Thai Journal of Obstetrics and Gynaecology
January 2018, Vol. 26, pp. 18-26

OBSTETRICS

Incidence of Intrapartum Abnormal Fetal Heart Rate Pattern in Siriraj Hospital

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ABSTRACT

Objectives: To determine the incidence of intrapartum abnormal fetal heart rate (FHR), possible associated factors and pregnancy outcomes.

Materials and Methods: A total of 900 low-risk pregnant women were enrolled in this retrospective cohort study. Obstetric, labor and delivery data were collected. Incidence of intrapartum abnormal FHR pattern was determined, according to the National Institute of Child Health and Human Development (NICHD) classification. Comparisons were made between those with and without abnormal FHR pattern to evaluate possible associated factors and pregnancy outcomes.

Results: Mean maternal age was 29.1 years, 55.7% were nulliparous, and mean gestational age at delivery was 38.1 weeks. Incidence of abnormal FHR pattern was 30.7% (30.3% and 0.4% in NICHD category II and III, respectively). Among these, 46.6% and 39.7% occurred in active and deceleration phase of labor, respectively. Univariate analysis showed that rate of abnormal FHR pattern was more common among nulliparous women (RR 1.22, 95% CI 1.003-1.5, p = 0.045). Cesarean delivery was required in 28.9% of cases with abnormal FHR pattern. Birth asphyxia was significantly more common among those with abnormal FHR pattern (7.2% vs. 3.7%, p = 0.016). Multivariate analysis demonstrated that only nulliparity was significantly associated with abnormal FHR pattern (adjusted OR 1.35, 95%CI 1.01-1.82, p = 0.045).

Conclusion: Incidence of intrapartum abnormal FHR pattern was 30.7% and nulliparity was the only independent associated factor. The condition significantly increased the risk of birth asphyxia.

Keywords: Abnormal fetal heart rate pattern, electronic fetal monitoring, incidence, nulliparity.

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อุบัติการณ์การเต้นผิดปกติของหัวใจทารกขณะเจ็บครรภ์คลอดในโรงพยาบาลศิริราช

กณิษฐา บุญชวน, กนกวรุณ วัฒนนิรันตร์, ดิฐกานต์ บริบูรณ์หิรัญสาร

บทคัดย่อ

วัตถุประสงค์: *เพื่อศึกษาอุบัติการณ์ ปัจจัยเสี่ยง และผลของการตั้งครรภ์ ของการเต้นผิดปกติของหัวใจทารกขณะเจ็บครรภ์คลอด*

วัสดุและวิธีการ: *ทำการศึกษาสตรีตั้งครรภ์ที่มีความเสี่ยงต่ำจำนวน 900 ราย ที่มาคลอดที่โรงพยาบาลศิริราช ทำการเก็บรวบรวมข้อมูลทางสูติศาสตร์ ข้อมูลการคลอด และผลของการตั้งครรภ์ จากนั้นทำการคำนวณอุบัติการณ์การเกิดการเต้นผิดปกติของหัวใจทารกขณะเจ็บครรภ์คลอด ตามการแบ่งกลุ่มของ NICHD ทำการเปรียบเทียบข้อมูลต่างๆ ระหว่างกลุ่มที่มีและไม่มีการเต้นผิดปกติของหัวใจทารกขณะเจ็บครรภ์คลอด เพื่อประเมินปัจจัยที่เกี่ยวข้อง และผลของการตั้งครรภ์*

ผลการศึกษา: *สตรีตั้งครรภ์มีอายุเฉลี่ย 29.1 ปี เป็นครรภ์แรกร้อยละ 55.7 อายุครรภ์เฉลี่ยเมื่อคลอด 38.1 สัปดาห์ อุบัติการณ์การเกิดการเต้นผิดปกติของหัวใจทารกขณะเจ็บครรภ์คลอดเท่ากับร้อยละ 30.7 ซึ่งเป็นกลุ่ม NICHD category II ร้อยละ 30.3 และ NICHD category III ร้อยละ 0.4 พบว่าการเต้นผิดปกติของหัวใจทารกเกิดในระยะ active phase ร้อยละ 46.6 และเกิดในระยะ deceleration phase ร้อยละ 39.7 และสตรีดังกล่าวคลอดโดยการผ่าท้องคลอดร้อยละ 28.9 พบอุบัติการณ์การเต้นผิดปกติของหัวใจทารกในสตรีที่คลอดครั้งแรกสูงกว่าครรภ์หลังอย่างมีนัยสำคัญทางสถิติ (RR 1.22, 95% CI 1.003-1.5, p = 0.045) และพบว่าอัตราการเกิดภาวะขาดออกซิเจนแรกคลอดในกลุ่มที่เกิดการเต้นผิดปกติของหัวใจทารกสูงขึ้นอย่างมีนัยสำคัญทางสถิติ (ร้อยละ 7.2 และร้อยละ 3.7, p = 0.016) จากการวิเคราะห์ multivariate analysis พบว่าการคลอดครั้งแรกเพิ่มความเสี่ยงต่อการเกิดการเต้นผิดปกติของหัวใจทารกอย่างมีนัยสำคัญทางสถิติ (adjusted OR 1.35, 95%CI 1.01-1.82, p = 0.045)*

สรุป: *อุบัติการณ์การเกิดการเต้นผิดปกติของหัวใจทารกขณะเจ็บครรภ์คลอดเท่ากับร้อยละ 30.7 และปัจจัยเสี่ยงที่สัมพันธ์กับภาวะนี้คือการคลอดครั้งแรก ภาวะนี้เพิ่มความเสี่ยงต่อการเกิดภาวะขาดออกซิเจนในทารกอย่างมีนัยสำคัญทางสถิติ*

คำสำคัญ: *การเต้นผิดปกติของหัวใจทารก, การตรวจติดตามการเต้นของหัวใจทารก, อุบัติการณ์, การคลอดครั้งแรก*

Introduction

Detection of abnormal fetal heart rate (FHR) pattern during intrapartum period indicated non-reassuring fetal condition. Without appropriate and immediate care, it may cause detrimental effect to the fetus, such as fetal hypoxia, acidosis and birth asphyxia. On the other hand, with suitable management, the complications can be prevented[1]. Thus, correct interpretation of fetal heart rate pattern is important. Fetal heart rate patterns are currently categorized into 3 categories according to The National Institute of Child Health and Human Development (NICHD) as demonstrated in Table 1[2] with different degree of severity and appropriate management has been recommended accordingly[2-7].

In terms of occurrence of different categories of FHR pattern, a previous study reported that majority of cases (77.9%) had normal FHR pattern (NICHD category I), and 22.1% had NICHD category II, while NICHD category III occurred in only 0.004%[8]. Another study reported the incidence of variable deceleration FHR pattern of 51.07%[9]. The differences might be due to differences in population characteristics or management guidelines in different settings. In addition, multiple factors also play important role in the occurrence of abnormal FHR pattern, including gravidity, amniotic fluid volume, meconium stain amniotic fluid, tocolytic drug administration[10-14].

When abnormal FHR pattern is detected, decision on appropriate route of delivery depends on the degree of abnormality and its improvement after appropriate management. For women with NICHD category II FHR pattern, if the abnormalities improve after appropriate management, vaginal delivery can be permitted. Otherwise, cesarean delivery should be performed. On the other hand, for women with NICHD category III FHR pattern, emergency cesarean delivery is usually mandatory[4, 5, 15, 16].

However, to date, there is still limited information on this important issue of abnormal FHR pattern in Siriraj Hospital and in Thailand. Therefore, this study was conducted to investigate the incidence of intrapartum abnormal FHR pattern in Siriraj Hospital. In addition, possible associated factors and pregnancy outcomes were also evaluated. The results of this study will provide more information and insights on this issue and can help obstetricians in giving better care of pregnant women for better pregnancy outcomes.

Table 1. Fetal heart rate classification system[2].

Fetal heart rate category	Characteristics
Category I	Baseline rate of 110–160 beats per minute
	Moderate baseline fetal heart rate variability
	Late or variable decelerations are absent
	Early decelerations may be present or absent
	Accelerations may be present or absent
Category II	Not categorized as category I or category III
Category III	Absent baseline fetal heart rate variability with any of the following:
	Recurrent late decelerations
	Recurrent variable decelerations
	Bradycardia
	Sinusoidal pattern

Materials and Methods

After approval from the Siriraj Institutional Review Board (SIRB), a retrospective cohort study was conducted at Department of Obstetrics and Gynaecology,

Faculty of Medicine, Siriraj Hospital during January and May 2016. A total of 900 low-risk, singleton pregnant women during first stage of labor were consecutively enrolled. Women who were scheduled for cesarean delivery, had severe maternal complications such as pregnancy-induced hypertension, overt diabetes, heart disease of functional class III or IV, etc., documented fetal anomaly, fetal arrhythmia, and fetal death were excluded. At 95% significance level, a sample size of at least 801 was required based on the rate of abnormal fetal heart rate pattern of 25% from a pilot study, with 3% allowable error.

Management of labor and delivery were provided according to institutional guideline. Baseline characteristics and related clinical data were recorded, including age, parity, gestational age, pre-pregnancy weight, height, maternal and fetal complications, route of delivery, and neonatal outcomes. Electronic FHR monitoring was offered to all women during labor and delivery. All fetal heart rate tracings were assessed by attending obstetricians under staff supervision, to determine abnormalities of FHR patterns. Management of abnormal FHR pattern was provided as appropriate, according to NICHD recommendation, which was adopted as institutional guideline. All fetal heart rate tracings were reviewed retrospectively by experienced staff before final classification was recorded.

Descriptive statistics were used to describe various variables, using mean, standard deviation, number, and percentage, as appropriate. Incidence of abnormal FHR pattern was estimated. Student t test and Chi square test were used in comparison of variables between those with normal and abnormal FHR pattern as appropriate. Relative risk (RR) and 95% confidence interval (CI) were estimated to determine association between various characteristics and abnormal FHR pattern. Logistic regression analysis was performed to determine independent associated factors with abnormal FHR patter, adjusted for potential confounders. Adjusted odds ratio (OR) and 95% confidence interval (CI) were estimated. A p value of < 0.05 was considered statistical significance.

Results

A total 900 pregnant women who delivered during the study period were included in this study and medical records were reviewed and documented. Table 2 showed baseline characteristics of the participants. Mean maternal age was 29.1 years and 55.7% were nulliparous. Complications during pregnancy included gestational diabetes (8.2%), gestational hypertension (10%), and suspected IUGR (2.4%).

Table 2. Baseline characteristics of the patients (N=900).

Characteristics	Mean ± SD
Mean maternal age ± SD (years)	29.1 ± 6.2
Mean BMI ± SD (kg/m^2)	21.9 ± 4.1
	N (%)
Nulliparous	501 (55.7)
BMI category	
Normal	570 (63.3)
Underweight	168 (18.7)
Overweight	162 (18.0)
Complications during pregnancy	
Gestational diabetes	74 (8.2)
Gestational hypertension	90 (10)
Antenatal suspected IUGR	22 (2.4)

Table 3 showed labor and delivery characteristics of the participants. Mean gestational age at delivery was 38.1 weeks and only 2.2% delivered at < 34 weeks. Thin and thick meconium stained amniotic fluid was observed in 8.6% and 3.4%, respectively. Majority of cases delivered vaginally (61.8%) and mean birth weight was 3015.4 g.

Table 3. Labor and delivery characteristics of the patients (N=900).

Characteristics	N (%)
Mean gestational age ± SD (weeks)	38.1 ± 1.7
Mean birth weight ± SD (g)	3015.4 ± 465.1
Gestational age at delivery	
< 34 weeks	20 (2.2)
34 - 36^{+6} weeks	84 (9.3)
≥ 37 weeks	796 (88.5)
Meconium stained amniotic fluid	
Thin	77 (8.6)
Thick	31 (3.4)
Route of delivery	
Vaginal delivery	556 (61.8)
Cesarean section	344 (38.2)

Table 4 showed characteristics of fetal heart rate pattern during labor. Incidence of abnormal FHR pattern was 30.7% (30.3% and 0.4% in NICHD category II and III respectively). Among these, 46.6% and 39.7% occurred during active and deceleration phase of labor, respectively.

Table 4. Characteristics of fetal heart rate pattern during labor (N=900).

Characteristics	N (%)
NICHD category	
Category I	623 (69.2)
Category II	273 (30.3)
Category III	4 (0.4)
Timing of abnormal fetal heart rate pattern	N = 277
Latent phase	38 (13.7)
Active phase	129 (46.6)
Deceleration phase	110 (39.7)
Thick	31 (3.4)
Route of delivery	
Vaginal delivery	556 (61.8)
Cesarean section	344 (38.2)

Table 5 showed analysis of risk of abnormal FHR patterns according to various characteristics. Rate of abnormal FHR pattern was significantly more common among nulliparous than multiparous women (33.5% vs. 27.3%, respectively; RR 1.22, 95% CI 1.003-1.5, p=0.045). Other factors including maternal age, pre-pregnancy BMI, gestational age, complication during pregnancy, meconium stained amniotic fluid were not significantly associated with abnormal fetal heart rate pattern.

Table 5. Risk of abnormal fetal heart rate patterns according to various characteristics.

Characteristics	N	Normal FHR N = 623	Abnormal FHR N = 277	RR (95% CI)	p value
Age group					
< 20 years	60	40 (66.7%)	20 (33.3%)	1.08 (0.73, 1.54)	0.78
20-34 years	666	456 (68.5%)	210 (31.5%)	1.0	
≥ 35 years	174	127 (73%)	47 (27%)	0.85 (0.65, 1.12)	0.245
BMI category					
Normal	570	395 (69.3%)	175 (30.7%)	1.0	
Underweight	168	105 (62.5%)	63 (37.5%)	1.23 (0.98, 1.56)	0.082
Overweight	162	123 (75.9%)	39 (24.1%)	0.8 (0.59, 1.08)	0.131
Parity					
Nulliparous	501	333 (66.5%)	168 (33.5%)	1.22 (1.003, 1.5)	0.045
Multiparous	399	290 (72.7%)	109 (27.3%)	1.0	
Gestational diabetes	74	55 (74.3%)	19 (25.7%)	0.82 (0.55, 1.23)	0.321
Gestational hypertension	90	64 (71.1%)	26 (28.9%)	0.93 (0.66, 1.31)	0.682
Suspected IUGR	22	14 (63.6%)	8 (36.4%)	1.19 (0.68, 2.08)	0.566
GA at delivery (weeks)					
< 34	20	11 (55%)	9 (45%)	1.46 (0.89, 2.4)	0.175
34-36^{+6}	84	61 (72.6%)	23 (27.4%)	0.89 (0.62, 1.28)	0.52
≥ 37	796	551 (69.2%)	245 (30.8%)	1.0	
Meconium stained AF					
No	792	554 (69.9%)	238 (30.1%)	1.0	
Thin	77	51 (66.2%)	26 (33.8%)	1.12 (0.81, 1.56)	0.499
Thick	31	18 (58.1%)	13 (41.9%)	1.4 (0.91, 2.14)	0.159

Table 6 showed pregnancy outcomes between those with and without abnormal FHR pattern. Cesarean section rate was significantly less in women with abnormal FHR pattern compared to others (28.9% vs. 42.2%, p<0.001), and only 19.1% required emergency cesarean section from the condition. Among those with abnormal FHR pattern, 66.3% had cesarean section from non-reassuring FHR pattern. 1-minute Apgar score of < 7 was significantly more common among those with abnormal FHR pattern (7.2% vs. 3.7%, p=0.016). NICU admission of fetus was not significantly associated with abnormal fetal heart rate pattern. All of the 4

cases with FHR pattern in NICHD category III delivered by cesarean section and none of the neonates had birth asphyxia.

Logistic regression analysis was performed to determine independent risk factors associated with abnormal FHR pattern and the results were shown in Table 7. After adjusting for potential confounders, only nulliparity was significantly associated with abnormal FHR pattern (adjusted OR 1.35, 95%CI 1.01-1.82, p=0.045).

Table 6. Outcomes of pregnant women between those with and without abnormal fetal heart rate patterns.

Characteristics	Normal FHR N = 623	Abnormal FHR N = 277	p value*
Route of delivery			< 0.001
Vaginal	359 (57.6%)	197 (71.1%)	
Cesarean section	264 (42.4%)	80 (28.9%)	
Indication for cesarean section			< 0.001
Non-reassuring FHR	NA	53/80 (66.3%)	
Others	264/264 (100%)	27/80 (33.7%)	
1-minute Apgar scores <7	23 (3.7%)	20 (7.2%)	0.016
NICU admission	13 (2.1%)	6 (2.2%)	0.939

* Chi square test

Table 7. Logistic regression analysis of risk factors associated with abnormal FHR pattern.

Risk factors	Adjusted OR	95% CI	p value
Nulliparous	1.35	1.01-1.82	0.045
Age			
20-34 years	1.0		
< 20 years	0.95	0.53-1.70	0.866
≥ 35 years	1.08	0.52-2.26	0.839
Meconium stained AF			
No	1.0		
Thin	1.15	0.7-1.9	0.580
Thick	1.73	0.83-3.6	0.142
GA at delivery			
37-40 weeks	1.0		
< 34 weeks	1.9	0.77-4.69	0.166
34-36+6weeks	0.85	0.52-1.42	0.541

Discussion

Intrapartum fetal heart rate monitoring is a procedure that used for fetal surveillance during labor. Fetal heart rate pattern is classified into 3 categories according to NICHD[2]. Category I is a normal FHR pattern that reflected of normal fetal oxygenation status

and complication or birth asphyxia are uncommon. Whereas category II and category III are abnormal FHR patterns that reflect some degree of fetal acidosis and fetal hypoxia, which may cause birth asphyxia and complication[2]. When abnormal FHR pattern is detected, appropriate management should be provided in a timely fashion to minimize neonatal morbidity and mortality. Multiple factors have been related with abnormal fetal heart rate pattern including gravidity, amniotic fluid volume, meconium stain amniotic fluid.

The result of this study showed that incidence of intrapartum abnormal FHR pattern was 30.7%, with mostly was in NICHD category II (30.4%). Among these, 46.6% and 39.7% occurred in active phase and deceleration phase of labor, respectively. The results were similar to previous studies that a majority of FHR pattern was in category I and II. Jackson M, et al[8], reviewed FHR pattern in 48,444 term singleton pregnant women with intrapartum fetal heart rate monitoring and found that the incidence of abnormal FHR pattern category II was 22.1% and only 0.004% were in category III. Salim R, et al[9], examined FHR pattern of 513 term singleton pregnant women in latent phase of labor and reported the incidence of NICHD category II variable deceleration was 51.1%.

Previous studies have reported that meconium-stained amniotic fluid and oxytocin used were associated with abnormal FHR pattern[13, 17]. A more recent study reported that hydramnios, oligohydramnios, and the presence of meconium-stained amniotic fluid were independently associated with abnormal FHR pattern[12]. However, nulliparity was the only factor that significantly associated with abnormal FHR pattern in this study. The differences might partly due to differences in definitions of abnormal FHR classification of some previous studies. In relation to multiparous women, nulliparous women usually have longer duration of labor that might also increase the probability of detection of abnormal FHR pattern. However, explanation of this relationship needs to be further investigated in future researches.

In terms of delivery route, the results showed that only 28.9% of women with abnormal FHR pattern had cesarean delivery, and, among them, 66.3% were conducted for FHR abnormalities. When abnormal FHR pattern develops, initial management with intrauterine resuscitation is provided (i.e., encouraging women to adopt the left lateral position, treatment of maternal hypotension, administrating facial oxygen and lowering or discontinuing of labor stimulation) and cesarean delivery is performed if the abnormalities do not resolve. The results of this study reflected that majority of FHR abnormalities resolved after such management was provided. The results also demonstrated that abnormal FHR pattern contributed to only 15.4% (53 of 344) of all cesarean delivery, which was lower than a previous study, which reported that 27% of intrapartum cesarean delivery was conducted for abnormal FHR patterns[18]. The differences might be from differences in study population and management guideline.

The results of the study showed that birth asphyxia was significantly more common among women with abnormal FHR pattern. This would be the results of fetal hypoxia and acidosis. Similar results of increased in adverse neonatal outcomes among abnormal FHR pattern have been reported previously, including 1-minute Apgar score of < 7, fetal acidosis, and NICU admission[8, 9, 12].

There were some limitations of the current study to be mentioned. The sample size and power might be inadequate when comparisons were made between groups. This study included patients from a single, tertiary care hospital that the findings may not be generalizable to other populations. In addition, there might be some variations in clinical practice in management and decision of cases with abnormal FHR pattern.

The results of this study provided more information and insights into pregnant women with intrapartum abnormal FHR. The condition was relatively common, even among low-risk women. Appropriate management could resolve the abnormalities in majority of cases. However, birth asphyxia was still more common among these women. Although the condition might not be accurately predictable, careful surveillance and timely detection of abnormalities and appropriate management could help improving the pregnancy outcomes. Future

studies are needed to investigate the importance of FHR abnormalities, possible predictive factors, and related care process improvements.

Conclusion

In conclusion, incidence of intrapartum abnormal FHR pattern in Siriraj Hospital was 30.7%. Cesarean delivery was required in 28.9% of cases. Only nulliparity was significantly increased the risk of FHR abnormalities. The condition significantly increased the risk of birth asphyxia.

Potential conflicts of interest

The authors declare no conflict of interest.

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