Lactate Levels in Labour/Post-Delivery

1. High levels of lactate in amniotic fluid (AFL) at delivery is associated with maternal as well as fetal morbidity

Author(s): Wiberg-Itzel E.; Akerud H.
Source: European Journal of Obstetrics Gynecology and Reproductive Biology; Mar 2019; vol. 234
Publication Date: Mar 2019
Publication Type(s): Conference Abstract

Abstract: Introduction: In a dystocic labor the myometrium will be in an anaerobic situation with increased production of lactate as a sign of hypoxia. The uterine lactate is mirrored in the amniotic fluid (AFL) and can easily be analyzed at the bedside during ongoing labor. Objective(s): To study the correlation between the level of AFL at delivery and maternal/fetal intra and postpartum morbidity. Method(s): Observational. Amniotic fluid from 1484 primiparous women was collected vaginally at the time of delivery and the AFL levels were analyzed at the bedside. Delivery and postpartum data were collected from the woman’s medical files and compared in the two groups (high levels > 12 mmol/l vs. low levels < 12.0 mmol/l) at delivery. Discussion and conclusions: A high AFL level at delivery was associated with an increased risk of maternal/fetal complications. In the group with a high AFL level the frequency of an acute cesarean section was 22 vs. 4.5% in the group with low levels (p < 0.001). Fetal distress with an affected CTG trace just before delivery was more common in the group with high levels compared to the group with low levels (20 vs.7%, p < 0.001), pH in cord blood < 7.05 was also more common in these deliveries (5.1 vs.1.3%, p = 0.04). In labors with high AFL levels at delivery, postpartum infections was more common (32% vs. 11%, p < 0.001) as well as postpartum hemorrhages > 1 L (13.6 vs 5.9%, p = 0.03). Conclusion(s): This study supports the importance of this new knowledge of AFL and the importance of avoiding high AFL levels during labor. A high level of AFL is a sign of hypoxia in the fetal/maternal unit. The results illustrate an increased risk of intra as well as postpartum complications for the laboring women as well as for her unborn child in deliveries with high AFL.

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Database: EMBASE

Author(s): Bauer, Melissa E; Balistreri, Michael; MacEachern, Mark; Cassidy, Ruth; Schoenfeld, Robert; Sankar, Keerthana; Clauw, Daniel J; Langen, Elizabeth

Source: American journal of perinatology; Nov 2018

Publication Date: Nov 2018

Publication Type(s): Journal Article

PubMedID: 30396223

Abstract: OBJECTIVE This article systematically reviews the literature to establish the normal range of lactic acid in healthy pregnant women. STUDY DESIGN Ovid MEDLINE, Embase.com, and Clinicaltrials.gov were searched to identify studies that reported maternal lactic acid in healthy pregnant women. Pooled aggregate means and two standard deviations for each time period were computed using the inverse variance weighting technique. Analyses were performed separately for 1st, 2nd, and 3rd trimesters, scheduled cesarean delivery, early labor, active labor, 2nd stage of labor, and delivery. RESULTS Overall, 22 studies met the inclusion criteria. There were 1,193 patients, and 2,008 observations identified. All time periods had maternal venous lactic acid aggregate means and two-standard-deviation ranges less than 4 mmol/L. Outside of labor, all ranges were less than 2 mmol/L. All labor periods had a range higher than 2 mmol/L. While the pooled ranges were less than 4 mmol/L, many individual studies reported ranges >4 mmol/L during labor. CONCLUSION This meta-analysis suggests that venous lactic acid levels can be used as a screening tool in pregnant women just as the test would be used in nonpregnant women, except that elevations may be seen during labor, especially later in labor when there is maximal skeletal muscle contraction.

Database: Medline

3. Serum lactate and obstetrics 2018

Author(s): Fields N.

Source: Australian and New Zealand Journal of Obstetrics and Gynaecology; Sep 2018; vol. 58 ; p. 50-51

Publication Date: Sep 2018

Publication Type(s): Conference Abstract

Abstract: Introduction: Serum lactate has a well established role in many areas of medicine including the emergency department, intensive care, anaesthetics and trauma. In recent years with increasing access to blood gas analysers and serum lactate assays, obstetric health providers are ordering more lactates in an increasing number of clinical scenarios including post-partum haemorrhage, obstetric sepsis and HELLP syndrome. This presentation will require one tertiary centres experience with lactate and the current evidence for its use in obstetrics. Method(s): A 5-year retrospective audit of all serum lactate assays ordered at a major tertiary hospital between 2012 and 2017 were collected and reviewed for clinical indication at time of specimen collection. 178 cases in total were reviewed over the 5-year period not including point-of-care blood-gas results. Result(s): Serum lactate is an increasing assay ordered by obstetric health care providers with growing evidence to support its role in everyday practice. Over the 5-year period 2012-2017 this tertiary level obstetric centre has noted an increase in the number of lactate tests ordered as well as the broadening clinical indications for its use. Discussion(s): Serum lactate has an increasing role in obstetrics with clinical indications...
including post-partum haemorrhage and particularly in sepsis during the peripartum period. Serum lactate is a relatively inexpensive assay that provides significant diagnostic and prognostic information for obstetric patients with a variety of clinical scenarios. Further research is required particularly during the intrapartum period to establish normal serum lactate levels.

Database: EMBASE

4. Blood lactate concentration and shock index associated with massive transfusion in emergency department patients with primary postpartum haemorrhage

Author(s): Sohn C.H.; Kim Y.-J.; Seo D.W.; Lim K.-S.; Kim W.Y.; Won H.-S.; Shim J.-Y.

Source: British Journal of Anaesthesia; Aug 2018; vol. 121 (no. 2); p. 378-383

Publication Date: Aug 2018

Publication Type(s): Article

PubMedID: 30032876

Available at British Journal of Anaesthesia - from Patricia Bowen Library & Knowledge Service West Middlesex University Hospital NHS Trust (lib302631) Local Full Text Collection

Abstract: Background: We hypothesised that lactate concentrations are independently associated with massive transfusion in patients with primary postpartum haemorrhage. Moreover, combining lactate concentrations with the shock index, defined as the ratio of heart rate to systolic arterial blood pressure, can improve the predictive performance for massive transfusion. Method(s): We retrospectively analysed patients with primary postpartum haemorrhage in the emergency department of a tertiary referral centre in Korea between January 1, 2004 and December 31, 2015. Result(s): Of the 302 patients, 101 (33.4%) patients required massive transfusion. Lactate concentration was independently associated with the requirement for massive transfusion [odds ratio, 1.56; 95% confidence interval (CI), 1.31-1.87; P<0.01]. The area under the receiver operating characteristic curve of lactate concentration and shock index for massive transfusion was 0.788 (95% CI: 0.736-0.840; P<0.01) and 0.776 (95% CI: 0.717-0.836; P<0.01), respectively. Lactate elevation (>4.0 mM L⁻¹) was associated with 86.1% specificity and 67.8% positive predictive value for massive transfusion. When combining elevated lactate concentrations (>4.0 mM L⁻¹) with a shock index >1.0, the specificity and positive predictive value increased to 95.5% and 82.4%, respectively.

Conclusion(s): Point-of-care testing of lactate concentrations in the emergency department may be useful to predict massive transfusion requirements in primary postpartum haemorrhage. Combining initial lactate concentrations with the shock index improves the predictive performance for massive transfusion requirements and may contribute to rapid risk stratification of patients with primary postpartum haemorrhage in need of transfusion and further focus on early interventions to control bleeding.

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Database: EMBASE
Abstract: Introduction NICE guidelines recommend fetal blood sampling (FBS) when the CTG is pathological. The pH or lactate value is then used to inform the decision to expedite delivery. However, there are no guidelines with regards to the methods of measuring lactate from an FBS. Confusion may arise if there is a discrepancy between pH and lactate results from a single FBS.

Objectives 1 Nationwide practice in the methods of analysing fetal scalp lactate in labour 2 If lactate or pH primarily influences the decision to expedite delivery.

Methods 167 NHS maternity units in England were contacted by telephone or email. Standalone or alongside birth centres were excluded. Results Data were obtained from 60 maternity units giving a response rate of 36%. 34/56 units (61%) routinely measured lactate as part of FBS analysis and this was done using a blood gas analyser in all instances. Only 1 unit used a bedside lactate meter, and this was done alongside a blood gas analyser. Of the 34 units that measured lactate, 13 (38%) used this result to decide whether to expedite delivery. 7/13 (54%) did so routinely and 6 (46%) reported use dependent clinical scenario. Conclusion The low respondent rate prohibits generalisability of our results. Maternity units that measured lactate from an FBS result did so using a blood gas analyser but the majority utilised on fetal scalp pH to aid decision to expedite delivery.

Database: EMBASE
6. Correlation of blood lactate levels as a predictor for blood transfusion in postpartum hemorrhage

**Author(s):** Hoskins I.; Berg R.

**Source:** Obstetrics and Gynecology; May 2017; vol. 129

**Publication Date:** May 2017

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

**Abstract:** INTRODUCTION: Postpartum hemorrhage is an obstetrical emergency which requires aggressive volume repletion. Serum lactate levels are used in the management of trauma patients because they reliably indicate tissue hypoperfusion. METHODS: A retrospective chart review was performed from June 01, 2013 through Sept 30, 2016 in patients undergoing an Obstetric Hemorrhage Team (OHT) alert, defined at our institution as a quantified blood loss of 900 cc after vaginal delivery and 1500 cc after Cesarean section. Stat venous lactate levels were correlated with hematocrit levels, vital signs (BP and pulse), urine output, crystalloid fluid resuscitation and blood transfusion. RESULTS: There were 1314 OHTs. Of these, 891 patients had venous lactate values. When the venous lactate level was "elevated", i.e. 4.0 (range 3.4 to 6.6), 632 patients (71%) required at least one unit blood transfusion in addition to the usual resuscitative measures, (statistically significant). Of these, only 347 patients (39%) were hemodynamically unstable (BP less than 60/40 and/or pulse rate greater than 120 bpm); and only 276 (31%) demonstrated a 10 point hematocrit drop from the admission value. When venous lactate levels were "normal", i.e. 2.0 (range 1.6 to 3.2), only 80 (9%) required blood transfusions. CONCLUSION: Venous lactate is a reliable indicator of tissue hypoperfusion in postpartum hemorrhage, and may help to identify patients who, regardless of hemodynamic status or hematocrit level, would most benefit from blood transfusion during the management of this condition.

**Database:** EMBASE

7. The presence of vaginal Lactobacillus species does not contribute to a measureable difference in amniotic fluid lactate levels collected from the vaginal tract of laboring women

**Author(s):** Hall B.; Healy C.; Tracy S.K.; Wong D.; Rawlinson W.D.; Tracy M.B.

**Source:** Acta Obstetrica et Gynecologica Scandinavica; Apr 2017; vol. 96 (no. 4); p. 487-495

**Publication Date:** Apr 2017

**Publication Type(s):** Article

**PubMedID:** 28039853

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

**Abstract:** Introduction: Amniotic fluid lactate research is based on the hypothesis that a relationship exists between fatigued uterine muscles and raised concentrations of the metabolite lactate, which is excreted into the amniotic fluid during labor. To assess potentially confounding effects of lactate-producing organisms on amniotic fluid lactate measurements, we aimed to determine if the presence of vaginal Lactobacillus species was associated with elevated levels of amniotic fluid lactate, measured from the vaginal tract of women in labor. Material and methods: Results from this study contribute to a large prospective longitudinal study of amniotic fluid lactate at a teaching hospital in Sydney, Australia. Amniotic fluid lactate measurement was assessed at the time of routine vaginal examination, after membranes had ruptured, using a hand-held lactate meter StatStripXPress (Nova Biomedical). Vaginal swab samples were collected at the time of the first amniotic fluid lactate measurement and stored for later detection and quantification of Lactobacillus species using a TaqMan real-time PCR assay. Swab sample and amniotic fluid lactate results were
paired and analyzed. Results: The PCR assay detected Lactobacillus species in 48 of 388 (12%) vaginal swab specimens (8% positive, 4% low positive) collected from women in labor after membranes had ruptured. There was no significant difference in median and mean (respectively) amniotic fluid lactate levels with (8.35 mmol/L; 8.95 mmol/L) or without (8.5 mmol/L; 9.08 mmol/L) Lactobacillus species detected. Conclusion: There was no association between the presence or level of vaginal Lactobacillus species and the measurement of amniotic fluid lactate collected from the vaginal tract of women during labor.

Database: EMBASE

8. Reference values for Lactate Pro 2TM in fetal blood sampling during labor: A cross-sectional study

Author(s): Nordstrom L.; Birgisdottir B.T.; Holzmann M.; Varli I.H.; Graner S.; Saltvedt S.

Source: Journal of Perinatal Medicine; Apr 2017; vol. 45 (no. 3); p. 321-325

Publication Date: Apr 2017

Publication Type(s): Review

PubMedID: 27089399

Abstract: Lactate ProTM (LP1) is the only lactate meter evaluated for fetal scalp blood sampling (FBS) in intrapartum use. The reference values for this meter are: Normal value <4.2 mmol/L, preacidemia 4.2-4.8 mmol/L, and acidemia >4.8 mmol/L. The production of this meter has been discontinued. An updated version, Lactate Pro 2TM (LP2), has been launched and is shown to be differently calibrated. The aims of the study were to retrieve a conversion equation to convert lactate values in FBS measured with LP2 to an estimated value if using LP1 and to define reference values for clinical management when using LP2. A cross-sectional study was conducted at a university hospital in Sweden. A total of 113 laboring women with fetal heart rate abnormalities on cardiotocography (CTG) had FBS carried out. Lactate concentration was measured bedside with both LP1 and LP2 from the same blood sample capillary. A linear regression model was constructed to retrieve a conversion equation to convert LP2 values to LP1 values. LP2 measured higher values than LP1 in all analyses. We found that 4.2 mmol/L with LP1 corresponded to 6.4 mmol/L with LP2. Likewise, 4.8 mmol/L with LP1 corresponded to 7.3 mmol/L with LP2. The correlation between the analyses was excellent (Spearman’s rank correlation, r=0.97). We recommend the following guidelines when interpreting lactate concentration in FBS with LP2: <6.4 mmol/L to be interpreted as normal, 6.4-7.3 mmol/L as preacidemia indicating a follow-up FBS within 20-30 min, and >7.3 mmol/L as acidemia indicating intervention.

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Database: EMBASE

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: OBJECTIVE To determine the reference interval of fetal scalp blood lactate during second stage of labor. MATERIAL Two 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. RESULTS In 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). CONCLUSION The 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

10. Intrapartum cervical lactate as a predictor of operative delivery?

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

Source: BJOG: An International Journal of Obstetrics and Gynaecology; Mar 2017; vol. 124; p. 60

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

Available at BJOG: An International Journal of Obstetrics and Gynaecology - from Unpaywall

Abstract: Introduction Previous studies have suggested that lactate concentration in amniotic fluid correlates to labor dystocia. Lactate increase might represent an exhausted muscle. The objective was to explore if lactate concentration in cervical blood (Cx-lactate) can be used in intrapartum monitoring to predict operative delivery. To compare Cx-lactate with lactate concentration in fetal scalp blood (FBS-lactate). Methods Interim analysis of a prospective study at Karolinska University Hospital, Sweden. Women in labor with an indication for FBS were included. Sampling and bedside analysis of lactate in Cx, FBS and AF were performed during 1st stage of labor using Lactate ProTM (KDK Corp. Kyoto, Japan). Results 65 women were included. Median concentration of Cx-lactate was 3.4 mmol/L (range 1.1-14.8). Comparison of lactate concentrations between women with
spontaneous, instrumental and caesarean deliveries showed a significant difference (median 2.8 versus 5.7 versus 4.4 mmol/L; P < 0.05). There was a significant correlation between cervical dilatation and cx-lactate (R = 0.50; P < 0.05), but not between cervical dilatation and FBS-lactate (R = 0.10; P = 0.46). There was a weak correlation between FBS-lactate and Cx-lactate (R = 0.31; P < 0.05).

Conclusion In contrast to FBS-lactate cx-lactate during 1st stage increases with progress of labor. Operative deliveries are associated with higher cx-lactate concentrations compared with spontaneous deliveries and highest concentrations were found when labor ended instrumentally. It seems that uterine lactate is not a major contributor to fetal lactate concentration. Our result suggests that Cx-lactate may be a predictor of operative delivery. However, larger data sets are needed.

Database: EMBASE

11. Lactate produced during labor modulates uterine inflammation via GPR81 (HCA1).

Author(s): Madaan, Ankush; Nadeau-Vallée, Mathieu; Rivera, Jose Carlos; Obari, Dima; Hou, Xin; Sierra, Estefania Marin; Girard, Sylvie; Olson, David M; Chemtob, Sylvain

Source: American journal of obstetrics and gynecology; Jan 2017; vol. 216 (no. 1); p. 60

Publication Date: Jan 2017

Publication Type(s): Journal Article

PubMedID: 27615440

Abstract: BACKGROUND Uterine inflammatory processes trigger prolabor pathways and orchestrate on-time labor onset. Although essential for successful labor, inflammation needs to be regulated to avoid uncontrolled amplification and resolve postpartum. During labor, myometrial smooth muscle cells generate ATP mainly via anaerobic glycolysis, resulting in accumulation of lactate. Aside from its metabolic function, lactate has been shown to activate a G protein-coupled receptor, GPR81, reported to regulate inflammation. We therefore hypothesize that lactate produced during labor may act via GPR81 in the uterus to exert in a feedback manner antiinflammatory effects, to resolve or mitigate inflammation. OBJECTIVE We sought to investigate the role of lactate produced during labor and its receptor, GPR81, in regulating inflammation in the uterus. STUDY DESIGN We investigated the expression of GPR81 in the uterus and the pharmacological role of lactate acting via GPR81 during labor, using shRNA-GPR81 and GPR81/-/- mice. RESULTS (1) Uterine lactate levels increased substantially from 2 to 9 mmol/L during labor. (2) Immunohistological analysis revealed expression of GPR81 in the uterus with high expression in myometrium. (3) GPR81 expression increased during gestation, and peaked near labor. (4) In primary myometrial smooth muscle cell and ex vivo uteri from wild-type mice, lactate decreased interleukin-1β-induced transcription of key proinflammatory Il1b, Il6, Ccl2, and Pghs2; suppressive effects of lactate were not observed in cells and tissues from GPR81/-/- mice. (5) Conversely, proinflammatory gene expression was augmented in the uterus at term in GPR81/-/- mice and wild-type mice treated intrauterine with lentiviral-encoded shRNA-GPR81; GPR81 silencing also induced proinflammatory gene transcription in the uterus when labor was induced by endotoxin (lipopolysaccharide). (6) Importantly, administration to pregnant mice of a metabolically stable specific GPR81 agonist, 3,5-dihydroxybenzoic acid, decreased endotoxin-induced uterine inflammation, preterm birth, and associated neonatal mortality. CONCLUSION Collectively, our data uncover a novel link between the anaerobic glycolysis and the control of uterine inflammation wherein the high levels of lactate produced during labor act on uterine GPR81 to down-regulate key proinflammatory genes. This discovery may represent a novel feedback mechanism to regulate inflammation during labor, and conveys a potential rationale for the use of GPR81 agonists to attenuate inflammation and resulting preterm birth.

Database: Medline

Author(s): Wiberg-Itzel, Eva; Pembe, Andrea B; Järnbert-Pettersson, Hans; Norman, Margareta; Wihlbäck, Anna-Carin; Hoesli, Irene; Todesco Bernasconi, Monya; Azria, Elie; Åkerud, Helena; Darj, Elisabet

Source: PloS one; 2016; vol. 11 (no. 10); p. e0161546

Publication Date: 2016

Publication Type(s): Journal Article

PubMedID: 27783611

Available at PloS one - from Europe PubMed Central - Open Access

Abstract: BACKGROUNDOne of the major complications related to delivery is labor dystocia, or an arrested labor progress. Many dystocic deliveries end vaginally after administration of oxytocin, but a large numbers of women with labor dystocia will undergo a long and unsafe parturition. As a result of the exertion required in labor, the uterus produces lactate. The uterine production of lactate is mirrored by the level of lactate in amniotic fluid (AFL).

OBJECTIVETo evaluate whether the level of AFL, analysed in a sample of amniotic fluid collected vaginally at arrested labor when oxytocin was needed, could predict labor outcome in nulliparous deliveries.

METHODS A prospective multicentre study including 3000 healthy primiparous women all with a singleton pregnancy, gestational age 37 to 42 weeks and no maternal /fetal chronic and/or pregnancy-related conditions. A spontaneous onset of labor, regular contractions and cervical dilation ≥ 3 cm were required before the women were invited to take part in the study.

RESULTS AFL, analysed within 30 minutes before augmentation, provides information about delivery outcome. Sensitivity for an acute cesarean section according to high (≥10.1mmol/l) or low (12h (p = 0.04), post-partum fever (>38°C, p = 0.01) and post-partum haemorrhage >1.5L (p = 0.04).

CONCLUSION The AFL is a good predictor of delivery outcome in arrested nulliparous deliveries. Low levels of AFL may support the decision to continue a prolonged vaginal labor by augmentation with oxytocin. A high level of AFL correlates with operative interventions and post-partum complications.

Database: Medline
13. A study to determine the normal concentrations of serum procalcitonin (PCT), plasma lactate and serum C-reactive protein (CRP) following normal parturition in low risk women

Author(s): Orr K.; McSwiggan S.; Strachan J.; Marwick C.; Nicoll A.


Publication Date: Jun 2016

Publication Type(s): Conference Abstract

Abstract: Introduction Sepsis is a major contributor to maternal and perinatal morbidity and mortality. Early recognition of sepsis can improve clinical outcomes. Non-specific inflammatory markers such as lactate and CRP are now routinely used for diagnosing intra-partum sepsis. PCT is considered to be a more specific marker for bacterial sepsis. Parturition is an inflammatory process and could potentially influence concentrations of maternal inflammatory markers. Objective To establish normal ranges for PCT, lactate and CRP for normal parturition in low risk women. Methods Data were collected prospectively from a cohort of low risk women in spontaneous labour at term. Samples were obtained within 1 hour of normal birth. Samples were analysed blind at the on-site biochemistry laboratory. Based on international standards for non pregnant women, elevated PCT was defined as > 0.5 ng/mL, elevated lactate was defined as > 2 mmol/L and elevated CRP was defined as > 10 mg/L. The local Maternity Database was examined to confirm that none of these women went on to develop sepsis in the 7 days following delivery. Results Samples were taken from 118 women. 33/118 (28%) were nulliparous. Median maternal age = 29 years (range = 19-40 years). Median BMI = 24 kg/m2 (range = 17-35 kg/m2). Median PCT = 0.07 ng/mL (range = 0-0.22 ng/mL). 0/118 (0%) had an elevated PCT. Median lactate = 2.5 mmol/L (range = 0.9-8.5 mmol/L). 80/118 (67.8%) had an elevated lactate. 22/118 (18.7%) had a lactate >4.0 mmol/L. Median CRP = 8 mg/L (range = 0-84 mg/L). 46/118 (39.0%) had an elevated CRP. Conclusion Normal labour does not affect maternal PCT concentrations. However normal parturition is associated with increases in maternal lactate and CRP. In the absence of infection a significant number of low risk women will have a lactate concentration greater than the current RCOG standard for sepsis recognition. In the absence of clinical signs or features of sepsis, elevated CRP and lactate should not be considered as diagnostic of maternal infection. During parturition PCT appears to be a better marker for excluding infection and consideration should be given to incorporate PCT into obstetric practice to allow the prompt recognition of intra-partum sepsis. Using PCT to diagnose obstetric sepsis might reduce the number of women and their infants receiving antibiotics unnecessarily. This potentially could reduce antibiotic resistance, enhance patient safety and reduce costs for the NHS.

Database: EMBASE
14. The lactate produced during labor exerts anti-inflammatory effects on uterus via GPR81 (HCA1)

**Author(s):** Nadeau-Vallee M.; Madaan A.; Hou X.; Chemtob S.; Obari D.; Rivera J.C.

**Source:** Reproductive Sciences; Mar 2016; vol. 23 (no. 1)

**Publication Date:** Mar 2016

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

**Abstract:**

**INTRODUCTION:** Inflammation inside the uterus triggers pro-labor pathways and orchestrates on-time labor onset. Albeit being essential for successful labor, inflammation is tightly regulated by endogenously produced anti-inflammatory mediators. During labor, glycogen and glucose are utilized by myometrial smooth muscle cells (mSMC) to produce ATP, leading to the accumulation of intermediates of carbohydrate metabolites, including lactate. Recently, lactate has been shown to activate a G protein-coupled receptor: GPR81 (HCA1). GPR81 has been suggested to regulate inflammation. We hypothesize that the lactate produced during labor could act on its receptor in the uterus to exert feedback anti-inflammatory effects.

**METHODS:** Using GPR81-/- mice, we investigated the expression of GPR81 in uterus and the pharmacological role of lactate during labor via GPR81.

**RESULTS:** Immunohistological analysis revealed expression of GPR81 in the uterus specifically in mSMC. We found that GPR81 expression increases during gestation to peak near labor, and that lactate levels increase from 2mM up to 9mM during labor (p<0.001). We then studied the transcription of genes coding for important pro-inflammatory mediators including IL-1beta, IL-6, CCL2 and Cox-2 in gestational tissue and cells. In primary mSMC and ex vivo uteri from WT mice stimulated with the pro-inflammatory cytokine interleukin-1, lactate had anti-inflammatory effects (p<0.05); this was not observed in cells and tissues from GPR81-/- mice. Concordantly with our hypothesis that GPR81 acts specifically during labor, we found that GPR81-/- mice had unaltered gestation length, albeit having increased inflammation during labor in comparison with WT mice (p<0.05).

**CONCLUSIONS:** Collectively, our data show that the lactate produced during labor has anti-inflammatory effects on the uterus via GPR81. This discovery may represent a novel feedback mechanism to control inflammation during labor and establishes a rationale for the usage of GPR81 agonists for the prevention of PTB associated with inflammation.

**Database:** EMBASE

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

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

**Source:** Best practice & research. Clinical obstetrics & gynaecology; Jan 2016; vol. 30; p. 62-67

**Publication Date:** Jan 2016

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

**PubMedID:** 26253238

**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


Author(s): Murphy, Martina; Butler, Michelle; Coughlan, Barbara; Brennan, Donal; O'Herlihy, Colm; Robson, Michael

Source: American journal of obstetrics and gynecology; Nov 2015; vol. 213 (no. 5); p. 673

Publication Date: Nov 2015

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

PubMedID: 26116871

Abstract: OBJECTIVE We sought to assess amniotic fluid lactate (AFL) at diagnosis of spontaneous labor at term (≥37 weeks) as a predictor of labor disorders (dystocia) and cesarean delivery (CD). STUDY DESIGN This was a single-institution, prospective cohort study of 905 singleton, cephalic, term (≥37 weeks) nulliparous women in spontaneous labor. A standard management of labor (active management of labor) including a standard oxytocin regimen up to a maximum dose of 30 mU/min was applied. AFL was measured using a point-of-care device (LMU061; ObsteCare, Stockholm, Sweden). Labor arrest in the first stage of labor was defined as the need for oxytocin when cervical dilatation was <1 cm/h over 2 hours and in the second stage of labor by poor descent and rotation over 1 hour. Standard statistical analysis included analysis of variance, Pearson correlations, and binary logistic regression. Unsupervised decision tree analysis with 10-fold cross-validation was used to identify AFL thresholds. RESULTS AFL was normally distributed and did not correlate with age, body mass index, or gestation. Unsupervised decision tree analysis demonstrated that AFL could be divided into 3 groups: 0-4.9 mmol/L (n = 118), 5.0-9.9 mmol/L (n = 707), and ≥10.0 mmol/L (n = 80). Increasing AFL was associated with higher total oxytocin dose (P = .001), labor disorders (P = .005), and CD (P ≤ .001). Multivariable regression analysis demonstrated that women with AFL ≥5.0-9.9 mmol/L (odds ratio [OR], 1.6; 95% confidence interval [CI], 1.06-2.39) and AFL ≥10.0 mmol/L (OR, 1.72; 95% CI, 1.01-2.93) were independent predictors of a labor disorder. AFL ≥5.0-9.9 mmol/L did not predict CD but multivariable analysis confirmed that AFL ≥10.0 mmol/L was an independent predictor of CD (OR, 3.35; 95% CI, 1.73-6.46). AFL ≥5.0-9.9 mmol/L had a sensitivity of 89% in predicting a labor disorder and a sensitivity of 93% in predicting CD with a 97% negative predictive value. AFL ≥10.0 mmol/L was highly specific but lacked sensitivity for CD. There was no difference in birthweight of infants according to labor disorder and delivery method. CONCLUSION AFL at diagnosis of labor in spontaneously laboring single cephalic nulliparous term women is an independent predictor of a labor disorder and CD. These data suggest that women with AFL between 5.0-9.9 mmol/L with a labor disorder may be amenable to correction using the active management of labor protocol.

Database: Medline
17. Level of lactate in amniotic fluid and its relation to the use of oxytocin and adverse neonatal outcome.

**Author(s):** Wiberg-Itzel, Eva; Pembe, Andrea B; Wray, Susan; Wihlbäck, Anna-Carin; Darj, Elisabeth; Hoesli, Irene; Åkerud, Helena

**Source:** Acta obstetrica et gynecologica Scandinavica; Jan 2014; vol. 93 (no. 1); p. 80-85

**Publication Date:** Jan 2014

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

**PubMedID:** 24102442

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

**Abstract:**

**OBJECTIVE:** To assess whether the frequency of adverse neonatal outcome at delivery is related to the level of lactate in amniotic fluid and to the use of oxytocin.

**DESIGN:** Prospective observational study.

**SETTING:** Soder Hospital, Stockholm, Sweden.

**POPULATION:** Seventy-four women in active labor with a gestational age ≥36 weeks and mixed parity.

**METHODS:** Levels of lactate in amniotic fluid were analyzed bedside from an intrauterine catheter every 30 min during labor. Deliveries were divided into groups with and without oxytocin.

**MAIN OUTCOME MEASURES:**

- The frequency of adverse neonatal outcome at delivery.

**RESULTS:** Of the deliveries 13.5% (10/74) concluded with an adverse neonatal outcome. The levels of lactate in amniotic fluid increased during labor, more so in deliveries where oxytocin was used. In the group with an adverse neonatal outcome, the level of lactate in amniotic fluid was significantly higher in the final sample before delivery (p = 0.04). In 18 deliveries, stimulation with oxytocin was temporarily halted for at least 30 min due to overly stimulated labor contractions. A decreasing level of lactate in amniotic fluid was shown within a median 5%/30 min. In the group where the administration of oxytocin was halted, there was no adverse neonatal outcome.

**CONCLUSION:** The frequency of adverse neonatal outcome was associated with the level of lactate in amniotic fluid and with the use of oxytocin. The level of lactate in amniotic fluid may be an additional valuable tool when oxytocin is administered during labor.

**Database:** Medline

18. Lactic acid measurement to identify risk of morbidity in pregnancy

**Author(s):** Albright C.; Lopes V.; Rouse D.; Anderson B.; Ali T.

**Source:** American Journal of Obstetrics and Gynecology; Jan 2014; vol. 210 (no. 1)

**Publication Date:** Jan 2014

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

**Abstract:**

**OBJECTIVE:** Lactic acid (LA) is a well-known marker for sepsis. The utility of LA measurement for sepsis in pregnancy is unknown and is the objective of this study.

**STUDY DESIGN:** Retrospective cohort of pregnant and postpartum patients with clinical suspicion of sepsis in the ED. Data abstracted included temperature, heart rate, blood pressure, respiratory rate, oxygen saturation, white blood cell count, percentage of immature neutrophils, and LA. Outcomes included intensive care unit (ICU) admission, telemetry unit admission, positive blood cultures, positive influenza swabs, and perinatal outcome. A linear regression model was used to evaluate the association between LA and adverse outcome. Outcomes were also compared by mean LA level.

**RESULTS:** Of 850 eligible women included, 159 had LA drawn. LA level was positively associated with requiring a higher level of care (admission to an ICU or telemetry unit), adjusted odds ratio (AOR) 2.34, 95% confidence interval (CI), 1.33-4.12, and positive blood cultures (AOR 1.6, 95% CI 0.83-3.08). In patients admitted to the ICU, the mean LA level was 2.6, versus 1.6 in those not admitted to
the ICU, p=0.04. A similar trend was seen in those requiring telemetry unit admission (2.0 versus 1.6, p=0.03) and with positive blood cultures (2.2 versus 1.6, p=0.003). Patients who had LA drawn differed from those who did not. Overall, they had higher morbidity rates: more likely to have positive blood cultures (16.8 versus 5.5%, p=0.039), require ICU (5 versus 0.1%, p<0.0001) or telemetry unit (17.2 versus 0.9%) admission, have a longer hospital stay (3.5 versus 2.7 days, p=0.0002), and deliver preterm (18.3 versus 10.9%, p=0.049). There was no association, nor was there a difference in the LA level, among patients with positive influenza swabs or in perinatal outcome. CONCLUSION: Elevated LA in pregnancy is associated with adverse outcomes from sepsis, including increased risk of ICU and telemetry unit admission and positive blood cultures. In this cohort, having LA drawn was a marker of more severe infection.

Database: EMBASE

19. Amniotic fluid lactate (AFL) at diagnosis of labour predicts dystocia and caesarean section (CS) in spontaneously labouring single cephalic nulliparous women ≤37 weeks gestation (SSCNT)

Author(s): Murphy M.; Robson M.; Brennan D.; O’Herlihy C.; Butler M.; Coughlan B.

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 assess whether AFL at diagnosis of labour is an independent predictor of dystocia and CS. STUDY DESIGN: A prospective cohort study of 905 SSCNT attending the National Maternity Hospital over 9 months. Standard management of labour (Active Management of Labour) was applied including amniotomy at the time of diagnosis of labour. AFL was measured in all women using a point of care device (LMU061 ObstetCare, Sweden). Dystocia in the first stage was defined as the need for oxytocin when cervical dilatation was less than 1cm/hr over 2 hours and in the second stage by poor descent over 1 hour. A standard oxytocin regimen was used with a maximum dose of 30mu/ min. Standard statistical analysis included ANOVA and Pearson's correlation. Multivariate binary logistic regression models included all variables that were significant in univariate analysis. RESULTS: AFL was normally distributed and did not correlate with age, BMI or gestation. Unsupervised decision tree analysis demonstrated that AFL could be divided into 3 groups <5(n=118), 5-10(n=707) and >10(n=80). Increasing AFL was associated with higher total oxytocin dose (p=0.001), dystocia (p=0.005) and CS (p=0.001). Multivariate regression analysis demonstrated that women with AFL>5 (OR=1.6, 95%CI 1.06-2.39) and AFL>10(OR=1.72, 95%CI 1.01-2.93) were independent predictors of dystocia. AFL>5 did not predict CS however multivariate analysis confirmed AFL>10 was an independent predictor of CS(OR=3.35, 95%CI 1.73-6.46). AFL>5 has a sensitivity of 89% in predicting dystocia and a sensitivity of 93% in predicting CS with a 97% negative predictive value. AFL>10 is highly specific but lacks sensitivity for CS. CONCLUSION: AFL at diagnosis of labour in SSCNT is an independent predictor of dystocia and CS. These data suggest that women with AFL 5-10 who are at risk of dystocia can be corrected with the Active Management of Labour protocol. (Table presented).

Database: EMBASE
20. Association between lactate levels in vaginal fluid and time of spontaneous onset of labor in suspected cases of prelabor rupture of membranes

**Author(s):** Jaiswar S.P.; Gupta A.; Chaurasia S.; Natu S.M.

**Source:** Journal of Obstetrics and Gynecology of India; Jun 2013; vol. 63 (no. 3); p. 182-185

**Publication Date:** Jun 2013

**Publication Type(s):** Article

**Abstract:** Purpose: To assess correlation between lactate levels in vaginal fluid and onset of labor in suspected PROM. Method: A prospective observational study conducted at the Dept. of Obstetrics and Gynecology and Pathology from 2008 to 2009. 118 women with complaints of leaking per vaginum underwent a sterile speculum examination and vaginal fluid was taken to estimate lactate level. Then, women were followed till the spontaneous onset of labor. The association was presented as Odds ratio with 95%CI. Results: The median time of onset of spontaneous labor and examination was 12 h in patients with lactate levels >5.0 mmol/L and 76 h in patients with lactate levels <5.0 mmol/L. Among 62 women with lactate levels >5.0 mmol/L, 67.7% of women (n = 42) had spontaneous onset of labor within 24 h and 83.87% women of (n = 52) within 48 h. Conclusion: A lactate level >5.0 mmol/L is significantly associated with the spontaneous onset of labor within 24 and 48 h in suspected cases of PROM. © 2013 Federation of Obstetric & Gynecological Societies of India.

**Database:** EMBASE

21. Arterial cord blood lactate at birth correlates with duration of pushing efforts.

**Author(s):** Dessolle, Lionel; Lebrec, Jeremie; Daraï, Emile

**Source:** Fetal diagnosis and therapy; 2010; vol. 27 (no. 2); p. 91-96

**Publication Date:** 2010

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

**PubMedID:** 19940442

**Abstract:** OBJECTIVE To evaluate the impact of the duration of pushing efforts on arterial cord blood lactate values. METHOD This was a prospective observational study of 124 consecutive normal vaginal deliveries in a tertiary teaching hospital. Arterial cord blood lactate was determined immediately at birth with a test strip method. Univariate and multivariate analyses were performed to check for clinical determinants of lactate levels. The main measure was lactate according to the duration of pushing efforts. RESULTS Arterial cord lactates increased significantly and were strongly correlated with the duration of pushing efforts, independent of gestational age and birthweight. Women pushing for more than 20 min had higher arterial cord blood lactates (4.9 +/- 1.4 vs. 3.3 +/- 1.16 mM, respectively) and a higher rate of lactates >6 mM (18 vs. 3%) than those pushing for less than 20 min. CONCLUSION At normal delivery, arterial cord blood lactates increase significantly with the duration of pushing efforts. Pushing for more than 20 min is associated with an increased risk of metabolic acidosis in the neonate. Further studies are required to evaluate the clinical significance of these observations.

**Database:** Medline
22. Lactate concentration in amniotic fluid: a good predictor of labor outcome.

Author(s): Wiberg-Itzel, Eva; Pettersson, Hans; Andolf, Eliika; Hansson, Agneta; Winbladh, Birger; Akerud, Helena

Source: European journal of obstetrics, gynecology, and reproductive biology; Sep 2010; vol. 152 (no. 1); p. 34-38

Publication Date: Sep 2010

Publication Type(s): Journal Article

PubMedID: 20542626

Abstract: OBJECTIVE Previous publications have suggested that high levels of lactate in amniotic fluid (AF) correlate with dysfunctional labor. The aim of this study was to investigate whether lactate concentration in AF together with the partogram is a better predictor of operative intervention in dysfunctional labor than the partogram alone. STUDY DESIGN A prospective observational study was carried out of 825 laboring women. Samples of AF were collected and the lactate concentration was analyzed at the bedside during labor. The main outcome of the study was the method of delivery (operative/spontaneous vaginal) in relation to the concentration of lactate in AF. Logistic regression was used to estimate the association between lactate concentration in AF and labor outcome and to adjust for well-known risk factors for dysfunctional labor. RESULTS 385/825 women had an arrested labor according to the partogram, and 193 of them were delivered operatively. High lactate in AF (>10.1 mmol/L) when labor arrested was associated with an increased risk of operative intervention due to dysfunctional labor (adjusted OR, 5.4, 95% CI, 3.2-9.1). Low levels of lactate in AF (<10.1 mmol/L) were associated with an increased probability of spontaneous vaginal delivery (adjusted OR, 2.7, 95% CI, 1.7-4.8). CONCLUSION The partogram together with the concentration of lactate in AF is a better predictor of operative intervention in dysfunctional labor than the partogram alone.

Database: Medline
23. Day 1 serum lactate values in preterm infants less than 32 weeks gestation

**Author(s):** Nadeem M.; Clarke A.; Dempsey E.M.

**Source:** European Journal of Pediatrics; Jun 2010; vol. 169 (no. 6); p. 667-670

**Publication Date:** Jun 2010

**Publication Type(s):** Article

**PubMedID:** 19834738

Available at European Journal of Pediatrics - from ProQuest (Hospital Premium Collection) - NHS

Available at European Journal of Pediatrics - from SpringerLink

**Abstract:** Base deficit and serum lactate concentrations may be important prognostic indicators in preterm infants. We sought to (1) determine the relationship between day1 serum lactate values and base deficit and (2) determine the relationship between day1 biochemical parameters and adverse outcome in preterm infants <32 weeks. This was a retrospective study of all patients less than 32 weeks gestation admitted to neonatal intensive care unit over a 6-month period. All blood gases performed during the first 24 h post delivery were analysed. Adverse outcome was defined as death, severe (grade 3 or 4) intraventricular haemorrhage or periventricular leukomalacia on cranial ultrasonography. Patients were excluded if there was a known lethal malformation or cardiac defect.

Seventy-two infants had a total of 473 lactate levels performed in the first 24 h. Mean (SD) gestational age was 29 (2.3) weeks, mean (SD) birth weight 1.28 (0.42)kg. Mean (SD) lactate values in first 6 h was 4.63 (3.69), at 12 h 3.08 (2.6), at 18 h 2.47 (2.68) and 2.08 (2.74) mmol/l at 24 h. There was a strong correlation between lactate values and base deficit values (R value 0.8, p<0.01). Mean base deficit values at 6 h were 5.9 (4.5), at 12 h 3.8 (3.9), at 18 h 3.6 (3.1) and at 24 h 4.1 (3.8) mmol/l. A single lactate value greater than 5.6 mmol/l had a sensitivity of 100% and specificity of 85% of identifying adverse outcome. Persistently elevated or worsening lactates were associated with adverse outcome. There is a strong correlation between lactate values and base deficit on day1 of life. Serial lactate measurements greater than 5.6 mmol/l predict adverse outcome and may aid the clinician in bedside decision making. © 2009 Springer-Verlag.

**Database:** EMBASE
24. Prediction of time to spontaneous onset of labour with lactate concentration in vaginal fluid in women with suspected preterm prelabour rupture of the membranes

Author(s): Wiberg-Itzel E.; Pettersson H.; Cnattingius S.; Nordstrom L.


Publication Date: Jan 2009
Publication Type(s): Article

PubMedID: 19087078

Abstract: Objective: To assess whether lactate determination in vaginal fluid is associated with and can predict onset of labour for women with suspected preterm prelabour rupture of membranes (PPROMs). Design: Prospective observational study. Setting: Labour ward at South General Hospital, Stockholm, Sweden. Population/participants: Women with suspected PPROMs at 20-36 completed weeks of gestation (n = 81). Methods: All women underwent a speculum examination and a test for determining lactate concentration in vaginal fluid. We used logistic regression to estimate the association between lactate concentration in vaginal fluid and time to onset of labour. Main outcome measure: Time from examination to spontaneous onset of labour (cervix >=4 cm). Results: The median time between examination and onset of labour was 13.6 hours for those with a high (>=4.5 mmol/l) lactate concentration and 1152 hours (i.e. 48 days) for those with a low (<4.5 mmol/l) lactate concentration. For a lactate threshold of 4.5 mmol/l, the likelihood ratio for positive test (LR+) was 12.6, and LR- was 0.14 for the outcome of spontaneous onset of labour within 48 hours. Conclusions: A high lactate concentration in vaginal fluid is strongly associated with whether a woman with suspected PPROM will commence onset of labour within 48 hours. If confirmed, use of lactate ('LAC test') as a predictive test for onset of preterm labour may be an attractive tool in bedside obstetrics. © 2008 Authors.

Database: EMBASE
25. Association between lactate concentration in amniotic fluid and dysfunctional labor.

**Author(s):** Wiberg-Itzel, Eva; Pettersson, Hans; Cnattingius, Sven; Nordström, Lennart

**Source:** Acta obstetricia et gynecologica Scandinavica; 2008; vol. 87 (no. 9); p. 924-928

**Publication Date:** 2008

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

**PubMedID:** 18720033

**Abstract:**
OBJECTIVES To assess whether there is an association between high lactate concentration in amniotic fluid (AF) and labor dystocia.

DESIGN Prospective observational study.

SETTING Labor ward at General South Hospital, Stockholm, Sweden.

POPULATION AND METHODS Women in active labor attending labor ward, having at least two consecutive measurements of lactate concentration in AF, measured 60 minutes apart.

MAIN OUTCOME MEASURED Dysfunctional labor, defined as instrumental or operative delivery due to dystocia.

RESULTS Among women with spontaneous vaginal deliveries (n=23) the mean lactate concentration in AF during labor was 8.9 mmol/l (range 6.6-10.8), and among women with operative delivery due to labor dystocia (n=31) the corresponding value was 10.9 mmol/l (range 8.0-16.1) (p or =10.1 mmol/l) in at least two consecutive measures collected at least 60 minutes apart, 25 (86%) were delivered instrumentally/operatively due to dystocia. Using this definition of a positive test, the diagnostic accuracy to predict operative delivery due to dystocia was: sensitivity 81% (25/31), specificity 83% (19/23), positive predictive value 86% (25/29), and negative predictive value 76% (19/25). The likelihood ratio was 5.0 for a positive test and 0.2 for a negative test.

CONCLUSIONS High lactate concentration (> or =10.1 mmol/l) in at least two consecutive samples of AF collected during labor 60 minutes apart is strongly associated with dystocia. This method might be useful in clinical management to identify labor dystocia at an early stage of labor.

**Database:** Medline


**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

**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. RESULTSEvidence 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
27. Umbilical cord blood lactate: A valuable tool in the assessment of fetal metabolic acidosis

**Author(s):** Gjerris A.C.; Staer-Jensen J.; Bergholt T.; Nickelsen C.; Jorgensen J.S.

**Source:** European Journal of Obstetrics Gynecology and Reproductive Biology; Jul 2008; vol. 139 (no. 1); p. 16-20

**Publication Date:** Jul 2008

**Publication Type(s):** Article

**PubMedID:** 18063469

**Abstract:** Objective: The aim of the present study was (1) to evaluate the relationship between umbilical cord arterial blood lactate and pH, standard base excess (SBE), and actual base excess (ABE) at delivery and (2) to suggest a cut-off level of umbilical cord arterial blood lactate in predicting fetal asphyxia using ROC-curves, where an ABE value less than -12 was used as "gold standard" for significant intrapartum asphyxia. Study design: This is a descriptive study of umbilical cord arterial blood samples from 2554 singleton deliveries. The deliveries took place at the Department of Obstetrics and Gynaecology, Hvidovre University Hospital, Copenhagen, Denmark where umbilical cord blood sampling and blood gas analysis is part of the routine assessment of all newborns. Results: We found significant correlations between lactate and pH ($r = 0.73$), lactate and SBE ($r = 0.76$), and lactate and ABE ($r = 0.83$). ROC-curves suggested a lactate cut-off level of 8 mmol/l for indicating intrapartum asphyxia. Conclusion: Lactate in arterial umbilical cord blood might be a more direct and accordingly more correct indicator of fetal asphyxia at delivery than pH and SBE (or ABE). Its potential as a predictor of neonatal outcome needs to be evaluated in future studies. © 2007 Elsevier Ireland Ltd. All rights reserved.

**Database:** EMBASE

28. Lactate concentration in umbilical cord blood is gestational age-dependent: a population-based study of 17 867 newborns.

**Author(s):** Wiberg, N; Källén, K; Herbst, A; Aberg, A; Olofsson, P

**Source:** BJOG : an international journal of obstetrics and gynaecology; May 2008; vol. 115 (no. 6); p. 704-709

**Publication Date:** May 2008

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

**PubMedID:** 18410653

**Abstract:** OBJECTIVE To study the influence of gestational age on lactate concentration in arterial and venous umbilical cord blood at birth and to define gestational age-specific reference values for lactate in vigorous newborns. DESIGN Population-based comparative. SETTING University hospitals. SAMPLE Vigorous newborns with validated umbilical cord blood samples. MATERIAL AND METHODS From 2000 to 2004, routine cord blood gases, lactate and obstetric data from two university hospitals were available for 17 867 newborns from gestational week 24 to 43. After validation of blood samples and inclusion only of singleton pregnancies aimed for vaginal delivery, 10 700 women remained. Among those, reference values were defined in 10 169 vigorous newborns, that is in newborns with a 5-minute Apgar score corresponding to the gestational age-specific median value minus 1 point score, or better. MAIN OUTCOME MEASURES Cord lactate concentration relative to gestational age. RESULT The arterial and venous lactate concentrations
increased monotonously with gestational age from 34 weeks. Considerable differences were found between mean and median values, but after logarithmic transformation the log-lactate values were normally distributed. Simple linear regression analysis showed a significant association between the log-lactate values and gestational age (P < 10(-6), R(2)= 0.024). Reference curves were constructed after anti-logarithmic transformation. Both the gestational age and the time of the second stage of labour influenced, independently of each other, the lactate concentrations.

**CONCLUSIONS** Lactate concentrations in arterial and venous umbilical cord blood are increasing significantly with advancing gestational age.

**Database:** Medline

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29. **Determining the fetal scalp lactate level that indicates the need for intervention in labour.**

**Author(s):** Allen, Rod M; Bowling, Francis G; Oats, Jeremy J N

**Source:** The Australian & New Zealand journal of obstetrics & gynaecology; Dec 2004; vol. 44 (no. 6); p. 549-552

**Publication Date:** Dec 2004

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

**PubMedID:** 15598295

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

[location] : Patricia Bowen Library and Knowledge Service West Middlesex university Hospital.

**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 microL 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:** Medline
30. Transient appearance of lactate dehydrogenase (LDH)-linked immunoglobulin and thyroid dysfunction at the postpartum period

**Author(s):** Morita S.; Ueda Y.; Izumi Y.; Origuchi T.; Eguchi K.

**Source:** Internal Medicine; Jul 2004; vol. 43 (no. 7); p. 575-577

**Publication Date:** Jul 2004

**Publication Type(s):** Article

**PubMedID:** 15335183

Available at [Internal Medicine](#) - from Unpaywall

**Abstract:** Here, we report a 28-year-old woman who transiently showed lactate dehydrogenase (LDH)-linked immunoglobulin 0 during postpartum thyroiditis. She demonstrated high levels of serum LDH (794 IU/l) and thyroid hormones 7 months after delivery. Electrophoretic isoenzyme analysis of LDH showed an abnormal broadband caused by LDH-linked immunoglobulin (IgG-kappa). Transient thyrotoxicosis due to postpartum thyroiditis improved without any specific treatment, and elevated serum concentration of LDH decreased to the normal level (395 IU/l) with disappearance of LDH-linked IgG. LDH-linked immunoglobulin may also appear at the postpartum period.

**Database:** EMBASE

31. Postnatal lactate as an early predictor of short-term outcome after intrapartum asphyxia

**Author(s):** Shah S.; Tracy M.; Smyth J.

**Source:** Journal of Perinatology; Jan 2004; vol. 24 (no. 1); p. 16-20

**Publication Date:** Jan 2004

**Publication Type(s):** Review

**PubMedID:** 14726932

Available at [Journal of Perinatology](#) - from ProQuest (Hospital Premium Collection) - NHS Version

Available at [Journal of Perinatology](#) - from Unpaywall

**Abstract:** Objectives: To compare the predictive value of pH, base deficit and lactate for the occurrence of moderate-to-severe hypoxic ischaemic encephalopathy (HIE) and systemic complications of asphyxia in term infants with intrapartum asphyxia. Study Design: We retrospectively reviewed the records of 61 full-term neonates (>=37 weeks gestation) suspected of having suffered from a significant degree of intrapartum asphyxia from a period of January 1997 to December 2001. The clinical signs of HIE, if any, were categorized using Sarnat and Sarnat classifications as mild (stage 1), moderate (stage 2) or severe (stage 3). Base deficit, pH and plasma lactate levels were measured from indwelling arterial catheters within 1 hour after birth and thereafter along with every blood gas measurement. The results were correlated with the subsequent presence or absence of moderate-to-severe HIE by computing receiver operating characteristics curves. Results: The initial lactate levels were significantly higher (p = 0.001) in neonates with moderate-to-severe HIE (mean +/- SD = 11.09 +/- 4.6) as compared to those with mild or no HIE (mean +/- SD = 7.1 +/- 4.7). Also, the lactate levels took longer to normalize in these babies. A plasma lactate concentration >7.5 +/- mmol/l was associated with moderate-or-severe HIE with a sensitivity of 94% and specificity of 67%. The sensitivity and negative predictive value of lactate was greater than that of the pH or base deficit. Conclusions: The highest recorded lactate level in the first hour of life and serial measurements of lactate are important predictors of moderate-to-severe HIE.

**Database:** EMBASE
32. Fetal and maternal lactate increase during active second stage of labour.

Author(s): Nordström, L; Achanna, S; Naka, K; Arulkumaran, S

Source: BJOG : an international journal of obstetrics and gynaecology; Mar 2001; vol. 108 (no. 3); p. 263-268

Publication Date: Mar 2001

Publication Type(s): Journal Article

PubMedID: 11281466

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

Available at BJOG : an international journal of obstetrics and gynaecology - from Unpaywall

Abstract:ObjectiveTo determine longitudinally fetal and maternal blood lactate concentrations during the second stage of labour. DesignProspective, observational study of randomly selected labours. SettingLabour ward, Sultanah Aminah General Hospital, Johore Bahru, Malaysia. Main outcome measuresFetal scalp and maternal venous blood lactate, umbilical arterial and vein lactate and acid-base balance at delivery. ResultsSixty-nine women and their infants were monitored in the second stage of labour. Mean maternal venous lactate by the end of the first stage was 2.6 +/- 1.0 (+/- S.D.) mmol/L and increased to 3.6 +/- 1.7, 4.2 +/- 1.6, 5.4 +/- 2.1 and 4.3 +/- 0.9 mmol/L, respectively, for every 15 minute of bearing down. Corresponding values for fetal scalp blood lactate were 2.4 +/- 1.1, 3.1 +/- 1.6, 3.2 +/- 1.8, 4.2 +/- 2.4, 4.9 +/- 2.8 and 5.8 +/- 1.9 mmol/L. The mean slope of maternal lactate increase was 0.070 mmol/L per minute (95% CI 0.050, 0.090) and for fetal lactate increase 0.032 mmol/L per minute (95% CI.: 0.018, 0.045). The duration of active second stage was significantly associated with fetal lactate (P < 0.001) and maternal lactate (P = 0.03) at the time of crowning of the fetal head, and lactate in umbilical arterial and vein blood at delivery (P or = 45 minutes, compared with shorter active second stage, and acidaemia at birth implied larger arterial-venous lactate differences (P < 0.001). Fetal lactate at crowning was also significantly associated with the umbilical arterial-veous lactate difference (P = 0.03). ConclusionMaternal and fetal lactate concentrations increase significantly with duration of the active second stage of labour, more rapidly in the mother. It is likely that fetal anaerobic metabolism is the main source for the fetal lactate increase.

Database: Medline
33. Clinical value of a single postnatal lactate measurement after intrapartum asphyxia

**Author(s):** Da Silva S.; Hennebert N.; Denis R.; Wayenberg J.-L.

**Source:** Acta Paediatrica, International Journal of Paediatrics; 2000; vol. 89 (no. 3); p. 320-323

**Publication Date:** 2000

**Publication Type(s):** Article

**PubMedID:** 10772280

Available at Acta Paediatrica, International Journal of Paediatrics - from Wiley Online Library

**Abstract:** Our aim was to compare the respective values of base deficit and lactate in birth asphyxia. Methods: Base deficit and lactate levels were measured from radial artery blood samples taken at 30 min of life in 115 term newborns suspected as having been asphyxiated during labour. Both base deficit and lactate levels were compared between patients who further developed moderate or severe encephalopathy and those who experienced no or only mild encephalopathy. Receiver operating characteristics curves and clinical values of both indicators were computed. Results: The correlation between base deficit and lactate was significant (r² = 0.51, p < 0.0001). Both indicators were significantly associated with neonatal outcome. Lactacidaemia lower than 5 mmol/l and/or base deficit level lower than 10 mEq/l were not followed by neurological complications. Plasma lactate concentration greater than 9 mmol/l was associated with moderate or severe encephalopathy with a sensitivity of 84% and a specificity of 67%. Base deficit and lactate had similar clinical values. Conclusions: Base deficit and lactate measurements in arterial blood at 30 min of life are equally valuable in assessing the severity of birth asphyxia.

**Database:** EMBASE

34. Role of lactate measurements during labor.

**Author(s):** Westgren, M; Kublickas, M; Kruger, K

**Source:** Obstetrical & gynecological survey; Jan 1999; vol. 54 (no. 1); p. 43-48

**Publication Date:** Jan 1999

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

**PubMedID:** 9891299

Available at Obstetrical & gynecological survey - from Ovid (LWW Total Access Collection 2015 - Q1 with Neurology)

**Abstract:** Lactate can safely and easily be determined in fetal scalp and umbilical artery blood with a new microvolume (5 microliters) lactate meter. Comparison between lactate and pH in scalp blood revealed a significant correlation (r = -0.43; P < .001). In a management trial where scalp lactate was compared to scalp pH, the lactate group underwent significantly more successful blood sampling procedures and fewer number of scalp incisions per blood sampling attempt. The mode of delivery and neonatal outcome were similar in patients managed with lactate and those using pH. Lactate concentration in umbilical artery blood had the same predictive properties as pH or base deficit in relation to poor neonatal outcome. Our data suggest that this method for lactate determination is robust and feasible and is suitable as a tool for fetal monitoring. Additional clinical management trials will be required to define the clinical usefulness of this method and how it should be combined with other modalities for fetal monitoring.

**Database:** Medline
35. Lactate and acid-base balance at delivery in relation to cardiotocography and T/QRS ratios in the second stage of labour.

**Author(s):** Nordström, L; Malcus, P; Chua, S; Shimojo, N; Arulkumaran, S

**Source:** European journal of obstetrics, gynecology, and reproductive biology; Feb 1998; vol. 76 (no. 2); p. 157-160

**Publication Date:** Feb 1998

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

**PubMedID:** 9481566

**Abstract:**

OBJECTIVE: To compare foetal electrocardiogram (T/QRS ratio) and cardiotocography (CTG) during the second stage of labour with lactate and acid-base balance in cord artery blood at delivery. DESIGN: Forty-six parturients delivered at the National University of Singapore were monitored during the second stage of labour with T/QRS ratios and CTG. At delivery blood from a segment of clamped cord was sampled for lactate and acid-base balance analyses. The Spearman Rank correlation, the Mann Whitney U-test and the Kruskal Wallis ANOVA were used when appropriate.

RESULTS: Maternal pushing time was significantly correlated to lactate (R = 0.51; P = 0.0003), pH (R = -0.38; P = 0.009) and base deficit (R = 0.33; P = 0.026), but not to T/QRS ratio (R = 0.002; P = 0.99). No significant correlation between lactate and T/QRS ratios (R = 0.06; P = 0.70) or type of CTG pattern was found (P = 0.10), though there were significant differences in pH (P = 0.029) and T/QRS ratios (P = 0.037) between groups with different FHR abnormalities.

CONCLUSION: Lactate increases progressively with maternal pushing time. No significant correlation was found between lactate and the T/QRS ratio. Lack of correlation is likely to be due to poor sensitivity of foetal ECG at this level of foetal stress, though the influence from transplacentally transferred maternal lactate cannot be excluded.

**Database:** Medline

36. Comparison of the lactate-pyruvate ratio during labour and delivery in singleton and twin pregnancy.

**Author(s):** Omu, A E; Oforofuo, I A

**Source:** Archives of gynecology and obstetrics; 1997; vol. 259 (no. 2); p. 59-64

**Publication Date:** 1997

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

**PubMedID:** 9059745

**Abstract:** Oxygen utilisation at the tissue level was investigated by the use of lactate-pyruvate (LP) ratio in forty women; twenty with term twin pregnancy, with a matched controlled group of twenty women with term singleton pregnancy. The lactate-pyruvate ratio in twin pregnancy was significantly higher than in singleton pregnancy at term (p < 0.05). There was also significantly higher LP ratio in advanced labour in twin pregnancy than in singleton pregnancy (p < 0.001). Similarly, the venous cord blood LP ratio of twin II was higher than in twin I. Our findings have thus demonstrated more marked anaerobic metabolism in twin pregnancy than in singleton pregnancy. Secondly, the second twin is more involved in anaerobic metabolism as a result of relative oxygen deficiency, than twin I. This may to some extent account for the higher morbidity and mortality in twin pregnancy, compared to singleton pregnancy, and in twin II compared to twin I.

**Database:** Medline
37. Cord lactate, pH, and blood gases from healthy neonates.

**Author(s):** Shirey, T; St Pierre, J; Winkelman, J

**Source:** Gynecologic and obstetric investigation; 1996; vol. 41 (no. 1); p. 15-19

**Publication Date:** 1996

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

**PubMedID:** 8821878

**Abstract:** Lactate, pH, pO2, and pCO2 were determined in arterial, venous, and free-flowing mixed umbilical cord blood obtained from deliveries of apparently healthy neonates. The goals of this study were to establish reference ranges for lactate and pH against which results in cases of high-risk labor and delivery could be compared, to see how the gases correlated with these values, and to determine whether easily accessible mixed umbilical cord blood can serve as the sample in lieu of cord arterial or cord venous blood. Arterial and venous cord lactates were 2.98 mmol/l (+/− 1.40) and 2.80 mmol/l (+/− 1.35), respectively, from 85 cords obtained from vaginal and cesarean deliveries. Mixed cord blood lactate, obtained on 48 cords, was 2.72 mmol/l (+/− 1.28) versus 3.14 and 2.97 mmol/l for the arterial and venous samples from those cords, respectively, and correlated quite well with lactate from the venous specimens (r = 0.97). Differences of > 0.5 mmol/l occurred between mixed and arterial cord bloods in 21 patients, and between mixed and venous cord bloods in 6 of the 48 patients, respectively. We conclude that (1) less than 2.5% of deliveries of apparently healthy neonates have arterial, venous, or mixed cord lactates > or = 7.0 mmol/l and pH < or = 7.15, (2) neither cord venous pO2 nor pCO2 correlate well with cord venous lactate, and (3) readily available mixed cord blood is a satisfactory specimen for the measurement of venous cord lactate.

**Database:** Medline

38. Continuous maternal glucose infusion during labor: Effects on maternal and fetal glucose and lactate levels

**Author(s):** Nordstrom L.; Arulkumaran S.; Chua S.; Ratham S.; Ingemarsson I.; Kublickas M.; Persson B.; Shimojo N.; Westgren M.

**Source:** American Journal of Perinatology; 1995; vol. 12 (no. 5); p. 357-362

**Publication Date:** 1995

**Publication Type(s):** Article

**PubMedID:** 8540943

**Abstract:** Fetal and neonatal glucose and lactate levels and acid-base balance after continuous maternal infusion of 5% dextrose at 180 mL/h (9 g/h) was compared with 0.9% saline solution in a prospective, randomized study from selected monitored labors. An infusion of 5% dextrose produced significantly increased glucose levels in maternal (p <0.01), cord artery (p <0.01), and cord vein (p <0.001) blood. An increased maternal insulin level was also present (p <0.05), but no differences in cord insulin levels were observed. beta-Hydroxybutyrate was lower in maternal (p <0.05) and cord vein (p <0.01), but not in cord artery blood, after maternal dextrose infusion. No significant changes occurred in blood lactate levels between the two groups in either mother, fetus, cord, or neonate. Acid-base balance in cord blood did not differ between the two groups. Maternal infusion of 5% dextrose at 180 mL/h (9 g/h), compared with saline solution, produces higher glucose levels in both mother and fetus, but increased insulin concentrations only in the mother. Dextrose infusion also lowers beta-hydroxybutyrate in maternal and cord vein blood. No differences were seen in lactate levels or cord acid-base balance. Both regimens seem safe according to risks for lactacidosis and neonatal hypoglycemia in the normoxemic, normal size fetus.

**Database:** EMBASE

**Author(s):** Ojengbede, O A; Akanji, A O; Osotimehin, B O

**Source:** African journal of medicine and medical sciences; Jun 1995; vol. 24 (no. 2); p. 169-172

**Publication Date:** Jun 1995

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

**PubMedID:** 8669397

**Abstract:** In this preliminary study, maternal and fetal blood lactate and 3-hydroxybutyrate (3-OHB) levels were assayed by specific enzymatic spectrophotometric methods in two groups of parturient Nigerian women during the three labour stages and their newborn: (i) thirty two women with babies' Apgar score ≥ 6, and, (ii) eighteen women with babies' Apgar scores ≤ 5. Cord blood was collected within 1 min. of cord clamping. In all the patients there was a lactate gradient between the foetus and mother. Neonates with Apgar score < 5 had greater cord blood 3-OHB levels. This could indicate reduced utilisation and/or increased production of this metabolite. Since in states of glucose deprivation as could be found in placenta insufficiency, 3-OHB is utilised by the foetus for the synthesis of essential cerebral lipids. It is speculated that the immediate poor clinical condition of babies with low Apgar scores may be a consequence of reduced synthesis of these cerebral lipids as they were unable to utilise circulating 3-OHB. The rapid response to routine resuscitative measures in these newborn babies could also indicate improved 3-OHB utilisation secondary to an improved tissue oxygenation status. These hypotheses from the basis for further studies.

**Database:** Medline

40. Is fetal acidosis in the human fetus maternogenic during labor? A reanalysis

**Author(s):** Piquard F.; Schaefer A.; Dellenbach P.; Haberey P.

**Source:** American Journal of Physiology - Regulatory Integrative and Comparative Physiology; 1991; vol. 261 (no. 5)

**Publication Date:** 1991

**Publication Type(s):** Article

**PubMedID:** 1951778

**Abstract:** The purpose of this study was to investigate whether maternogenic fetal acidosis can occur at the time of labor and delivery and to evaluate the extent of the possible maternal contribution to fetal acidosis. We have therefore determined fetal and maternal lactate concentrations and acid-base status under various conditions in 589 women at the end of gestation and during labor. The results show that metabolic acidosis develops in all fetuses because of increased production of lactic acid. Analysis of the mean data shows that this fetal lactic acidosis is primarily of fetal origin: 1) the umbilical arteriovenous lactate differences were positive and large in steady-state conditions as well as in depressed newborns; 2) the conditions that could produce a net transfer of lactate from the mother to the fetus, namely a positive maternofetal gradient of lactate and proton, were rarely observed; and 3) the correlation between fetal and maternal lactate levels was very weak, with regression coefficients decreasing from near steady-state conditions to acute stress conditions, indicating that the increase in lactate in the fetus and mother occurs independently. This correlation indicates also that increased maternal lactate production under conditions of labor and delivery can make a contribution by affecting the rate of net transfer from fetus to mother. This is possible in ~6% of the fetuses.
41. Biochemical changes in the mother and the fetus during labor and its significance for the management of the second stage

Author(s): Schneider H.; Progler M.; Ziegler W.H.; Huch R.

Source: International Journal of Gynecology and Obstetrics; 1990; vol. 31 (no. 2); p. 117-126

Abstract: In 69 patients with uneventful pregnancies, term labor was studied prospectively with respect to length of second stage, number of bearing down efforts, maternal and fetal levels of lactate, epinephrine and norepinephrine. Maternal venous blood concentrations were measured in early labor and at the time of delivery while samples from umbilical artery and vein provided fetal blood. There was a significant rise of lactate and catecholamines in maternal blood during labor and at delivery fetal lactate concentration was lower than the maternal level while for epinephrine and norepinephrine fetal levels were higher. For all three compounds umbilical artery concentrations were higher than umbilical venous levels. While there was no correlation between the biochemical parameters in maternal blood and length of second stage maternal lactate and norepinephrine concentration at the time of delivery significantly correlated with the number of bearing down efforts. Umbilical artery lactate correlated with both, length of second stage and number of bearing down efforts.

42. Human maternal-fetal lactate relationships

Author(s): Suidan J.S.; Antoine C.; Silverman F.; Lustig I.D.; Wasserman J.F.; Young B.K.

Source: Journal of Perinatal Medicine; 1984; vol. 12 (no. 4); p. 211-217

Abstract: This study attempts to determine the major source of lactate in the normal and in the depressed human fetus, in order to assess the applicability of fetal blood lactate measurement for the evaluation of fetal stress during labor. We obtained umbilical arterial and venous blood samples at delivery in 132 liveborn infants, together with simultaneous maternal radial arterial samples. All samples were analyzed immediately for pH, blood gases, and lactate. In vigorous newborns (1-minute Apgar score >= 7), umbilical arterial and venous lactate levels were lowest with elective cesarean section done before the onset of labor, higher with cesarean section performed during labor, and highest at the time of vaginal delivery (p < 0.001). Fetal lactate levels were also significantly higher than maternal levels in vigorous newborns (p < 0.01), the lactate difference between umbilical artery and maternal artery being lowest with elective cesarean section, higher with cesarean section performed during labor, and highest with vaginal delivery (p < 0.02). Depressed newborns (1-minute Apgar score < 7) had higher umbilical lactates and higher fetal-maternal lactate differences than vigorous newborns (p < 0.01). Our results indicate that the blood lactate levels in both mother and fetus increase with labor and reach their highest values at the time of vaginal delivery. The lactate levels are highest in the umbilical artery, lower in the umbilical vein, and lowest in the maternal artery before the onset of labor. In normal babies, the fetal-maternal
differences of lactate increase with labor, reaching their highest values at the time of vaginal delivery. This implies increasing production of lactate with increasing duration of labor. With neonatal depression, we found a significant rise in the umbilical lactate levels and in the fetal-maternal differences of lactate. The increase in the fetal-maternal differences of lactate with labor and with depression points to the fetoplacental unit as the major source of the increased lactate. The relative placental contribution to the increased lactate production in response to hypoxia cannot be estimated from the available data. However, since the major part of the placental production of lactate seems to be discharged into the maternal circulation, it is reasonable to assume that the major source of lactate in the fetal circulation is the fetus itself. This should make lactate measurement in fetal scalp blood a useful method for evaluating fetal stress during labor.

Database: EMBASE

43. Homeostasis of fetal lactate metabolism in late pregnancy and the changes during labor and delivery.

Author(s): Schneider, H; Danko, J; Huch, R; Huch, A

Source: European journal of obstetrics, gynecology, and reproductive biology; May 1984; vol. 17 (no. 2-3); p. 183-192

Publication Date: May 1984

Publication Type(s): Journal Article Review

PubMedID: 6376200

Abstract: Electrochemical enzymatic measurements of whole blood lactate concentrations were performed in 110 deliveries. In the majority of uncomplicated vaginal deliveries and of elective cesarean sections cord blood levels were higher than maternal concentrations and, as indicated by a positive arterio-venous difference for the cord vessels, lactate is originating in the fetus. In cases with clinical signs of fetal distress production of lactate due to anaerobic glycolysis is markedly increased. Differently from some other studies with uncomplicated vaginal deliveries, maternal lactate concentrations remained below fetal levels in almost 80%, which is explained by a conservative management of the second stage of labor with active pushing being restricted to the final phase of expulsion. The question whether also in late pregnancy the undisturbed human fetus in utero produces lactate or makes use of placental lactate as a substrate for its oxidative metabolism - as has been shown for some animal species - cannot be answered from the presently available evidence.

Database: Medline
44. Lactate dehydrogenase isoenzymes in human myometrium during pregnancy and labor.

Author(s): Makkonen, M; Puhakainen, E; Hänninen, O; Castrén, O
Source: Acta obstetricia et gynecologica Scandinavica; 1982; vol. 61 (no. 1); p. 35-37
Publication Date: 1982
Publication Type(s): Journal Article
PubMedID: 7090748
Abstract: Myometrial lactate dehydrogenase isoenzymes were investigated in 32 pregnant women and in 21 women during labor. During pregnancy and labor the H-type LDH isoenzymes were found to preponderate in contrast to M-type LDH isoenzymes. Both H-LDH and M-LDH isoenzyme activities showed a tendency to increase in normal pregnancy. In severe pre-eclampsia and in chronic hypertension, the uterine M-LDH level decreased. In normal labor, M-LDH activity declined in both the uterine and the rectus abdominis muscles.
Database: Medline

45. Changes in plasma lactate concentration in women in labour and their newborns within the first days of life.

Author(s): Bargiel, Z; Kobus, E; Wasilewska, E
Source: Acta physiologica Polonica; 1980; vol. 31 (no. 1); p. 21-29
Publication Date: 1980
Publication Type(s): Comparative Study Journal Article
PubMedID: 7376895
Abstract: Changes in venous-blood lactate level were studied in women in three periods of labour and three time periods after labour, as well as in their newborns in the umbilical core blood and during the first several days of extrauterine life. The level was highest in women at the time of fetus delivery (passage of fetal head through the genital channel) and in the umbilical cord blood in newborns. The return of normal lactate value occurred parallelly in mothers and newborns. In several cases of labour with complications not induced pharmacologically the lactate levels were not different from those observed during spontaneous labours.
Database: Medline
46. Serum lactic acid dehydrogenase and isoenzymes during pregnancy and labor.

**Author(s):** Makkonen, M; Penttilä, I M; Castrén, O

**Source:** Acta obstetricia et gynecologica Scandinavica; 1980; vol. 59 (no. 2); p. 97-102

**Publication Date:** 1980

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

**PubMedID:** 7405558

**Abstract:** Total serum lactic acid dehydrogenase activity (LDH) and the levels of LDH isoenzymes were investigated in 14 women during early pregnancy (8–16th week), in 28 women during late pregnancy (29–37th week), in 73 at term (38–42nd week) and in 27 during labor (38–42nd week). LDH activity was found to be elevated in severe pre-eclampsia and in chronic hypertensive women during pregnancy as well as during normal and dysfunctional labor. No change was established in total serum LDH during normal pregnancy. LDH 1 was increased during late pregnancy and at term. In severe pre-eclampsia and during normal labor it was decreased. LDH 2 was also decreased in severe pre-eclampsia and during dysfunctional labor. LDH 3 was decreased during late pregnancy but increased in severe pre-eclampsia. No change was observed in LDH 4 during pregnancy, or in labor. LDH 5 was increased in normal and dysfunctional labor.

**Database:** Medline

47. Carbohydrate and lipid metabolism during human labor: free fatty acids, glucose, insulin, and lactic acid metabolism during normal and oxytocin induced labor for postmaturity

**Author(s):** Kashyap M.L.; Sivasamboo R.; Sothy S.P.; Cheah J.S.; Gartside P.S.

**Source:** Metabolism: Clinical and Experimental; 1976; vol. 25 (no. 8); p. 865-875

**Publication Date:** 1976

**Publication Type(s):** Article

**PubMedID:** 940472

**Abstract:** An investigation was performed to study the metabolism of the major body fuels (viz. glucose and free fatty acids), insulin, and lactic acid during the stress of human labor. In addition, the role of the normal placenta in the transport of these substances between mother and the fetus was evaluated by measuring them in the mother and cord blood at delivery. To study possible alterations of this role in the placenta which had exceeded the normal period of gestation, a second comparable group of women had labor induced with oxytocin 16–18 days beyond the expected date of delivery. A dramatic twofold increase in maternal plasma free fatty acids was observed during labor. There was a lesser but definite increase in blood glucose concentrations. No rise in serum insulin levels was noted which coincided with the changes in blood glucose. Lactic acid concentrations during the course of labor were variable from baseline but at delivery, the concentrations rose to very significant levels. Free fatty acids and blood glucose levels were significantly higher in the maternal than in the fetal side. A significantly positive correlation was noted between the maternal and cord blood values except for free fatty acids in the postmature group. No significant difference, nor a correlation was found between the 2 compartments in the insulin nor lactic acid levels. These results suggest that during human labor free fatty acids are the principal metabolic fuel. This increase in maternal free fatty acids may serve to spare glucose as a metabolic fuel in the fetus. The mechanism responsible for the increased maternal free fatty acid mobilization remains to be determined. It is not possible to discern any consistent alteration in placental function as a consequence of prolonged gestation.

**Database:** EMBASE
48. Acid base, lactate, and pyruvate characteristics of the normal obstetric patient and fetus during the intrapartum period

Author(s): Low J.A.; Pancha S.R.; Worthington D.; Boston R.W.

Source: American Journal of Obstetrics and Gynecology; 1974; vol. 120 (no. 7); p. 862-867

Publication Date: 1974

Publication Type(s): Article

PubMedID: 4429103

Abstract: The maternal and fetal acid base, lactate, and pyruvate characteristics during the course of labor and at delivery were studied in 140 normal patients. In maternal venous blood, there is a small decrease of buffer base with a 2 fold increase in lactate concentration, principally caused by a parallel increase in pyruvate. The projected pattern in the normal fetus is a 2 fold increase in lactate concentration with a parallel increase in the lactate/pyruvate ratio, indicating a minor degree of tissue oxygen debt in the fetus. The spectrum of minor degrees of tissue oxygen debt can be accurately identified with a measure of lactate concentration and a lactate pyruvate ratio as a complementary observation to an acid base assessment.

Database: EMBASE

49. The effect on continuous lumbar epidural analgesia on maternal acid-base balance and arterial lactate concentration during the second stage of labour.

Author(s): Pearson, J F; Davies, P

Source: The Journal of obstetrics and gynaecology of the British Commonwealth; Mar 1973; vol. 80 (no. 3); p. 225-229

Publication Date: Mar 1973

Publication Type(s): Journal Article

PubMedID: 4703260

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