Guideline

Fetal Blood Sampling

1. Purpose

Cardiotocography (CTG) or electronic fetal monitoring (EFM) is the most widely used technique for assessing fetal wellbeing in labour in the developed world. CTGs have a high degree of sensitivity but a low level of specificity which means that they are very good at telling us which fetuses are well but are poor at identifying which fetuses are unwell[1]. The differences in individual fetal responses to a decrease in oxygen (and therefore differences in heart rate changes) mean that the positive predictive value of CTG for adverse outcome is low and the negative predictive value high [2].

The increased intervention rates associated with EFM can be reduced with the use of fetal blood sampling (FBS) [3]. FBS can be performed as an adjunct to an abnormal CTG. The RANZCOG Intrapartum Fetal Surveillance Clinical Guidelines state that "units employing EFM are strongly encouraged to have access to fetal blood sampling facilities to assist in the management of labours where the fetus is demonstrating equivocal CTG changes".[4]

Scalp lactate, rather than scalp pH sampling, provides and easier and more affordable adjunct to CTG monitoring.[4]

This guideline outlines the requirements for fetal scalp lactate sampling to assess acid-base status at the Women's.

2. Definitions

FBS: Fetal blood sampling

Lactate: is a measurement of the circulating lactic acid.

Lactate Pro: is the device used at the Women's.

Lactate measurement: is the preferred method of FBS at the Women's. Lactate sampling is more likely to be successful and the result available more quickly than pH sampling. It requires a smaller volume, so has a higher sampling success rate and is a point of care test. The use of scalp lactate rather than pH measurement provides an easier and more affordable adjunct to EFM for most units [1].

An abnormal CTG is defined one which contains features which are 'unlikely to be', 'likely to be' or 'are associated' with significant fetal compromise. Accordingly, a decision to perform lactate sampling must be made with consideration to the total clinical picture and the severity of the features[4].

Petroleum jelly is also known as soft white paraffin gel.

3. Responsibilities

The Obstetric medical staff are responsible for interpreting and acting upon abnormal CTG patterns, performing fetal scalp blood sampling, interpreting the result, documenting the procedure and subsequent plan of management.

The **Midwifery staff** are responsible for assisting with the procedure, ensuring the Lactate Pro is calibrated and providing midwifery care to the woman.

Medical and midwifery students under supervision are responsible for providing care to the woman and assistance to the clinicians.

4. Guideline

4.1 Principles of care

Where there is clear evidence of acute fetal compromise, FBS should not be undertaken and urgent preparations to expedite birth should be made [14].

Note: the on-duty or on-call consultant obstetrician must be notified when a CTG is interpreted as abnormal or is of concern and fetal scalp lactate sampling considered necessary. The notification and outcome of the discussion must be documented in the woman's medical record.

Ultimately it must always be the decision of the clinician responsible for the woman as to whether FBS is appropriate.

All fetal scalp lactate measurements should be interpreted taking into account:

- clinical history
- gestation
- parity
- onset of the labour
- progress of the labour
- presence of meconium stained liquor
- number and type of CTG abnormalities
- previous fetal scalp lactate measurement

4.2 Indications

Suspected fetal compromise suggested by an abnormal CTG pattern [4, 14].

4.3 Contraindications

- clear evidence on continuous EFM of serious, sustained fetal compromise
- fetal bleeding disorders (e.g. suspected fetal thrombocytopaenia, haemophilia)
- face or brow presentation or uncertain presenting part
- maternal infection (eg HIV, hepatitis virus, and herpes simplex virus and suspected intrauterine sepsis) NB: GBS+ve does not preclude FBS[4]
- suspected intrauterine sepsis
- gestation less than 34 weeks' gestation [4]
- The effect of gestational age on the development of lactic acidosis due to hypoxia remains to be investigated.
- active second stage of labour (see Appendix 2 - Additional Clinical Information: Fetal Scalp Lactate Sampling)

Relative contraindications (discuss with Consultant Obstetrician)

- Gestation range 34 weeks to 36 weeks and 6 days
- Maternal pyrexia above 38^0C

When a third FBS is considered necessary, Consultant Obstetric opinion must be sought [4].

4.4 Management

- Ensure that the Lactate Pro™ machine is available, calibrated and functioning.
- The membranes must be ruptured and the cervix at least 3 cm dilated for the procedure to be attempted.
- Other technical considerations include the amount of effacement, station, application of the vertex to the cervix, volume of amniotic fluid and amount of baby hair
- This procedure may be uncomfortable and intrusive for the woman. It is invasive to the fetus.
- Explain the procedure to the woman and obtain verbal consent.
- Assemble the equipment on the trolley
- Place the woman in the left-lateral position or in lithotomy with a wedge under the right hip to reduce the risk of supine hypotension.

- Sampling is performed under direct vision via an amnioscope to avoid contamination with amniotic fluid.
- The incision site is carefully cleaned and a thin layer of petroleum jelly is applied.
- The baby's fontanelles should be avoided.
- Disposable blades, fixed in a plastic mount are used in a blade holder from which the blade does not protrude more than 2mm.
- A 2mm fetal scalp incision is made with steady pressure of the blade.
- The blood is collected in pre-heparinised glass capillary tubes.
- Pressure is applied to the incision site with a dry swab until the bleeding stops.
- Discard the blade in the sharps container.
- Document the procedure, the result and the subsequent plan of management.
- Postnatal examination of the baby should include examination of the sampling site.

Every lactate measurement device needs it own reference values. Lactate Pro™ is the device used at the Women's. The recommended intervention cut of value with the Lactate Pro™ is greater than 4.8mmol/L

Lactate Pro™ uses whole blood for analysis.

Lactate analysis of a blood sample collected in a glass capillary should be carried out within ten minutes of sampling because lactate increases linearly with time [8].

Accuracy with the Lactate Pro™ has been tested on fetal blood and it has a between run co-efficient of variation (CV) of less than 4% [9]. A possible source of error in the analysis is contamination with amniotic fluid which contains high concentrations of lactate but the risk of amniotic fluid contamination is small due to the small blood sample volume needed.

The recommended intervention cut-off value of 4.8 mmol/L measured with the Lactate Pro™ is considerably higher than the cut-off value of 4.2 mmol/L recommended following an observational Australian study using the Accusport and highlights the importance of being familiar with the device in use in any unit [15] [16].

4.5 Interpretation of values

Fetal blood sample	Lactate (mmol/L)	pH
Normal	≤ 4.1	≥ 7.25
Pre-acidotic range	4.2 - 4.8	7.21 - 7.24
Acidotic range	> 4.8	≤ 7.20

The results need to be interpreted as part of the full clinical picture. If the result seems completely out of keeping with the full clinical picture (lactate either lower or higher than expected) this needs to be discussed with the Consultant Obstetrician.

Normal range

- if CTG returns to normal there is no need to repeat the fetal scalp lactate
- if abnormalities continue the fetal scalp lactate should be repeated in one hour
- if abnormalities worsen then repeat sooner than an hour.

Pre-acidotic range

- repeat within 30 minutes to establish a trend in results or deliver if there is significant deterioration from the previous result

Acidotic range

- the fetus should be delivered immediately by either instrumental delivery or urgent CS
- stop oxytocin infusion if in progress

Call an immediate emergency caesarean section if Lactate > 4.8mmol/l

4.6 Complications

Complications of FBS are very rare and include haemorrhage, infection and breakage of the blade [17]. The incision site should be observed carefully until all bleeding has ceased. If significant bleeding persists the baby should be delivered. A baby's blood volume ranges from 70-100mls/kg. Advise the neonatologist and consider an underlying haematological abnormality [18]. Postnatal examination of the baby should include examination of the sampling site.

4.7 Post Birth

Ensure that paired arterial and venous cord blood samples are collected following the birth of the baby and sent to the laboratory for blood gas analysis. These results need to be reviewed and added to the clinical notes.

5. Evaluation, monitoring and reporting of compliance to this guideline

Compliance to this guideline will be monitored by incidents reported through VHIMS.

6. References

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15. NICE Clinical Guideline 55- intrapartum care. September 2007.
16. Wiber-Itzel E, Lipponer C, Norman M, Herbst A, Prebensen D, Hansson A, Bryngelsson A-L, Christoffersson M, Sennström M, Wennerholm U-B, Nordström L. Determination of pH or lactate in fetal scalp blood in management of intrapartum fetal distress: randomized controlled multicentre trial. BMJ, 2008;336:1284-1287.
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18. Jaiyesimi RK, Hickey WP. Fetal haemorrhage after fetal scalp blood sampling. Lancet. 1990;336:819-20.
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7. Legislation/Regulations related to this guideline

Not applicable.

8. Appendices

Appendix 1: RWH Procedure: Cord Blood Sampling - Paired

Appendix 2: Additional Clinical Information: Fetal Scalp Lactate Sampling

Please ensure that you adhere to the below disclaimer:

Appendix 2

Additional Clinical Information: Fetal Scalp Lactate Sampling

Continuous EFM during labour is associated with a reduction in neonatal seizures but no significant differences in rates of cerebral palsy, perinatal mortality, low Apgar scores, and admission to neonatal intensive care or hypoxic ischaemic encephalopathy [3]. This may be because the incidence of these conditions is too low or conditions such as cerebral palsy occur antenatally rather than intrapartum so that EFM would be unlikely to have an effect. Continuous EFM is associated with an increase in caesarean section and instrumental vaginal births.
FBS, based on pH analysis during the first stage of labour was introduced by Saling in 1962 [5]. 30 to 50 microlitres of blood are required for pH analysis and it has been reported to fail in 20% of cases [6]. Owing to the practical limitations associated with blood sampling for pH measurement, work commenced on developing a simpler method. The measurement of intrapartum fetal scalp lactate has been studied since the 1970s but previous methods for lactate measurement required large amounts of blood and laboratory resources and were therefore not clinically useful.

Lactate in first stage of labour:
The relationship between maternal and fetal lactate concentrations in labour has been studied. No significant correlation was demonstrated between the duration of the first stage of labour and fetal lactate concentration at the beginning of the second stage of labour [7, 9]. This confirms previous findings suggesting that in the absence of hypoxia, fetal lactate concentrations are constant during the first stage of labour [8].

Lactate in the second stage of labour:
Maternal lactate concentrations increase significantly during the active phase of the second stage of labour. The source of this lactate is thought to be maternal skeletal muscles. It is estimated that the maternal lactate increases by 2mmol/L for every 30 minutes of active pushing [10]. The fetal lactate also rises during active pushing when it is estimated to increase by 1mmol/L for every 30 minutes of active pushing. The question of whether this lactate rise is driven by fetal hypoxia or derived from the mother has been investigated by studying the arterio-venous lactate difference at delivery. The results suggest that the main contributor to the fetal lactate increase is the fetus itself, especially with a prolonged second stage [10]. Animal studies support these results [11].
These findings suggest that a fetal scalp lactate is an appropriate indicator of fetal hypoxia in the passive second stage, for example whilst awaiting further descent of the presenting part. After the commencement of active pushing however, lactate will rise as suggested above.

CTG abnormalities during the ACTIVE second stage of labour require consideration of expedited delivery NOT further assessment by FBS.

Normal (aerobic) metabolism: when the fetus is well oxygenated, the fetus generates energy in the form of adenosine triphosphate (ATP), from glucose, forming pyruvate. This pyruvate is further metabolised in the presence of oxygen to form carbon dioxide and water with the release of ATP for cellular metabolism. The carbon dioxide and water are easily eliminated from the fetus across the placenta.
Abnormal (anaerobic) metabolism: when the fetus is short of oxygen (hypoxic) there is insufficient oxygen for the aerobic metabolism of pyruvate. Instead pyruvate is converted into a small amount of ATP as well as lactic acid and hydrogen ions which accumulate resulting in increased lactate levels (metabolic acidosis)[12]. Non-reassuring CTG patterns may reflect the ability of the individual fetus to adapt to decreases in oxygen supply. Inadequate oxygen supply results in anaerobic metabolism of glucose, which leads to metabolic acidosis [12]. Lactate sampling gives an assessment of metabolic acidosis. Full analysis of acid-base balance including base deficit is required to discriminate between respiratory and metabolic acidosis.

Umbilical cord blood lactate concentrations in newborns: Umbilical cord blood lactate concentrations in newborns were studies in order to establish reference ranges [13]. 10,169 “vigorous” newborns, presumably healthy, delivered vaginally either spontaneously or by instrumental delivery were included. Babies with complicated pregnancies and those delivered by CS were excluded. The variation in lactate values at term ranged from a mean of 3.5mmol/L at 37 weeks’ gestation to a mean of 4.3mmol/L at 42 weeks’ gestation. Based on these data, the use of the accepted cut-off value for fetal scalp lactate of 4.8mmol/L would not result in any unnecessary interventions even in babies at 42 weeks’ gestation.

Appendix 2

Additional Clinical Information: Fetal Scalp Lactate Sampling

Lactate values at gestations less than 34 weeks' gestation: The effect of gestational age on the development of lactic acidosis due to hypoxia remains to be investigated. In view of the lack of information the measurement of fetal scalp lactate prior to 34 weeks' gestation is contraindicated.