



Fetal heart rate abnormalities associated with uterine rupture: a case–control study A new time-lapse approach using a standardized classification



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ABSTRACT

Objective: The aim of this study was to identify fetal heart rate abnormalities (FHRA) in the two hours preceding uterine rupture during trial of labor after a previous C-section compared with successful vaginal birth after cesarean controls.

Study design: A multicenter case–control study was conducted from 2006 to 2012. Fetal heart rate tracings of the two-hour period preceding delivery were segmented, anonymized and independently classified by two obstetricians according to a standardized grid based on FIGO guidelines (4 grades: 1 – normal, 2 – intermediate, 3 – abnormal, 4 – preterminal). Each case of uterine rupture was matched to 2 controls.

Survival curves were generated for both groups using the Kaplan–Meier method to analyze the occurrence of each FHR category across time.

Results: During the study period, 39,773 patients gave birth. 2649 involved women with a previous C-section (6.6%). A total of 33 uterine rupture/scar dehiscence cases occurred (0.08% of all births), of which 22 were included. These were matched to 44 controls.

FIGO grade-3 FHRA were significantly associated with uterine rupture in the hour preceding its diagnosis: odds ratios were 4.1 (95% CI 1.2–14.0), 4.3 (95% CI 1.4–13.0) and 3.7 (95% CI 1.2–11.3), in the 60–40 min, 40–20 min and last 20 min before childbirth, respectively. Agreement between the two reviewers (Cohen's kappa) was 84% (CI 95%: 0.79–0.89).

Conclusion: In the hour preceding uterine rupture, there are often significant FHRA. This leads us to consider the possibility of an earlier C-section when faced with grade-3 FHRA, before the onset of terminal bradycardia jeopardizing maternal and fetal prognosis.

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Tweetable abstract

Fetal heart rate abnormalities in the hour preceding uterine rupture.

Introduction

The increasing rate of cesarean delivery confronts obstetricians with the need to manage a growing number of patients with uterine scarring.

In 2010, the reported Cesarean section rate was 25.2% in northern European countries [1] and 32.9% in the U.S. [2].

Many different health authorities approve of, even encourage, vaginal birth after cesarean delivery (VBAC) under certain conditions [3–7].

While VBAC diminishes maternal and perinatal morbidity associated with iterative C-section deliveries, it does expose to the risk of uterine rupture (UR), estimated to occur in 0.5% of cases (95% confidence interval, 0.306–0.685%) [8].

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The lack of specific clinical warning signs for UR explains why diagnosis is often delayed, exposing to life-threatening maternal and fetal compromise [8–13].

It has been reported that fetal heart rate abnormalities (FHRA) consisting of variable or late decelerations occur prior to UR in 55–87% of cases [9,10,14–19]. A case–control study found that terminal bradycardia was significantly associated with UR in patients with a previous C-section [14].

This severity of bradycardia is associated with poor perinatal outcome, despite the urgent delivery that takes place.

Finding FHRA associated with UR other than bradycardia and of earlier onset could help minimize maternal and neonatal morbidity.

The aim of this study was to characterize fetal heart rate patterns in the two hours preceding uterine rupture compared with successful vaginal birth after cesarean (VBAC) controls.

Assessing elapsed time between the onset of grade 3 FHRA (FIGO classification) and diagnosis of uterine rupture was its secondary aim.

Material and methods

A multicenter case–control study was conducted between January 1, 2006 and July 31, 2012 in four maternity wards of the Poitou-Charentes region of France.

Data collection

Obstetric records of patients from each maternity ward were reviewed for cases of uterine rupture, as defined by the International Classification of Diseases (ICD-10).

Patients had to meet the following inclusion criteria:

- Women with at least one previous C-section;
- Complete UR according to Plauché [20] or uterine scar dehiscence during labor (defined by rupture of the entire uterine wall with an intact serosa), confirmed operatively;
- Singleton pregnancy, cephalic presentation, gestational age greater than or equal to 34 weeks;
- Availability of fetal heart tracings.

Exclusion criteria were: in utero fetal death and first- or second-stage labor arrest, as defined by the American College of Obstetrician and Gynecologists' (ACOG) 2014 consensus [21].

Controls were selected from the pool of patients having undergone trial of labor after a previous cesarean delivery (TOLAC) subsequently to each case of uterine rupture, whatever the means of delivery.

The same inclusion and exclusion criteria were applied to controls, except for the event of uterine rupture.

Each case was matched to two controls based on the number of vaginal births following the last C-section.

Case and control characteristics (age, BMI, number of previous pregnancies and deliveries, number of previous vaginal deliveries, time interval between last C-section and studied pregnancy) were compared using matched pairs *t*-test, chi-squared test, Fisher's test, as well as interquartile range.

Data analysis

In the case group, fetal heart rate tracings of the two-hour period preceding diagnosis of uterine rupture were examined. In the control group, heart rate tracings of the two-hour period prior to the onset of expulsive efforts or C-section were analyzed.

The strips were divided into 20-min segments, anonymized and randomly ordered.

The selected segments were independently evaluated by two senior grade obstetricians and classified according into four grades of increasing severity: normal, intermediate, abnormal and preterminal (Fig. 1). The classification was based on FIGO (International Federation of Gynecology and Obstetrics) guidelines, as modified by Amer-Wahlin et al. [22,23]. In the event of a disagreement between reviewers, a third-party senior expert analyzed the tracings.

Cohen's kappa coefficient [24] was used to assess interobserver agreement.

For each patient, the fetal heart tracing was then chronologically reconstructed.

The occurrence of each FHR category was analyzed across time and graphically represented for both cases and controls. Survival curves were generated for each group using the Kaplan–Meier method, first using grade 3 and grade 4 FHRA as the studied event, secondly using only grade 3 FHRA.

The proportional hazards assumption could be applied since the curves did not cross.

Differences in the survival curves were assessed using the Gehan-Breslow-Wilcoxon test.

CTG-Class	FIGO-FHR-class	Baseline heart rate	Variability/reactivity	Deceleration
<i>Normal FHR</i>	<i>FIGO 1</i>	♦ 110–150 bpm	♦ 5–25 bpm ♦ Acceleration	♦ Early uniform decelerations ♦ Uncomplicated variable deceleration with a duration of <60 sec and loss of <60 beats
<i>Intermediate FHR</i>	<i>FIGO 2</i>	♦ 100–110 bpm ♦ 150–170 bpm ♦ Short bradycardia episode (<100 bpm for ≤ 3 minutes)	♦ >25 bpm (saltatory pattern) ♦ <5 bpm for >40 minutes with absence of acceleration	♦ Uncomplicated variable decelerations with a duration <60 sec and loss of >60 beats
<i>A combinaison of several intermediary observations will result in an abnormal CTG</i>				
<i>Abnormal FHR</i>	<i>FIGO 3</i>	♦ 150–170 bpm and reduced variability ♦ >170 bpm ♦ Persistent bradycardia (<100 bpm for >3minutes)	♦ < 5 bpm for >60 minutes ♦ Sinusoidal pattern	♦ Complicated variable deceleration with a duration of >60 sec ♦ Repeated late uniform deceleration
<i>Preterminal FHR</i>	<i>FIGO 4</i>	<i>Total lack of variability (<2 bpm) and reactivity with or without deceleration or bradycardia</i>		

FHR: CardioTocography-class, FIGO : Federation-International-of-Gynecology-and -Obstetric, bpm: beats per minutes

Fig. 1. Classification of fetal heart rate according to FIGO, as modified by Amer-Wahlin [23].

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