Obstetric Guideline 6B
ELECTRONIC FETAL MONITORING IN LABOUR, SCALP SAMPLING, & CORD BLOOD GASES

1. PREAMBLE

Meta-analysis of randomized clinical trials\textsuperscript{1,2} indicate that electronic fetal monitor (EFM) changes indicating non-reassuring fetal status have poor predictive value, i.e. there is a high false positive rate which leads to increased operative deliveries (with or without fetal blood sampling). \textbf{Normal EFM tracings have a high predictive value}, i.e. the fetus is not compromised during the time of monitoring when the EFM shows normal rate, normal variability, appropriate accelerations, and no significant decelerations. When comparing outcomes for EFM versus intermittent auscultation in healthy women, maternal morbidity is increased with EFM related to increased operative delivery, while perinatal morbidity shows no improvement over those mothers receiving intermittent auscultation in labour. Electronic fetal monitoring should be reserved for those women with adverse risk factors in labour or for those women with non-reassuring auscultation findings.

This guideline is an adjunct to the 2002 SOGC guideline on Fetal Health Surveillance in Labour and is consistent with the information contained in the Fetal Health Surveillance in Labour\textsuperscript{3} manual produced by the Canadian Perinatal Regionalization Coalition. The BCRCP supports a slight modification to the SOGC guideline however, regarding Recommendation 5 b) and c) which recommends continuous intrapartum fetal monitoring during oxytocin infusion for labour augmentation and induction. The BCRCP recommendation is, “Continuous electronic fetal surveillance and uterine monitoring throughout the induction is recommended. \textit{However, when the oxytocin dose and maternal/fetal conditions are stable, and there is NO evidence of fetal compromise, intermittent electronic monitoring may be commenced to allow for periods of ambulation, bath, or position change.” (See BCRCP Obstetric Guideline 1: Induction of Labour).

The following table shows the BC provincial averages and rates that EFM was used in each of the Health Authorities for 2000/2001, 2001/2002, and 2002/2003 for singleton pregnancies.
2. FACILITY POLICIES AND PROCEDURES

All facilities in BC providing planned obstetrical services require policies and procedures relating to:
- Indications for EFM
- Techniques for EFM
- Management for non-reassuring EFM findings
- Admission baseline fetal heart strips
- Lines of communication 24/7 and consultation process between caregivers

3. ELECTRONIC FETAL MONITORING

3.1 PAPER SPEED

Hospitals vary in their use of paper speed between 2 and 3 cm/minute. To ensure consistency in EFM interpretation, reporting and education, the BCRCP recommends a speed of 2 cm/min.

3.2 ADMISSION EFM TRACINGS

There are two randomized controlled trials that have examined the outcomes of cardiotocography versus doppler auscultation of the fetal heart at admission in labour in the low risk obstetric population.\(^{14,15}\) The Mires (2001) study concluded that admission cardiotocography does not benefit neonatal outcome (indicators included cord pH < 7.20 and Base deficit > 8 mmol/L) in low risk women and results in increased obstetric intervention, e.g. EFM in labour, ARM, augmentation of labour, and operative delivery. It has been noted however, that the final sample size of 1704 in this study was inadequate to detect clinically meaningful measures of more adverse neonatal outcome.\(^{15}\)

Another trial of 8580 women\(^{15}\) in 2003 compared the effect of admission cardiotocography versus doppler auscultation in low risk women on moderate to severe neonatal morbidity or perinatal mortality in the absence of a major congenital malformation, and on maternal obstetric intervention. Severe neonatal morbidity included: admission to the neonatal unit with an arterial pH < 7.05 and base deficit > 12.0 mmol/L, capillary pH < 7.05, or any of the following: neonatal seizures, hypotonia > 4 hours, mechanical ventilation > 15 minutes, use of inotropic support, renal failure or meconium aspiration syndrome. Secondary neonatal outcomes included length of stay in the neonatal unit, mean arterial and venous pH and base deficit, Apgar scores, and postnatal imaging. Maternal secondary outcomes included use of continuous EFM, use of fetal blood sampling, caesarean section delivery rates, instrumental delivery and episiotomy rates, and mean estimated blood loss. The researchers found that for the primary outcomes of neonatal morbidity or mortality, there were no differences between the groups assigned to admission cardiotocography and IA. Unlike the finding of Mires, the rates of obstetrical intervention were not statistically significant at the 99% level. The researchers conclude, “Our results suggest that use of a very widely used approach, admission cardiotocography, at the start of a labour in a pregnancy judged to be normal, cannot be justified.” (p.469).

Until evidence is available supporting the benefits of admission cardiotocography on neonatal outcome, the BCRCP does not recommend the use of admission EFM tracings on admission of healthy, term women in labour with an absence of risk factors for adverse perinatal outcome.
3.3 INDICATIONS FOR EFM\(^1\) (as per SOGC, 2002 adapted from RCOG Evidence-based Clinical Guideline Number 8, May 2001)

A. Antenatal Maternal Conditions
- Hypertension/hypertension with adverse conditions
- Diabetes
- Antepartum hemorrhage
- Other maternal medical disease

B. Antenatal Fetal Conditions
- Growth restricted fetus
- Prematurity
- Oligohydramnios
- Abnormal umbilical artery Doppler velocimetry
- Isoimmunization
- Multiple pregnancy
- Breech presentation

C. Intrapartum Maternal Conditions
- Vaginal bleeding in labour
- Intrauterine infection

D. Labour
- Previous caesarean section
- Prolonged membrane rupture
- Induced labour
- Augmented labour
- Hypertonic uterus

E. Fetal Conditions
- Meconium stained amniotic fluid
- Post-term pregnancy
- Suspicious (non-reassuring) fetal heart rate features on auscultation (See Obstetric Guideline 6A: Intermittent Auscultation in Labour, page 3)

3.4 FETAL HEALTH SURVEILLANCE MAY NOT BE WARRANTED IF:
- Lethal fetal anomalies (e.g. anencephaly)
- Extreme prematurity (< 23 weeks)

3.5 RESPONSIBILITIES ASSOCIATED WITH ELECTRONIC FETAL MONITORING
- The reasons, the benefits and limitations for use of EFM should be explained to the woman
- All physicians and midwives providing intrapartum care should have knowledge regarding interpretation of EFM tracings, an understanding of the benefits and limitations of EFM, and knowledge of medical/midwifery management for non-reassuring fetal heart tracings
All registered nurses providing intrapartum care should have knowledge and skills regarding EFM equipment, EFM interpretation, appropriate nursing interventions for non-reassuring EFM tracings, and effective verbal communication and documentation skills using clear and correct terminology.

The EFM tracings are part of the patient record and relevant events and interventions should be noted on the tracing (See BCRCP Perinatal Forms Guideline 2: Generic Charting Guideline for Perinatal Care Providers).

Registered nurses performing EFM are responsible for:

- obtaining an interpretable EFM tracing with both ultrasound and tocotransducer channels
- assessing the EFM tracing when indicated, and at least every 15 minutes in established labour
- interpretation of the EFM
- appropriate communication to the physician or midwife of EFM findings
- documentation of EFM findings on the patient’s chart, and
- appropriate emergency nursing interventions which include:
  - Change maternal position
  - Give oxygen per mask @ 8-10 Litres
  - Initiate or increase IV fluids (Solution should be a plasma expander such as Ringers Lactate)

  and may include:
  - Discontinue oxytocin; Remove prostaglandin if possible or administer Nitroglycerine as per facility policy
  - Vaginal examination, Note: Vaginal Exam should be done promptly if cord prolapse suspected

3.6 INTERNAL OR DIRECT MONITORING

A. Indications
- External tracing inadequate for accurate interpretation

B. Contraindications
- Placenta praevia
- Face presentation
- Unknown presentation
- HIV seropositive
- Active genital herpes

3.7 MANAGEMENT FOR NON-REASSURING EFM TRACING

- Initiate appropriate emergency nursing interventions (see above)
- Consider fetal scalp stimulation during vaginal exam and observe presence/absence of fetal heart acceleration. An acceleration (increased FHR by 15 bpm, lasting 15 sec.) indicates a strong probability of a pH > 7.25,6
- Consider faxing the tracing to the regional referral center or to BC Women’s (604-875-2742) for consultation, as required
• If scalp sampling is thought to be necessary, then consultation with an appropriate secondary or tertiary center should be considered
• Consider transfer/delivery if severe fetal compromise

4. FETAL BLOOD SAMPLING (FBS)

Consider FBS if physician/nurse is skilled and if equipment (including gas analysis within a 10-15 minute turnaround time) is available. Hospitals providing fetal scalp sampling should have a hospital policy and procedure describing the technique and responsibilities of both the physician performing the collection of the sample and the nurse assisting.

4.1 INDICATIONS

• A confusing/non-reassuring FHR pattern is present with elements suggestive of fetal hypoxic acidemia, e.g. uncorrectable late decelerations with average variability, or combined patterns of late or variable decelerations with decreased variability
• Variability ≤ 5 bpm with/without periodic changes
• Sinusoidal pattern
• Fetal cardiac arrhythmias
• Mixed deceleration pattern which complicates interpretation

4.2 FBS NOT INDICATED WHEN

• EFM is reassuring (baseline rate 110-160 bpm, variability 6-25 bpm), presence of accelerations (FHR increases ≥ 15 bpm above baseline, lasting ≥ 15 seconds and < 2 minutes), absence of decelerations
• Non-reassuring EFM pattern suggests significant fetal decompensation requiring immediate delivery

4.3 CONTRAINDICATIONS

• mother known carrier of hemophilia and fetus either affected or of unknown status
• mother is HIV seropositive
• active maternal genital infection (e.g. herpes).

4.4 CLASSIFICATION OF FETAL BLOOD SAMPLE RESULTS

<table>
<thead>
<tr>
<th>Fetal Blood Sample(FBS) result (pH)*</th>
<th>Subsequent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥7.25</td>
<td>FBS should be repeated if the FHR abnormality persists.</td>
</tr>
<tr>
<td>7.21 – 7.24</td>
<td>Repeat FBS within 30 minutes or consider delivery if rapid fall since last sample.</td>
</tr>
<tr>
<td>≤ 7.20</td>
<td>Delivery indicated.</td>
</tr>
</tbody>
</table>

*All scalp pH estimations should be interpreted taking into account the initial pH measurement, the rate of progress in labour, and the clinical features of the mother and baby.
5. CORD BLOOD GAS (CBG) COLLECTION FOR ACID-BASE ASSESSMENT

5.1 INDICATIONS FOR CBG’S

The SOGC suggests that CBG samples be obtained at all births. Some facilities may prefer to use the acceptable alternative of obtaining a clamped segment of cord (approximate length of 20 cm) and delay analysis until the baby’s condition is assessed. At a minimum, CBG’s should be obtained on the following patients:

- EFM pattern is non-reassuring, especially combined patterns of late or variable decelerations with variability ≤ 5 bpm
- any maternal/fetal risk factors creating a risk for adverse fetal/newborn outcome (see page 3, Section 3.3)
- caesarean section for fetal indications
- cord prolapse
- low Apgar scores, i.e. 5 minute apgar less than 7
- newborns not behaving healthy at birth

The following table shows the number of umbilical arterial (UA) pH samples done in BC in 2000/2001, 2001/2002, and 2002/2003. Less than 1% of umbilical cord pH results are <7.0 in all three years, approximately 73% fall within the mean of $7.27^{13} \pm 1$ standard deviation (SD), approximately 93% fall within the mean $\pm 2$ SD, and approximately 98% fall within the mean $\pm 3$SD.

### Normal pH in Term Newborns $7.27 \pm 0.069$

<table>
<thead>
<tr>
<th>pH Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2 - 7.34</td>
<td>Mean ± 1 SD</td>
</tr>
<tr>
<td>7.13 - 7.40</td>
<td>Mean ± 2 SD</td>
</tr>
<tr>
<td>7.06 - 7.48</td>
<td>Mean ± 3 SD</td>
</tr>
</tbody>
</table>

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5.2 STABILITY OF CORD BLOOD SAMPLE

- Blood in a double-clamped segment of cord is stable for up to an hour at room temperature\(^8\) (see diagram below)
- A cord blood sample in a syringe flushed with heparin is stable for 30-60 minutes at room temperature\(^4,9,10\)
- There is some evidence that placing the cord segment or the blood filled syringe on ice will increase the time before testing is necessary, however, how long this extends the reliability of the test results is unknown\(^11\)
- The minimum amount of blood required from the double clamped section of cord is 0.3 ml.
- It is preferable to obtain both arterial and venous samples. If only one is obtained, the arterial sample is preferable as this will provide the acid base status of fetal blood returning to the placenta.

![Diagram of a double-clamped section of umbilical cord for pH and blood gases.]

5.3 CORD BLOOD ACID / BASE VALUES

Acid-base tests (pH, Base excess, pCO2, HCO3, pO2, O2 sat.) can be done to clarify if acidosis is metabolic or respiratory. However, pO2 is not reliable on cord blood.\(^12\) There are a number of studies\(^4\) that have calculated normal umbilical cord blood pH gas values in term newborns. The results presented here are from Riley et al\(^13\).

**Normal Umbilical Cord Blood pH and Blood Gas Values in Term Newborns (Riley)**
(Data are from infants of unselected patients with vaginal deliveries)

<table>
<thead>
<tr>
<th>Value</th>
<th>Mean (+/- One Standard Deviation)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arterial blood</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.27 (0.069)</td>
<td>7.2 – 7.34</td>
</tr>
<tr>
<td>Pco(_2) (mm Hg)</td>
<td>50.3 (11.1)</td>
<td>39.2 – 61.4</td>
</tr>
<tr>
<td>HCO(_3)-(meq/L)</td>
<td>22.0 (3.6)</td>
<td>18.4 – 25.6</td>
</tr>
<tr>
<td>Base excess (meq/L)</td>
<td>-2.7 (2.8)</td>
<td>-5.5 – 0.1</td>
</tr>
<tr>
<td><strong>Venous blood</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.34 (0.063)</td>
<td>7.28 – 7.40</td>
</tr>
<tr>
<td>Pco(_2) (mm Hg)</td>
<td>40.7 (7.9)</td>
<td>32.8 – 48.6</td>
</tr>
<tr>
<td>HCO(_3)-(meq/l)</td>
<td>21.4 (2.5)</td>
<td>18.9 – 23.9</td>
</tr>
<tr>
<td>Base excess (meq/L)</td>
<td>-2.4 (2)</td>
<td>-4.4 – 0.4</td>
</tr>
</tbody>
</table>
6. DOCUMENTATION

Documentation of EFM should be done according to facility policies and consistent with the BCRCP Perinatal Forms Guidelines 2: Generic Charting Guideline for Perinatal Care Providers and 4: Labour Admission and Partogram (HLTH 1583).

REFERENCES