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The Importance of Fetal Bradycardia in Fetal Heart Rate Monitoring

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Abstract

Fetal bradycardia is very important in fetal monitoring, as hypoxia stimulates vagus nerve center to develop fetal bradycardia, thus, a deceleration (transient fetal bradycardia) develops if fetal PaO2 is less than 50 mmHg. The hypoxia damages fetal central nervous system, if the hypoxic deceleration frequently repeated, and fetal brain lost the reaction to fetal movement and the baseline variability is lost in frequently repeated hypoxia, which is similar to anencephalic FHR, followed by infantile cerebral palsy. Thus, hypoxic fetus should be cured by early delivery before the loss of variability, where the threshold is shown by novel Hypoxia Index (HI), which is the sum of deceleration duration (min), divided by the lowest FHR (bpm), and multiplied by 100. The numeric threshold of no cerebral palsy is 24, namely, cerebral palsy is prevented if the HI is 24 or less in the labor. Neonate whose HI is 25 or more can be treated by early cerebral palsy therapy. Traditional FHR pattern classification is exchanged by such numeric methods as hypoxia index & deceleration area. A FHR deceleration should be rejected by maternal lateral posture to prevent large hazardous indices.

Keywords: Fetal monitoring; Hypoxia index; Cerebral palsy; Late deceleration; Lateral posture

Introduction

A senior OBGY doctor told newcomer as the author that fetal bradycardia is important fetal sign, listening fetal heart sound with a tube stethoscope in 1949, the education was true in modern fetal pathophysiology. The first fetal monitor in Asia was reported by Maeda in 1964, by fetal scalp electrode or fetal heart tone microphone, namely, it was selection of internal or external monitoring. Hon [1] created his own intrapartum Fetal Heart Rate (FHR) monitor recorded by fetal scalp ECG with clip electrode and uterine contraction by intrauterine pressure. His FHR deceleration pattern classification was early, late and variable decelerations, which were used until now. Caldeyro-Barcia et al. [2,3] detected fetal ECG to record FHR curve, using needle electrode through maternal abdominal wall, where his Type 2 Dip was the same as Hon's late deceleration. Hammacher [4] of Germany developed purely external fetal monitor, and emphasized the importance of FHR baseline variability, where the loss of variability was the worst sign.

A new numeric threshold was needed to prevent cerebral palsy to reveal the repetition of fetal bradycardia which reflect the summation of fetal hypoxia. Thus, typical late deceleration was analyzed by the author to clarify important repetition of bradycardia by a novel hypoxia index.

Methods

Three connected typical late deceleration with 45 sec lag time were suspected to be ominous in the newborn early delivered by caesarean section, preparing neonatal resuscitation, whereas the neonate was completely normal, and Apgar score was 9. Thus, the particular pattern of late deceleration did not influence fetal outcome, if the repetition was none.

However, another case repeated typical late decelerations for 50 minutes due to refusal of caesarean delivery, and finally baseline variability was lost, then the Apgar score was 3, severe neonatal asphyxia, severe neonatal brain damage, and ended by brain hemorrhage and death.

In addition, late deceleration was defined when the late deceleration repeated for 15 minutes or more in a experts opinion, namely, repetition was necessary to predict outcome in this definition.

Thus, it was concluded that a late deceleration is ominous, when frequent decelerations repeated, but not by the typical late deceleration pattern by the author.

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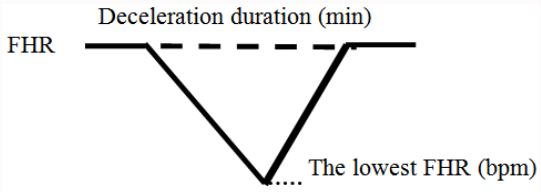

Figure 1: Hypoxia Index is the sum of deceleration durations (min) divided by the lowest FHR (bpm) in whole fetal monitoring, and multiplied by 100.

Table 1: χ^2 test in 6 cerebral palsy cases whose hypoxia index was 25 or more, and 16 no cerebral palsy cases whose hypoxia index was 24 or less; p=0.000008<0.05, significant difference, thus, it was decided that cerebral palsy is prevented if hypoxia index is 24 or less.

Hypoxia index	Case number	Cerebral palsy	
		Yes	No
25 or more	6 cases	6	0
24 or less	16 cases	0	16

In summary, frequent repetition is necessary condition of ominous outcome of late decelerations, where the late appearance pattern was unnecessary, thus, the hypoxia is estimated in repeated FHR deceleration in all of deceleration as well as continuous bradycardia, where lag time should not be added the calculation equation, that is the application to all of decelerations including early, late and variable decelerations as well as continuous bradycardia, which developed by the hypoxia, namely, FHR is fully parallel to the PaO_2, if it is lower than 50 mmHg [5], and human fetal PaO_2 is lower than 50 mmHg [6].

Thus, novel Hypoxia Index (HI) is: the sum of deceleration duration (min) in whole monitoring, divided by the lowest FHR (bpm), and multiplied by 100 to keep integer of HI (Figure 1).

We collected 6 cerebral palsy cases and 16 no cerebral palsy cases comparing the HI in these cases by preserved monitoring records.

Ethics committee agreed the retrospective study to analyze the relation of HI to cerebral palsy.

Results

The HI of all 6 cases of cerebral palsy was 25 or more, and the HI of all 16 cases of no cerebral palsy was 24 or less. The χ^2 test of number of cerebral cases p=0.000008<0.05, significant difference (Table 1).

Discussion

Thus, the case whose HI is 24 or less in fetal monitoring cerebral palsy is prevented.

As the case whose HI is 25 or more has the probability to be cerebral palsy, the case can receive early cerebral palsy treatments.

The HI is adopted all deceleration including early, late, variable decelerations as well as the fetus of continuous bradycardia.

As the HI is the sum of deceleration durations, maternal posture should change to lateral posture to remove the deceleration or bradycardia and prevent large HI value, because late deceleration disappeared by changing maternal posture to lateral one from supine [2,3].

The deceleration pattern classification into early, late and variable decelerations will be exchanged to the hypoxia index, deceleration area or other numeric parameters in coming fetal heart rate monitoring [5].

Conclusion

Subjective visual classification of fetal heart rate patterns, which caused controversy results, will be changed to objective numeric parameters as novel hypoxic index in fetal monitoring based on truly correct mechanisms of fetal heart rate.

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