Fetal Blood Sampling and Labour Management

1. Fetal scalp stimulation (FSS) versus fetal blood sampling (FBS) for women with abnormal fetal heart rate monitoring in labor: a prospective cohort study.

Author(s): Tahir Mahmood, Uzma; O’Gorman, Catherine; Marchocki, Zibi; O’Brien, Yvonne; Murphy, Deirdre J

Source: The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians; Jul 2018; vol. 31 (no. 13); p. 1742-1747

Publication Date: Jul 2018

Publication Type(s): Comparative Study Journal Article Evaluation Studies

PubMedID: 28475393

Abstract: OBJECTIVE To evaluate the performance of fetal scalp stimulation (FSS) compared to fetal blood sampling (FBS) as a second line test of fetal wellbeing in labor. STUDY DESIGN A prospective cohort study was conducted including 298 fetal blood sampling procedures performed due to abnormal fetal cardiotocography (CTG). Two independent observers interpreted the CTG following stimulation. The FSS test was classified as normal when an elicited acceleration and/or provoked fetal heart rate variability was recorded. The FBS was classified as normal (pH ≥7.25), borderline (pH 7.21–7.24), and abnormal (pH ≤7.20). RESULTS Of the 298 procedures, 249 (84%) had a normal scalp pH result, 199 (67%) had an acceleration in response to FSS and 255 (86%) had an acceleration or normal variability in response to FSS. All 11 of the neonates classified as normal by FSS, but abnormal by FBS were born with normal Apgar scores and cord pH results. The consistency between FSS and FBS was "fair" (kappa 0.28) while the consistency between either test and cord arterial pH was "poor". CONCLUSION This study suggests that FSS has the potential to be a reliable alternative to FBS. The findings require evaluation in a well-designed randomized controlled trial.

Database: Medline
2. Use of Lactate ProTM2 for measurement of fetal scalp blood lactate during labor - proposing new cutoffs for normality, preacidemia and acidemia: a cross-sectional study.

Author(s): Iorizzo, L; Klausen, T W; Wiberg-Itzel, E; Ovin, F; Wiberg, N

Source: The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians; Jan 2018 ; p. 1-7

Publication Date: Jan 2018

Publication Type(s): Journal Article

PubMedID: 29301439

Abstract:OBJECTIVEMeasurement of fetal scalp blood lactate is a supplementary tool to cardiotocography in the case of a non-reassuring tracing. Several hand-held lactate meters have been launched, all with differentials in absolute values. Therefore, the reference intervals must be calculated for each device. The internationally accepted reference interval is based on measurement with Lactate ProTM with recently go out of production. The aim of this study was to propose cutoffs for normality, preacidemia, and acidemia in fetal scalp blood for Lactate ProTM2 based on the comparison of lactate values measured with Lactate ProTM and Lactate ProTM2.DESIGNSeven hundred one fetal scalp blood samples were analyzed simultaneously. The conversion equations were retrieved from the linear regression model. On the basis of the cutoffs for Lactate ProTM cutoffs for Lactate ProTM2 were calculated.RESULTSThe conversion equations obtained were Lactate ProTM = -0.02 + 0.68 × Lactate ProTM2 (SD: -0.09-0.07 × Lactate ProTM2) and Lactate proTM2 (LP2) = 0.03 + 1.48 × Lactate ProTM (SD: 0.16 + 0.17 × Lactate ProTM). The correlation to umbilical arterial pH was identical for the two devices (r = -0.18), whereas the correlation to umbilical arterial lactate was better for Lactate ProTM than for Lactate ProTM2 (r = 0.38, respectively, r = 0.33). The correlation to umbilical arterial lactate was dependent on time from sampling to delivery.CONCLUSIONProposed reference values for Lactate ProTM2: scalp lactate 7.1 mmol/L = acidemia, expedite delivery.

Database: Medline

3. Accuracy of intrapartum fetal blood gas analysis by scalp sampling: A retrospective cohort study

Author(s): Hilal Z.; Mrkvicka J.; Reznicek G.A.; Dogan A.; Tempfer C.B.

Source: Medicine (United States); Dec 2017; vol. 96 (no. 49)

Publication Date: Dec 2017

Publication Type(s): Article

PubMedID: 29245247

Available at Medicine - from Europe PubMed Central - Open Access

Abstract:Fetal blood gas analysis (FBGA) using scalp blood is commonly used to identify serious fetal distress. However, there is a lack of data regarding its accuracy and reliability. The aim of this study was to determine the positive predictive value (PPV) and negative predictive value (NPV) of FBGA for predicting postpartum acidosis in case of nonreassuring fetal heart rate tracings (NRFHRT). To this end, we conducted a retrospective cohort study of singleton term deliveries with NRFHRT according to Federation Internationale de Gynecologie et d'Obstetrique and Fisher cardiotocography scores undergoing FBGA in a university hospital. The PPV and NPV of FBGA regarding neonatal acidosis (defined as a pH value <= 7.15 in arterial or venous umbilical cord blood) and Apgar scores indicating neonatal depression (defined as a 5-min Apgar score <=5) were evaluated. Multivariate analysis was used to determine the influence of cardiotocography variations and the time delay between FBGA and delivery on the accuracy of FBGA. We analyzed 343 deliveries with NRFHRT. In 32 (9%) of these
cases, fetal acidosis was confirmed by a postpartum umbilical cord blood pH value <= 7.15. In 308/343 (90%) cases, FBGA identified NRFHRT as false positive (as confirmed by nonacidotic postpartum pH values) and thus avoided unnecessary interventions such as operative delivery. The overall test accuracy of FBGA was 91%. FBGA accurately predicted postpartum cord blood pH values with a margin of +/-0.2 in 319/343 (93%) cases. On the other hand, the false negative rate of FBGA was 8% (29/343). The PPV and NPV of FBGA for predicting postpartum acidosis were 50% and 91%, respectively. The sensitivity was 9% and the specificity was 99%. In a multivariate logistic regression analysis, maternal body mass index (odds ratio [OR] 1.1; 95% confidence interval [CI] 1.01-1.17; \( P = .029 \)) and cardiotocography variations (OR 0.80; 95% CI 0.66-0.98; \( P = .029 \)) independently affected the predictive value of FBGA. The PPV of FBGA regarding neonatal depression according to Apgar scores was low with only 17%. We conclude that FBGA may be used in clinical practice to rule out, but not to rule in, neonatal acidosis in parturients with NRFHRT. It can avoid unnecessary interventions such as cesarean section or operative vaginal delivery in up to 90% of cases, but cannot reliably detect fetal acidosis.

Database: EMBASE

5. Fetal scalp blood lactate during second stage of labor: determination of reference values and impact of obstetrical interventions.

Author(s): Wiberg, Nana; Källén, Karin

Source: The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians; Mar 2017; vol. 30 (no. 5); p. 612-617

Publication Date: Mar 2017

Publication Type(s): Journal Article Validation Studies

PubMedID: 27181136

Abstract: OBJECTIVETo determine the reference interval of fetal scalp blood lactate during second stage of labor. MATERIALTwo hundred and fifty-three women in first stage of labor with a reassuring CTG were asked for permission to sample fetal scalp blood during second stage. RESULTSIn cases with reassuring CTG and five minute Apgar score ≥9, the mean lactate value (±2 SD) was 2.5 mmol/L (lower limit 1.1, higher limit 5.2). The lactate concentration was significantly higher among nulliparous and in cases with use of epidural or oxytocin (\( p <0.001 \)). There was a moderate positive correlation between scalp lactate values and active pushing time. When parity, epidural, oxytocin and active pushing time were analyzed together, they had equal influence on lactate values (\( p <0.001 \)). Higher lactate values were associated with intermediate/pathological CTG compared to normal CTG (\( p <0.001 \)). There was no correlation to gestational age or birthweight (\( p = 0.72 \), respectively 0.43). CONCLUSIONSThe reference interval of fetal scalp lactate during second stage is 1.1-5.2 mmol/L. Parity, use of epidural or oxytocin and the duration of pushing are associated to increased lactate concentration; however, we could not demonstrate any correlation to advancing gestational age or birthweight.

Database: Medline
5. Clinical evaluation of statstrip lactate for use in fetal scalp blood sampling

Author(s): Heinis A.; van Dillen J.; Rhose S.; Vandenbussche F.; van Drongelen J.; Oosting J.

Source: Acta Obstetricia et Gynecologica Scandinavica; Mar 2017; vol. 96 (no. 3); p. 334-341

Publication Date: Mar 2017

Publication Type(s): Article

PubMedID: 27935627

Available at Acta Obstetricia et Gynecologica Scandinavica - from Wiley Online Library Science, Technology and Medicine Collection 2017

Abstract: Introduction. Point-of-care testing of fetal scalp blood lactate is used as an alternative to pH analysis in fetal scalp blood sampling (FBS) during labor. Lactate measurements are not standardized and values vary with each device used. The aim of this study was to evaluate StatStrip Lactate (SSL) in the clinical setting in comparison with lactate (RLL) and pH (RLpH) using RapidLab. Material and methods. We obtained 323 FBS samples from 139 women. Parallel sampling of SSL and RLL/RLpH was performed in 247 samples. Outcome measures were the agreement and discrepancy rates between SSL, RLL and RLpH and the failure rate of all three methods. We constructed a Bland-Altman graph to assess the variability between the measurements across the range of values. The discrepancy rates between methods were compared using previously established cut-off values for SSL indicating reassurance (<5.7 mmol/L) and immediate delivery (>7.0 mmol/L) with those for RLpH (<7.20 and >7.25). Results. SSL showed excellent agreement with RLL (R² = 0.742) and poor agreement with RLpH (R² = 0.204). Failure rates for SSL, RLL and RLpH were 7, 43 and 23%, respectively. Using the cut-off values for reassurance and immediate delivery, the discrepancy rates between SSL and RLpH were 14 and 5%, respectively. Conclusions. SSL is a reliable test to measure lactate in FBS with a low failure rate. As there are discrepancies between SSL and RLpH, and the cut-off values have not yet been evaluated prospectively regarding intervention rates and neonatal outcome, we recommend using SSL in addition to pH in FBS. Copyright © 2016 Nordic Federation of Societies of Obstetrics and Gynecology.

Database: EMBASE
6. FBS-pH versus lactate - A service evaluation study at a district general hospital in UK

Author(s): Vimalamma S.; Fawzy M.; Khanem N.

Source: BJOG: An International Journal of Obstetrics and Gynaecology; Mar 2017; vol. 124 ; p. 76-77

Publication Date: Mar 2017

Publication Type(s): Conference Abstract

Available at BJOG: an international journal of obstetrics and gynaecology - from Wiley Online Library Science, Technology and Medicine Collection 2017

Abstract: Introduction Fetal scalp lactate for establishing fetal condition in labour, has been in obstetric practice in different countries but not in common practice in UK. At Barnsley DGH, fetal scalp lactate estimation was introduced from September 2015 along with FBS pH estimation, to assess fetal well being in labour. Objectives To look at the outcomes since introducing lactate estimation - whether there are any significant difference in neonatal outcomes and whether it has increased caesarean section rates. Methods All patients having fetal blood sampling during 1st December 2015 to 31st May 2016 were reviewed and analysed based on a specifically designed proforma. 87 cases were included with a total of 119 FBS. We compared the outcomes of the abnormal lactate group with the abnormal pH group and also compared it with a previous FBS audit findings to look at the CS rates. Results Out of these 119 FBS, there were 15 (12.6%) cases of abnormal fetal scalp lactate and 7 (6.7%) cases of abnormal fetal scalp pH. 92 cases had normal fetal scalp lactate. Apgar scores (86% for lactate versus 87% for pH) and need for resuscitation (26% versus 25%) were comparable in both the groups. NNU admissions were comparatively less in the Lactate group (13% versus 25%). Caesarean section rates were less in the lactate group compared to pH group and abnormal FBS group from previous audit (53% versus 87% versus 70%). Conclusion The use of fetal lactate did not increase the CS rate and potentially can reduce admission to neonatal unit.

Database: EMBASE
7. Lactate versus pH levels in fetal scalp blood during labor—using the Lactate Scout System.

**Author(s):** Rørbye, Christina; Perslev, Anette; Nickelsen, Carsten

**Source:** The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians; 2016; vol. 29 (no. 8); p. 1200-1204

**Publication Date:** 2016

**Publication Type(s):** Comparative Study Journal Article

**PubMedID:** 26004985

**Abstract:** OBJECTIVE To assess if lactate measured with the Scout Lactate System is a reliable alternative to pH in intrapartum monitoring of the fetus. METHODSA prospective study analyzing (1) the correlation between scalp lactate measured by the Scout Lactate System and the Automatic Blood Laboratory (ABL), (2) the correlation between lactate and pH measured in scalp blood and (3) the correlation between fetal scalp lactate and umbilical cord SBE. The sensitivity/specificity and positive/negative predictive values of lactate in predicting low pH were analyzed and expressed as Receiver Operating Curves (ROC). RESULTS Lactate measured by the Scout Lactate System and the ABL correlated well (r(2)=0.85). Both lactate and pH were measured in 1009 scalp blood samples. The sensitivity and specificity of lactate ≥ 4.8 mmol/l in predicting a pH <7.20 were 0.63 and 0.85, respectively. The correlation between scalp lactate measured within 15 min prior to delivery and the umbilical cord SBE was low. CONCLUSION Monitoring non-reassuring deliveries with scalp lactate instead of pH would have resulted in more (155 instead of 56) instrumental deliveries with no decrease in newborns with severe metabolic acidosis.

**Database:** Medline

8. Should fetal scalp blood sampling be performed in the case of meconium-stained amniotic fluid?

**Author(s):** Boujenah, J; Oliveira, J; De La Hosseraye, C; Benbara, A; Tigaizin, A; Bricou, A; Carbillon, L

**Source:** The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians; Dec 2016; vol. 29 (no. 23); p. 3875-3878

**Publication Date:** Dec 2016

**Publication Type(s):** Journal Article

**PubMedID:** 26852888

**Abstract:** OBJECTIVE To investigate the effect of using fetal scalp blood sampling on the risk of neonatal respiratory distress syndrome (NRDS) with meconium-stained amniotic fluid (MSAF). METHODSProspective data collection with regard to MSAF during labor for low-risk term cephalic singleton live birth from 2012 to 2014. Maternal, obstetric and neonatal data were compared according to the occurrence of respiratory distress syndrome (RDS group) or not (no RDS group). RESULTS OF 515 newborns born through MSAF, 46 experienced RDS and from them 10 experienced meconium aspiration syndrome. No difference was observed according to maternal characteristic, abnormal fetal heart rate tracing pattern irrespective of its category and cesarean rate. Apgar at one minute was lower in the group RDS (7.6 versus 8.5, p < 0.05). The mean umbilical artery pH values did not differ between the two groups. Significant difference between newborns with and without RDS in terms of fetal scalp lactate sampling during the labor (71.1% versus 55.1%, p < 0.05), and neonatal care unit (NCU) admissions (22.8% versus 10.8%, p < 0.05). Secondary rather than primary meconium was associated with RDS when performing fetal scalp blood assessment (p < 0.05). A significant correlation between RDS, fetal scalp blood assessment and MSAF diagnosed...
During the first stage of labor (after spontaneous rupture of membranes or at amniotomy) was found. CONCLUSION In case of MSAF, fetal scalp blood sampling did not reduce the risk of RDS.

Database: Medline

9. Correlation of fetal scalp blood sampling pH with neonatal outcome umbilical artery pH value.

Author(s): Kuehnle, E; Herm, S; Kohls, F; Kundu, S; Hillemanns, P; Staboulidou, Ismini

Source: Archives of gynecology and obstetrics; Oct 2016; vol. 294 (no. 4); p. 763-770

Publication Date: Oct 2016

Publication Type(s): Journal Article

PubMedID: 26969647

Available at Archives of Gynecology and Obstetrics - from SpringerLink

Abstract: PURPOSE Fetal scalp blood sampling is considered as a complimentary tool in addition to cardiotocography to assess fetal well-being. This blood sampling is important as the obstetrician has to judge and make decisions regarding the further management of the delivery based on this pH result. The aim of this study was to analyze the correlation between fetal scalp blood pH and the umbilical artery pH after birth. Furthermore, it was investigated whether tocolysis, a performed episiotomy or cord encirclement have an influence on the umbilical artery pH. METHODSThis retrospective study over a period of 11 years included all singleton pregnancies without fetal anomalies, which were monitored by fetal scalp blood sampling during labor. RESULTS 844 out of 1502 deliveries were included for analysis. The analysis demonstrates a good correlation between fetal scalp pH value and outcome pH value. Subgroup analysis with fetal scalp blood pH <7.20 showed a difference in 40 of 82 cases, with an outcome pH value ≥7.20, but this difference was statistically insignificant. Neither did tocolysis, episiotomy or the presence of cord encirclement show an overall effect, nor did they have an impact on the subgroup. CONCLUSION Obstetricians must consider that the values of fetal scalp blood are not always reliable and can be false. However, on the basis of CTG and fetal scalp blood pH, decisions are made regarding delivery interventions. Therefore, we would encourage the consideration of taking two samples routinely at every attempt of fetal blood sampling.

Database: Medline
10. Involving the consultant before fetal blood sampling.

Author(s): Lowe, Belinda; Beckmann, Michael

Source: The Australian & New Zealand journal of obstetrics & gynaecology; Aug 2016; vol. 56 (no. 4); p. 387-390

Publication Date: Aug 2016

Publication Type(s): Journal Article

PubMedID: 27297955

Available at The Australian & New Zealand journal of obstetrics & gynaecology - from Wiley Online Library Science, Technology and Medicine Collection 2017

Abstract: BACKGROUND: Fetal scalp lactate (FSL) is used when the cardiotocography (CTG) is not normal in an attempt to reduce the false-positive rate and the likelihood of unnecessary intervention. Whilst the test has almost a 100% negative predictive value, the positive predictive value of this test is very low.

AIMS: To measure the effect of introducing consultant obstetrician review of every abnormal CTG prior to the decision to perform FSL.

MATERIALS AND METHODS: A retrospective cohort study was performed using routinely collected de-identified data. Mode of birth outcomes for women who had a continuous CTG in labour were compared in two equal time periods, 12 months before and after a change in hospital policy. Change in hospital policy dictated that FSL was only performed on a pathological CTG after consultant obstetrician review of the CTG.

RESULTS: Consultant obstetrician review of CTG prior to FSL was associated with fewer FSL performed (1.7% vs 3.5%; P ≤ 0.01), fewer babies acidaemic at birth pH < 7.1 (0.8% vs 2.2%; P < 0.01), fewer caesarean sections for presumed fetal distress (CS for FD) (6.6% vs 8.1%; P = 0.05) and fewer instrumental births (17.6% vs 20%; P = 0.04). When adjusted for confounders, the change in policy was independently associated with a reduced likelihood of CS for FD (adjusted odds ratios = 0.78 (0.63-0.97); P = 0.03).

CONCLUSION: A hospital policy whereby a consultant obstetrician reviews abnormal CTGs prior to performing FSL may help to increase the pretest probability and reduce the rate of CS for FD, as well as instrumental birth and unnecessary FSL.

Database: Medline

11. Randomised trial of fetal scalp blood sampling for lactate measurement: The Flamingo trial

Author(s): East C.; Sheehan P.; Kane S.; Brennecke S.; Davey M.-A.; Kamlin O.; Davis P.


Publication Date: Jun 2016

Publication Type(s): Conference Abstract

Available at BJOG: An International Journal of Obstetrics & Gynaecology - from Wiley Online Library Science, Technology and Medicine Collection 2017

Abstract: Objectives: The practice of fetal blood sampling is relatively widespread in some countries and recommended in many clinical guidelines. We aimed to determine whether the addition of fetal scalp blood sampling for lactate measurement (FBSLM) during labour complicated by a non-reassuring fetal heart rate cardiotocographic (CTG) trace reduces the risk of birth by caesarean section, compared with monitoring by CTG alone. Specifically, we aimed to test the hypothesis that the addition of FBSLM would reduce the intrapartum caesarean section rate from 38% to 25%.

Methods: We conducted an unblinded randomised controlled trial (RCT) at The Royal Women's Hospital, Melbourne, Australia. Women were eligible for recruitment if they were in labour with a singleton cephalic pregnancy at term, spoke English, had ruptured amniotic membranes and were at least at 3 cm cervical dilatation. Funding was sought for full recruitment of the calculated sample size of 600. However, funding shortfalls limited recruitment. Randomisation was by consecutively
numbered sealed, opaque envelopes. Women with a non-reassuring CTG according to strictly defined criteria were recruited to the study during labour. The control group had continuous CTG-only and the intervention group had FBSLM availability added to continuous CTG. The primary outcome was caesarean section (C/S). Results In total, 123 labouring women were enrolled between March 2012 and July 2015: 61 to the CTG-only group and 62 to the CTG + lactate group. The C/S rate was 45.2% in the CTGonly group and 41.0% in the CTG plus lactate group (risk ratio 0.91, 95% confidence interval 0.60,1.36, P = 0.64). Five infants had a 5-min Apgar score<7 in the CTG+lactate group (two admitted to special care nursery), compared to none in the CTGonly group (P=<0.05). There was no difference in the rate of admission to the neonatal intensive care unit (two babies in the CTG-only group compared with none from the CTG plus lactate group, P = 0.16). Conclusions We attempted to conduct the world’s first RCT to evaluate the effectiveness of FBS for lactate measurement during labour complicated by a non-reassuring CTG. Unfortunately, the funding shortfall limited sufficient recruitment to have the power to address the hypothesis. The presentation of the data remains important to inform future meta-analysis, to complement the findings from observational studies and to consider the higher than expected C/S rate in the control group and the lack of difference in intrapartum C/S rates when FBS for lactate measurement was undertaken, compared with CTG monitoring alone.

Database: EMBASE

12. Foetal scalp blood sampling during labour for pH and lactate measurements.

Author(s): Carbonne, Bruno; Pons, Kelly; Maisonneuve, Emeline


Publication Date: Jan 2016

Publication Type(s): Journal Article Review

PubMedID: 26253238

Available at Best Practice & Research Clinical Obstetrics & Gynaecology - from Unpaywall

Abstract:Second-line methods of foetal monitoring have been developed in an attempt to reduce unnecessary interventions due to continuous cardiotocography (CTG), and to better identify foetuses that are at risk of intrapartum asphyxia. Very few studies directly compared CTG with foetal scalp blood (FBS) and CTG only. Only one randomised controlled trial (RCT) was published in the 1970s and had limited power to assess neonatal outcome. Direct and indirect comparisons conclude that FBS could reduce the number of caesarean deliveries associated with the use of continuous CTG. The main drawbacks of FBS are its invasive and discontinuous nature and the need for a sufficient volume of foetal blood for analysis, especially for pH measurement, resulting in failure rates reaching 10%. FBS for lactate measurement became popular with the design of test-strip devices, requiring <0.5 mL of foetal blood. RCTs showed similar outcomes with the use of FBS for lactates compared with pH in terms of obstetrical interventions and neonatal outcomes. In conclusion, there is some evidence that FBS reduces the need for operative deliveries. However, the evidence is limited with regard to actual standards, and large RCTs, directly comparing CTG only with CTG with FBS, are still needed.

Database: Medline
13. Cardiotocography patterns and risk of intrapartum fetal acidemia

**Author(s):** Holzmann M.; Wretler S.; Nordstrom L.; Cnattingius S.

**Source:** Journal of Perinatal Medicine; Jul 2015; vol. 43 (no. 4); p. 473-479

**Publication Date:** Jul 2015

**Publication Type(s):** Article

**PubMedID:** 24914710

**Abstract:**

Aim: To identify cardiotocography (CTG) patterns associated with increased risk of intrapartum fetal acidemia. Methods: A prospective observational cohort study of 1070 women with fetal scalp blood sampling (FBS) during labor was conducted at Karolinska University Hospital, Stockholm, Sweden. Women with a nonreassuring CTG pattern underwent FBS, and lactate concentration was measured at the bedside. Lactate concentrations >4.8 mmol/L were defined as fetal acidemia. A senior obstetrician, blinded to the lactate concentration at FBS, visually interpreted the CTG tracings that had prompted FBS. Results: There were 2134 FBSs performed on 1070 laboring women, constituting 11% of all deliveries at this labor ward. The CTG patterns with the highest frequency of lactacidemia at FBS were late or severe variable decelerations combined with tachycardia (20%-25% at first FBS and 33%-49% at last FBS). With a normal baseline fetal heart rate, normal variability, and absence of serious decelerations, the fetal scalp blood lactate concentration at the first FBS was normal in 97.5% of cases. The group with isolated reduced variability had no increased prevalence of acidemia and median lactate concentration did not differ from the normal group. Conclusion: Isolated reduced variability is in most cases not a sign of hypoxia. If development of hypoxia is ruled out with one FBS, this pattern does not require monitoring with repetitive FBSs throughout labor. Late decelerations and severe variable decelerations increase the risk for intrapartum fetal metabolic acidemia to the same extent. The combination of these decelerations and tachycardia was associated with the highest rate of fetal metabolic acidemia. Copyright © 2015 by De Gruyter.

**Database:** EMBASE
BACKGROUND
Fetal scalp blood sampling for lactate estimation may be considered following identification of an abnormal or non-reassuring fetal heart rate pattern. The smaller volume of blood required for this test, compared with the more traditional pH estimation, may improve sampling rates. The appropriate use of this practice mandates systematic review of its safety and clinical effectiveness prior to widespread introduction.

OBJECTIVE
To evaluate the effectiveness and risks of fetal scalp lactate sampling in the assessment of fetal well-being during labour, compared with no testing or alternative testing.

SEARCH METHODS
We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (31 January 2015).

SELECTION CRITERIA
All published and unpublished randomised and quasi-randomised trials that compared fetal scalp lactate testing with no testing or alternative testing to evaluate fetal status in the presence of a non-reassuring cardiotocograph during labour.

DATA COLLECTION AND ANALYSIS
We used the standard methodological procedures of the Cochrane Pregnancy and Childbirth Group. Two review authors independently assessed the studies.

MAIN RESULTS
The search identified two completed randomised controlled trials (RCTs) and two ongoing trials. The two published RCTs considered outcomes for 3348 mother-baby pairs allocated to either lactate or pH estimation of fetal blood samples when clinically indicated in labour. Overall, the published RCTs were of low or unclear risk of bias. There was a high risk of performance bias, because it would not have been feasible to blind clinicians or participants. No statistically significant between-group differences were found for neonatal encephalopathy (risk ratio (RR) 1.00, 95% confidence interval (CI) 0.32 to 3.09, one study, 2992 infants) or death. No studies reported neonatal seizures. We had planned to report death with other morbidities, for example, neonatal encephalopathy; however, the data were not available in a format suitable for this, therefore death due to congenital abnormality was considered alone. The three reported neonatal deaths occurred in babies with diaphragmatic hernias (n = 2) or congenital cardiac fibrosis (n = 1). All three babies had been randomised to the pH group and were not acidaemic at birth. There were no statistically significant differences for any of the pre-specified secondary fetal/neonatal/infant outcomes for which data were available. This included low Apgar score at five minutes (RR 1.13, 95% CI 0.76 to 1.68, two studies, 3319 infants) and admission to neonatal intensive care units (RR 1.02, 95% CI 0.83 to 1.25, one study, 2992 infants), or metabolic acidaemia (RR 0.91, 95% CI 0.60 to 1.36, one study, 2675 infants) considered within the studies, either overall or where data were available for those where fetal blood sampling had occurred within 60 minutes of delivery. Similar proportions of fetuses underwent additional tests to further evaluate well-being during labour, including scalp pH if in the lactate group or scalp lactate if in the pH group (RR 0.22, 95% CI 0.04 to 1.30, two studies, 3333 infants; Tau² 1.00, I² = 58%). Fetal blood sampling attempts for lactate and pH estimation were successful in 98.7% and 79.4% of procedures respectively in the one study that reported this outcome. There were no significant between-group differences in mode of birth or operative birth for non-reassuring fetal status, either for all women, or within the group where the fetal blood sample had been taken within 60 minutes of delivery (for example, caesarean section for all enrolled, RR 1.09, 95% CI 0.97 to 1.22, two studies, 3319 women; operative delivery for non-reassuring fetal status for all enrolled RR 1.02, 95% CI 0.93 to 1.11, one

Abstract: BACKGROUND Fetal scalp blood sampling for lactate estimation may be considered following identification of an abnormal or non-reassuring fetal heart rate pattern. The smaller volume of blood required for this test, compared with the more traditional pH estimation, may improve sampling rates. The appropriate use of this practice mandates systematic review of its safety and clinical effectiveness prior to widespread introduction. OBJECTIVE To evaluate the effectiveness and risks of fetal scalp lactate sampling in the assessment of fetal well-being during labour, compared with no testing or alternative testing. SEARCH METHODS We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (31 January 2015). SELECTION CRITERIA All published and unpublished randomised and quasi-randomised trials that compared fetal scalp lactate testing with no testing or alternative testing to evaluate fetal status in the presence of a non-reassuring cardiotocograph during labour. DATA COLLECTION AND ANALYSIS We used the standard methodological procedures of the Cochrane Pregnancy and Childbirth Group. Two review authors independently assessed the studies. MAIN RESULTS The search identified two completed randomised controlled trials (RCTs) and two ongoing trials. The two published RCTs considered outcomes for 3348 mother-baby pairs allocated to either lactate or pH estimation of fetal blood samples when clinically indicated in labour. Overall, the published RCTs were of low or unclear risk of bias. There was a high risk of performance bias, because it would not have been feasible to blind clinicians or participants. No statistically significant between-group differences were found for neonatal encephalopathy (risk ratio (RR) 1.00, 95% confidence interval (CI) 0.32 to 3.09, one study, 2992 infants) or death. No studies reported neonatal seizures. We had planned to report death with other morbidities, for example, neonatal encephalopathy; however, the data were not available in a format suitable for this, therefore death due to congenital abnormality was considered alone. The three reported neonatal deaths occurred in babies with diaphragmatic hernias (n = 2) or congenital cardiac fibrosis (n = 1). All three babies had been randomised to the pH group and were not acidaemic at birth. There were no statistically significant differences for any of the pre-specified secondary fetal/neonatal/infant outcomes for which data were available. This included low Apgar score at five minutes (RR 1.13, 95% CI 0.76 to 1.68, two studies, 3319 infants) and admission to neonatal intensive care units (RR 1.02, 95% CI 0.83 to 1.25, one study, 2992 infants), or metabolic acidaemia (RR 0.91, 95% CI 0.60 to 1.36, one study, 2675 infants) considered within the studies, either overall or where data were available for those where fetal blood sampling had occurred within 60 minutes of delivery. Similar proportions of fetuses underwent additional tests to further evaluate well-being during labour, including scalp pH if in the lactate group or scalp lactate if in the pH group (RR 0.22, 95% CI 0.04 to 1.30, two studies, 3333 infants; Tau² 1.00, I² = 58%). Fetal blood sampling attempts for lactate and pH estimation were successful in 98.7% and 79.4% of procedures respectively in the one study that reported this outcome. There were no significant between-group differences in mode of birth or operative birth for non-reassuring fetal status, either for all women, or within the group where the fetal blood sample had been taken within 60 minutes of delivery (for example, caesarean section for all enrolled, RR 1.09, 95% CI 0.97 to 1.22, two studies, 3319 women; operative delivery for non-reassuring fetal status for all enrolled RR 1.02, 95% CI 0.93 to 1.11, one
study, 2992 women). Neither study reported on adverse effects of fetal scalp lacerations or maternal anxiety. 

**AUTHORS’ CONCLUSIONS** When further testing to assess fetal well-being in labour is indicated, fetal scalp blood lactate estimation is more likely to be successfully undertaken than pH estimation. Further studies may consider subgroup analysis by gestational age, the stage of labour and sampling within a prolonged second stage of labour. Additionally, we await the findings from the ongoing studies that compare allocation to no fetal blood sample with sampling for lactate and address longer-term neonatal outcomes, maternal satisfaction with intrapartum fetal monitoring and an economic analysis.

**Database:** Medline

15. Expert systems for fetal assessment in labour  
**Author(s):** Lutomski J.E.; Meaney S.; Greene R.A.; Ryan A.C.; Devane D.  
**Source:** Cochrane Database of Systematic Reviews; Apr 2015; vol. 2015 (no. 4)  
**Publication Date:** Apr 2015  
**Publication Type(s):** Review

**Available at** Cochrane Database of Systematic Reviews: Reviews - from Cochrane Collaboration (Wiley)

**Abstract:** Background: Cardiotocography (CTG) records the fetal heart rate in relation to maternal uterine contractions and is one of the most common forms of fetal assessment during labour. Despite guidelines for CTG interpretation, substantial inter- and intra-observer variation in interpretation has been reported among maternity care providers. Misinterpretation of CTG readings can lead to poor decisions, which can result in unnecessary intervention or delay or withholding of necessary intervention. Expert systems (ESs) represent a type of applied artificial intelligence, which can assist in complex clinical decision-making and potentially serve as a mechanism to improve interpretation of fetal heart rate tracings. Objectives: To evaluate the effectiveness of continuous or intermittent CTG monitoring during labour with an ES compared with (1) continuous or intermittent CTG monitoring during labour without an ES or (2) intermittent auscultation with a Pinard stethoscope or hand-held Doppler ultrasound device. Outcomes of interest included incidence of perinatal mortality, caesarean delivery, operative vaginal birth, fetal blood sampling, artificial rupture of amniotic membranes, oxytocin augmentation of labour, maternal satisfaction with labour, neonatal seizures, fetal acidemia, hypoxic ischaemic encephalopathy, admission to neonatal special care and/or neonatal intensive care unit and an Apgar score less than seven at five minutes. Search methods: We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (27 October 2014), Open Grey (6 October 2014) ProQuest Dissertation & Theses Database (6 October 2014) and reference lists of retrieved studies. Selection criteria: Randomised and quasi-randomised controlled trials comparing continuous or intermittent CTG monitoring during labour with an ES compared with an ES were eligible for this review. Trials comparing continuous or intermittent CTG monitoring during labour with an ES with intermittent auscultation with a Pinard or hand-held Doppler were also eligible. Data collection and analysis: Two review authors independently assessed the eligibility and quality of the trials as well as extracted data to ensure accuracy. The authors of included trials were contacted to clarify aspects of the study design that were not clearly reported in the original trial publications. Main results: No studies comparing CTG monitoring during labour with an ES to intermittent auscultation were identified. Two randomised controlled trials comparing CTG monitoring during labour with an ES versus CTG without an ES were identified and included in the qualitative synthesis of results, but only one trial (n = 220) provided data for quantitative analysis. Both trials were classified as low risk of bias. There was no strong evidence that CTG with an ES has an effect on the incidence of caesarean delivery (risk ratio (RR) 0.61; 95% confidence interval (CI)
when compared with CTG with fetal blood sampling. There was no strong evidence supporting a reduction in the incidence of neonatal seizures (RR 0.33; 95% CI 0.01 to 8.09) or fetal acidaemia (RR 0.50; 95% CI 0.09 to 2.67) in women monitored using a CTG with an ES versus a CTG without an ES. Overall perinatal mortality could not be ascertained for this trial since data on early neonatal deaths were unavailable. Although fetal deaths were recorded, no fetal deaths occurred in either arm of the trial, and thus no risk estimates could be derived. There was no strong evidence supporting a reduction in the incidence of forceps-assisted vaginal birth (RR 0.50; 95% CI 0.05 to 5.43), hypoxic ischaemic encephalopathy (RR 0.33; 95% CI 0.01 to 8.09), admission to the neonatal intensive care unit (RR 0.40; 95% CI 0.08 to 2.02) or an Apgar less than seven at five minutes (RR 0.50; 95% CI 0.13 to 1.95). The trial did not report on artificial rupture of amniotic membranes, oxytocin augmentation of labour or maternal satisfaction with labour. Authors’ conclusions: Two trials met the inclusion criteria for this review but one trial did not provide data for any of this review’s outcomes. The single trial that did contribute data was underpowered to evaluate the association between CTG monitoring with an ES and the primary outcomes of interest. No recommendations for clinical practice can be made at this time. Adequately powered trials are necessary before the impact of ESs for fetal assessment in labour can be determined. Copyright © 2015 The Cochrane Collaboration.

Database: EMBASE


Author(s): Holzmann, Malin; Wretler, Stina; Cnattingius, Sven; Nordström, Lennart
Source: European journal of obstetrics, gynecology, and reproductive biology; Jan 2015; vol. 184 ; p. 97-102
Publication Date: Jan 2015
Publication Type(s): Research Support, Non-u.s. Gov't Journal Article
PubMedID: 25483990

Abstract: OBJECTIVE To investigate if repeat (≥ 3) fetal scalp blood sampling (FBS) is associated with increased risk of caesarean delivery and worse neonatal outcome than occasional (1-2) FBS. STUDY DESIGN Prospective cohort study of women undergoing intrapartum FBS at Karolinska University Hospital, Sweden. FBS with lactate analysis was performed if the attending doctor found the cardiotocography (CTG) tracing suspicious or abnormal. Lactate concentration was measured bedside. As a routine in all deliveries, acid-base analyses were performed on umbilical artery and vein blood immediately after delivery. Main outcome measures were metabolic acidemia in umbilical artery at delivery, Apgar score <7 at 5 min and caesarean delivery. RESULTS During the study period there were 2134 FBSs performed on 1070 laboring women with a median of two samplings (range 1-8). There were no differences in Apgar score <7 at 5 min or metabolic acidemia in umbilical artery blood at birth between labors with 1-2 FBS and ≥ 3 FBS. Among women who underwent 1-2 FBS, 23% had a caesarean delivery as compared with 42% of those having ≥ 3 FBS. After adjustment for confounders, repeat FBS remained an independent risk factor for caesarean delivery (adj OR 2.05; 95% CI 1.5-2.8). CONCLUSION Fetal monitoring with repetitive FBS (≥ 3) during labors with CTG changes is safe for the baby, but the rate of caesarean delivery is doubled as compared to labors where 1-2 FBS are needed. Still, more than 50% of women with repetitive FBS will be delivered vaginally, and 1/3 of these spontaneously.

Database: Medline
17. Fetal scalp blood sampling during labour: is it a useful diagnostic test or a historical test that no longer has a place in modern clinical obstetrics?

**Author(s):** Chandraharan, E

**Source:** BJOG : an international journal of obstetrics and gynaecology; Aug 2014; vol. 121 (no. 9); p. 1056

**Publication Date:** Aug 2014

**Publication Type(s):** Journal Article

**PubMedID:** 24597746

Available at [BJOG : an international journal of obstetrics and gynaecology](https://onlinelibrary.wiley.com/doi/full/10.1111/bjo.12495) - from Wiley Online Library Science , Technology and Medicine Collection 2017

**Database:** Medline

18. Validation of a point-of-care (POC) lactate testing device for fetal scalp blood sampling during labor: clinical considerations, practicalities and realities.

**Author(s):** Reif, Philipp; Lakovschek, Ioanna; Tappauf, Carmen; Haas, Josef; Lang, Uwe; Schöll, Wolfgang

**Source:** Clinical chemistry and laboratory medicine; Jun 2014; vol. 52 (no. 6); p. 825-833

**Publication Date:** Jun 2014

**Publication Type(s):** Journal Article Validation Studies

**PubMedID:** 24406288

**Abstract:**

**BACKGROUND** Although fetal blood sampling for pH is well established the use of lactate has not been widely adopted. This study validated the performance and utility of a handheld point-of-care (POC) lactate device in comparison with the lactate and pH values obtained by the ABL 800 blood gas analyzer.

**METHODS** The clinical performance and influences on accuracy and decision-making criteria were assessed with freshly taken fetal blood scalp samples (n=57) and umbilical cord samples (n=310). Bland-Altman plot was used for data plotting and analyzing the agreement between the two measurement devices and correlation coefficients (R²) were determined using Passing-Bablok regression analysis.

**RESULTS**

Sample processing errors were much lower in the testing device (22.8% vs. 0.5%). Following a preclinical assessment and calibration offset alignment (0.5 mmol/L) the test POC device showed good correlation with the reference method for lactate FBS (R²=0.977, p<0.0001, 95% CI 0.9 59-0.988), arterial cord blood (R²=0.976, p<0.0001, 95% CI 0.967-0.983) and venous cord blood (R²=0.977, p<0.0001, 95% CI 0.968-0.984). CONCLUSIONSA POC device which allows for a calibration adjustment to be made following preclinical testing can provide results that will correlate closely to an incumbent lactate method such as a blood gas analyzer. The use of a POC lactate device can address the impracticality and reality of pH sample collection and testing failures experienced in day to day clinical practice. For the StatStrip Lactate meter we suggest using a lactate cut-off of 5.1 mmol/L for predicting fetal acidosis (pH<7.20).

**Database:** Medline
19. Fetal scalp blood sampling during labor: an appraisal of the physiological basis and scientific evidence.

Author(s): Chandraharan, Edwin; Wiberg, Nana

Source: Acta obstetricia et gynecologica Scandinavica; Jun 2014; vol. 93 (no. 6); p. 544-547

Publication Date: Jun 2014

Publication Type(s): Journal Article

PubMedID: 24806702

Abstract: Fetal cardiotocography is characterized by low specificity; therefore, in an attempt to ensure fetal well-being, fetal scalp blood sampling has been recommended by most obstetric societies in the case of a non-reassuring cardiotocography. The scientific agreement on the evidence for using fetal scalp blood sampling to decrease the rate of operative delivery for fetal distress is ambiguous. Based on the same studies, a Cochrane review states that fetal scalp blood sampling increases the rate of instrumental delivery while decreasing neonatal acidosis, whereas the National Institute of Health and Clinical Excellence guideline considers that fetal scalp blood sampling decreases instrumental delivery without differences in other outcome variables. The fetal scalp is supplied by vessels outside the skull below the level of the cranial vault, which is likely to be compressed during contractions. The self-regulated redistribution of oxygenated blood from peripheral to central organs causes peripheral ischemia, thus theoretically bringing into question the scalp capillary bed as representative of the central circulation.

Database: Medline

20. CTG or STAN - With or without FBS?

Author(s): Langhoff-Roos J.

Source: Acta Obstetricia et Gynecologica Scandinavica; Jun 2014; vol. 93 (no. 6); p. 531-532

Publication Date: Jun 2014

Publication Type(s): Editorial

PubMedID: 24889046

Available at Acta obstetricia et gynecologica Scandinavica - from Wiley Online Library Science, Technology and Medicine Collection 2017

Available at Acta obstetricia et gynecologica Scandinavica - from Unpaywall

Database: EMBASE
21. Fetal scalp blood sampling in labor—a review.

**Author(s):** Jørgensen, Jan S; Weber, Tom

**Source:** Acta obstetricia et gynecologica Scandinavica; Jun 2014; vol. 93 (no. 6); p. 548-555

**Publication Date:** Jun 2014

**Publication Type(s):** Journal Article Review

**PubMedID:** 24806978

**Abstract:** During the 1970s and 1980s, electronic fetal monitoring and fetal scalp blood sampling were introduced without robust evidence. With a methodical review of the published literature, and using one randomized controlled trial, seven controlled studies, nine randomized studies of various surveillance methods and data from the Danish National Birth Registry, we have assessed the usefulness of fetal scalp blood sampling as a complementary tool to improve the specificity and sensitivity of electronic cardiotocography. Based on heterogeneous studies of modest quality with somewhat inconsistent results, we conclude that fetal scalp blood sampling in conjunction with cardiotocography can reduce the risk of operative delivery. Fetal scalp blood sampling can provide additional information on fetal wellbeing and fetal reserves at a time before decisions are made concerning the need for and timing of operative delivery and the choice of anesthesia, and be an adjunct in the interpretation of cardiotocography patterns.

**Database:** Medline

22. Comparing fetal scalp lactate and umbilical cord arterial blood gas values.

**Author(s):** Bowler, Thea; Beckmann, Michael

**Source:** The Australian & New Zealand journal of obstetrics & gynaecology; Feb 2014; vol. 54 (no. 1); p. 79-83

**Publication Date:** Feb 2014

**Publication Type(s):** Comparative Study Journal Article

**PubMedID:** 24471849

**Abstract:** BACKGROUND: Fetal scalp lactate has been shown to be as effective as scalp pH in predicting fetal outcomes. However, there is limited clinical evidence to demonstrate a strong correlation with fetal acidaemia at birth. AIM: To compare the diagnostic accuracy of fetal scalp lactate and umbilical cord arterial blood gas values sampling, as it is used in clinical practice. METHODS: A retrospective cohort study was performed on 661 term (≥37 weeks) births where a fetal scalp lactate sample was taken during labour. Cases were excluded where either the lactate was taken greater than 1 h prior to delivery, incomplete cord gas analyses were available, or a sentinel hypoxic event occurred prior to delivery. The final data set included 229 microvolume scalp lactate measurements which were compared with neonatal paired cord blood gas values taken at delivery. RESULTS: Fetal scalp lactate measurement of ≥4.8 mmol/L had a positive predictive value (PPV) of 1% and a negative predictive value (NPV) of 100% in predicting umbilical artery pH ≤7.00, and a PPV of 5% and a NPV of 98% in predicting umbilical artery pH ≤7.10. The sensitivity and specificity for these values were 100%, 23% and 90%, 23%, respectively. CONCLUSIONS: Fetal scalp lactate microsampling has a strong negative predictive value for fetal acidaemia at birth.

**Database:** Medline
23. Different CTG patterns and risk of intrapartum acidemia

Author(s): Holzmann M.; Wretler S.; Nordstrom L.; Cnattingius S.
Source: American Journal of Obstetrics and Gynecology; Jan 2014; vol. 210 (no. 1)
Publication Date: Jan 2014
Publication Type(s): Conference Abstract

Abstract: OBJECTIVE: To identify cardiotocography (CTG) patterns associated with increased risk for intrapartum acidemia. STUDY DESIGN: Observational cohort study of consecutive FBS's performed between February 2009 and February 2011 at Karolinska University Hospital Solna, Stockholm. During the study period 1070 women in labor underwent fetal blood sampling (FBS) due to an abnormal CTG pattern. Lactate concentration was measured bedside (Lactate Pro). At a later moment, a senior obstetrician (LN) visually interpreted the CTG tracings prior to each FBS, blinded to the lactate concentration at FBS. We documented baseline fetal heart rate, variability, moment of most recent acceleration, types of decelerations and frequency of contractions. We categorized the CTG patterns according to different combinations of the variables. RESULTS: During the study period, there were 2132 FBS's performed on 1070 laboring women. With a normal baseline and variability and absence of decelerations at the 1st FBS, the fetal scalp blood lactate was normal in 97.5% of cases. Presence of reduced variability without tachycardia or decelerations did not increase the incidence of acidemia, not even when present for an extended time. At the last FBS (active pushing excluded), the rate of increased lactate concentration (>4.8 mmol/L) was 4.8% in the group with normal baseline, variability and no decelerations. If late or complicated variable decelerations occurred, the rate was 22%. If those decelerations occurred together with reduced variability, the prevalence was 29%, and if tachycardia was present together with the decelerations, the fetal scalp blood lactate was >4.8 mmol/L in a range from 33% to 49%. CONCLUSION: Isolated reduced variability does not necessitate repeated FBS's. Late decelerations and complicated variable decelerations both have a hypoxic component. They increase the risk for intrapartum acidemia to the same extent and distinguishing them is not crucial. The combination of decelerations and tachycardia was the pattern with the highest proportion of acidemic fuses. (Table presented).

Database: EMBASE

24. What is the evidence for the use of fetal blood sampling during labour?

Author(s): Carbonne B.
Source: Journal of Perinatal Medicine; Jun 2013; vol. 41
Publication Date: Jun 2013
Publication Type(s): Conference Abstract
Available at Journal of Perinatal Medicine - from Unpaywall

Abstract: Introduction: Fetal blood sampling (FBS) for measurement of pH and base excess is regarded as the gold standard for fetal monitoring in case of non-reassuring fetal heart rate (FHR). However, data comparing cardiotocography (CTG) only to CTG with FBS are scarce and do not fit today's requirement for the assessment of a new technology. FBS for scalp lactates measurement has been more recently evaluated. Literature review: All randomised controlled trials involving FBS during labour have been searched for. Six trials compared CTG only to IA (18,305 women included) and 6 trials compared CTG with FBS to IA (15,074 women included). Only one randomized trial performed in 1979 compared CTG only to CTG with FBS and to intermittent auscultation (IA). It demonstrated an increase in cesarean deliveries with the use of CTG only, compared with IA. With the use of CTG and FBS, the intervention rate was intermediate, and not different from that of IA. This trial included around 230 women per arm, which is widely undersized for assessing neonatal outcome criteria such as severe metabolic acidosis or 5' Apgar score < 7. The use of FBS for lactate
measurement has been studied in a large randomised trial comparing CTG with FBS for lactate to CTG with FBS for pH. The predictive value of both tests is similar but the failure to obtain a result is about 10 times greater with pH than with lactate. Conclusion: The use of FBS for pH seems to restrict the increase in cesarean deliveries associated with the use of continuous CTG. However, very few women have been involved in a direct comparison between CTG only and CTG with FBS. The use of FBS during labor as a reference method for fetal monitoring in case of abnormal CTG should be questioned.

Database: EMBASE

25. The reliability of foetal blood sampling as a test of foetal acidosis in labour.

Author(s): O'Brien, Yvonne M; Murphy, Deirdre J

Source: European journal of obstetrics, gynecology, and reproductive biology; Apr 2013; vol. 167 (no. 2); p. 142-145

Publication Date: Apr 2013

Publication Type(s): Journal Article Evaluation Studies

PubMedID: 23270744

Abstract: OBJECTIVES To establish whether foetal blood sampling for pH is a reliable test of foetal acidosis in labour by comparing paired foetal blood samples taken at a single procedure. STUDY DESIGN We conducted a prospective study assessing 293 consecutive attempts at foetal blood sampling in labour over a four month period from February to May 2012. A total of 100 paired samples were suitable for analysis. We compared the consistency of pH results of paired foetal blood samples, evaluated cases where inconsistent results would result in conflicting clinical decisions, and explored factors associated with discordant results. RESULTS There was a statistically significant difference between the mean pH of the two samples: 7.297 (SD 0.065) versus 7.315 (SD 0.059), p<0.0005. Of the 100 paired samples, 43 had a difference greater than the laboratory acceptable maximum analytical difference of 0.038. There was discordance between the samples in 16 cases with results crossing a decision threshold, and in 11 cases (69%) delivery was by emergency caesarean section. Inconsistent results were not associated with specific clinical factors and occurred more often with senior operators. CONCLUSION Foetal blood sampling is considered by many as the gold standard in assessing intrapartum foetal wellbeing. We have demonstrated inconsistency of paired foetal blood pH results which suggests that foetal blood sampling should not be considered infallible.

Database: Medline

Author(s): Orsonneau, Jean-Luc; Fraissinet, François; Sébille-Rivain, Véronique; Dudouet, Daniele; Bigot-Corbel, Edith

Source: Clinical chemistry and laboratory medicine; Feb 2013; vol. 51 (no. 2); p. 397-404

Publication Date: Feb 2013

Publication Type(s): Research Support, Non-u.s. Gov't Comparative Study Journal Article

PubMedID: 23096019

Abstract: BACKGROUND Point of care (POC) testing for fetal scalp blood lactate is a more user friendly and more successful approach compared to scalp pH for intrapartum fetal monitoring. The aim of this study was to assess the analytical specificity and clinical reliability of three POC lactate methods. METHODSThe analytical performance of three POC lactate methods was compared to Cobas 6000 (Roche Diagnostics) laboratory reference method: Lactate Pro from Arkray, GEM 4000 from Instrumentation Laboratory and StatStrip Lactate from Nova Biomedical. The clinical performance and influences on accuracy and decision making criteria for the three POC methods was assessed with umbilical cord samples and compared to the laboratory reference method. The influence of varying ranges of hemoglobin, pH and partial oxygen pressure (pO(2)) on the accuracy of results was assessed. RESULTS Although all three POC methods showed good correlation with the reference method for the umbilical cord sample population (r=0.989, 0.973 and 0.980, respectively), Lactate Pro and Gem 4000 showed a significant negative bias compared to the reference method. The degree of bias meant a significant readjustment of decision making criteria was required for fetal lactate use. The accuracy of the Lactate Pro results was affected by hemoglobin and to a lesser extent pH. CONCLUSIONSThe three electrochemical POC devices can measure fetal lactate reliably. StatStrip Lactate showed a closer correlation and concordance to our laboratory reference method. The results of this study indicate the requirement for predetermining the reliability of POC lactate methods before use present in fetal and perinatal settings.

Database: Medline

27. Audit of fetal blood sampling in labour - Correlation with cord blood results and fetal outcomes

Author(s): Sharma N.; Philpott M.; Siraj N.

Source: International Journal of Gynecology and Obstetrics; Oct 2012; vol. 119

Publication Date: Oct 2012

Publication Type(s): Conference Abstract

Available at International Journal of Gynecology & Obstetrics - from Wiley Online Library Science , Technology and Medicine Collection 2017

Abstract: Objectives: Fetal blood sampling (FBS) is used commonly to confirm suspected fetal compromise in labour. The usual indication is a pathological cardiotocography. CNST (Clinical Negligence Scheme for Trusts) has outlined certain standards for conducting FBS in labour. This audit was conducted to review our current practice of fetal blood sampling (FBS) and to compare it with standards laid by CNST. Materials: This audit was conducted at University Hospital North Staffordshire, UK. It is a retrospective audit conducted over a one year period from 01/01/2011 to 31/12/2011. Five women who underwent FBS were randomly selected from each month making a total of 60 women. Methods: A standard proforma was designed. Hospital notes of the patients included in this study were reviewed to identify the indication for FBS and the dilatation at which FBS was conducted i.e. <=3cm classed as early labour or >3cm classed as established labour. We assessed different parameters like analgesia in labour, mode of delivery, fetal outcomes after FBS
through apgar scores and paired cord blood samples and any record of fetal scalp injury. These were plotted in graphical analysis. Results: It was interesting to see that some of our national standards are not met. These are being addressed at our unit. Conclusions: Criteria that are not met were highlighted and presented in our monthly audit meeting. We need a larger cohort and re-audit to identify whether there is a higher incidence of delivery by caesarean section in women who undergo FBS in early labour.

Database: EMBASE

28. 'Pathological' decelerations' on CTG: Time for FPS or FBS?

Author(s): Chandrakaran E.; Lowe V.; Arulkumaran S.

Source: International Journal of Gynecology and Obstetrics; Oct 2012; vol. 119

Publication Date: Oct 2012

Publication Type(s): Conference Abstract

Abstract:Objectives: To assess the role of a fetal physiological score (FPS) that is based on fetal response to hypoxic stress during labour to understand fetal wellbeing, when pathological decelerations are observed on CTG Trace. Materials: 48 CTG traces showing pathological (late or atypical variable) decelerations during the last 30 minutes prior to delivery, for which neonatal outcome data were available, were selected. Fetal Physiological Score (FPS) was calculated by comparing the last 30 minutes of the Trace with the features of CTG trace at commencement of fetal monitoring. Methods: Percentage increase in Baseline Heart Rate, changes in Baseline Variability, the sum of Inter-deceleration interval for 30 minutes, and the sum of Inter-contraction Interval for 30 minutes, were determined and the Fetal Physiological Score (FPS) was calculated (see table).

Results: 41/48 (85.4%) of CTGs with pathological decelerations during the last 30 minutes of labour had a Fetal Physiological Score (FPS) of >7/10. Only one neonate (2%) had APGAR score of <7 and all newborn had cord arterial pH of >7.05 and Base excess <12 mmol/l, when the FPS was >7/10. A poor FPS (<4) was associated with APGAR Score <6 (75%) and abnormal cord gases (50%). Sum of inter-contraction and inter-deceleration intervals of <10 minutes during the last 30 minutes were associated with lower cord arterial pH (75%) and poor FPS Scores (60%). An increase in baseline fetal heart rate >20% was not associated with a poor outcome, if the sum of inter-contraction and inter-deceleration intervals during the last 30 minutes prior to birth are >10 minutes. Saltatory pattern persisting for over 20 minutes was associated with poor umbilical cord gases (80%). Conclusions: Fetal Physiological Score (FPS) appears to be a useful tool to assess fetal compensatory response to intrapartum hypoxia, when pathological decelerations are observed on the CTG Trace. In our series, FPS of >7 is associated with normal APGAR Scores (98%) and umbilical cord gases (100%). Hence, presence of pathological decelerations alone does not indicate a poor perinatal outcome and clinicians should aim to improve the inter-contraction and interdeceleration intervals by interventions such as reducing or stopping oxytocin infusion when FPS of <5 is observed, to improve uteroplacental circulation, prior to considering Fetal Blood Sampling (FBS). We hope our pilot attempt to develop a tool based on fetal physiology will stimulate a larger study to determine clinical applicability. (Table Presented).

Database: EMBASE
29. What is the gold standard for intrapartum fetal monitoring?

Author(s): Yli B.M.; Henriksen T.; Kessler J.; Eikeland T.; Hustad B.L.; Dragnes W.
Source: Acta Obstetricia et Gynecologica Scandinavica; Sep 2012; vol. 91 (no. 9); p. 1011-1014
Publication Date: Sep 2012
Publication Type(s): Review
PubMedID: 22671962
Available at Acta obstetricia et gynecologica Scandinavica - from Wiley Online Library Science, Technology and Medicine Collection 2017

Abstract: The health authorities of Stockholm county recently published a Health Technology Assessment report: "Fetal monitoring with computerized STAN analysis during labor - a systematic review" with the aim to ensure that high quality research information on costs, effectiveness and broader impact of health technologies is analysed and presented in the most efficient way for those who use, manage and work in this field. The report claims to analyse available research in relation to ST interval analysis of fetal electrocardiogram (STAN) and concludes that scientific evidence for advantages of the STAN technology for maternal and fetal outcome was insufficient and that clinical use cannot be recommended and should be restricted to research protocols. The Norwegian reference group for fetal surveillance points out that the report suffers from two insufficiencies: selection bias by not providing a complete collection of the evidence for the clinical performance of the STAN technology and, secondly, that it does not provide evidence-based alternative methods. © 2012 Nordic Federation of Societies of Obstetrics and Gynecology.

Database: EMBASE

30. Re-audit of the use of fetal blood sampling prior to emergency caesarean section

Author(s): McCauley M.; McClenahan J.; Hunter A.
Source: Archives of Disease in Childhood: Fetal and Neonatal Edition; Apr 2012; vol. 97
Publication Date: Apr 2012
Publication Type(s): Conference Abstract
Available at Archives of Disease in Childhood - Fetal and Neonatal Edition - from BMJ Journals - NHS

Abstract: Aim To determine the change in management of the pathological cardiotocograph (CTG) in labour with regards to the use of fetal blood sampling (FBS) prior to delivery by emergency Caesarean section. Methods A retrospective study of a population delivered by emergency Caesarean section, the primary indication being an abnormal CTG was conducted in 2008. This study was repeated in 2010. Results Fifty cases were reviewed each time. There was 50% increase in the number of FBS attempted in this re-audit. There was 85% increase in the appropriate interpretation and management of all FBS taken. In 2008, 9/50 (18%) cases had a successful normal pH level taken but all proceeded straight to Caesarean section regardless. However in 2010, 11/13 cases (85%) had successful normal pH levels taken and all were reviewed in the appropriate time frame. 5/11 (45%) cases had repeat FBS taken. The remainder 7/11 (65%) cases were reviewed as appropriate and delivered by Caesarean section for other obstetric indications, primarily failure to progress. A general improvement in the documentation of the procedure of FBS was noted. Conclusions With a background of rising local and national Caesarean section rates, this re-audit demonstrates a significant increase and much improved use of FBS to establish fetal pH levels in cases where delivery by Caesarean section is contemplated because of a pathological CTG.

Database: EMBASE
Complications of intrapartum fetal monitoring: A case of neonatal scalp abscess following fetal blood sample (FBS) and fetal scalp electrode (FSE)

Author(s): Hardiman A.; Charova J.; Muotune A.

Source: Archives of Disease in Childhood: Fetal and Neonatal Edition; Apr 2012; vol. 97

Publication Date: Apr 2012

Available at Archives of Disease in Childhood - Fetal and Neonatal Edition - from BMJ Journals - NHS

Abstract: Background A 2006 Cochrane review demonstrated that although the use of CTG reduces the incidence of neonatal seizures, it makes no difference on the incidence of cerebral palsy or neonatal mortality. Fetal scalp electrodes are commonly used to accurately monitor fetal heart rate during labour in cases of poor CTG contact. Fetal blood sampling has also been used for over 60 years as a means of providing a more direct assessment of fetal well-being. Case We present the case of a neonate, born to a 21 year old primigravida by emergency caesarean section. During labour, a fetal blood sample was taken and a fetal scalp electrode applied for accurate monitoring. Five days following discharge, the baby presented with seizures and a scalp abscess around the site of the FBS/FSE. Following CT scan, the baby was transferred to a tertiary unit for surgical drainage. Simultaneously, his mother was re-admitted with intra-abdominal sepsis with pelvic abscess requiring laparotomy and washout twice. Mother and baby both made a full recovery. Discussion We review the literature and investigate the incidence of reported complications secondary to the process of fetal blood sampling and fetal scalp electrode application over the past 40 years. We discover that complications are rare, with the most frequent appearing to be haemorrhage, followed by infection, alongside some more isolated adverse events. We also revisit contraindications and precautions to prevent complications and conclude that, although uncommon, the clinician should be reminded that these are invasive techniques and are not without their risks.

Database: EMBASE
32. Comparison of two point-of-care testing (POCT) devices for fetal lactate during labor

Author(s): Heinis A.M.F.; Spaanderman M.E.A.; Lotgering F.K.; Dinnissen J.; Klein Gunnewiek J.M.T.

Source: Clinical Chemistry and Laboratory Medicine; Jan 2012; vol. 50 (no. 1); p. 89-93

Publication Date: Jan 2012

Publication Type(s): Article

PubMedID: 21955187

Abstract:
Background: Point-of-care testing (POCT) of fetal scalp blood lactate is used as an alternative for pH analysis. Lactate measurements have not been standardized and values vary with each device used. The aim of this study was to evaluate the performance of two POCT lactate meters for intrapartum use. Methods: Analytical performance of StatStrip Lactate (Nova Biomedical) and Lactate Pro (Arkray) was evaluated using CLSI EP10. Both POCT meters were compared with our lactate reference method (RapidLab 860; Siemens Healthcare Diagnostics) using fetal scalp and neonatal cord blood. Deming regression analysis was performed. Results: StatStrip Lactate coefficients of variation (CVs) were 5.1 %, 5.0 % and 2.6 % at 0.9, 7.5 and 14.1 mmol/L lactate, respectively. CVs for Lactate Pro were 10.7 %, 5.2 % and 5.7 % at 1.7, 4.1 and 6.4 mmol/L lactate, respectively. Consecutive lactate measurements in 37 fetal scalp and 122 cord blood samples revealed different test characteristics for the two POCT devices. In fetal scalp blood: StatStrip Lactate = 1.13*RapidLab-0.39 (R² = 0.907) and Lactate Pro = 0.95*RapidLab-0.03 (R² = 0.823). In cord artery blood: StatStrip Lactate = 1.08*RapidLab-0.09 (R² = 0.810) and Lactate Pro = 0.72*RapidLab + 0.59 (R² = 0.807). Conclusions: Overall performance of both Lactate Pro and StatStrip Lactate was good, with StatStrip Lactate having smallest CVs and closest correlation to our reference method. Both StatStrip Lactate and Lactate Pro can be used as a lactate POCT device for obstetric use. © 2011 by Walter de Gruyter.

Database: EMBASE

33. Scalp blood lactate for intra-partum assessment of fetal metabolic acidosis.

Author(s): Heinis, Ayesha M F; Spaanderman, Marc E; Gunnewiek, Jacqueline M T Klein; Lotgering, Fred K

Source: Acta obstetricia et gynecologica Scandinavica; Oct 2011; vol. 90 (no. 10); p. 1107-1114

Publication Date: Oct 2011

Publication Type(s): Comparative Study Journal Article

PubMedID: 21751970

Available at Acta obstetricia et gynecologica Scandinavica - from Wiley Online Library Science , Technology and Medicine Collection 2017

Abstract: OBJECTIVE To study to what extent the fetal scalp blood lactate concentration during labor correlates with fetal scalp pH and base deficit, and metabolic acidosis at birth, and to suggest lactate cut-off values to serve as indicators for either reassurance or immediate intervention. DESIGNA retrospective observational study. SETTING Labor ward at a university medical center. SAMPLE Fetal scalp and cord blood samples with acid-base and lactate values from 486 singleton pregnancies beyond 34 weeks’ gestation. METHODSThe relation between lactate, pH and base deficit (BD) in fetal scalp blood was tested by Spearman’s rho correlation coefficient. Lactate cut-off values indicating either reassuring fetal status or immediate intervention were estimated using percentile distribution and compared with pH and BD. MAIN OUTCOME MEASURES Metabolic acidosis, defined as umbilical cord artery pH below 7.05 and BD calculated for the blood compartment above 12 mmol/l. RESULTS After 127 (21%) exclusions, 486 cases were available for analysis. Fetal lactate values increased with evolving metabolic acidosis. Lactate concentration correlated with both pH
(r=−0.50, p<0.01) and BD (r=0.48, p<0.01). Lactate <5.4 mmol/l indicated reassuring fetal status, whereas lactate ≥6.6 mmol/l indicated metabolic acidosis. Fetal lactate correlated better with either the absence or presence of metabolic acidosis at birth than did fetal pH and BD.

CONCLUSIONS
In the case of a non-reassuring fetal heart rate, fetal scalp blood lactate provides more accurate information on fetal acid-base status than does pH and/or BD.

Database: Medline

34. Evaluation of the discrepancy between pH and lactate in combined fetal scalp blood sampling.

Author(s): Liljeström, Lena; Wikström, Anna-Karin; Hanson, Ulf; Akerud, Helena; Jonsson, Maria

Source: Acta obstetricia et gynecologica Scandinavica; Oct 2011; vol. 90 (no. 10); p. 1088-1093

Publication Date: Oct 2011

Publication Type(s): Research Support, Non-u.s. Gov't Comparative Study Journal Article Evaluation Studies

PubMedID: 21707554

Available at Acta obstetricia et gynecologica Scandinavica - from Wiley Online Library Science, Technology and Medicine Collection 2017

Abstract: OBJECTIVE
To evaluate the rate of discrepancy between pH and lactate values in fetal blood sampling (FBS). To evaluate differences in obstetric management in response to combined tests (pH and lactate) and single tests (pH or lactate).

DESIGN
Descriptive study.

SETTING
Uppsala University Hospital, Sweden.

POPULATION
Labor monitored by FBS during one year (n=241).

METHODS
Discrepancy in the combined tests was defined as a test having one abnormal and one normal value. Abnormal pH was defined as 7.24 or lower and abnormal lactate as 4.2 or higher. The results were categorized according to whether the test was normal or abnormal and according to whether it was a combined or single analysis.

MAIN OUTCOME MEASURES
Discrepancy between pH and lactate values in combined tests. Frequency of operative delivery for fetal distress (ODFD).

Time interval from the last FBS to ODFD.

RESULTS
In the combined tests with abnormality, a discrepancy between pH and lactate values occurred in 55%. The mean time interval from the last FBS to ODFD was longer in combined tests with one abnormal compared with two abnormal test results, 75 vs. 37 minutes (p<0.05). Operative delivery for fetal distress was performed less often after combined tests than after single tests: 41/62 (66%) vs. 19/20 (95%) (p<0.05).

CONCLUSION
In the combined test, discrepancies were common and occurred in half of the samples with an abnormality. Obstetric management was influenced by the discrepancy between test results with respect to ODFD rates and the time interval from the last FBS to delivery.

Database: Medline
35. Fetal blood sampling in addition to intrapartum ST-analysis of the fetal electrocardiogram: evaluation of the recommendations in the Dutch STAN® trial.

Author(s): Becker, J H; Westerhuis, M E M H; Sterrenburg, K; van den Akker, E S A; van Beek, E; Bolte, A C; van Dessel, T J H M; Drogtrop, A P; van Geijn, H P; Graziosi, G C M; van Lith, J M M; Mol, B W J; Moons, K G M; Nijhuis, J G; Oei, S G; Oosterbaan, H P; Porath, M M; Rijnders, R J P; Schuitemaker, N W E; Wijnberger, L D E; Willekes, C; Visser, G H A; Kwee, A

Source: BJOG : an international journal of obstetrics and gynaecology; Sep 2011; vol. 118 (no. 10); p. 1239-1246

Publication Date: Sep 2011

Publication Type(s): Research Support, Non-u.s. Gov't Journal Article

PubMedID: 21668767

Available at BJOG : an international journal of obstetrics and gynaecology - from Wiley Online Library Science , Technology and Medicine Collection 2017

Abstract:OBJECTIVETo evaluate the recommendations for additional fetal blood sampling (FBS) when using ST-analysis of the fetal electrocardiogram.DESIGNProspective cohort study.SETTINGThree academic and six non-academic teaching hospitals in the Netherlands.POPULATIONLabouring women with a high-risk singleton pregnancy in cephalic position beyond 36 weeks of gestation.METHODSIn labouring women allocated to the STAN® arm of a previously published randomised controlled trial who underwent one or more FBS during delivery, we assessed whether FBS was performed according to the trial protocol and how fetal acidosis, defined as an FBS pH < 7.20, was related to ST-waveform analysis.MAIN OUTCOME MEASURESThe number of FBS showing fetal acidosis, related to the different STAN® criteria where additional FBS is recommended.RESULTSAmong 2827 women monitored with STAN®, 297 underwent FBS, of whom 171 (57.6%) were performed according to the predefined criteria and 126 were performed in absence of these criteria. In the first group, rates of fetal acidosis (pH 60 minutes, and poor electrocardiogram quality, respectively. When the predefined criteria were not met and ST-analysis showed no ST-events, only two incidents of fetal acidosis were seen.CONCLUSIONSThe performance of FBS is valuable in the advised STAN® criteria. When these criteria are not met, performance of FBS does not seem helpful in the detection of fetal acidosis.

Database: Medline
36. Outcome of severe intrapartum acidemia diagnosed with fetal scalp blood sampling

**Author(s):** Holzmann M.; Nordstrom L.; Cnattingius S.

**Source:** Journal of Perinatal Medicine; Sep 2011; vol. 39 (no. 5); p. 545-548

**Publication Date:** Sep 2011

**Publication Type(s):** Article

**PubMedID:** 21787260

**Abstract:** Aim: To analyze short-term neonatal outcome and the sampling to delivery interval in cases with severe intrapartum acidemia diagnosed with fetal scalp blood sampling (FBS). Methods: This is a secondary analysis of data from a trial of 2992 women, who were, when indicated, randomized to either lactate or pH analyses by FBS. Median and 95th centile values for lactate analyses were 2.9 mmol/L and 6.6 mmol/L, respectively. Corresponding pH values were 7.30 and 7.17. We defined severe intrapartum acidemia as lactate >6.6 mmol/L or pH <7.17. Outcome measures were cord artery pH <7.00, Apgar <7 at 5 min, hypoxic ischemic encephalopathy and time interval from FBS to delivery. Results: Severe intrapartum acidemia was present in 85/1355 (6.3%) cases with lactate analyses and in 69/1008 (6.8%) cases with pH analyses. Cord artery pH <7.00 occurred in 12/154 (7.8%), Apgar <7 at 5 min in 16/154 (10.4%) and hypoxic ischemic encephalopathy in 4/154 (2.6%) of the cases. There were no differences in outcomes between the two groups. However, delivery was expedited more rapidly in the pH management group (median 16 vs. 21 min; P=0.01). Conclusion: Severe neonatal morbidity occurred in 10% or less in this high-risk group. FBS is an early marker of intrapartum hypoxia and can be used to prevent severe birth acidemia. Lactate might be an earlier marker than pH in the hypoxic process. © 2011 by Walter de Gruyter Berlin Boston.

**Database:** EMBASE

37. Is intrapartum fetal blood sampling a gold standard diagnostic tool for fetal distress?

**Author(s):** Mahendru, Amita A; Lees, Christoph C

**Source:** European journal of obstetrics, gynecology, and reproductive biology; Jun 2011; vol. 156 (no. 2); p. 137-139

**Publication Date:** Jun 2011

**Publication Type(s):** Journal Article

**PubMedID:** 21300427

**Abstract:** Developed in 1960s, cardiotocography is a screening test and fetal blood sampling (FBS) is an adjunctive, diagnostic technique to detect fetal hypoxia. A fetal blood sample pH value of less than 7.20 has a higher specificity than a pathological CTG to predict low Apgar score at 1 min. Though with a pathological CTG and despite a normal FBS pH value the risk of delivering a hypoxic infant is 30-50%, FBS has assumed considerable importance in purportedly reducing unnecessary obstetric intervention. The evidence for this is weak: the use of FBS with CTG has been shown to reduce operative vaginal deliveries though not Caesarean sections due to fetal distress. There is no difference in the umbilical artery pH at delivery with the use of intermittent FBS with CTG compared to CTG alone. FBS is an invasive procedure: obtaining an adequate blood sample is often difficult and the pH results are affected by handling of the sample, aerobic contamination and processing. Validation of intrapartum FBS requires that the pH and other values obtained are compared to a ‘gold standard’ technique. Although FBS has been compared to other tests such as scalp lactate, pulse oximetry, fetal ECG waveform analysis, and central haemodynamics in labouring rhesus monkeys, none of these can be considered as ‘gold standard’. In the light of the existing evidence, the role of intrapartum FBS as a gold standard diagnostic technique is unproven.

**Database:** Medline
38. Fetal blood sampling in early labour: is there an increased risk of operative delivery and fetal morbidity?

Author(s): Heazell, A E P; Riches, J; Hopkins, L; Myers, J E

Source: BJOG: an international journal of obstetrics and gynaecology; Jun 2011; vol. 118 (no. 7); p. 849-855

Publication Date: Jun 2011

Publication Type(s): Comparative Study Journal Article

PubMedID: 21401852

Abstract: OBJECTIVE To determine whether the rate of caesarean section was increased in women undergoing fetal blood sampling (FBS) in early labour. DESIGN Retrospective study. SETTING Secondary and tertiary obstetric units in the UK. POPULATION A cohort of 381 women undergoing FBS. METHODS Data relating to demographics, labour and delivery characteristics, and neonatal outcomes were collected on women undergoing FBS in labour. Odds ratios (ORs) for caesarean section compared with vaginal delivery for women who had their first FBS in early labour (≤ 3 cm cervical dilatation) and for women who required multiple samples were calculated. MAIN OUTCOME MEASURES Mode of delivery. RESULTS Forty-eight percent of women who required their first FBS at a cervical dilatation of ≤ 3 cm achieved a vaginal delivery; these women were at modestly increased risk of caesarean section (adjusted OR 1.80; 95% CI 1.04-3.13) compared with women who had their first FBS at a cervical dilatation of ≥ 4 cm. The odds ratio for caesarean section in women who required two or more FBS was 1.71 (95% CI 1.37-2.13) compared with those requiring a single sample. There were no differences in instrumental delivery. Infants undergoing three or more FBS were more likely to be admitted to a neonatal intensive care unit (NICU; OR 2.69; 95% CI 1.09-6.64), although this was not associated with increased acidaemia. CONCLUSIONS Women who require FBS in early labour or multiple FBS are at a modestly increased risk of caesarean section compared with those in established labour. When contemplating FBS at ≤ 3-cm cervical dilatation, practitioners should not be put off by the perceived low chance of vaginal delivery, but repeating FBS on more than three occasions should be considered carefully.

Database: Medline

39. Fetal scalp blood measurements during labour-lactate or pH?

Author(s): Nordstrom L.

Source: Clinical Biochemistry; May 2011; vol. 44 (no. 7); p. 456-457

Publication Date: May 2011

Publication Type(s): Article

PubMedID: 22036324

Database: EMBASE
40. Use of peripartum ST analysis of fetal electrocardiogram without blood sampling: A large prospective cohort study

**Author(s):** Doret M.; Massoud M.; Constans A.; Gaucherand P.

**Source:** European Journal of Obstetrics Gynecology and Reproductive Biology; May 2011; vol. 156 (no. 1); p. 35-40

**Publication Date:** May 2011

**Publication Type(s):** Article

**PubMedID:** 21257256

**Abstract:** Objective: Fetal peripartum surveillance with ST analysis of fetal electrocardiogram (STAN) alone or in combination with fetal blood sampling (FBS) is a worldwide debate. STAN monitoring without FBS support was implemented in 2000 in the authors' department when it took part in a European multicentre project. The aim of this study was to evaluate neonatal outcomes associated with peripartum STAN monitoring without FBS support in a large prospective cohort of patients at high risk of peripartum fetal asphyxia. Study design: This prospective cohort study included all consecutive high-risk women monitored with STAN technology over a 77-month period, excluding fetuses with congenital anomalies. Outcome variables were fetal metabolic acidosis, umbilical pH <= 7.05 and normal extracellular base deficit, transfer to a neonatal intensive care unit, neonatal encephalopathy and neonatal death related to peripartum asphyxia. Cases with metabolic acidosis were reviewed by a referent midwife and referent obstetricians to check whether or not labour management was consistent with the STAN guidelines. Results: In total, 3112 women were included in the study. The caesarean section rate for suspected fetal distress was 9.5% [95% confidence interval (CI) 8.5-10.5]. Acid-base status was available for 3067 (98.5%) neonates. There were 14 cases of fetal metabolic acidosis (0.45%; 95% CI 0.2-0.7), 62 cases with umbilical pH <= 7.05 and normal extracellular base deficit (2%; 95% CI 1.5-2.5), 27 neonates with 5-min Apgar scores <= 7 (0.87%; 95% CI 0.54-1.20) and 16 neonates were transferred to the neonatal intensive care unit (0.51%; 95% CI 0.26-0.76) due to peripartum asphyxia. No cases of neonatal encephalopathy, or fetal or neonatal death occurred. Out of the 14 cases of fetal metabolic acidosis, 11 were not managed in accordance with the STAN guidelines. Specificity was 80.5% and the negative predictive value was 99.9%. Sensitivity was highly affected by medical staff interpretation, varying from 9.1% in the authors' experience to 90.9% with appropriate labour management according to the STAN guidelines. Conclusions: STAN monitoring without FBS support was associated with a low rate of fetal metabolic acidosis. Most cases of fetal metabolic acidosis were not managed in accordance with the STAN guidelines. This study not only supports STAN usage without FBS support, but also warns of possible guideline violations and subsequent adverse neonatal outcomes. © 2011 Elsevier Ireland Ltd.

**Database:** EMBASE
41. Normalized spectral power of fetal heart rate variability is associated with fetal scalp blood pH.

Author(s): van Laar, J O E H; Peters, C H L; Houterman, S; Wijn, P F F; Kwee, A; Oei, S G

Source: Early human development; Apr 2011; vol. 87 (no. 4); p. 259-263

Publication Date: Apr 2011

Publication Type(s): Journal Article

PubMedID: 21316165

Abstract: BACKGROUND Spectral power of fetal heart rate variability is related to fetal condition. Previous studies found an increased normalized low frequency power in case of severe fetal acidosis. AIMSTo analyze whether absolute or normalized low or high frequency power of fetal heart rate variability is associated with fetal scalp blood pH. STUDY DESIGN Prospective cohort study, performed in an obstetric unit of a tertiary care teaching hospital. SUBJECT Consecutive singleton term fetuses in cephalic presentation that underwent one or more scalp blood samples, monitored during labour using ST-analysis of the fetal electrocardiogram. Ten-minute continuous beat-to-beat fetal heart rate segments, preceding the scalp blood measurement were used. OUTCOME MEASURES Absolute and normalized spectral power in the low frequency band (0.04-0.15 Hz) and in the high frequency band (0.4-1.5 Hz). RESULTS In total 39 fetal blood samples from 30 patients were studied. We found that normalized low frequency and normalized high frequency power of fetal heart rate variability is associated with fetal scalp blood pH. The estimated β of normalized low frequency power was -0.37 (95% confidence interval -0.68 to -0.06) and the relative risk was 0.69 (95% confidence interval 0.51-0.94). The estimated β of normalized high frequency power was 0.33 (95% confidence interval 0.01-0.65) and the relative risk was 1.39 (95% confidence interval 1.01-1.92). CONCLUSION Normalized low and normalized high frequency power of fetal heart rate variability is associated with fetal scalp blood pH.

Database: Medline

42. Fetal blood sampling in normal and dysfunctional labor

Author(s): Wiberg-Itzel E.; Akerud H.

Source: American Journal of Obstetrics and Gynecology; Jan 2011; vol. 204 (no. 1)

Publication Date: Jan 2011

Publication Type(s): Conference Abstract

Abstract: OBJECTIVE: To compare the association between pH or lactate in fetal scalp blood before delivery and fetal outcome in normal or dysfunctional labor. STUDY DESIGN: This is a secondary analysis of data from a randomized controlled trial, where 2996 cases with fetal heart rate abnormalities indicating fetal blood sampling were randomized to either scalp blood lactate or pH analysis. Dysfunctional labor was defined as a cervical dilatation slower than 1cm per hour over two hours or more. A logistic regression was made. The pH or lactate level in fetal blood at last sampling occasion before delivery was compared with fetal outcome (metabolic acidosis, Apgar< 7 at 5min, and pH in cord blood< = 7.05 at delivery) in the dysfunctional vs. normal labor group. RESULTS: 25% of the deliveries had the diagnosis of dysfunctional labor and the representation was equal in the two randomized groups. Totally 4249 fetal blood samples were collected. Lactate concentration in fetal blood increase and correlate significantly to length of labor (p< 0.001). pH did not decrease significantly with the length of labor (p=0.06). In the dysfunctional labor group a high level of lactate (> =4.8mmol/l) in fetal blood seemed to have a better association to metabolic acidosis (OR 14.1 vs. 1.9), Apgar < 7 at 5 minutes (OR: 6.9 vs 1.6) and a pH in cord blood< 7.05 at delivery (OR: 9.9 vs 4.6) than a low pH value (< 7.20). In the normal labor group a low level of pH (< 7.20) or a high level of lactate (> =4.8mmol/l) in fetal blood seemed to have an equivalent association to metabolic acidosis (OR: 2.7 vs. 3.0), Apgar < 7 at 5 minutes (OR: 4.6 vs 3.8) and pH< 7.05 in cord blood at
delivery (OR: 2.0 vs 2.4). CONCLUSIONS: The level of lactate in fetal blood corresponds with length of labor. High level of lactate in fetal blood seems to have a better association to bad fetal outcome than a low pH value, especially in dysfunctional labor. We suggest that length of labor should be taken in consideration when levels of lactate or pH are evaluated during labor.

**Database:** EMBASE

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43. Cardiotocography plus ST analysis of fetal electrocardiogram compared with cardiotocography only for intrapartum monitoring: A randomized controlled trial


**Source:** Obstetrics and Gynecology; Jun 2010; vol. 115 (no. 6); p. 1173-1180

**Publication Date:** Jun 2010

**Publication Type(s):** Article

**PubMedID:** 20502287

**Abstract:** Objective: To estimate the effectiveness of intrapartum fetal monitoring by cardiotocography plus ST analysis using a strict protocol for performance of fetal blood sampling. Methods: We performed a multicenter randomized trial among laboring women with a high-risk singleton pregnancy in cephalic presentation beyond 36 weeks of gestation. Participants were assigned to monitoring by cardiotocography with ST analysis (index) or cardiotocography only (control). Primary outcome was metabolic acidosis, defined as an umbilical cord artery pH below 7.05 combined with a base deficit calculated in the extracellular fluid compartment above 12 mmol/L. Secondary outcomes were metabolic acidosis in blood, operative deliveries, Apgar scores, neonatal admissions, and hypoxic-ischemic encephalopathy. Results: We randomly assigned 5,681 women to the two groups (2,832 index, 2,849 control). The fetal blood sampling rate was 10.6% in the index compared with 20.4% in the control group (relative risk 0.52; 95% CI 0.46-0.59). The primary outcome occurred 0.7% in the index compared with 1.1% in the control group (relative risk 0.70; 95% CI 0.38-1.28; number needed to treat 252). Using metabolic acidosis calculated in blood, these rates were 1.6% and 2.6%, respectively (relative risk 0.63; 95% CI 0.42-0.94; number needed to treat 100). The number of operative deliveries, low Apgar scores, neonatal admissions, and newborns with hypoxic-ischemic encephalopathy was comparable in both groups. Conclusion: Intrapartum monitoring by cardiotocography combined with ST analysis does not significantly reduce the incidence of metabolic acidosis calculated in the extracellular fluid compartment. It does reduce the incidence of metabolic acidosis calculated in blood and the need for fetal blood sampling without affecting the Apgar score, neonatal admissions, hypoxic-ischemic encephalopathy, or operative deliveries. © 2010 by The American College of Obstetricians and Gynecologists. Published by Lippincott Williams & Wilkins.

**Database:** EMBASE
44. Fetal blood sampling - How many samples are needed?

**Author(s):** Santangeli L.; Ratnavelu N.; Hair W.M.; Thomson A.J.

**Source:** Archives of Disease in Childhood: Fetal and Neonatal Edition; Jun 2010; vol. 95

**Publication Date:** Jun 2010

**Publication Type(s):** Conference Abstract

**Abstract:** Introduction Intrapartum fetal blood sampling (FBS) is a crucial tool in the assessment of fetal wellbeing. No published guidance or evidence exists regarding the number of samples required to support clinical decision-making; the authors sought to address this in the current study. Methods FBS were obtained from 50 labouring women. Other data included number of samples obtained and analysed, sampling time, pH values and subsequent clinical decisions. An abnormal FBS value necessitating delivery or re-sampling was defined as <7.25. Results 160 samples were obtained (median per patient=3, range 0-6), and 71% were processed successfully. 10/50 women had an FBS pH <7.25. In those patients whose first FBS pH was <7.20 (n=6), all subsequent samples were also abnormal. In patients whose first pH was 7.20-7.25 (n=4), subsequent pHs varied (range 7.20-7.29), but clinical decisions were based on the initial result. FBS sampling times ranged from 6 to 45 min. Conclusion In those patients where FBS is indicated, there appears to be no benefit in obtaining more than one result. Indeed this may lead to unnecessary delays in clinical decisionmaking.

**Database:** EMBASE

45. Is fetal blood sampling in early labour safe and effective in avoiding Caesarean section?

**Author(s):** Heazell A.E.; Riches J.M.; Hopkins L.; Myers J.E.; Martindale E.A.

**Source:** Archives of Disease in Childhood: Fetal and Neonatal Edition; Jun 2010; vol. 95

**Publication Date:** Jun 2010

**Publication Type(s):** Conference Abstract

**Abstract:** Background Fetal blood sampling (FBS) is undertaken to identify fetal academia and the need to expedite delivery. Currently, there are few data regarding the outcome of labour when a FBS is required in early labour (<=3 cm) or when multiple samples are required. Methods A retrospective study of 381 women undergoing FBS in labour in a 1-year period in two obstetric units was undertaken. OR for Caesarean section (CS) when FBS began prior to 3 cm cervical dilatation, and when multiple samples were required were calculated. OR were adjusted for confounding variables. Results Women requiring FBS at cervical dilatation <=3 cm at first sample were at moderately increased risk of CS (OR 1.71, p<0.001, 95% CI 1.37 to 2.13). There was no increased risk of instrumental delivery in this group (OR 0.51, CI 0.18 to 1.15) There was no significant effect of age, parity, body mass index or gestation. 63 (16.5%) of patients required three or more FBS; repeated FBS was not associated with increased CS (OR 0.52, CI 0.22 to 1.26) or instrumental delivery (OR 1.66, CI 0.88 to 3.30). There was no increased neonatal academia or admission to NICU in infants with >=3 FBS. Conclusion Women who require FBS in early labour are at a moderately increased risk of CS compared to those in established labour. Women who require multiple FBS are at no increased risk of CS or instrumental delivery. When contemplating FBS at 3 cm dilated, practitioners should not be put off by a perceived low chance of vaginal delivery or concerns about repeated FBS.

**Database:** EMBASE
46. Fetal blood sampling in labour and the decision to delivery interval.

**Author(s):** Annappa, Rajesh; Campbell, David James; Simpson, Nigel A B

**Source:** European journal of obstetrics, gynecology, and reproductive biology; Nov 2008; vol. 141 (no. 1); p. 10-12

**Publication Date:** Nov 2008

**Publication Type(s):** Journal Article

**PubMedID:** 18760522

**Abstract:**

OBJECTIVE: To determine the time interval from decision to result for fetal blood sampling (FBS) and the time from an abnormal pH result to delivery of the neonate.

STUDY DESIGN: A prospective study of 107 consecutive attempts at FBS on 72 out of 1450 patients in labour from 1st April 2006 to 1st August 2006 at St James University Hospital in Leeds, England. Statistical analysis was performed by using nonparametric tests.

RESULTS: 107 attempts at FBS on 72 cases were reviewed. Overall the median time from decision to the result of FBS was 17 minutes (interquartile range: 11-22 minutes). 27% (19/70) of fetuses had abnormal results and the median time from result to delivery was 21 minutes (interquartile range: 16-25 minutes) in these cases. The median time from decision to perform FBS to delivery was 37 minutes in cases where acidemia was present. Body mass index (BMI) cervical dilatation and grade of operator were the factors which affected median time from decision to the result of FBS.

CONCLUSION: The time from decision to the result of FBS should be considered in the delivery decision-making process in cases complicated by suspected fetal compromise.

**Database:** Medline

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47. Prevention of cerebral palsy during labour: role of foetal lactate.

**Author(s):** Borruto, Franco; Comparetto, Ciro; Treisser, Alain

**Source:** Archives of gynecology and obstetrics; Jul 2008; vol. 278 (no. 1); p. 17-22

**Publication Date:** Jul 2008

**Publication Type(s):** Journal Article

**PubMedID:** 18071726

**Available at [Archives of gynecology and obstetrics - from SpringerLink](https://link.springer.com/article/10.1007%2Fs00404-008-0656-8)

**Abstract:**

OBJECTIVES: Intrapartum foetal monitoring goal is to prevent foetal asphyxia and its most severe consequence: cerebral palsy (CP). In this paper we describe the detection methods and the criteria needed to assess asphyxia during labour for preventing CP. Foetal cerebral damage assessment is considered from the medical-legal point of view. CP represents the most frequent pathology of childhood related to pregnancy and childbirth with an incidence of 0.2% in children born alive. It is clinically regarded as the result of a spectrum of diseases due to damage or to faded development of the nervous system which generally appears at the time of the first stage of intrauterine growth or depends on problems arising at birth. The goal of our analysis is to recall the various moments in which this event can take place and, if possible, the moment and the degree of the event of asphyxia and its effect on foetal conditions, in order to control and treat it.

STUDY DESIGN: One hundred and eighty-eight fetuses were evaluated by means of Apgar score, intrapartum cardiotocography, observation of the presence of meconium stained amniotic fluid, and clinical features of distress at birth. Lactate concentrations were measured during labour and at delivery in blood samples obtained from the foetal presenting part (foetal scalp) and from the umbilical cord with the use of a rapid electrochemical technique.

RESULTS: Evidence of clinical foetal distress was not related to the severity of asphyxia. An increased lactate level was found in asphyctic infants and a clear correlation between lactic acidosis and foetal distress was documented. Low Apgar scores were observed in infants with moderate or severe asphyxia at delivery. Scalp lactate correlated
significantly with umbilical artery lactate (P = 0.49, 0.01), but with neither Apgar score at 1 min (R = -0.21, ns) nor at 5 min (R = -0.11, ns). Lactate concentration was higher in case of instrumental delivery compared to spontaneous delivery (P = 0.0001). No perfect correlation was found between lactate level and neonatal outcome, but there were not a significant number of neonates with immediate complications. The rate of instrumental delivery in the distress group was significantly higher than in that of the healthy fetuses (P < 0.01), so spontaneous labour was less frequently associated with foetal distress than instrumental delivery (P < 0.01). In the distress group, severe variable decelerations were generally recorded in the second stage of labour. The incidence of neonatal Apgar score <=7 in neonates with abnormal baseline foetal heart rate (FHR) was higher than in those with severe variable decelerations, mild variable decelerations, and transient tachycardia (P < 0.05). The duration of the active second stage of labour correlated significantly with the presence of foetal lactate (P < 0.001) at the time of crowning of foetal head, and the presence of lactate in umbilical cord blood at delivery (P /=45 min, compared with a shorter active second stage, and acidaemia at birth implied larger arterial-venous lactate differences (P < 0.001). The presence of foetal lactate at crowning was also significantly associated with the level of umbilical arterial-venous lactate difference (P = 0.03).CONCLUSIONSAnalysis of the fetus should start with the assessment of lactates and acid-base balance. The method which revolutionized the techniques of foetal monitoring is undoubtedly represented by cardiotocography. However, likely most of neurological outcomes are not correlated with a perinatal event or with peripartum asphyxia. Approximately 10% of cases of CP would actually be due to perinatal asphyxia, and this percentage approaches approximately to 15% if we consider only newborns at term. This again confirms the weak association of a causal relationship between asphyxia and CP. In addition, available foetal suffering markers are vague and allow to identify only less than half of the effective cases of newborns which will develop CP.

Database: Medline
48. Determination of pH or lactate in fetal scalp blood in management of intrapartum fetal distress: randomised controlled multicentre trial.

**Author(s):** Wiberg-Itzel, E; Lipponer, C; Norman, M; Herbst, A; Prebensen, D; Hansson, A; Bryngelsson, A-L; Christoffersson, M; Sennström, M; Wennerholm, U-B; Nordström, L

**Source:** BMJ (Clinical research ed.); Jun 2008; vol. 336 (no. 7656); p. 1284-1287

**Publication Date:** Jun 2008

**Publication Type(s):** Research Support, Non-u.s. Gov't Randomized Controlled Trial Multicenter Study Journal Article

**PubMedID:** 18503103

Available at BMJ - from BMJ Journals - NHS

**Abstract:**
OBJECTIVE: To examine the effectiveness of pH analysis of fetal scalp blood compared with lactate analysis in identifying hypoxia in labour to prevent acidaemia at birth.

DESIGN: Randomised controlled multicentre trial.

SETTING: Labour wards.

PARTICIPANTS: Women with a singleton pregnancy, cephalic presentation, gestational age ≥34 weeks, and clinical indication for fetal scalp blood sampling.

INTERVENTIONS: Standard pH analysis (n=1496) or lactate analysis (n=1496) with an electrochemical microvolume (5 μl) test strip device. The cut-off levels for intervention were pH 4.8 mmol/l, respectively.

MAIN OUTCOME MEASURES: Metabolic acidaemia (pH <7.00) or pH <7.00 occurred in 1.5% in the lactate group and in 1.8% in the pH group (0.84, 0.47 to 1.50). There was no significant difference in Apgar scores <7 at 5 minutes (1.15, 0.76 to 1.75) or operative deliveries for fetal distress (1.02, 0.93 to 1.11).

CONCLUSION: There were no significant differences in rate of acidaemia at birth after use of lactate analysis or pH analysis of fetal scalp blood samples to determine hypoxia during labour. TRIAL REGISTRATION: ISRCT No 1606064.

**Database:** Medline

49. Fetal scalp pH and ST analysis of the fetal ECG as an adjunct to cardiotocography to predict fetal acidosis in labor / A multi-center, case controlled study.

**Author(s):** Norén H; Luttkus AK; Stupin JH; Blad S; Arulkumaran S; Erkkola R; Luzietti R; Visser GH; Yli B; Rosén KG

**Source:** Journal of Perinatal Medicine; Sep 2007; vol. 35 (no. 5); p. 408-414

**Publication Date:** Sep 2007

**Publication Type(s):** Academic Journal

**PubMedID:** 17685855

**Abstract:**
Objective: To assess the relationship between scalp pH (FBS) and ST analysis in situations of acidosis with special emphasis on the timing of cardiotocography (CTG), FBS and ST changes during labor. Study design: From a European Union multicenter study on clinical implementation of the STAN methodology, 911 cases were identified where a scalp-pH had been obtained. In 53 cases, marked cord artery acidosis was found (cord artery pH/<7.20). Results: Of those cases with FHR+ST events recorded within 16 min of delivery, 61% (17/28) had a cord artery pH/<7.20. The corresponding figure for cases where STAN indications occurred for more than 16 min was 19% (13/69) (OR 6.66, 2.53-17.55, P<0.001). Out of the 121 cases with an abnormal CTG, 84 (69%) showed a cord artery pH of <7.10. STAN indicated abnormality in 83% (70 out of 84). The corresponding figure for scalp pH<7.20 was 43% (36/84). In the case of CTG changes at the start of an adequate recording STAN guidelines provided information on developing acidosis in all cases but one (16 out of 17) in the marked acidosis group. STAN guidelines indicated abnormality prior to an
abnormal FBS in 14 out of 17 cases. The median duration between STAN indications to intervention and an abnormal FBS was 29 (95% CI 11-74) min. Conclusions: ST analysis, as an adjunct to CTG, identifies adverse fetal conditions during labor similar to that of FBS but on a more consistent basis. The timing of CTG+ST changes relates to the level of acidosis at birth.

Database: CINAHL

50. A randomised clinical trial on cardiotocography plus fetal blood sampling versus cardiotocography plus ST-analysis of the fetal electrocardiogram (STAN) for intrapartum monitoring

Author(s): Westerhuis M.E.M.H.; Visser G.H.A.; Kwee A.; Moons K.G.M.; van Beek E.; Bijvoet S.M.; van Geijn H.P.; Drogtrop A.P.; van Lith J.M.M.; Mol B.W.J.; Oei S.G.; Porath M.M.; Nijhuis J.G.; Willekes C.; Rijnders R.J.P.; Schuitmaker N.W.E.; van der Tweel I.

Source: BMC Pregnancy and Childbirth; Jul 2007; vol. 7
Publication Date: Jul 2007
Publication Type(s): Article
PubMedID: 17655764

Available at BMC pregnancy and childbirth - from BioMed Central

Abstract: Background: Cardiotocography (CTG) is worldwide the method for fetal surveillance during labour. However, CTG alone shows many false positive test results and without fetal blood sampling (FBS), it results in an increase in operative deliveries without improvement of fetal outcome. FBS requires additional expertise, is invasive and has often to be repeated during labour. Two clinical trials have shown that a combination of CTG and ST-analysis of the fetal electrocardiogram (ECG) reduces the rates of metabolic acidosis and instrumental delivery. However, in both trials FBS was still performed in the ST-analysis arm, and it is therefore still unknown if the observed results were indeed due to the ST-analysis or to the use of FBS in combination with ST-analysis. Methods/Design: We aim to evaluate the effectiveness of non-invasive monitoring (CTG + ST-analysis) as compared to normal care (CTG + FBS), in a multicentre randomised clinical trial setting. Secondary aims are: 1) to judge whether ST-analysis of fetal electrocardiogram can significantly decrease frequency of performance of FBS or even replace it; 2) perform a cost analysis to establish the economic impact of the two treatment options. Women in labour with a gestational age >=36 weeks and an indication for CTG-monitoring can be included in the trial. Eligible women will be randomised for fetal surveillance with CTG and, if necessary, FBS or CTG combined with ST-analysis of the fetal ECG. The primary outcome of the study is the incidence of serious metabolic acidosis (defined as pH < 7.05 and Bdecf > 12 mmol/L in the umbilical cord artery). Secondary outcome measures are: instrumental delivery, neonatal outcome (Apgar score, admission to a neonatal ward), incidence of performance of FBS in both arms and cost-effectiveness of both monitoring strategies across hospitals. The analysis will follow the intention to treat principle. The incidence of metabolic acidosis will be compared across both groups. Assuming a reduction of metabolic acidosis from 3.5% to 2.1%, using a two-sided test with an alpha of 0.05 and a power of 0.80, in favour of CTG plus ST-analysis, about 5100 women have to be randomised. Furthermore, the cost-effectiveness of CTG and ST-analysis as compared to CTG and FBS will be studied. Discussion: This study will provide data about the use of intrapartum ST-analysis with a strict protocol for performance of FBS to limit its incidence. We aim to clarify to what extent intrapartum ST-analysis can be used without the performance of FBS and in which cases FBS is still needed. © 2007 Westerhuis et al; licensee BioMed Central Ltd.

Database: EMBASE
51. Impact of fetal blood sampling on vaginal delivery and neonatal outcome in deliveries complicated by pathologic fetal heart rate: A population based cohort study

Author(s): Stein W.; Hellmeyer L.; Schmidt S.; Misselwitz B.

Source: Journal of Perinatal Medicine; Dec 2006; vol. 34 (no. 6); p. 479-483

Publication Date: Dec 2006

Publication Type(s): Article

PubMedID: 17140298

Abstract: Objective: To compare the impact of electronic fetal monitoring (EFM) alone vs. EFM with additional fetal blood sampling (FBS) in vaginal deliveries complicated by pathologic fetal heart rate (FHR). Methods: All deliveries in Hesse between 1990 and 2000 were evaluated for participation in this study. Inclusion criteria comprised (1) pathologic fetal heart rate, (2) singleton pregnancy, (3) cephalic presentation, (4) vaginal delivery, and (5) gestational age at delivery of more than 35 weeks' gestation. In order to analyze the meaning of additional risk factors at birth for the effectiveness of FBS two subgroups were selected depending on the presence of additional risk factors at birth. To examine the impact of FBS in deliveries with pathologic FHR on the mode of delivery and on neonatal outcome, univariate regression analysis was performed and odds ratios (OR) and their corresponding 95% confidence intervals (95% CI) were calculated. Results: The study population comprised 49,560 deliveries, among deliveries complicated by pathologic FHR, 26% underwent FBS. Deliveries with pathologic FHR and controlled by FBS, with no additional antepartum risk factors, were associated with an increase in spontaneous births OR 1.41 (95% CI 1.27-1.58), and in the presence of additional risk factors OR 1.24 (1.19-1.30). Short-term neonatal outcome parameters were characterized by a lower frequency of severe fetal acidosis (umbilical artery pH <7.0) OR 0.55 (0.42-0.72), and Apgar score <5 after 5 min, OR 0.71 (0.55-0.90). Conclusion: In vaginal deliveries with pathologic FHR the use of FBS as an additional means of intrapartum fetal surveillance is associated with less vaginal operative deliveries, and with an improved short-term neonatal outcome. Copyright © by Walter de Gruyter.

Database: EMBASE
Determining the fetal scalp lactate level that indicates the need for intervention in labour

Author(s): Allen R.M.; Bowling F.G.; Oats J.J.N.

Source: Australian and New Zealand Journal of Obstetrics and Gynaecology; Dec 2004; vol. 44 (no. 6); p. 549-552

Publication Date: Dec 2004

Publication Type(s): Article

PubMedID: 15598295

Available at The Australian & New Zealand journal of obstetrics & gynaecology - from Wiley Online Library Science, Technology and Medicine Collection 2017

Abstract: Background: Fetal scalp lactate testing has been shown to be as useful as pH with added benefits. One remaining question is 'What level of lactate should trigger intervention in the first stage of labour?' Aims: This study aimed to establish the lactate level in the first stage of labour that indicates the need for intervention to ensure satisfactory outcomes for both babies and mothers. Methods: A prospective study at Mater Mothers' Hospital, Brisbane, Australia, a tertiary referral centre. One hundred and forty women in labour, with non-reassuring fetal heart rate traces, were tested using fetal blood scalp sampling of 5 μl of capillary blood tested on an Accusport (Boeringer, Mannheim, East Sussex, UK) lactate meter. Decision to intervene in labour was based on clinical assessment plus a predetermined cut off. Main outcome measures were APGAR scores, cord arterial pH, meconium stained liquor and Intensive Care Nursery admission. Results: Two-graph receiver operating characteristic (TG-ROC) analysis showed optimal specificity, and sensitivity for predicting adverse neonatal outcomes was a scalp lactate level above 4.2 mmol/L. Conclusions: Fetal blood sampling remains the standard for further investigating non-reassuring cardiotocograph (CTG) traces. Even so, it is a poor predictor of fetal outcomes. Scalp lactate has been shown to be at least as good a predictor as scalp pH, with the advantages of being easier, cheaper and with a lower rate of technical failure. Our study found that a cut off fetal scalp lactate level of 4.2 mmol/L, in combination with an assessment of the entire clinical picture, is a useful tool in identifying those women who need intervention.

Database: EMBASE

Author(s): Carbonne, B; Langer, B; Goffinet, F; Audibert, F; Tardif, D; Le Goueff, F; Laville, M; Maillard, F

Source: American journal of obstetrics and gynecology; Sep 1997; vol. 177 (no. 3); p. 593-598

Publication Date: Sep 1997

Publication Type(s): Comparative Study Multicenter Study Journal Article

PubMedID: 9322629

Abstract: OBJECTIVE Our purpose was to compare the predictive value of intrapartum fetal pulse oximetry with that of fetal blood analysis for an abnormal neonatal outcome in case of an abnormal fetal heart rate. STUDY DESIGN A prospective multicenter observational study was conducted from June 1994 to November 1995. Fetal oxygen saturation was continuously recorded with a Nellcor N-400 fetal pulse oximeter in case of an abnormal fetal heart rate during labor. Simultaneous readings of fetal oxygen saturation and fetal blood analysis obtained before birth (i.e., either at full dilatation or before cesarean section when indicated) were compared with the neonatal status. The criteria for an abnormal neonatal outcome were (1) an umbilical arterial blood pH < or = 7.15 and (2) a combined variable including 5-minute Apgar score < or = 7, umbilical arterial pH < or = 7.15, secondary respiratory distress, transfer in a neonatal care unit, or neonatal death. RESULTS At a 7.20 threshold for fetal scalp pH and 30% for fetal oxygen saturation (i.e., the 10th percentile in the study population), the predictive value of fetal pulse oximetry was similar to that of fetal blood analysis for an arterial umbilical pH < or = 7.15 and for an abnormal neonatal outcome (positive predictive value 56% vs 55%, negative predictive value 81% vs 82%, sensitivity 29% vs 35%, and specificity 93% vs 91%, respectively). The receiver-operator characteristic curve showed similar performance of either technique for cutoff values < or = 7.20 for fetal blood pH and < or = 30% for fetal oxygen saturation, whereas fetal pulse oximetry became superior at higher thresholds. CONCLUSION The predictive value of intrapartum fetal pulse oximetry can be favorably compared with that of fetal blood analysis. Randomized controlled management trials can now be performed to assess potential clinical benefits of this new tool.

Database: Medline

54. Electronic monitoring of fetal heart rate and determination of fetal scalp blood pH in prediction of intrapartum fetal distress.

Author(s): Dai, M S; Fox, H

Source: Chinese medical journal; Feb 1991; vol. 104 (no. 2); p. 132-137

Publication Date: Feb 1991

Publication Type(s): Journal Article

PubMedID: 1874012

Abstract: A prospective study on consecutive fetal monitoring in 559 deliveries was carried out. The difference between the first 30-minute and the last 30-minute monitoring was compared. Abnormal fetal heart rate (FHR) pattern in the last 30 minutes combined with abnormal fetal scalp blood pH has a good predictability of 1- and 5-minute Apgar scores. The correlation of fetal heart rate-uterine contraction (FHR-UC) monitoring (525 cases) and fetal scalp blood pH determinations (FSB-pH) (79 cases) with the fetal condition was assessed. It is indicated that the first 30-minute FHR tracing can reflect the fetal status in labor, and FHR-UC monitoring assessment is evidently superior to FSB-pH in the prediction of a vigorous fetus. Whereas, FSB-pH is superior to FHR-UC monitoring in the prediction of a compromised fetus.
The use of intrapartum fetal blood lactate measurements for the early diagnosis of fetal distress.

Author(s): Eguiuluz, A; López Bernal, A; McPherson, K; Parrilla, J J; Abad, L

Source: American journal of obstetrics and gynecology; Dec 1983; vol. 147 (no. 8); p. 949-954

Publication Date: Dec 1983

Publication Type(s): Journal Article

Abstract: Lactate concentrations were measured during labor and at delivery in blood samples from the fetal presenting part and from the umbilical cord with the use of a rapid electrochemical technique. The value of these measurements to discriminate between normal and distressed fetuses was compared to that of pH, base excess, PCO2 and PO2 measurements in the same blood samples. The fetuses were divided into three groups, normal, prepathologic, and pathologic, according to the presence and severity of fetal distress as evaluated by Apgar score, intrapartum cardiotocography, meconium staining of the amniotic fluid, and cord arterial pH at birth. Lactate and pH provided the best parameters to distinguish between groups, with lactate having the most discriminating power at least in early labor and midlabor. The prospective value of discriminant functions derived from lactate and pH data was good when the fetuses were allocated into the normal group but poor when an attempt was made to allocate the fetuses into prepathologic and pathologic groups, with a high false negative rate. However, the discriminating ability was improved when prepathologic and pathologic fetuses were included into one single abnormal group. These results confirm the potential use of rapid fetal blood lactate measurements for the early diagnosis of intrapartum fetal distress.

Fetal scalp blood lactate as an indicator of intrapartum hypoxia.

Author(s): Smith, N C; Soutter, W P; Sharp, F; McColl, J; Ford, I

Source: British journal of obstetrics and gynaecology; Sep 1983; vol. 90 (no. 9); p. 821-831

Publication Date: Sep 1983

Publication Type(s): Research Support, Non-u.s. Gov't Journal Article

Abstract: Fetal scalp blood lactate was measured during labour by a simple, rapid method and its value as an indicator of fetal intrauterine hypoxia was assessed and compared with that of pH measurement. The normal ranges of lactate concentration and of pH values were calculated. Significantly higher concentrations of lactate and lower pH values were found in samples of scalp blood taken close to delivery from babies with Apgar scores of less than or equal to 6 at 1 min compared with those from healthy babies with Apgar scores of greater than or equal to 7 at 1 min. A similarly significant difference was observed between the cord blood lactate and pH values of these two groups of babies. Ominous fetal heart rate patterns were associated with higher lactate concentrations and lower pH values in fetal scalp blood than were normal fetal heart rate patterns. The measurement of fetal scalp blood lactate or pH, or continuous electronic fetal heart rate monitoring were equally good at predicting the condition of the infant at birth.
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