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Research Article

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Prevention of Cerebral Palsy with Novel Hypoxia Index Composed of Fetal Heart Rate Deceleration

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Abstract

Fetal brain damage develops after the loss of FHR variability followed by infantile cerebral palsy due to severe hypoxia in frequently repeated fetal heart rate (FHR) decelerations (transient bradycardia) or prolonged fetal bradycardia, where novel hypxia index is 25 or more, and it is prevented if the hpoxia index is 24 or less. The hypoxia index (HI) is the sum of FHR deceleration durations (min) divided by the lowest FHR (bpm), and multiplied by 100 (Figure 1). The HI is calculated by visual measurement, while it is also suitably calculated by computerized FHR monitoring. Cerebral palsy is prevented when HI is 24 or less with almost zero error probability in the delivery. The cases whose HI was 25 or more will develop cerebral palsy, thus, it can receive early cerebral palsy trearments in neonatal stage. As late deceleration disappeared when the parturient woman changed her posture to lateral one from supine, a parturient woman is recommended to have lateral posture, when they notice the appearance of FHR deceleration during the delivery to disappear deceleration to prevent the increase of HI value. As the HI is adopted not only late deceleration, but also all decelerations and continuous bradycardia, fetal diagnosis will change to objective numeric FHR analysis from the monitoring with vague subjective FHR pattern classification.

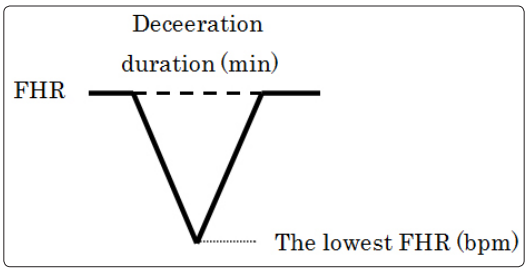

Figure 1: The measurement of deceleration duration and the lowest FHR

Introduction

As the corresponding author noticed completely normal outcome of three connected typical late decelerations, the typical late appearance of deceleration after uterine contraction lost their role to develop ominous outcome, while frequently repeated late decelerations for 50 minutes developed severely depressed neonate of which Apgar score was 3 points where the neonatal brain was severely damaged, namely died due to brain hemorrhage, frequent repetitions of FHR deceleration was emphasized in repeated late deceleration [1]. As fetal hypoxia stimulates parasympathetic (vagus) nerve center in medulla oblongata, FHR decreases developing bradycardia, FHR deceleration and continuous bradycardia are the sign of fetal hypoxia, frequent FHR deceleration and continuous bradycardia show prolonged fetal hypoxia, so that the hypoxic effect is emphasized by the hypoxia index, of which large value means intensive effect of hypoxia on the fetus, particularly on its brain. Thus, high hypoxia index meant strong hypoxic effect.

Methods and Results

The novel hypoxia index (HI) is the sum of deceleration (transient bradycardia) durations (min) in full delivery course, divided by the lowest FHR, and multipled by 100 to keep it integer.

We collected 6 cases of cerebral palsy and 16 cases of no cerebral palsy that were diagnosed in pediatric clinics, and calculated their hypoxia index of fetal heart rate recorded during their delivery in obstetric wards. The hypoxia index of all 6 cases of cerebral palsy was 25 or more, while the hypoxia index of all 16 cases were 24 or less. In the $\chi 2$ test of two groups, $p=0.000008<0.05$, significant difference (Table 1).

Table 1: The cerebral palsy in 25 or more and 24 or less hypoxia index groups

Hypoxia Index	Cerebral palsy cases	
	Yes	No
25 or more	6	0
24 or less	0	16

χ^2 test: $p=0.000008<0.05$, significant difference

Discussion

The hypoxia index was composed on the facts of vague outcome of scarce and frequently repeated late decelerations. Although "Cerebral palsy" is a summarized disease name, the cerebral palsy and normal cases were grouped also according to the facts [2]. Two groups of hypoxia index were composed of "cerebral palsy" and "no cerebral palsy" cases, which were suitable to separate two groups separated by a clear numeric threshold, which was severely requested to estimate the outcome of fetal monitoring. However, statistic technique was established, namely, the threshold is hypoxia index, which is similar to Apgar score, which is a single numeric score. The target is a disease or one simple numeric data, for example estimate Apgar scope or umb pH by the hypoxia index, and so on.

It was problem to decide fetal outcome by observer's visual classification. The method allowed observers difference and vague results. That was FHR pattern classification after Hon till present in 60 years [1].

Numeric decision was made by Maeda's FHR score which predicted Apgar and UAPH [3, 4]. Frequency spectrum analysis decided pathologic sinusoidal FHR [5]. FHR score, hypoxia index and FHR frequency spectrum will be sufficient at present. Such simple computer composed 3 parameters is constructing.

Past pattern diagnosis prevented severe asphyxia and fetal demise, but not cerebral palsy, which are possible by the hypoxia index, if it is tried to prevent severe asphyxia. Although the FHR pattern prevented fetal demise, neither Apgar score nor UAPH, which is done by FHR score [4]. The regression equation is useful.

Every diagnosis should be done by three parameters. Even deceleration removal is recommended by lateral posture of parturient woman. The new field is wide in update fetal monitoring.

Conclusion

New field is open in FHR monitoring by numerical criteria to prevent infantile cerebral palsy with hypoxia index and other update mathematical analysis, instead of subjective fetal outcome estimation with FHR deceleration pattern classification.

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