasat University, Pathum Thani 12120, Thailand.

Phone: +66-2-9269343, **Fax**: +66-2-549-8003

Email: ntongta@gmail.com

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of that, waiting to carry pregnancy further increases the risk of fetal complications such as meconium aspiration syndrome, non-reassuring fetal heart rate pattern, and oligohydramnios. Those complications normally lead to lawsuits. An appropriate tool to assist accurate prediction of successful NL is needed. It will be better if such a tool is available and accessible at antenatal health visit prior to the labor onset. If health care professionals have a simple tool to predict the likelihood of safe NL in these post-term mothers, they can accurately inform their patients of the nature of the approaching deliveries and reduce their fears. Mothers can be advised to safely carry on their pregnancies for a few more days.

Engaged fetal head as determined by digital examination before the labor onset has been used as a good prediction of NL in nulliparous. However, in parous women, the engagement can occur later during pregnancy or even during the labor process. It is not a useful tool even with an experienced professional[6].

Three different tools have been popularly used to predict the onset of labor, namely ultrasound via the angle of progression (AOP), cervical length (CL), and pelvic examination for evaluating Bishop score (BS). Ultrasound has been extensively used in the late third trimester and before the onset of labor to predict the mode of delivery[7]. AOP, the measuring of angle between the long axis of the symphysis pubis and a line extending from its most inferior edge tangentially to the fetal skull (Figure 1) was suggested to be used to predict mode of delivery when performed at trimester onward[8]. CL in the second trimester of pregnancy has been studied extensively and correlated with spontaneous preterm delivery[9]. BS when used with ultrasonic CL was good to predict onset of labor in nulliparous women in a logistic regression model in less than 24 hours to the delivery time but the prediction was less accurate in parous women[10].

The aim of the present study was to evaluate if AOP, CL, or BS could offer a significant predictive value for normal delivery in pregnant women of more than 38 week of gestation. The comparison between nulliparous and parous groups would then be evaluated. A guideline could be suggested for awaiting NL or proceeding to IOL for the safety of the mother and her fetus.

Materials and Methods

The present study was a prospective study conducted at Thammasat University Hospital. It was approved by the Ethics Committee, Faculty of Medicine, Thammasat University (EC-OB-6-204/59).

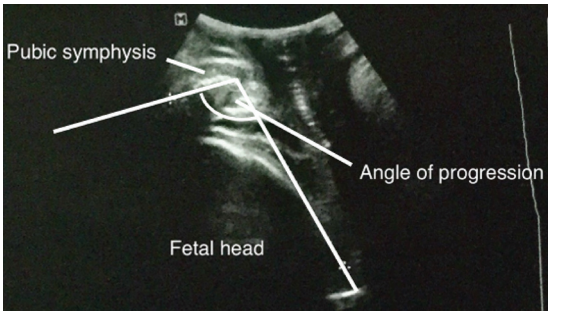

Figure 1. Angle of progression (AOP) was measured between line A (pubic axis) and line B (line from lower border pubic symphysis to the lowest part of fetal head).

Study period was between February 2017 and January 2018. The participants were Thai pregnant women, aged between 15 and 45 years old. They came to the antenatal clinic by appointment and intended to deliver at Thammasat University Hospital. Inclusion criteria were singleton pregnancies, gestational age equal to or greater than 38 weeks, cephalic presentation, and not in labor. The exclusion criteria were the refusal to participate in the study, inability to speak Thai language, having antenatal complications such as placenta previa or abruptio placentae, had medical underlying diseases, had a cesarean delivery due to non-reassuring fetal heart sound pattern or had no plan to deliver at Thammasat University Hospital. During the study period, 200 pregnant women were enrolled in the present study.

The participants who were enrolled in the present study underwent pelvic examination and transperineal and transvaginal ultrasonography with only one researcher using 5 MHz portable probe (accurixXG, Medison, Korea). BS was evaluated by pelvic examination. CL and AOP were measured by transvaginal and transperineal ultrasonography, respectively. Both parameters were collected by the same operator in each case.

Participants were advised to empty their urinary bladders prior to the ultrasound examination. Dorsal lithotomy was the position for the evaluation. The ultrasound probe was lubricated by ultrasound gel and covered with a clean glove. It was placed in a mid-sagittal position between the labia majora below the pubic symphysis for fetal head descent determination. Slight lateral movement of the probe was performed for adequate sonographic pictures. Adequate sonographic view consisted of clear maternal pelvic symphysis and fetal head without acoustic shadow of pubic rami. CL was measured

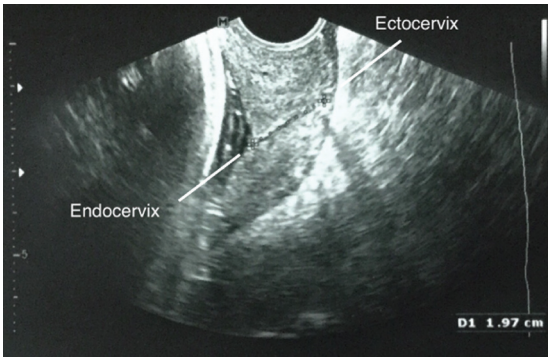

Figure 2. Cervical length was measured from endocervix to ectocervix by transvaginal ultrasound.

by transvaginal ultrasound probe (Figure 2). The ultrasound imaging was obtained in a photographic form. BS was evaluated by digital examination. It included cervical dilatation, effacement, consistency, fetal head station and position. The score rated from zero to three (minimum=0, maximum=13). All three data for BS were recorded. The attending obstetricians were blinded to the results of the sonographic measurement.

The management of labor was performed according to the standard hospital protocol. Spontaneous vaginal delivery was the primary outcome of choice. Methods of delivery were recorded. After delivery, gestational age at delivery, time from ultrasound to delivery, IOL, route of delivery, indication for cesarean delivery, fetal birth weight, and APGAR scores were recorded.

Patient's demographic data included age, parity, body mass index (BMI), gestational age, time from study to delivery, and fetal body weight. Continuous data were represented by mean and standard deviation (SD). Chi-square was used for category data. Receivers-operating characteristics curves of AOP, CL, and BS were performed. Predictive power of AOP, CL, and BS was achieved to predict probability of vaginal delivery.

Statistical package for the social science (SPSS Inc., Chicago, IL, USA) for Windows version 17 was used in statistical analysis. The p-value less than 0.05 were classified as statistical significance.

Ethical approval

This clinical trial was registered in the Thai Clinical Trails Registry (TCTR). Study ID: TCTR20171215001 (http://www.clinicaltrialsin.th). The study was approved by the Ethics Committee, Faculty of Medicine, Thammasat University, the study protocol numbers MTU-EC-OB-6-204/59).

Table 1. Demographic characteristics of study population of 186 term women with singleton pregnancy

	NL* (n=144) Mean±SD	CS* (n=42) Mean±SD	p-value
Age (year)	28.6±5.8	27.9±6.9	0.46
BMI (kg/m^2)	28.0±4.5	28.9±3.8	0.23
GA at scan (day)	271.9±4.6	273.6±5.0	0.45
Parity, n (%)			
Nulliparous	70 (48.6)	30 (71.4)	0.009
Multiparous	74 (51.4)	12 (28.6)	
Obstetrics parameters			
AOP (degree)	105.7±12.8	105.1±11.9	0.80
Cervical length (cm)	2.5±0.7	2.7±0.8	0.20
Bishop score	3.6±1.9	3.2±1.9	0.23
Induction, n (%)			
Yes	10 (7.0)	14 (33.3)	<0.001
No	134 (93.0)	28 (66.7)	
GA at delivery (day)	277.8±5.1	279.5±5.9	0.061
Time interval* (day)	6.0±4.3	6.7±5.5	0.37
Birth weight (g)	3,233.8±382.0	3,206.5±282.5	0.69

NL=normal delivery; CS=cesarean delivery; BMI=body mass index; GA=gestational age; AOP=angle of progression; SD= standard deviation

* Duration from ultrasound scan to delivery

Results

In the present study, 200 participants who met the inclusion criteria were recruited. AOP, CL, and BS were obtained successfully in all women. The patients were then divided into two groups per their route of delivery, vaginal delivery and CS delivery. No participants delivered by forceps or vacuum extraction. Cesarean delivery was performed in 42 patients due to cephalopelvic disproportion. Non-reassuring fetal heart sound pattern was found in another 14 women with CS. The latter were excluded from the study.

One hundred eighty-six cases were enrolled in the present study after the exclusion criteria. The characteristics of the study population are presented in Table 1.

The NL and CS groups showed comparable characteristics with no statistical significance except in the categories of parity and delivery induction. NL group showed 48.6%:51.4%, nulliparous:multiparous ratio while CS ratio was at 71.4%:28.6% (p=0.009). Ninety three percent of NL delivery happened

without labor induction, while only 66.7% of CS had no induction (p<0.001). Obstetrics parameters are compared in Table 2.

The predictive values of AOP, CL, and BS for delivery are presented as the receiver operating characteristic (ROC) curve in Figure 3. The area under the curve (AUC) for AOP, CL, and BS were 54%, 44%, and 56%, respectively. CS delivery was performed to those with slow progress in labor. Comparison of obstetrics parameters of the studied population according to patients' mode of delivery are shown in Table 3. AOP larger than 100 degree in both nulliparous and multiparous groups would predict vaginal delivery with positive predictive value (PPV) of 73.8% and 88.7%, respectively. Predictive power of AOP, CL, and BS was achieved to predict probability of vaginal delivery as shown in Table 4.

Table 2. Pearsons correlation between AOP, CL, and Bishop score determined for the study population ≥38 weeks gestation

	AOP		Bishop score	
AOP	r=–0.303	p=0.000	r=0.250	p=0.001
CL			r=–0.436	p=0.000

AOP=angle of progression; CL=cervical length

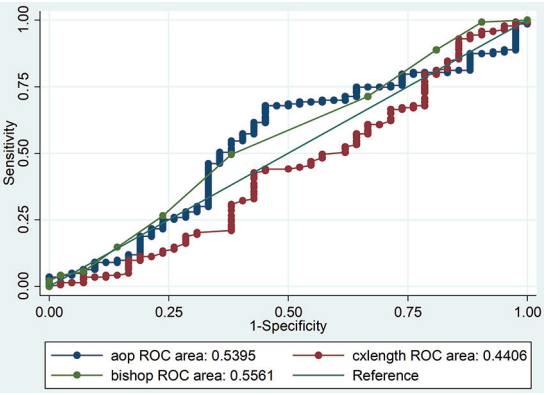

Figure 3. Receiver-operating characteristics curves for AOP, CL, and Bishop scores in the prediction of vaginal delivery in pregnant women ≥38 weeks gestation.

Table 3. Comparison of obstetrics parameters of the studied population according to patients'mode of delivery

Obstetric parameters	NL n (%)	CS n (%)	OR (95% CI)	p-value
AOP			1.4 (0.71 to 3.07)	0.80
≤100	39 (27.1)	15 (35.7)		
>100	105 (72.9)	27 (64.3)		
Bishop score			1.14 (0.51 to 2.55)	0.23
<5	106 (73.6)	32 (76.2)		
≥5	38 (26.4)	10 (23.8)		
CL (mm)			0.71 (0.35 to 1.45)	0.20
<25	63 (43.7)	15 (35.7)		
≥25	81 (56.3)	27 (64.3)		

NL=normal delivery; CS=cesarean delivery; AOP=angle of progression; CL=cervical length; OR=odds ratio; CI=confidence interval

p<0.05 was considered statistically significant

Discussion

The present study was performed with Thai pregnant women aged between 15 and 45 years old. They came to the antenatal clinic by appointment, intended to deliver at Thammasat University Hospital, carried singleton pregnancies with a gestational age greater than or equal to 38 weeks in cephalic presentation, and were not in labor. The present study used obstetrics parameter such as AOP, BS, and CL in pregnant women before the onset of labor in an attempt to predict spontaneous delivery.

Table 4. Predictive power of AOP, CL, and BS to predict probability of vaginal delivery

	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV (%)	NPV (%)	LR+	LR–	OR
AOP	62.5	54.8	60.8	82.6	29.9	1.4	0.7	2.0
AOPN	80.8	32.3	66.3	73.8	41.7	1.2	0.6	2.0
AOPM	66.2	45.5	63.4	88.7	17.2	1.2	0.8	1.6
CL	56.3	35.7	51.6	75.0	19.2	0.9	1.2	7.0
BS	26.4	76.1	37.6	79.1	23.2	1.1	1.0	1.1

AOP=angle of progression; AOPN=angle of progression nulliparous; AOPM=angle of progression multiparous; CL=cervical length; BS=Bishop score; PPV=positive predictive value; NPV=negative predictive value; LR+=likelihood ratio for positive test; LR–=likelihood ratio for negative test; OR=diagnostic odd ratio

From all participants, those that did not receive labor induction had a 6.7 times chance of normal delivery compared to those who received induction regardless of their ultrasound and BS reading. It is worth noting that those chosen for induction had some unfavorable condition and were not considered to go through delivery spontaneously. If AOP was larger than 100 degree in both nulliparous and multiparous groups, one could predict vaginal delivery with PPV of 73.8% and 88.7%, respectively. The present study participants with CL longer than 2.5 cm showed a 0.7 time less chance of NL. BS gave us no useful prediction of mode of delivery in all groups.

Numerous studies reported successful prediction of vaginal delivery by using different methods in antepartum pregnancy[6-8]. Levy et al work with transperineal ultrasound in pregnant women of more than 39 weeks' gestation who delivered within one week of sonography, revealed that an AOP of less than 95 degree in non-laboring nulliparous women at term was associated with a high rate of cesarean delivery. However, a narrow AOP in parous women in Levy's study did not appear to be associated with cesarean delivery[6].

Pereira et al examined the potential value of pre-induction CL, cervical elastography, and AOP in the prediction of successful vaginal delivery at 35 to 42 weeks' gestation. AOP and elastographic score at the internal os were useful in neither the prediction of NL nor the induction-to-delivery interval[7].

Saccone et al in 2014 evaluated the predictive accuracy of CL by transvaginal ultrasound measurement (TVS CL) for spontaneous onset of labor in singleton gestation enrolled at term by a meta-analysis. Saccone's work suggested that TVS CL at term had only moderate value in predicting the onset of spontaneous labor[11].

The present study included 186 term pregnant women both nulliparous and multiparous. An AOP cut-off of 100 degrees had no significant predicted value between those who delivered vaginally and those who underwent CS. However, AOP more than 100 degree increased the rate of vaginal delivery 1.48 times. CL and BS revealed no significant finding. The reason that the present study showed no statistically significant association with mode of delivery was the present study was performed in pregnant women who were not in labor. There are many confounding factors that effect to mode of delivery such as position of fetal head, uterine contraction response, cervical progression, augmentation procedure, amniotomy time, and decision making of the service staff.

Conclusion

In the office checkup of patients of more than 38 weeks, there was no statistically significant association with vaginal delivery. AOP larger than 100 degree in both nulliparous and multiparous groups would predict vaginal delivery with PPV of 73.8% and 88.7%, respectively. Those with a CL larger than 2.5 cm showed a 0.7 time less chance of vaginal delivery. These findings suggest a guideline for health professionals to use in discussions with term pregnant women about their potential labor progression for mutual informed decision in labor management. As a result, fear of the unknown would no longer be a driving force for both parties to choose either labor induction or caesarean session. The authors are in hope that a better-informed decision based on fact finding would encourage pregnant mothers toward vaginal delivery for a better health of mothers and their newborns. It is better to discuss the future option based on an ultrasound result during an antenatal visit than at the onset of labor.

What is already known on this topic?

When their labor progressions are slow the tending physicians often request labor induction for the fear of any post-term fetal complication. As a result, the number of CS cases is on a rise. There is no good tool to predict and ensure NL in these cases.

What this study adds?

In the office checkup of pregnant patients of more than 38 weeks, there is no statistically significant association with vaginal delivery. AOP larger than 100 degree in both nulliparous and multiparous groups would predict vaginal delivery with PPV of 73.8% and 88.7%, respectively. Those with a CL larger than 2.5 cm showed a 0.7 time less chance of vaginal delivery. These findings suggest a guideline for health professionals to use in discussions with term pregnant women about their potential labor progression for mutual informed decision in labor management.

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Conflicts of interest

The authors declare no conflict of interest.

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