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Does maternal race influence the short-term variation of the fetal heart rate? An historical cohort study

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ABSTRACT

Objectives: The main aim of this article was to analyze short-term variation (STV) of the fetal heart rate according to maternal race. The secondary aim was to study the baseline fetal heart rate according to this factor.

Study design: This single-center historical cohort study covered the period from November 2008 through December 2011 ($n = 182$). The inclusion criteria were: black women from sub-Saharan Africa or white European women, with a singleton pregnancy ≥34 weeks and fetal heart rate recorded by computerized analysis (Oxford Sonicaid System 8002) at a prenatal visit. The exclusion criteria were: medication likely to modify fetal heart rate, abnormal fetal heart rate tracing, and being in labor. A multiple linear regression analysis was used to study the association between maternal race and STV.

Results: STV was lower by 2.6 ms in fetuses of black women ($n = 55$) compared to those of white women ($n = 127$) (8.9 ± 2.1 ms vs. 11.4 ± 3.4 ms) ($p < 0.001$). The basal fetal heart rate was higher ($p = 0.001$), and the recording criteria were met less often for the black women ($p = 0.04$). After adjustment for maternal age, body mass index at the beginning of pregnancy, maternal cigarette smoking, parity, gestational diabetes, gestational age at the time of the fetal heart rate recording, and the time between the last meal and the recording, mean STV was lower by 3.1 ± 0.6 ms in fetuses of black compared with white women ($p < 0.001$).

Conclusion: STV is lower in fetuses of black women compared to those of white women in a low-risk population. A study of black and white women with high-risk pregnancies is necessary to assess the impact of medical practices on perinatal outcome after STV analysis.

Introduction

In France, analysis of fetal heart rate (FHR) is an essential, frequently performed part of fetal monitoring, during both pregnancy and labor. Conventional cardiotocography is probably the most widespread method of fetal surveillance worldwide, but visual interpretation of the traces is subjective and has unacceptably high intra- and interobserver variability [1,2]. The computerized analysis system developed by Dawes and Redman runs on a personal computer (PC) and receives data from the fetal monitor via a cable connection [3]. All recordings are electronically archived on the PC, and computerized cardiotocography (cCTG) can be viewed on screen. This medical technology improves the reproducibility of the results and their interpretations and reduces recording time [3–6]. In particular, it measures the short-term variation (STV), which cannot be assessed by the naked eye [5]. STV is the best predictive criterion for fetal well-being [5,7], and the relation between reduced STV and the degree of neonatal acidosis has been demonstrated [5,7–9].

Abbreviations: Bpm, beats per minute; BMI, body mass index; cCTG, computerized cardiotocography; FHR, fetal heart rate; PC, personal computer; STV, short-term variation.

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Some authors have suggested that maternal race influences the FHR parameters considered in standard visual FHR monitoring. Accordingly, compared to the fetuses of white women, fetuses of black women are significantly less reactive [10], have a higher basal heart rate [11], and are more likely to have micro-fluctuating or flat FHR during labor and delivery [12].

To our knowledge, only one study has used computerized FHR analysis to examine the influence of maternal geographic origin on FHR variation. Ogueh and Steer [13] reported less long-term FHR variation and fewer accelerations, before labor, in fetuses of black compared with white women, but observed no statistically significant reduction in STV between the two groups. This study's methods, however, had several limitations: relatively few subjects (27 black and 79 white women); black women from sub-Saharan Africa but also the Caribbean, where racial mixing is common; and no adjustment for maternal age (which differed significantly between the groups).

The influence of race on STV thus remains to be demonstrated. Nonetheless, childbirth professionals must be aware of this possible link between race and STV to provide pregnant women with the best possible care. Washington et al. showed that black women have a higher rate of cesareans for non-reassuring FHR than white women do [14]. Cesarean rates are also a cause for concern in European countries, in view of their association with the risk of maternal complications. Their indications should thus be limited as much as possible [15].

The main aim of this work was to analyze STV according to maternal race. The secondary aim was to study basal FHR according to this same variable.

Materials and methods

Materials

The study population comprised pregnant women who were outpatients in the obstetrics unit at the Clermont-Ferrand academic center. Inclusion criteria for our sample were: black women from sub-Saharan Africa or white women from Europe, with a singleton pregnancy ≥34 weeks of gestation (gestational age was measured by ultrasound between 11 weeks$^{+0\ days}$ and 13 weeks$^{+6\ days}$ in all cases, as recommended by French guidelines) [16], who came for prenatal care after 34 weeks of pregnancy or for a checkup with a midwife between the monthly doctor's appointments (after an isolated episode of threatened preterm delivery, psychosocial problems, etc.) that included computerized FHR recording and analysis. Exclusion criteria were: women from North Africa (Algeria, Tunisia, Morocco, Egypt, and Libya), use of medication likely to modify the FHR, an abnormal fetal heart rate tracing, and women in labor.

This study was approved by a French institutional review board [IRB 5044 (CECIC) for Rhônes-Alpes-Auvergne (Grenoble) in September 2011].

Methods

We identified the women who gave birth in our unit between November 3, 2008, and December 3, 2011, and whose computerized records allowed us to be certain that they were from sub-Saharan Africa or Europe (8142 women). After exclusion of women not from sub-Saharan Africa or Europe, women whose cCTG took place before <34 weeks, and those with a multiple pregnancy, there were 5865 women: 197 from Africa (exposed cohort group) and 5668 from Europe (non-exposed cohort group) (Fig. 1). Next, the paper files were sorted by hand to select only those unambiguously specifying the women's race and geographic origin. Because we intended to have a cohort with at least two white women for each black women and to ensure that the same midwives examined all women, we consulted the hospital's computerized appointment schedule: after including all eligible black women (that is, who met none of the exclusion criteria above), we selected the white woman immediately before and the two white women immediately after each black woman's visit. White women with any of the exclusion criteria described above were not selected for the study and were not replaced.

At the visit considered, each woman included had undergone a computerized cardiotocography, performed with an Oxford Sonicaid System 8002 (Oxford, Sonicaid Ltd., Chichester, UK). Computerized analysis is systematically used in our unit, particularly in prenatal visits around term, as it requires the shortest amount of staff time as long as the recording criteria are met (12 min).

We used the cCTG parameters described in the Sonicaid FetalCare Clinical Application Guide [17] and used in previous studies [13,18–21]: basal FHR, in beats per minute (bpm), number of accelerations (defined as an increase in FHR above the baseline that lasts for more than 15 s and exceeds the basal FHR by more than 15 bpm); number of decelerations (defined as decrease in FHR more than 20 bpm below the baseline for at least 15 s); episodes of high and low variation, measured in minutes and ms; long-term (defined as minute-by-minute range of the pulse intervals) and short-term variation (defined as epoch-to-epoch variation), measured in ms; fetal movements (assessed by maternal perception per hour). To calculate the STV, the Oxford system divides each minute of the tracing into 16 sections of 3.75 s. For each of these periods, the software calculates the difference between the average pulse interval values for adjacent epochs, averages them over each minute, and then averages the 1-minute averages over the entire FHR tracing [19].

The computerized FHR criteria are met when all of the following have been recorded: at least one episode of high variation, a basal heart rate of 116–160 bpm, no deceleration of more than 20 beats, at least one fetal movement and three accelerations, a mean STV >3 ms, a long-term mean FHR variation >22 ms, and no sinusoidal heart rate. As recommended, the FHR recording must continue at least 12 min for the criteria to be met and 60 min, if they are not [5,18].

The relevant medical data for the study were collected from the women's computerized obstetric and administrative records and printed paper data with the FHR tracings. All data relevant to the study were in the computer file or on the paper FHR record (time of last food intake and race). Race (black or white) was therefore recorded on a prospective basis in the medical records by the midwives doing the outpatient FHR recordings.

Statistical analysis

The qualitative variables were compared with Pearson's Chi-square or Fisher's exact test, as necessary. The quantitative variables were compared with Student's t test or a Mann–Whitney test, as necessary. We used multiple linear regression analysis to study the associations between maternal race and STV, by estimating the adjusted coefficient. The factors potentially associated with an STV modification were examined in univariate analyses and included in the manual backward stepwise multivariate analysis when $p < 0.20$. In addition, the following variables were forced in the model: gestational age at the time of the FHR recording (continuous variable), gestational diabetes (yes/no), time between last meal and the FHR recording (≥4 h and <4 h), and current maternal cigarette smoking (yes/no), as the literature has identified them as potential influences on FHR variability [20–24]. Significance was defined by $p < 0.05$. Statistical analyses were