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Original Article

Relationship between fetal heart rate patterns and a time course for evaluation of fetal well-being: “the 30 minutes rule” for decision of mechanical delivery

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ABSTRACT

Objective: To predict acidosis in fetus showing deceleration associated with non-reassuring fetal status during delivery, we examined the relationship between duration of the deceleration and umbilical arterial pH.

Materials and methods: A total of 19,907 deliveries in eight facilities of the Juntendo Perinatal Care Group, 895 cases of vaginal deliveries with level 3 decelerations were selected for the subjects of this study. The cut-off point of time when the umbilical arterial pH fell below 7.20 in all cases of level 3 and for each deceleration type were examined. The explanatory variables were the pH and pO_2 of umbilical arterial gas and the time from onset of the level 3 pattern to delivery. From receiver operating characteristic (ROC) analysis using these variables, the critical point indicating low Apgar score was set at an umbilical arterial pH < 7.20.

Results: The cut-off point of time when the umbilical arterial pH fell below 7.2 was 33.5 min for all cases of level 3, and 604 cases of severe variable decelerations with normal baseline variability and normal baseline heart rates, the cut-off point was 33.5 min as well. For 108 cases of late decelerations, there was no significant cut-off point for either the mild or severe cases. Mild prolonged deceleration showed the cut-off point of 34.5 min.

Conclusions: We confirmed the time indices for predicting and preventing acidosis in fetuses showing decelerations. To prevent fetal acidosis, the decision related to proper timing for performing assisted delivery by considering the time course is important.

Introduction

Currently, fetal well-being is assessed primarily through cardiotocography (CTG) and umbilical arterial gas analysis at birth. CTG is the only method for evaluating fetal well-being during delivery, and abnormal heart rate patterns that may indicate a threat to fetal well-being and a heart rate pattern classification system for the diagnosis of non-reassuring fetal status have been described [1]. In recent years, wide acceptance of obstetrical practice according to the recommendation of the Guideline for Obstetrical Practice in Japan has contributed to the standardization. In addition, the analysis of data obtained through the Japan Obstetric Compensation System for Cerebral Palsy has contributed to the accumulation of evidence regarding cerebral palsy causation [2]. Given this situation, obstetricians and midwives are increasingly expected to provide high-quality management of labor and delivery. In 2011, that guideline introduced a 5-stage fetal heart rate pattern classification system with the aim to provide a guide for preserving fetal well-being for a safe delivery.

However, there is no consensus regarding appropriate action for abnormal heart rate patterns; that is, the guideline says no recommendation for treatment concerning fetuses with abnormal heart rate pattern along with the axis of time. Perhaps as a result, there are a few reported cases of cerebral palsy that might be related to a delay in performing cesarean delivery or the prolongation of time for forced delivery due to multiple vacuum extractions [3]. It is reasonable to repeat evaluations of the fetal condition and well-being based on the knowledge of fetal physiology when decelerations occur; however, it should be noted that CTG monitoring cannot predict the appropriate delivery time-point.

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In 1983, Mukubo et al. showed that variable decelerations correlated with umbilical arterial pH and Apgar score; they reported that the time from the onset of variable deceleration to the time at which an umbilical arterial pH fell to ≤7.2 was 105.1 min [4]. In 1986, Horiguchi et al. reported that the time interval from onset of severe variable deceleration to delivery that produced an umbilical arterial pH < 7.2 was 30.7 min, and that of late decelerations was 28.7 min [5]. Although these studies are excellent, their findings have not been used as criteria in clinical practice because of their small sample sizes.

To predict acidosis in fetus showing deceleration associated with non-reassuring fetal status during delivery, the relationship between duration of the deceleration and umbilical arterial pH were examined in the present study.

Methods

Materials

This study was conducted as multicenter retrospective cohort study, and was approved by the ethics committee of our hospital. A total of 19,907 deliveries were performed in eight facilities of the Juntendo Perinatal Care Group between January 1, 2012, and December 31, 2014. After excluding preterm, post-term and cesarean deliveries, the remaining 14,686 were full-term vaginal deliveries. Among them, 1052 had CTG data continuously recorded for the last 120 min before delivery and also had normal baseline variability and normal baseline heart rate. Of those 1052 deliveries, 895 cases of vaginal deliveries with level 3 decelerations (observed in 50% or more of contractions) were selected for the subjects of this study (Fig. 1), after excluding cases showing clinical chorioamnionitis at 120 min before delivery. Clinical chorioamnionitis was diagnosed in the presence of a maternal temperature of ≥38.0 °C and ≥2 of the following criteria [1]: uterine tenderness [2]; malodorous vaginal discharge [3]; maternal leukocytosis (white blood cell count of ≥15,000/μL); and [4] maternal tachycardia (≥100/min) [1].

The subjects were retrospectively studied according to the following protocols. There were 263 (29.4%) vaginal operative deliveries (i.e. vacuum extraction and forceps delivery) among 895 cases.

Definition of decelerations

Our 5-stage classification (Fig. 2) is based on the classification of The American College of Obstetricians & Gynecologists put out a Practice Bulletin in 2010 accepting the 3 categories, and appeared to rationalize Category II by describing 3 groups within it, primarily based on different types of FHR patterns [6].

Variable deceleration was defined as deceleration (≥15 bpm) with sudden decrease in fetal heart rate, which is lasting ≥15 s but <2 min from onset to return to baseline. Severe variable deceleration was defined as deceleration that is lasting ≥30 s with bottom of <70 bpm, or ≥60 s with bottom of 70–80 bpm.

Late deceleration was defined as deceleration (≥15 bpm) with slow decrease in fetal heart rate which bottom is behind a nadir of the uterine contraction, which is lasting ≥15 s but <2 min. Severe late deceleration was defined when the difference with the baseline more than 15 bpm.

Prolonged deceleration was defined as deceleration is ≥15 bpm, lasting ≥2 min but <10 min. Severe prolonged deceleration was defined as deceleration which bottom is <80 bpm.

Analysis

First, the cut-off point of time when the umbilical arterial pH fell below 7.20 in all cases of level 3 and for each deceleration type were examined.

If a case had prolonged deceleration first and additionally developed variable deceleration, it was classified into prolonged

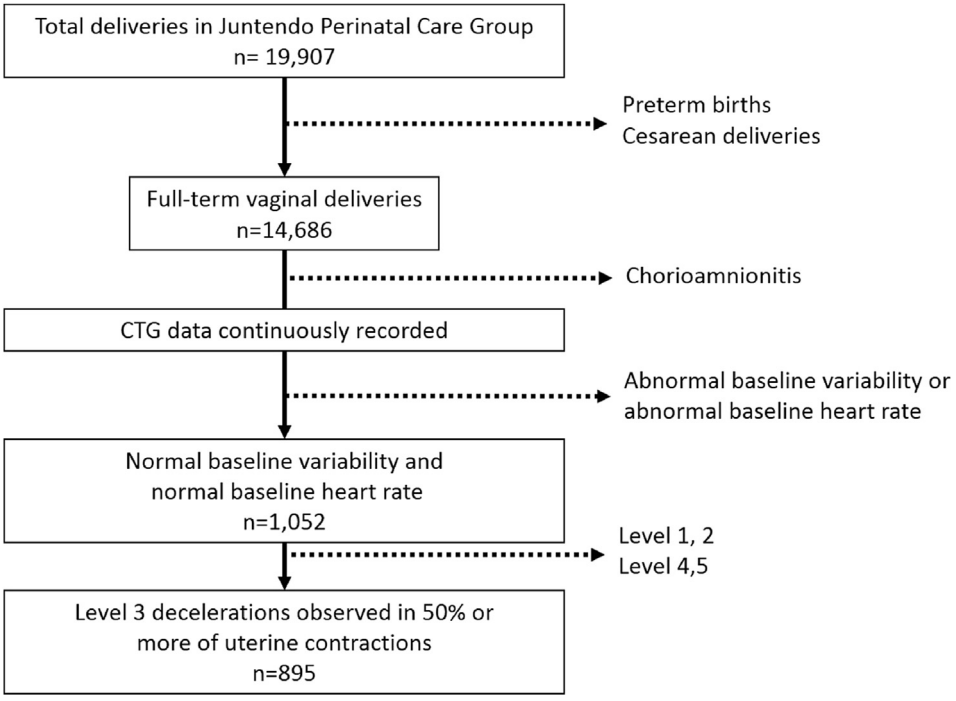

Fig. 1. Subjects. After excluding preterm and cesarean deliveries, the remaining 14,686 of 19,907 were full-term vaginal deliveries. Among them, 1052 had CTG data continuously recorded for the last 120 min before delivery and also had normal baseline variability and normal baseline heart rate. Of those 1052 deliveries, 895 cases of vaginal deliveries with level 3 decelerations.