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Clinical Group

Journal of Gynecological Research and Obstetrics

DOI: http://dx.doi.org/10.17352/jgro

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Received: 25 September, 2018
Accepted: 18 October, 2018
Published: 20 October, 2018

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Keywords: Friedman Curve; Labor progress; Prediction of labor progress; Sensitivity

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Review Article

The prediction of the progress of labor using the Friedman Curve in Primiparous Thai women

Abstract

At present most of studies showed that the duration of labor of women is longer than in the past making it necessary to conduct the study to confirm the sensitivity of the Friedman Curve in the prediction of labor progress in the first stage of labor. This study used convenient sampling to recruit primiparous women in a labor room at a central hospital in southern Thailand among which 350 women were used in the analysis for the sensitivity prediction of the Friedman Curve.

The results showed that the Friedman Curve has moderate sensitivity in predicting the progress of labor throughout the first stage of labor: latent, acceleration, and maximum slope phases (correction of prediction 72%, 79%, 78%, respectively) but the deceleration phase showed a high sensitivity (85%). Thus, using the Friedman Curve to monitor the progress of labor is still reliable in Thai women.

Introduction

Currently around the world including Thailand assessment of labor progress is generally undertaken using cervical dilation and the Friedman Curve, a graph for recording labor progress or the duration of time in the first stage of labor and it is used to identify potential of a safe vaginal delivery, developed by Emanuel A. Friedman and was published in the year 1955 [1,2]. However, the progress of the active phase of labor in women (n = 1,329 primiparous women) is longer than in the past, according to the results of monitoring cervical dilation and duration using the Friedman Curve [3]. For over 50 years, the duration of labor in the first stage of labor has been increasing, with a median of 2.6 hours longer in nulliparous and 2 hours in multiparous especially during cervical dilation of 4-6 cm [4]. Also, in one study (n = 97 primiparous women) there was little difference of time in the first stage of labor compared to time according to the Friedman Curve [5]. A review literature also reported that the lowest-yet-normal linear cervical dilation rate approximates 0.5 cm/hr for low risk primiparous women with spontaneous onset of labor [6], which does not support the quality of the Friedman Curve. However, one study showed that the duration of labor from a cervical dilation of 4-10 cm became shorter when age of the women increased from 20 to 40 years old both in primiparous and multiparous women [7].

Nonetheless, there are inconsistency regarding the duration of labor using the Friedman Curve. The American College of Obestricians and Gynaecologists (ACOG) has recently suggested that labor models by the Friedman Curve are no longer applicable to modern obstetrical practice [8]. At present many Thai women (44.9%) are overweight or obese (BMI > 23kg/m^2, using Asian cutting point) due to socioeconomic status, behavioral factors and dietary intake [9]. These factors might cause laboring women to have prolonged labor leading to the inappropriate application of the Friedman Curve for monitoring the progress of labor as in the past and it needs to have a good decision to consider about the suitable time whether to wait for vaginal delivery or to perform Cesarean section since Cesarean section seems to cause more health risks even death either newborn or mother [10]. Recently, data showed that the underlying cause for the highest number of Cesarean sections (30.7%) was due to obstructed labor [11]. At present, there is an inconsistency in the studies regarding the duration of time in labor being either longer or shorter than in the past, therefore, it is necessary to confirm the sensitivity of the Friedman Curve [3,12] at the present time in the prediction of the progress of labor in the first stage in primiparous Thai women.

Study Aim

To test the sensitivity of the Friedman Curve in the prediction of the progress of labor in the first stage.

Research Question

What are the sensitivities of the Friedman Curve in the prediction of the progress of labor in the latent, acceleration,

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maximum slope, and deceleration phases in primiparous Thai women?

Methods

Research design

This was an applied study designed to find a solution to a practical problem [13], which was to test for the sensitivity in predicting the progress of labor of primiparous women in the first stage of the Friedman Curve.

Samples

Yamane's formula ($n = N/(1+Ne^2)$) where N = 2,767 primiparous women in the year 2012, with confidence interval of 95%, and error of 5%, was used to calculate the required number of participants [14]. A sample size of 350 primiparous women during labor was required. The study used the data of time in the first stage of labor and cervical dilation in the analysis only in the phase of labor in which women did not receive oxytocin.

Potential participants who met the inclusion criteria were recruited by convenience sampling. Inclusion criteria were: primiparous pregnant women with height of at least 147 cm (ensuring normal labor) [15], age 16-35 years, no health complications during pregnancy, (such as, anemia, gestational diabetes, pregnancy induced hypertension, and not having any psychological problems), 37-42 weeks gestation, singleton fetus with vertex presentation and no fetal distress, and having true labor.

Ethical considerations

Before conducting this study, approval was given by the Human Ethics Committee of the School of Nursing, Prince of Songkla University (MOE.606.1/075, March21, 2013), and a central hospital in southern Thailand (Approval No. 21/2013, August7, 2013; Approval No.21/2013, August 7, 2014). In the labor room, nurses screened women in labor and asked for their permission to let a research assistant (RA) who was trained by the principal investigator (PI) approach them. The RA explained the purposes of the study, the participants' rights in participating, including the assurance of confidentiality. Written informed consent was also obtained by the RA before collecting data.

Data collection

The setting was the labor room at a major hospital in southern Thailand. Data were collected in the year 2013-2014, the selection procedure is shown in figure 1. The RA was trained by the PI conducting the study to collect data regarding time in each cervical dilation from the labor records of the nurses or physicians. Vaginal examinations were performed by the nurses or the physicians in the labor room to assess cervical dilation as standard practice.

Participant Enrollment

Convenient sampling was used to recruit 397 primiparous Thai women who met the inclusion criteria. After recruitment 47 participants were excluded from the study, so only 350 participants were used in the analysis. The enrollment was as follows

The RA collected demographic, obstetric, and infant data. The RA also recorded the time (from the labor records) at each cervical dilation of the participants from the onset of labor, an initiation of regular uterine contractions 3-4 times/hr [16,17], in the first stage of labor. The intra-rater reliability was assessed by plotting the Friedman Curve as standard protocol for 20 cases of the PI (a registered nurse who has supervised Bachelor nursing students in the labor room for over 17 years) gained Pearson correlation of [1].

The PI plotted the Friedman curve as follows: the first cervical dilation was drawn at 90° angle from the Y axis (axis of cervical dilation) to the line of time in the first stage of labor; while at the cutting point of the graph was drawn at a 90° angle to the duration of time in the first stage of labor on the X axis. After that, each cervical dilation was plotted against the duration throughout the first stage of labor. The PI performed a double check of the plotted graph to affirm its accuracy and then interpreted the prediction on the progress of labor.

Interpretation of the prediction of the Friedman Curve in predicting labor progress fell into two categories: either correct or incorrect. If the prediction were correct, the cervical dilation should fall exactly or closely to the line of the graph. For the correctness of prediction, two characteristics were presented: the two lines (the actual cervical dilation and the time) in the graph may run parallel to each other, or they may run exactly on top of each other. Nonetheless, the correctness of the prediction for each phase: latent, acceleration, maximum slope, and deceleration would be independently interpreted. In contrast, if the prediction was wrong, the plotted value might fall either above or below this level, or even fall farther outside of the line of cervical dilation.

The graph was reported in four parts (Figure 2) [18], of the prediction of the labor progress accordingly: Latent phase is the phase of the onset of labor to 3 cm cervical dilation;

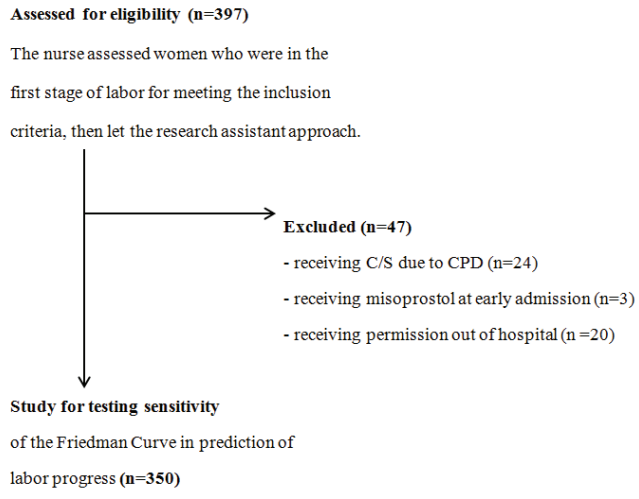

Figure 1: Flow diagram of selection procedure .

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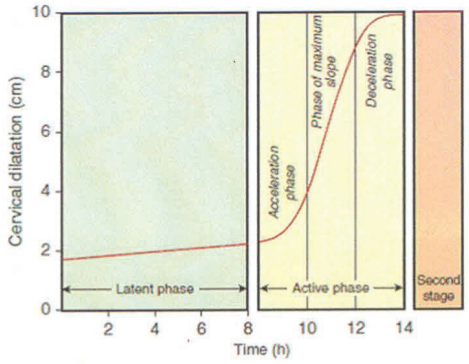

Figure 2: The Friedman Curve in primiparous women.

Acceleration phase is the phase of cervical dilation from 3 to 4 cm; Maximum slope is the phase of cervical dilation from 4 to 9 cm; and the Deceleration phase is the phase of cervical dilation from 9 to 10 cm [6,18]. Sensitivity is susceptibility to detect either the correctness or the incorrectness of the prediction of cervical dilation and time of each cervical dilation. The formula of the sensitivity is indicated by the number of corrections in predicting progress of labor/(number of corrective predictions + number of wrong predictions) [19,20].

Data analysis

Demographic, obstetric and infant data were analyzed using frequency, percentage, mean, standard deviation (SD) and median. Data from the period after receiving oxytocin augmentation were not included in the analysis due to this drug stimulating uterine contractions then shortening the duration of labor [21]. The sensitivities of the prediction of the progress of labor using the Friedman Curve were reported.

Results

The mean age of participants was 22.42 years Most of the participants were Buddhist, with education levels ranging from less than high school to Bachelor degree. Most of the participants were housewives or employees. The majority had low to moderate income. These and other characteristics are presented in table 1. The mean duration of the first stage of labor from only the participants who did not receive the oxytocin drug throughout the first stage of labor was 8.98 hr (SD = 4.55 hr). The durations of time in the first stage of labor at 1 cm intervals of cervical dilation are shown in table 2.

The results showed that the Friedman Curve in predicting the progress of labor in the first stage had moderate sensitivity throughout the first stage of labor: in the latent phase (72% for probability of correct detection of increasing cervical dilation), acceleration (79% correct), and maximum slope (78% correct) except for high sensitivity in the deceleration phase (85% correction) [22,23]. Table 3 shows the sensitivity of the Friedman Curve in predicting labor progress in the first stage of labor.

Discussion

The results of predicting labor progress using the Friedman Curve showed moderate to high sensitivity to predict the progress of labor in women with no health complications. The moderate to high sensitivity in predicting the progress

Table 1: Demographic, Receiving Oxytocin, and Infant Data of Participants (n=350)

Characteristics	Subject n (%)
Age, year, mean (SD)	22.42 (4.8)
Religion, n (%)	
Buddhist	289 (82.6)
Islamic	60 (17.1)
Missing	1
Educational level, n (%)	
<High school	162 (46.4)
High school	49 (14.0)
Vocational school	76 (21.7)
Bachelor's degree	62 (17.7)
Missing	1
Family income/month (US$), n (%)	
<100	12 (3.6)
100-300	114 (34)
301-600	110 (32.8)
601-900	57 (17)
>900	42 (12.5)
Missing	15
BMI, kg/m^2, mean (SD)	20.67 (3.9)
Height, cm, mean (SD)	157.50 (10.8)
Receiving oxytocin, n (%)	
Yes	127 (36.29)
No	223 (63.71)
Infant weight, g, mean (SD)	3055.79 (384.27)

Note: Percentages are for those of non-missing.

Table 2: Mean and Median of Duration of Time to Cervical Dilation at 1-cm Intervals in the First Stage of Labor (n =350).

Cervical dilation (cm)			Duration of time (min)			
	n		Min	Max	Mean (SD)	Median
Onset-1 cm	60		21	720	225.43 (142.98)	202.50
1-2	59		60	1325	381.10 (300.00)	290
2-3	103		15	1290	272.74 (213.58)	240
3-4	66		15	490	158.78 (108.59)	135
4-5	45		25	360	119.33 (82.43)	90
5-6	44		15	240	83.29 (63.49)	
6-7	26		15	225	84.80 (60.32)	
7-8	27		5	130	42.03 (31.93)	30
8-9	21		13	70	39.90 (15.10)	
9-10	102		5	75	21.75 (17.35)	15

Note: Median was used in case of deviation from normal distribution (skewness/ standard error >3).

Table 3: Sensitivity of the Friedman Curve in the Prediction of Labor Progress (n = 350).

First stage of labor	Prediction of increasing cervical dilation		
	Correct (n)	Incorrect (n)	sensitivity
Latent	141	54	0.72
Acceleration	102	27	0.79
Maximum slope	178	48	0.78
Deceleration	158	26	0.85*

Note: *represents high sensitivity [22,23].

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of labor was due to the graph being developed directly from cervical dilation and duration of time at each cervical dilation in the first stage of labor in a large sample with no health complications[1] which was the same as the healthy status of the participants in the present study. Furthermore, the women (n =345) in this study had a normal height of no less than 147 cm with a mean weight of 65.6 kg (SD = 12.1 kg) and almost had normal BMI (M = 20.7 kg/m^2, SD = 3.9 kg/m^2) in which they were accepted as being of a healthy weight (BMI 18.5-25 kg/m^2) [24] In addition, the infant weights were at a normal level (M = 3,056 g, SD = 384 g) [25]. These imply no risk for cephalopelvic disproportion, resulting in normal progress of labor [26]. One study has also supported the notion that the higher the birthweight the higher the duration of labor [27].

Our data imply that it would still be beneficial to use the Friedman Curve for monitoring the progress of labor in Thai women who are in a healthy condition, in the first stage of labor. However, the new guidelines released by ACOG suggest that the active phase of labor should start when with a cervical dilation of 6 cm rather than from 3cm or 4 cm dilation [8].

Limitations and recommendations

In this study, as some participants (36.2%) received oxytocin for augmentation, we thus did not include their data point after they received this drug in testing the sensitivity of the Friedman Curve. Hence, it might be a limitation for the generalization of the Friedman Curve to the general population, for those primiparous women using oxytocin. Due to the small number of subjects at 1 cm intervals of cervical dilation in the first stage of labor, these data may have some limitations upon the generalizability.

The results indicate that, to monitor labor progress, it would be beneficial to use the Friedman Curve. However, further research should be conducted to test the sensitivity in prediction of labor progress using the Friedman Curve in the first stage of labor in a larger sample size.

Conclusion and Implication for Nursing Practice

The Friedman Curve has moderate to high sensitivity in predicting the progress of labor of primiparous women with no health complication. Nurses should use the Friedman Curve in laboring women with normal health status, do not receive the oxytocin drug , are not suspected of having cephalopelvic disproportion with careful monitoring of uterine contractions and fetal health status.

Acknowledgements

This study was supported by the budget revenue of Prince of Songkla University (code NUR560510S). The authors would like to thank the research assistant for her endurance in data collection and all participants for their cooperation in the study.

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