Research Article

Friedman Curve Positively Correlates with Cesarean Section and Oxytocin Augmentation in Active Phase Delivery as Compared to Partograph

Kurva Friedman Berkorelasi Positif dengan Seksio Sesarea dan Augmentasi Oksitosin pada Fase Aktif Persalinan dibandingkan Partograf

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Abstract

Objective: To investigate the correlation between cesarean section and oxytocin augmentation in childbirth monitored with the Friedman curve compared to the World Health Organization (WHO) partographs.

Methods: An analytic cross-sectional study was conducted from March to May 2021, involving mothers giving birth whose delivery process was monitored using either the Friedman curve or the WHO partograph (n=28 for each group) at Wangaya Hospital in Denpasar City. The duration of the active phase until delivery, occurrence of cesarean section, and administration of oxytocin augmentation were assessed using the Friedman curve and the WHO partograph. The normality of the data was tested using the Kolmogorov-Smirnov test, and the Spearman correlation test was employed to measure the direction and strength of the correlation.

Results: There was no significant difference between the groups in terms of monitoring the active phase until delivery using the Friedman curve compared to the WHO partograph (p=1.000 > 0.05). Maternal monitoring with the Friedman curve showed a positive correlation with the occurrence of cesarean section compared to the WHO partograph (r=0.296, p=0.027). Additionally, monitoring childbirth with the Friedman curve exhibited a positive correlation with the administration of oxytocin augmentation compared to the WHO partograph (r=0.298, p=0.026).

Conclusion: The findings suggest a stronger positive correlation between the incidence of cesarean section and the administration of oxytocin augmentation in childbirth monitored with the Friedman curve compared to the WHO partograph.

Keywords: cesarean section, Friedman curve, oxytocin augmentation, WHO partograph.

Abstrak

Tujuan: *Untuk menentukan korelasi antara operasi sesar dan augmentasi oksitosin pada persalinan yang dipantau dengan kurva Friedman dibandingkan dengan partograf Organisasi Kesehatan Dunia (WHO).*

Metode: *Desain penelitian analitik potong lintang dilakukan pada Maret-Mei 2021, dengan melibatkan ibu bersalin yang proses persalinannya dipantau menggunakan kurva Friedman atau Partograf WHO (n=28 untuk setiap kelompok) di ruang bersalin di Rumah Sakit Wangaya, Kota Denpasar. Waktu fase aktif hingga kelahiran bayi, persalinan seksio sesarea, dan augmentasi oksitosin dinilai dengan menggunakan kurva Friedman dan Partograf WHO. Uji normalitas dilakukan dengan uji Kolmogorov-Smirnov, dilanjutkan dengan uji korelasi Spearman untuk mengukur arah dan kekuatan korelasi.*

Hasil: *Pemantauan ibu bersalin dengan kurva Friedman dibandingkan dengan Partograf WHO dalam hal fase aktif-persalinan bayi menunjukkan tidak ada perbedaan yang signifikan di antara kedua kelompok (p = 0,000 > 0,05). Pemantauan ibu dengan kurva Friedman berkorelasi positif dengan kejadian bedah sesar dibandingkan dengan Partograf WHO (r = 0,296, p = 0,027). Selain itu, pemantauan persalinan dengan kurva Friedman berkorelasi positif dengan pemberian oksitosin dibandingkan dengan partograf WHO (r = 0,298, p = 0,026).*

Kesimpulan: *Terdapat korelasi positif yang lebih tinggi antara kejadian bedah sesar dan pemberian augmentasi oksitosin pada proses persalinan yang dipantau dengan kurva Friedman dibandingkan dengan partograf WHO.*

Kata kunci: *augmentasi oksitosin, kurva friedman, partograf WHO, seksio sesarea*

INTRODUCTION

The maternal mortality rate is an indicator of women's health status and a component of Indonesia's development and quality of life index.[1] The occurrence of labor and delivery complications worldwide ranges from 15% to 20%. Based on these statistics, it has been found that only 5% to 10% of deliveries necessitate a cesarean section. According to the International Conference on Indonesia Family Planning and Reproductive Health, Indonesia's maternal mortality rate remained high at 305 per 100,000 live births as of 2019. The Sustainable Development Goals aim to achieve a maternal mortality rate of 70 per 100,000 live births by 2030.[2] Problems associated with pregnancy and childbirth, including the elevated maternal mortality rate, cannot be isolated from the various influencing factors.Delivery methods and immediate post-delivery care are among the factors contributing to the high maternal mortality rate.[3]

The Friedman curve and the World Health Organization (WHO) partograph are widely utilized for delivery monitoring and guiding clinical decision-making. The Friedman curve demonstrates moderate sensitivity in predicting the progress of the first stage of delivery. It accurately detects cervical dilatation progress in the latent phase with a 72% correctness rate, in the accelerated phase with 79%, in the maximum slope phase with 78%, and in the deceleration phase with the highest sensitivity of 85%.[4] The partograph, a simple and cost-effective tool, employs visual aids to monitor labor progress for healthcare providers. The WHO partograph is a synthesis and implementation of various partograph models from around the world. In 2000, the WHO Partograph underwent modifications to enhance simplicity and ease of use. The modified partograph eliminated the latent phase and started from the active phase when the cervix is open at 4 cm. Partographs are utilized to assess labor progress and identify the need for interventions.

There is a debate over whether the Friedman curve, which examines the duration of delivery, increases the likelihood of interventions such as cesarean sections and oxytocin augmentation. Generally, the examination principles of the Friedman curve differ from those of the WHO partograph. Attempts to establish normal limits for delivery duration have yielded varying results due to the limited number of tests that can be performed based solely on periodic cervical dilatation examinations. Compared with the WHO partograph, the Friedman curve does not include other clinical information that influences decisions on delivery management.[5] The use of partographs has been previously evaluated in a multicenter trial involving 35,484 parturient women. The results showed that the use of a partograph reduced prolonged labor by about half (from 6.4% to 3.4% of labors) and decreased the proportion of labors requiring stimulation from 20.7% to 9.1%. Emergency cesarean sections were also reduced from 9.9% to 8.3%, and intrapartum stillbirths decreased from 0.5% to 0.3%. This is further supported by research conducted by Walss Rodriguez, where cesarean rates were lower in the group observed with a partograph than in the group that did not use one (RR 0.38, 95% CI 0.24 to 0.61).[6]

To evaluate the role of the Friedman curve, this study aims to assess the correlation between the duration of the active phase of delivery until the birth of the baby, the increased rate of cesarean section deliveries, and the use of oxytocin augmentation, comparing the Friedman curve with the WHO partograph.

METHODS

An analytical observational study with a cross-sectional design was conducted from March to May 2021 in the delivery room of the Emergency Unit at Wangaya Regional General Hospital, located in Denpasar City, Bali Province, Indonesia. The study aimed to examine pregnant women who underwent delivery in the delivery room. The participants were divided into two groups based on the monitoring tools used: the Friedman curve group and the WHO partograph group. Participant selection was performed using a simple random sampling technique. The inclusion criteria consisted of pregnant women with cervical dilatation ranging from 1 to 4 cm and fetuses in the cephalic presentation. Exclusion criteria included pregnant women with a height less than 140 cm, a history of antepartum bleeding, medical abnormalities, malpresentation, fetal emergencies, intrauterine fetal death, previous cesarean section deliveries, grand multiparity, twin pregnancies, and premature rupture of membranes. The minimum sample size was calculated using the study formula for testing the hypothesis of two independent proportions,[7]

(α = 0.05 and β = 0.2). It was determined that a minimum sample size of 28 patients was required for each group. Informed consent was obtained from each participant. Ethical clearance for this study was granted by the Ethical Review Board of Wangaya Regional General Hospital with letter number 017/11.3/KEP/RSW/2022. Additionally, research permission was obtained from the Education and Research Unit with letter number 070/1080/RSUDW.

The study identified the dependent variables as the duration of the active phase (reported in minutes) and the decision to perform cesarean section delivery and oxytocin augmentation. The independent variables examined were the use of the Friedman curve and the WHO partograph. To account for potential confounding factors, the statistical analysis included the following variables: maternal age, gestational age, maternal body mass index, estimated fetal weight, and cervical effacement.

During the monitoring of the active phase, the duration of the active phase and decisions regarding cesarean section delivery and oxytocin augmentation were recorded. Interviews were conducted to gather information on parity, maternal age, history of previous cesarean section delivery, twin pregnancy, and premature rupture of membranes. The interview data were then cross-referenced with the available medical records. Gestational age, maternal body mass index, cervical effacement, and estimated fetal weight were measured directly through physical examinations and ultrasonography. Gestational age was determined using the Naegle rule based on uterine fundal height, and it was categorized as preterm (<37 weeks) or at term (≥37 weeks). Parity was further classified as grand multiparity (≥5 births at ≥37 weeks of gestation) or not grand multiparity. Data collected for variables listed in the exclusion criteria were used to exclude participants accordingly.

Statistical analysis was conducted using IBM Statistical Package Software for Social Sciences version 22. The Kolmogorov-Smirnov test was employed to assess the normality of numerical scale data. If the p-value was less than 0.05, the data were considered non-normally distributed. Normally distributed numerical data were reported as mean (standard deviation), while non-normally distributed data were reported as median (minimum-maximum value). Categorical scale data were presented as frequency distributions and proportions. The Spearman correlation test was utilized to evaluate the correlation between the independent and dependent variables due to the non-normal distribution of the data. A correlation was deemed significant if the p-value was less than 0.05. Additionally, the correlation coefficient (r) indicating the direction and strength of the correlation was reported.

RESULTS

Table 1 presents the correlation of participant characteristics between the groups. The results indicate that there were no significant differences in the characteristics of pregnant women monitored by the Friedman curve and WHO partograph.

Table 1. Participant's Characteristics between Groups

Variable	Median (IQR) between Groups		*P-value*
	Friedman Curve	**WHO Partograph**	
Maternal age (years)	26.50 (12)	26 (8)	0.313
Parity	2 (3)	1 (2)	0.202
Gestational age (weeks)	39 (2)	39 (2)	0.553
Cervical effacement (%)	25 (0)	25 (19)	0.752
Body mass index (kg/m^2)	27.50 (3)	27 (3)	0.920
Estimated fetal weight (grams)	3186.50 (508)	3118 (597)	0.553

Table 2 presents the results of the correlation test comparing maternal monitoring using the Friedman curve to the WHO partograph in terms of the duration of the active phase until the birth of the baby, cesarean section, and oxytocin augmentation.

Table 2. Correlation Test Results

Variable	Delivery Monitoring				r	P-value
	Friedman Curve		WHO Partograph			
	n=28	%	n=28	%		
Duration of active phase until the birth of baby (hours)					0.000	1.000
< 4.5	16	57.1	16	57.1		
≥ 4.5	12	42.9	12	42.9		
Cesarean Section					0.296	0.027*
Yes	10	35.7	3	10.7		
No	18	64.3	25	89.3		
Oxytocin Augmentation					0.298	0.026*
Yes	14	50	6	21.4		
No	14	50	22	78.6		

*significant correlation, p-value<0.05

The correlation test revealed a weak positive correlation between the Friedman curve and the incidence of delivery by cesarean section when compared to the WHO partograph. Additionally, there was a weak positive correlation observed between the Friedman curve and oxytocin augmentation, indicating that the administration of oxytocin augmentation increased following maternal monitoring using the Friedman curve.

DISCUSSION

This study demonstrates that monitoring using the Friedman curve is associated with an increased incidence of cesarean section and oxytocin augmentation. The findings reveal a positive correlation, indicating that maternal monitoring using the Friedman curve leads to a 29.6 times higher likelihood of deliveries by cesarean section compared to the WHO partograph. Specifically, when delivery was monitored using the Friedman curve, 35.7% of participants underwent cesarean section, while monitoring with the WHO partograph resulted in only 10.7% of participants having a cesarean section. Previous research has shown that the use of the WHO partograph effectively reduces the rate of cesarean section, surgical interventions, and complications associated with prolonged delivery.[8]

The Friedman curve is a labor monitoring device that relies on simple measurements obtained through periodic physical examinations during labor after the onset of labor has been determined. The monitoring primarily focuses on cervical dilation, which marks the onset of active labor and influences the decision-making process for appropriate interventions that impact the clinical outcomes of both the mother and the child. Friedman divided the active phase into three stages: the acceleration phase, the maximum slope phase, and the deceleration phase, during which labor progress is evaluated through vaginal examinations conducted every 2 hours. Furthermore, distinctions are made between childbirth in nulliparous (first-time mothers) and multiparous (women who have given birth before) women. According to Friedman, problems that arise during the active phase can be categorized as protraction disorders or arrest disorders. Protraction is characterized by a slow rate of cervical opening or descent, with a cervical dilatation of less than 1.2 cm/hour for nulliparous women and less than 1.5 cm/hour for multiparous women. Arrest of dilatation refers to the absence of cervical changes within 2 hours, while arrest of descent indicates the absence of fetal descent within 1 hour. Recommended therapies for prolonged labor include a waiting approach, administration of oxytocin for obstructed labor without cephalopelvic disproportion, and cesarean section in cases of cephalopelvic disproportion.

The American College of Obstetricians and Gynecologists (ACOG) has recently issued new guidelines that are grounded in evidence-based data provided by the Consortium of Safe Labor. As part of these guidelines, a new curve has been developed, building upon the findings of the study.[9] The new recommendation differs significantly from Friedman's curve, particularly in terms of the slower cervical dilation observed, especially before reaching six centimeters of dilation. Additionally, Zhang's curve lacks the distinct deflection observed in Friedman's curve between nine and ten centimeters. These findings suggest that the diagnostic standards for labor dystocia based on Friedman's curve may be excessively stringent.[10] Thus, this study result reflected the higher cesarean section delivery in mothers monitored with the Friedman curve.

In this study, the proportion of pregnant women who received oxytocin augmentation was similar between those monitored using the Friedman curve and those who were not. However, in the case of delivery monitoring using the WHO partograph, the majority of women (78.6%) did not receive oxytocin augmentation. The administration of oxytocin augmentation is typically prioritized for mothers experiencing complications related to prolonged delivery (dystocia) caused by abnormalities in uterine contractions, such as uterine inertia. One characteristic of oxytocin is its rapid action, providing visible results quickly. Therefore, prolonged administration of oxytocin is unnecessary in most cases.[11] The ACOG and the Japanese Society of Obstetrics and Gynecology (JSOG) guidelines agree that the latent phase of labor is highly individualized; thus, interventions such as oxytocin augmentation are not always required.[12–14] This study result showed that maternal monitoring using the Friedman curve increased the administration of oxytocin augmentation 29.8 times greater than the WHO partograph. Overall, this study has shown no significant differences in the duration of active phase delivery until the birth of the baby between groups. Although the duration was comparable, monitoring with the Friedman curve was associated in a more aggressive delivery approach, including a higher likelihood of decisions for cesarean section and oxytocin augmentation.

The study has a number of limitations that need to be addressed. Firstly, due to the cross-sectional study design, it is challenging to establish clear cause-and-effect relationships. Although efforts were made to control potential confounding variables, the design itself does not allow for definitive causal conclusions. Secondly, the study was conducted at a single center and involved a relatively small sample size. To obtain more conclusive results, further research with a larger sample size and multiple centers is necessary.

CONCLUSION

Delivery monitoring with the Friedman curve positively correlates with increased incidence of cesarean section deliveries and oxytocin augmentation. Therefore, using the WHO partograph as a delivery monitoring tool is recommended.

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