ASSOCIATION BETWEEN LACTATE CONCENTRATION IN AMNIOTIC FLUID AND DYSFUNCTIONAL LABOR

Introduction

Dysfunctional labor or labor dystocia (Greek, actually means ”difficult birth”), is a common obstetrical problem worldwide, and is one of the main indications for operative intervention during parturition. In the literature the frequency of labor dystocia is varying between 4-40 %[1]. A major problem associated with labor dystocia is that no precise definition exists and there is no standardized treatment method available. WHO has described a procedure (Care in Normal BirthWHO/FRH/MSM/96.24), but that is rarely used in clinical practice.

The Partogram is today used during active delivery to objectively confirm a suspected labor dystocia. The Partogram was originally designed by Friedman during his large study in Africa during the 50’s [2,3]. The Partogram has gone through many improvements after its introduction [4]. The Partogram is the tool that is currently used in modern obstetric care to identify labor dystocia, but it is a rather imprecise tool to predict delivery outcome. The Partogram is also used to define other actions during delivery such as Oxytocin infusion and amniotomy.

Labor dystocia is a multifaceted condition. One background to labor dystocia is considered to be inefficient and long-lasting muscle activity that leads to muscle hypoxia with progressive lactic acidosis in the myometrium. A high level of lactic acidosis in the uterine muscle might lead to reduced contraction force [5-10]. An increased level of lactate acid in the uterine muscle is reflected and can be measured in the amniotic fluid[11-13]. By combining the information about the delivery progress, determined by the Partogram, and the measured lactic acid concentration in the amniotic fluid (AFL-test) a good prediction of delivery outcome can be obtained.

Scientific background

During the 80’s and 90’s a number of studies were done on uterine metabolism and energy exchange by the group around Prof. Ulmsten in Uppsala, Sweden [13-20]. They showed that a pregnant uterus had a low energy exchange, which was reported as an "index of energy status”. Comparisons were done with the situation in skeletal muscles and the heart muscle.

The big difference was found to be the special condition the uterine muscle is working under during labor. The heart is working continuously with very short relaxation pauses. The skeletal muscle is working”on command”. The uterus is in a relatively relaxed status during the major part of the woman’s life but is during the short time of active delivery changed to a status with very strong contractions. For this instant change, a high amount of energy is needed.

Several studies have confirmed that the anaerobic metabolism is higher in the uterus muscle tissue compared with other muscles. L/P (lactate/pyrovate) ratio in uterus is also reported to be higher in the pregnant uterus compared with other muscles. The level of lactate acid is about twice as high in a uterus of a pregnant woman compared with a non-pregnant, presumably due to high glycolic flow when the uterus is active.

There is also evidence showing that the uterus is going through a metabolic preparation in late part of the pregnancy, to tolerate the long contractions during active delivery.

During the 90s, a number of studies were published by the research group around Prof. Susanne Wray, Liverpool, UK [5-10]. This group has, as the Uppsala group, studied the acid-base metabolism in the uterus tissue. One of their main findings was that the accumulation of lactic acid in the myometrium during contractions may reduce the strength of the remaining contractions and contribute to labor dystocia.

In 2004, the same group [1], made a clinical study measuring the lactate acid in the blood from the uterus during caesarean section, and found that women with labor dystocia had a higher level of lactate acid in the uterus blood compared with women going through caesarean section for other reasons. A possible explanation to this is that the circulation to the uterus is shut off at each contraction, and that the metabolic status only for a short period of time becomes anaerobic. Accumulated lactic acid is reduced when the circulation returns, when the contraction ends. At labor dystocia the pattern is differently, and insufficient relaxation brings no new oxygen to the muscle. Accumulation of lactic acid and the condition dysfunctional labor is a fact.

- In 2007-2008, a number of experimental studies were performed in collaboration with the Depertment of Women´s and children´s Helath, Uppsala University, Sweden. These studies have shown that the myometrium has a significant production of lactic acid both in aerobic and in anaerobic environment, and that the lactic acid is transported into the surrounding fluid [11] They have also shown that amniotic fluid itself has no own production of lactic acid.

- Studies have also been done with the goal to explain the mechanism behind the transport of the lactate acid from the myometrium into surrounding amniotic fluid. An explanation is the presence of a number of lactate-bearing proteins, not detected in myometrium before. One lactate-bearing protein, MCT1, seems to be continuously active in the transport of lactate acid in aerobic and anaerobic environments [21] Other proteins (i.e. MCT4) seems to mainly be activated when the myometrium is exposed to acute hypoxia (labor dystocia). The amount of MCT4 protein seems to have a good correlation to the lactic acid in the amniotic fluid [21-22].

- In studies, the concentration of lactic acid has been continuously monitored in amniotic fluid (AFL-test) during active delivery on a large number of women [12]. These studies show a good association between high levels of lactic acid in the amniotic fluid (AFL-level), during a longer period of time, and delivery outcome. If the AFL level was high in at least two consecutive samples of AF collected during labor 60 minutes apart, the probability was very high that the delivery had to be ended instrumentally or with caesarian section. The study also showed very good association between high AFL level at Action Line passage and operative intervention during parturition.

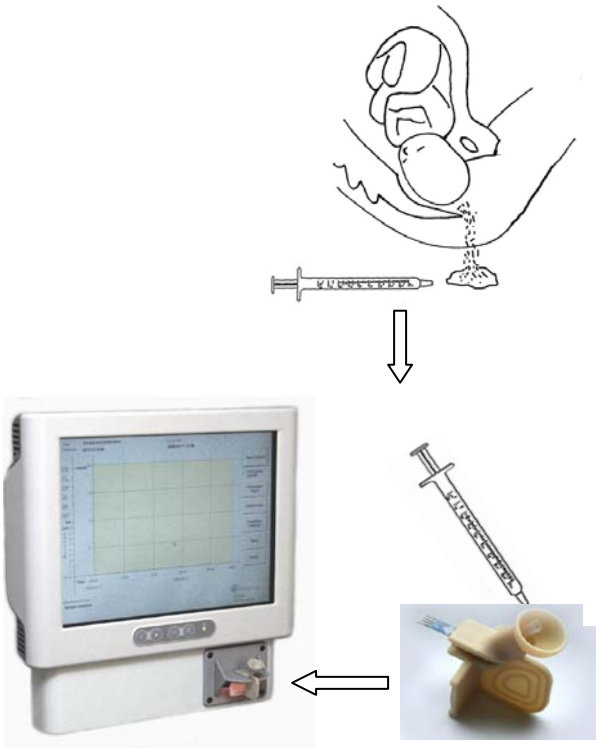
- 2008 a large study including 850 women was closed. The study was a research project with Karolinska Institute, Söder Hospital Stockholm, Sweden and Karlstad Hospital, Karlstad Sweden. This study confirms earlier findings that there is a good association between high AFL level at action line passage and delivery outcome. High levels showed a good association with caesarean section or instrumental delivery and low levels a high probability for normal spontaneous vaginal delivery[13].

Duration of labor has a wide range, and has a large individual variation. It is of course of a great importance not to interfere during the normal delivery process. On the other hand, to be able to identify the group of women who will have a normal spontaneous vaginal delivery even with the diagnosis of dysfunctional labor is very appealing. This in order to

reduce the possibility of iatrogenic intervention in a labor which otherwise would proceed to a spontaneous vaginal delivery.

Amniotic fluid can easily be collected by the midwife in charge during vaginal examination, and the AFL level can be analyzed at the bedside in the delivery room. The method is easy, non-invasive and safe for the woman in labor and her fetus.

AFL test in practice



- Indication (Dystocia identified and membranes ruptured)
  - When there is a slow progress
    or
  - When Oxytocin infusion is decided
- Collect about ¼ ml free flowing amniotic fluid
- Fill the amniotic fluid in the measuring device's AFL sensor
- The AFL level is after 15 seconds automatically displayed, integrated in the Partogram on the monitor

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