How to reduce fetal scalp blood sampling? A retrospective study evaluating the diagnostic value of scalp stimulation to predict fetal wellbeing assessed by scalp blood sampling

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How to reduce fetal scalp blood sampling? A retrospective study evaluating the diagnostic value of scalp stimulation to predict fetal wellbeing assessed by scalp blood sampling.

Short title: Fetal Scalp Stimulation to predict fetal acidosis

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Abstract:

Background: The Fetal Blood Sample (FBS) is used as an indicator of fetal acidosis during labor. Its place is discussed through the lack of randomized trials, as well as the limitations related to the technical procedure. An alternative could be the Fetal Scalp Stimulation (FSS).

Aim: Our objective was to describe the FSS diagnostic value to predict fetal wellbeing defined from FBS.

Methods: The FSS consisted in a digital scalp stimulation for 15 seconds. Test was negative when an acceleration and/or a normal variability were elicited in the 2 minutes following. FSS was performed before each FBS which was classified as normal when pH was > 7.25. The diagnostic value was assessed by sensibility, specificity, positive and negative predictive values.

Findings -148 women were included in our center from February to December 2019. Of the 191 FBS procedures, when accelerations were elicited sensibility was 58,3 (36.8-77.1), specificity was 67,5 (59.3-75), positive predictive value was 20,9 (12.5-32.9) and negative predictive value was 91.7% (95%CI, 85-95.5).

Discussion- FBS is considered as the gold standard in our study which could be discussed as it is abandoned in some countries because of its questioned reliability and the lack of controlled randomized trials

Conclusion - This study suggests that FSS could be an interesting alternative adjunctive test to perform in the first instance as it seems to be reliable, non-invasive and easy to perform in order to limit FBS only to absence of acceleration after FSS.

FUNDING
No funding source was necessary for this work.

Key words: Fetal Blood sampling; Fetal Scalp Stimulation; Cardiotocography; Fetal Heart Rate

Key Message: Fetal Scalp Stimulation could be an alternative adjunctive test to Fetal Blood Sampling as it seems to be reliable to detect non-acidotic fetus: when an acceleration is elicited after FSS, FBS pH result is normal in 91,6% cases.

Abbreviations:

FSS: Fetal Scalp Stimulation

FBS: Fetal Blood Sampling

CTG: Cardiotocography

FHR: Fetal Heart Rate

NICE: National Institute For Health and Care Excellence

SD: Standard Deviation

IQR: Interquartile Range

CI: Confidence Interval

TOP: Termination Of Pregnancy

IUFD: In Utero fetal Death

Se: Sensitivity

Sp: Specificity

PPV: Predictive Positive Value

NPV: Negative Predictive Value

IA: Intermittent Auscultation

1-Introduction

Intrapartum cardiotocography (CTG) has been introduced into clinical practice to reduce perinatal death and neonatal hypoxic brain injuries (1). However, it is submitted to intra and inter-observer variation which could affect the validity of cardiotocograph interpretation (2–5). Since then, several classification systems have emerged (4,6,7) to assist clinicians by giving them a systematic methodology of fetal heart rate (FHR) interpretation using criteria such as fetal heart rate baseline, variability, acceleration, deceleration and uterine contractions. The clinician is then supposed to be able to determine the fetal risk of hypoxia and/or acidosis and to decide of the best clinical management. Unfortunately, the rates of cerebral palsy and mortality have not decreased over the past 30 years (3,8,9). Moreover, even if some abnormalities of the FHR monitoring have been linked to cerebral palsy risk, the false positive rate of 60% is very high (1,8,9). Due to this high false positive rate and the increasing caesarean sections rate, obstetricians have been looking for adjunctive tests of fetal well-being such as fetal blood sampling (FBS) for assessment of lactates or pH and STAN analysis (6,10,11). The FBS is used as an indicator of fetal acidosis with a cut-off value of pH for intervention at 7.20 (7.20-7.24 being a pre-acidosis range) (12). However, the place of FBS is discussed notably through the lack of randomized trials, the influencing factors in the pH value, as well as the limitations related to the technical procedure (13).

An alternative to FBS could be Fetal Scalp Stimulation (FSS). FSS involves stimulating the fetal scalp by rubbing it with the examiner's fingers or using forceps to clasp the fetal skin, or alternatively using vibroacoustic stimulation applied to the mother's abdomen (6). A meta-analysis comparing different FSS (vibroacoustic, digital, Allis clamp and scalp puncture) concluded that an acceleration following a FSS could help to rule out fetal acidemia when the CTG was pathological (14). However, few studies are included in this meta-analysis with

different methods of FSS (only two of them were using digital scalp stimulation) and fetal acidemia was defined as FBS result < 7.20. In our center, FBS is used for many years as a second line tool. As recommended by the NICE guidelines and due to recent controversies on FBS, we modified our protocol and FSS is systematically performed (15). Therefore, our objective was to compare the FSS to FBS as an adjunctive test of fetal wellbeing in labor in order to reduce Fetal Blood Sampling.

2-Material and Methods

A retrospective monocentric (CHU, Lille) cohort study was carried out from February to December 2019. The inclusion criteria were singleton pregnancy with gestational age of more than 36 weeks, cephalic fetal presentation and fetal heart rate abnormalities during labor with indication of FBS.

The protocol in our center is continuous recording of FHR during labor whatever the risk level of the patient. Midwives benefit a CTG assessment training twice a year. We also conducted a study evaluating different CTG classifications in our center showing that a five-tier classification as designed by CNGOF was the most helpful (16) . The risk of acidosis is assessed by the national guidelines which are classified in five groups: normal, almost normal, intermediate, pathological and pre-terminal (7). When FHR pattern was classified as intermediate or pathological by the midwife, indication of FBS was discussed and performed if necessary in absence of fetal or maternal contraindication. Since February 2019, we modified our protocol and FSS was performed before FBS. All the women who met the eligibility criteria received both FSS and FBS. A gentle digital scalp stimulation was first performed for 15 seconds. Then, the midwife could immediately install the amnioscope to perform the FBS sampled in pre-heparinized capillaries and analyzed immediately (ABL90FlexPlus, Radiometer®). The FBS was classified as normal (pH ≥7.25) or abnormal (pH < 7,25).

FHR variations after the FSS were analyzed by an expert. Response was considered negative in the presence of:

- - Acceleration defined as an increase in the FHR above the baseline of at least 15 beats per minute for at least 15 seconds, for the 2 minutes following the FSS

- - And/or variability defined as normal when variations of the baseline were between 5 and 25 beats per minute for at least 10 minutes following the FSS. FBS was performed whatever the result of FSS during this period. The primary outcome was the diagnostic value of FSS assessed by Se, Sp, PPV and NPV. Cases of potential false negative results on comparing FSS with FBS (pH < 7.25 on FBS and acceleration present on FSS) were reviewed individually in terms of the neonatal outcome.

Statistics

Categorical variables are expressed as numbers (percentage). Quantitative variables are expressed as mean ± standard deviation (SD) or median (interquartile range, IQR). Normality of distributions was assessed using histograms and Shapiro-Wilk test. Diagnostic values of absence of accelerations and variability post FSS to predict pathological in utero pH ($p<7.25$) were evaluated by calculating sensibility, specificity, positive predictive value, negative predictive value (17). 95% confidence intervals (CIs) of each diagnostic values were estimated using a generalized linear mixed model (binomial distribution, logit link function), by including woman as random effect to take into account the possibility of multiple FBS results per woman. First analyses covered all available FBS results; we performed a sensitivity analysis, by calculating the diagnostic values of absence of accelerations and variability post FSS in FBS results from the women fulfilled the eligibility criteria (i.e. with intermediate, pathological or preterminal fetal heart rate). All analyses were done using SAS software, release 9.4 (SAS Institute, Cary, NC).

Ethics

The study was approved by the French Committee of Research in Obstetrics and Gynecology CEROG 2020-OBST-0503 the 3rd of June 2020.

3-Results:

During the study period, 4589 deliveries occurred with 3913 trials of labor (Figure1). One hundred and forty-eight women met the eligibility criteria and 191 FBS were performed. Table 1 represents the population and labor characteristics. Seventy-three (49.3%) of these women had an induction of labor and 68.9% were nulliparous. Almost every woman had an epidural during labor (95.3%). Among these 148 women, 62,2% had a vaginal delivery and 65,2% of them needed operative deliveries. The main indication for these instrumental deliveries were non-reassuring FHR (44/60). Mean arterial birth pH was 7.20 ± 0.1 and 19 (12.9%) were less than 7,10.

When the FBS were performed, the CTGs were classified as normal or almost normal (16.9%), intermediate (57.9%), pathological (24.7%) and preterminal (0.5%) (Table 2). Of the 191 completed procedures, 187 FBS results were obtained. 163 (85.3%) FBS pH results were normal (pH ≥ 7.25). When the FSS was performed, we observed accelerations in 63.9% of cases, and variability in 80.6% of cases. 64.9% FBS were performed successfully at the first attempt and one operator was sufficient in 93.2% of cases. The median time gap between the decision of performing FBS and the result was 17. 0 (12;22) minutes.

Table 3 reports the diagnostic values of FSS to predict fetal wellbeing defined as FBS pH ≥ 7.25. When accelerations were observed after FSS, FBS pH result was normal in 91.7% cases (95%CI, 85-95.5) and when change in variability followed the FSS, FBS pH was normal in 87,4 (95% CI 81-91.9). When no acceleration was elicited, FBS pH was abnormal in 20,9% (95% CI, 12.5-32.9). When no change in variability was elicited, FBS pH was abnormal in 13,9 % (95% CI 5.4-31.1).

Table 4 reports the diagnosis values of FSS to predict fetal wellbeing defined as pH ≥ 7.25 among women with abnormal fetal heart rate (intermediate, pathological and preterminal). When accelerations were observed after FSS, FBS pH result was normal in 90.2% cases (95%CI, 82-94.9) and when change in variability followed the FSS, FBS pH was normal in 84.9 (95% CI 77.1-90.4).

Table 5 reports the cases of false negative results with FSS (pH < 7.25 on FBS and accelerations after FSS). Six of these FBS pH results were pre-acidotic (7.20-7.24) and 4 were acidotic. Two umbilical cord pH were < 7.10 (cases 2 and 3) with presence of acceleration during FSS and pathological FBS (respectively 7.11 and 7.19). No Apgar Score was less than 7 at 5 minutes and no transfer in Neonatal Intensive Care Unit was needed.

4-Discussion:

Main findings

To reduce our practice of FBS given the lack of evidence of its usefulness, we aimed to evaluate the diagnostic values of FSS to predict fetal wellbeing detected by the FBS and we found that the presence of accelerations is associated in 91.7 % with a normal scalp pH. This study highlights the place of FSS to assess fetal well-being and as proposed by the NICE guidelines. Therefore, FSS could be the adjunctive technology performed in the first instance when non-reassuring FHR is observed in order to limit FBS use to only in case of a positive response after FSS (18).

Interpretation

Continuous cardiotocography is associated with no significant difference in reducing cerebral palsy, neonatal mortality or other standard measures of neonatal well- being (8,9). Its high false positive rate, however, lead to an increase of caesarean sections and operative deliveries (3). To avoid these limits, several adjunctive technologies have been developed such as FBS (pH and/or lactates). For many years, FBS was the most used second line test in labor ward in complement with cardiotocography and recommended in national guidelines (7). However, the reliability of this test is questioned. First of all, it is supposed to detect hypoxia and acidosis but the blood sample is taken from the fetus scalp, a peripheral tissue, when it is known that in cases of hypoxia, the oxygenated blood is diverted to essential organs (heart, brain, adrenal glands) (15). There are also influencing factors in the pH value such as the scalp localization of the sample, the presence of amniotic fluid or uterine contraction during sample (19–21). The FBS result is quickly outdated and needs to be repeated. Moreover, a Cochrane systematic review showed no evidence of reducing caesarean sections rate nor

neonatal seizures nor improvement in long-term neurological outcomes when FBS was practiced (22–24). FBS required having a trained team, a sufficient cervix dilatation and no contraindication (HIV, Herpes Simplex Virus or suspected fetal blood disorder) (6). It may be a time-consuming test with a median interval of 18 minutes between the decision to perform and the result (25). In about 10% of attempts no pH information is obtained owing to blood clotting within the capillary, insufficient blood obtained, air bubbles inside the capillary, or a blood gas measurer that is calibrating at the time the sample needs to be analyzed (6). Some countries have abandoned the FBS as it seemed that a properly interpreted CTG would be equal or superior to the fetal scalp pH to predict both good and bad fetal outcomes (26). Even if the FBS complications are very rare, they can be severe: cerebrospinal fluid leakage, fetal hemorrhagic shock or scalp abscess. (27,28). Some studies have assessed lactates in FBS and showed no significant difference with pH analysis for Apgar score at 5 minutes of life, nor in rates of operative delivery. The interest is the smaller amount of blood required for the analysis (10,11,29).

Because of all these questions about the interest of FBS, FSS returns to the spotlight after multiple studies published in the 1990s (14,30). Indeed, fetal heart rate acceleration in response to various stimuli has long been considered to be a reliable sign of fetal well-being in both the intrapartum and antepartum periods (14,31). In a meta-analysis, Skupski et al. evaluated eleven studies on FSS which included four kind of tests: fetal scalp puncture, Allis clamp scalp stimulation, vibroacoustic stimulation, and digital scalp stimulation (14). The Likehood ratio for both positive and negative tests (assessed by the presence or absence of acceleration) was similar for the different techniques. It appeared that these tests were valuable to predict both presence and lack of fetal acidemia. Digital scalp stimulation is the most chosen technique as it is easy to perform and less invasive (14). More recently, Mahmood et al. conducted a prospective study comparing FSS and FBS over 298 procedures

(32). The consistency between FSS and FBS was “fair” so as the FSS and the FBS when compared to cord blood results respectively, suggesting that FSS could be a reliable alternative to FBS. Goodman et al. also conducted a prospective, non-randomized trial which aimed was to compare the diagnostic value of intermittent auscultation (IA) alone (n=251) versus IA and FSS (n=267) in a limited resource setting. It appeared that FSS improved the performance of IA for detecting severe acidemia (pH < 7.0) from 27 to 70% (p = 0.032) (33). The negative predictive value of intermittent auscultation was also improved with the fetal scalp stimulation test from 88 to 99% for mild (pH < 7.2) to severe fetal acidemia. Finally, Murphy and al. recently published the results of their feasibility study of a pilot randomized controlled trial comparing FSS to FBS as second line-tests for fetal well-being assessment (34). They highlighted that the feasibility for such a trial was acceptable for both groups (FSS and FBS). The randomized controlled trial protocol had a high rate of adherence in patients and clinicians. The cesarean section rate was high in both arms, as expected with a cohort of women requiring second-line tests for abnormal FHR monitoring, with a tendency of reduction in the FSS group vs FBS (5/25; 20% versus 13/25; 52%, p = .018) without increasing adverse fetal outcomes. Their estimates suggest that a sample of 2500 women is required to conduct a definitive randomized controlled trial.

Clinical implication

FSS seems to be an interesting adjunctive test when it leads to the appearance of acceleration and/or normal variability. In our study, we observed that the highest negative predictive value was for accelerations post-FSS, and highest specificity for presence of accelerations and/or normal variability. We then proposed to avoid FBS in case of accelerations (with or without modification of the variability). We choose the negative predictive value (NPV) as the most important result for assessing the diagnostic value of FSS for several reasons. First of all, the

aim of our study was to reduce FBS use, and consequently to avoid invasive procedures when reassurance criteria were present without missing potential fetal acidemia. Second of all, the NPV is the most studied criteria in literature when it comes to evaluating FSS. In our study, when an acceleration or a normal variability was elicited, respectively 91.7% and 87.4% of FBS pH results were normal but the positive predictive value seemed to be limited. The cases of discordance between an abnormal FBS pH and normal FSS based on an elicited acceleration were associated with 2 cases of acidotic cord arterial pH but new born had a 5 minutes Apgar score of 10 and had no NICU transfer. In ten cases, FSS elicited an acceleration but the FBS pH result was abnormal which may suggest that FSS value could be questionable in certain CTG patterns when it is helpful when the CTG shows reduced variability (6). It also suggests that it relies on CTG interpretation which has limitations (1).

Strengths and limitations

The strength of this study is the sample of almost 200 consecutive FBS procedures with various experiences of obstetricians and midwives. Our results seem to be consistent with literature especially concerning the NPV of FSS and the small number of abnormal FBS pH results. It also shows that in almost 17% of cases, FBS is performed even if the CTG is classified as normal or quasi-normal. This may show the limitations of such a classification which doesn't include the obstetrical (fetal and maternal) context to assess fetal well-being (35). Moreover, the knowledge of the physiological fetal response to hypoxemia during labor is described by different authors to improve fetal monitoring (36–38). Our study has a main limitation: we compared FSS to FBS. FBS is considered as the gold standard in our study which could be discussed as it is abandoned in some countries because of its questioned reliability and the lack of controlled randomized trials (39). Eventually, FSS response is subject to observer variability as it depends on CTG interpretation. We also can't

exclude a temporal trend of our CTG interpretation post-FSS as we began our inclusions immediately after the protocol implementation.

5-CONCLUSION:

This study suggests that FSS could be an interesting alternative adjunctive test to FBS as it seems to be reliable, non-invasive and easy to perform. Thus, FSS could be performed in the first instance when non-reassuring FHR is observed in order to limit FBS only to absence of acceleration after FSS.

DISCLOSURE OF INTEREST
The authors have no conflicts of interest

FUNDING
No funding source was necessary for this work.

CONTRIBUTION OF AUTHORSHIP
M.G collected data from patient files. She wrote the manuscript with assistance of C.G. E.D conducted all the statistical analysis and wrote the statistic methodology. D.S, P.B, L.G, V.F and E. D reviewed and corrected the manuscript.

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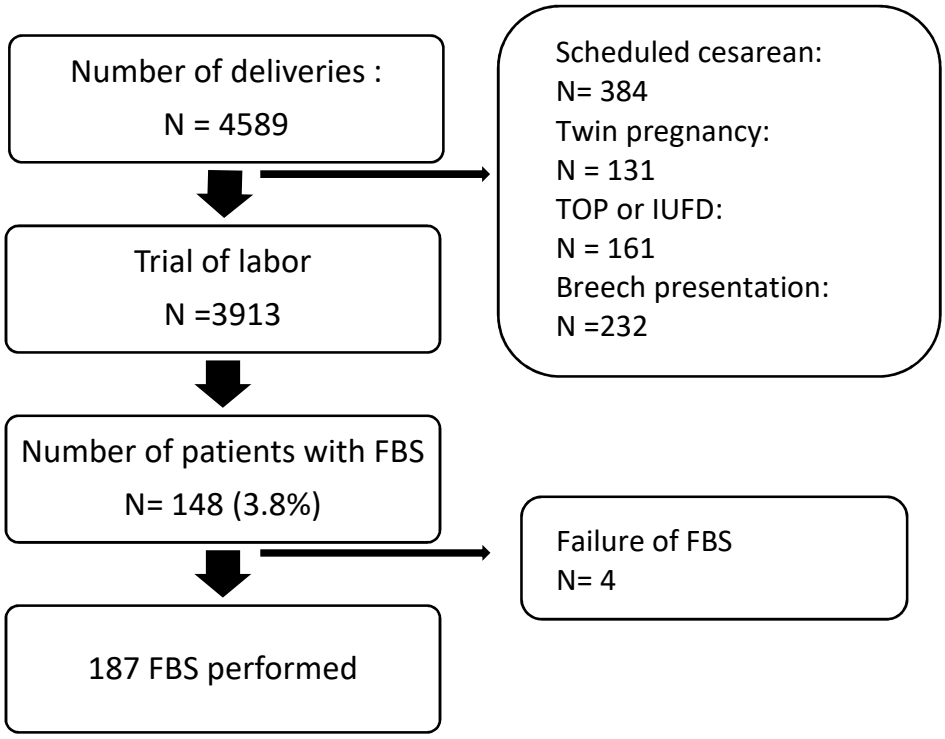
Tables and figures

Figure : Flowchart



TOP: Termination Of Pregnancy, IUFD: In Utero Fetal Death, FBS: Fetal Blood Sample

Table 1 - Population and labor characteristics (n= 148)

Population and labor characteristics	N =148
Age (years)	27 ± 6
Gestational age (weeks)	40 ± 1
Body mass index (kg/m2)	25.2 ± 5.2
Induction of Labor	73 (49.3)
Nulliparous	102 (68.9)
Scared uterus	17 (11.5)
Pregnancy complication	
Gestational diabetes	50 (33.8)
Preeclampsia	2 (1.4)
Rupture of membranes > 24h	10 (6.8)
Preexisting diabetes	2 (1.4)
Growth restriction	7 (4.7)
Vaginal delivery	92 (62.2)
Operative delivery	60/92 (65.2)
Forceps	25/60 (41.7)
Vacuum	24/60 (40)
Spatula	5/60 (8.3)
Sequential instruments	6/60 (10)
Indication of operative delivery	
Non-reassuring fetal heart rate	44/60 (73.3)
Failure of progress	16/60 (26.7)
Cesarean	56 (37.8)
Indications	
Dystocia	12/56 (21.4)
Unsuccessful instrumental delivery	2/56 (3.6)
Fetal blood sample result	18/56 (32.1)
Non-reassuring fetal heart rate	24/56 (42.9)
Birth characteristics	
Umbilical cord pH	7.20 ± 0.1
Umbilical cord pH < 10	19 (12.9)
Lactates (mmol/L)	6.0 ± 2.1
Base excess (mmol/L)	-6.0 ± 3.6
Apgar Score < 7 at 5 minutes	4 (2.7)
Respiratory distress	2 (1.3)
Neonatal Care Intensive Unit transfer	3 (2)
Birth weight (g)	3425 ± 479

Results are presented as number (percentage) or Mean ± Standard deviation

Table 2 - FBS characteristics (n =191)

FHR, labor, FSS and FBS characteristics	N = 191
Fetal heart rate (CNGOF Classification)	
Normal	3 (1.6)
Almost normal	29 (15.3)
Intermediate	111 (58.1)
Pathological	47 (24.7)
Preterminal	1 (0.5)
Labor characteristics	
Oxytocin	74 (38.7)
Maternal fever	21 (11.1)
Amniotic fluid:	
Clear	141 (73.8)
Stained	9 (4.7)
Meconium	16 (8.4)
Absent	24 (12.6)
Bloody	1 (0.5)
Fetal Scalp Stimulation	
Acceleration	122 (63.9)
Variability	154 (80.6)
Fetal Blood Scalp	
Cervix dilatation (cm)	6 ± 2
Number of attempts/each FBS:	
1	124 (64.9)
2	46 (24.1)
3	19 (9.9)
4	1 (0.5)
5	1 (0.5)
Number of operators/each FBS:	
1	178 (93.2)
2	12 (6.3)
3	1 (0.5)
Failure of FBS	4 (2.1)
Time gap between Decision and FBS result (mn)	17.0 (12.0; 22.0)
Time gap between FBS and result (mn)	9.0 (6.0; 13.0)
Time gap between 2 FBS (mn)	87.5 (57.5; 115.0)
Time gap between FBS and Birth (mn)	99.5 (48.0 ; 177.0)
Fetal Blood Scalp result	
Normal ≥ 7.25	163 (85.3)
Abnormal:	24 (12,6)
Pre-acidosis 7.20-7.24	17 (8.9)
Acidosis < 7.20	7 (3.7)

Results are presented as number (percentage), Mean +/– Standard deviation or Median and interquartile

Table 3 – Diagnostic values of accelerations and variability post FSS to predict pH ≥ 7.25

	pH					
	≥7.25 (n=163)	*<7.25 (n=24)*	*Se (95% CI)*	*Sp (95% CI)*	*PPV (95% CI)*	*NPV (95% CI)*
Accelerations						
Presence	*110 (67.5)*	*10 (41.7)*	*58.3 (36.8 to 77.1)*	*67.5 (59.3 to 75.0)*	*20.9 (12.5 to 32.9)*	*91.7 (85.0 to 95.5)*
Absence	*53 (32.5)*	*14 (58.3)*				
Variability						
Presence	*132 (81.0)*	*19 (79.2)*	*20.8 (8.3 to 43.2)*	*81.0 (74.1 to 87.3)*	*13.9 (5.4 to 31.1)*	*87.4 (81.0 to 91.9)*
Absence	*31 (19.0)*	*5 (20.8)*				
Accelerations and/or variability						
Presence	*135 (82.8)*	*19 (79.2)*	*20.8 (8.3 to 43.2)*	*82.8 (76.3 to 88.9)*	*15.2 (5.9 to 33.7)*	*87.7 (81.3 to 92.1)*
Absence	*28 (17.2)*	*5 (20.8)*				

Diagnostic values are calculated for presence vs. absence, and are expressed as % (95% confidence interval calculated using generalized linear mixed model, including woman as random effect to take into account the possibility of multiple FBS results per woman)
Abbreviations: Se = sensitivity, Sp = specificity, PPV = positive predictive value, NPV = negative predictive value

Table 4 – Diagnostic values of accelerations and variability post FSS to predict pH ≥ 7.25 among women with abnormal fetal heart rate (intermediate, pathological and preterminal as classified by CNGOF)

	pH					
	≥7.25 (n=131)	*<7.25 (n=23)*	*Se (95% CI)*	*Sp (95% CI)*	*PPV (95% CI)*	*NPV (95% CI)*
Accelerations						
Presence	*83 (63.4)*	*9 (39.1)*	*60.9 (38.5 to 79.5)*	*63.4 (53.8 to 71.9)*	*22.6 (13.5 to 35.3)*	*90.2 (82.0 to 94.9)*
Absence	*48 (36.6)*	*14 (60.9)*				
Variability						
Presence	*101 (77.1)*	*18 (78.3)*	*21.7 (8.6 to 44.8)*	*77.1 (68.5 to 84.3)*	*14.3 (5.6 to 31.7)*	*84.9 (77.1 to 90.4)*
Absence	*30 (22.9)*	*5 (21.7)*				
Accelerations and/or variability						
Presence	*104 (79.4)*	*18 (78.3)*	*21.7 (8.6 to 44.8)*	*79.4 (71.1 to 86.3)*	*15.6 (6.1 to 34.4)*	*85.3 (77.6 to 90.6)*
Absence	*27 (20.6)*	*5 (21.7)*				

Diagnostic values are calculated for presence vs. absence, and are expressed as % (95% confidence interval calculated using generalized linear mixed model, including woman as random effect to take into account the possibility of multiple FBS results per woman)
Abbreviations : Se = sensitivity, Sp = specificity, PPV = positive predictive value, NPV = negative predictive value

Table 5 - Cases of FSS false negative results (FBS value <7.25 and acceleration present on FSS)

Case number	FBS pH	Cervical dilatation (cm)	Mode of delivery	Cord artery pH	Apgar Score (5min)	Delay FBS-birth (min)
1	7.15	9	Cesarean	7.25	10	23
2	7.11	4	Cesarean	7.01	10	11
3	7.19	5	Cesarean	7.08	10	6
4	7.20	7	Forceps + Vacuum	7.16	10	13
5	7.14	5	Cesarean	7.22	10	11
6	7.24	4	Cesarean	7.12	9	19
7	7.21	10	Cesarean	7.22	10	39
8	7.24	6	Cesarean	7.16	10	21
9	7.23	7	Cesarean	7.19	10	19
10	7.24	8	Cesarean	7.17	8	20

FBS = Fetal Blood Sample; FSS = Fetal Scalp Stimulation