



**Karolinska  
Institutet**

Department of Women's and Children's health

## **Lactate as an early marker of intrapartum hypoxia**

AKADEMISK AVHANDLING

som för avläggande av medicine doktorsexamen vid Karolinska Institutet offentligen försvaras i Skandiasalen, Astrid Lindgrens Barnsjukhus, Karolinska Universitetssjukhuset Solna

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av

**Malin Holzmänn**

Leg. läkare

*Huvudhandledare:*

Docent Lennart Nordström  
Karolinska Institutet  
Institutionen för Kvinnors och Barns Hälsa  
Enheten för Obstetrik och Gynekologi

*Bihandledare:*

Professor Sven Cnattingius  
Karolinska Institutet  
Institutionen för Medicin  
Enheten för Klinisk Epidemiologi

*Fakultetsopponent:*

Professor Henrik Hagberg  
Göteborgs Universitet  
Sahlgrenska Akademin  
Institutionen för Obstetrik och  
Gynekologi

*Betygsnämnd:*

Docent Henry Nisell  
Karolinska Institutet  
Institutionen för klinisk vetenskap,  
intervention och teknik

Docent Marie Blomberg  
Linköpings universitet  
Institutionen för klinisk och experimentell  
medicin  
Enheten för Obstetrik och Gynekologi

Docent Ulrika Ådén  
Karolinska Institutet  
Institutionen för Kvinnors och Barns  
Hälsa  
Enheten för Neonatologi

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## ABSTRACT

**Background:** Cardiotocography (CTG) is the main method for intrapartum fetal surveillance in many countries. The method has a high sensitivity, but a poor specificity, which leads to an increased rate of interventions compared with auscultation. Fetal blood sampling (FBS) was developed parallel to CTG, and can be used as an adjunct to diagnose or exclude fetal acidemia when the CTG tracing is non-reassuring. Lactate analysis has been shown as reliable as gold standard pH analysis, and FBS with lactate analysis has the advantages of a lower failure rate, shorter time from sampling to analysis result, and lactate concentration identifies the metabolic component of acidemia in contrast to pH. However, since guidelines for CTG interpretation cannot be regarded as fully evidence-based, neither can guidelines for the use of FBS.

The aim of this thesis was to further increase the knowledge of FBS and measurements of fetal lactate concentrations as an adjunct in intrapartum fetal surveillance.

**Materials and Methods:** The study population consisted of women with a simplex pregnancy, gestational age  $\geq 34$  weeks, cephalic presentation and indication for FBS during labor. The cohort in papers I and II were women who had participated in a former RCT at ten obstetric units in Sweden. Study I included all 2992 women randomized to either pH-, or lactate analysis, and Study II included the 1496 women with lactate analysis. The cohort in studies III and IV were all consecutive women with FBS during labor at Karolinska University Hospital Solna, Sweden, during two years. In the 1<sup>st</sup> cohort, the 95<sup>th</sup> percentile of all lactate values and the 5<sup>th</sup> percentile of all pH values were used as the definition of severe intrapartum acidemia and frequencies of adverse neonatal outcome were calculated. The neonates were classified according to birth weight as small/appropriate/large, and medians in lactate concentration at FBS were calculated in the total population and in acidemic cases as well as neonatal outcome according to birth weight groups. In the 2<sup>nd</sup> cohort, all CTG traces prior to FBSs were interpreted, and CTG patterns were correlated to acidemia at FBS. Delivery mode and neonatal outcomes were analyzed in relation to number of FBSs during labor, 1-2 vs  $\geq 3$ .

**Results:** The risk of serious adverse neonatal outcome was 10 % or less in the high risk groups with severe intrapartum acidemia, and time interval from FBS to delivery was shorter in the pH group. In comparison between birth weight groups, the median lactate concentration at FBS in acidemic fetuses did not differ, nor did the proportion of acidemic fetuses at FBS or neonatal outcome. A CTG tracing with isolated reduced variability did not increase the risk of acidemia at FBS, severe variable decelerations and late decelerations correlated equally to acidemia, and tachycardia with either of those decelerations had the highest prevalence of acidemia. Neonatal outcome did not differ in labors with  $\geq 3$  FBSs compared with 1-2 FBSs, but cesarean delivery rate was 42 % vs 23 %, with an adjusted odds ratio of 2.0.

**Conclusions:** Acidemia in scalp blood is an early marker of intrapartum fetal hypoxia, and FBS can be used to prevent severe birth acidemia. Lactate might react earlier than pH in the hypoxic process. Small for gestational age fetuses can produce equally amounts of lactate as a response to hypoxia as normally grown fetuses, and FBS with lactate analysis is a reliable surveillance method also for growth restricted fetuses in labor. A CTG tracing with isolated reduced variability does not necessitate repeat FBSs during labor. The two types of serious decelerations correspond equally to fetal acidemia and distinguishing them is not crucial. Monitoring a woman with repeat FBSs during labour is safe for the baby, but doubles the risk for cesarean delivery.

Key words: cardiotocography, fetal blood sampling, fetal acidemia, fetal hypoxia

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