Intrapartum fetal surveillance (IFS)
Flow Chart: Mode of fetal heart rate monitoring

**Risk Factors**

### Antenatal
- Abnormal antenatal CTG
- Abnormal Doppler studies and/or bio-physical profile
- Suspected/confirmed FGR
- Multiple pregnancy
- Breech presentation
- Known fetal abnormality requiring monitoring
- Reduced fetal movements within week preceding labour

### Intrapartum
- IOL with Prostaglandin
- Abnormal auscultation or CTG
- Oxytocin induction/augmentation
- Post PV Prostaglandins at onset of contractions
- Regional analgesia/peracervical block (obtain baseline trace prior to insertion)
- Abnormal PV bleeding
- Pyrexia T ≥ 38°C
- Meconium or blood stained liquor
- Absent liquor following amniotomy
- Prolonged first stage of labour
- Prolonged 2nd stage where birth not imminent
- PTL < 37/40
- Uterine hyperstimulation/hypersystole

### Maternal
- Oligohydramnios/polyhydramnios
- APH
- PROM ≥ 24 hours
- Gestation ≥ 42 weeks
- Previous caesarean section or uterine surgery
- Essential hypertension or preeclampsia
- Diabetes on medication or poorly controlled or fetal macrosomia
- Current/previous obstetric or medical conditions
- Morbid obesity (BMI ≥ 40 kg/m²)
- Age ≥ 42 years
- Abnormal PaPP-A (<0.4 MoM)
- Vasa praevia

### Other
- Multiple (≥2 conditions)
  - Gestation 41+0 to 41+6 weeks
  - Gestational hypertension
  - GDM without complicating factors
  - Obesity (BMI 30-40 kg/m²)
  - Age ≥ 40 and < 42 years
  - Pyrexia T = 37.8°C or 37.9°C

### Abbreviations:
- APH: Antepartum Haemorrhage
- BMI: Body Mass Index
- CTG: Cardiotocograph
- FBS: Fetal blood sample
- FGR: Fetal Growth Restriction
- GDM: Gestational Diabetes
- IOL: Induction of labour
- MoM: Multiples of Median
- PaPP-A: Pregnancy associated plasma protein-A
- PROM: Premature Rupture of Membranes
- PTL: Preterm labour
- PV: Per Vaginal
- CT: Temperature
  - ≥: greater than or equal to
  - <: Less than
  - =: Equal to
  - °C: Degrees Celsius

---

Review clinical picture

- Risk factors
  - Continuous CTG when in established labour
  - Normal
  - Intermittent auscultation
    - Normal

Consider:
- Management of reversible causes
- FBS
- Assisted birth or caesarean section

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Queensland Clinical Guidelines: Intrapartum Fetal Surveillance Guideline No: MN15.15-V4-R20
Flow Chart: Abnormal fetal heart

Abnormal FHR auscultated

Confirmatory CTG

Normal CTG
- Baseline FHR 110-160 bpm
- Baseline variability 6-25 bpm
- Accelerations present
- Decelerations absent

Yes

Normal?

No

Assess for reversible causes

Initiate corrective actions Continuous CTG

Problem resolved?

No

Individualised care
Consider IA

Yes

Reversible causes & actions may include:
- Cord compression/reduced placental perfusion due to:
  - Maternal position
  - Maternal hypotension
  - Recent VE, vomiting, epidural, ROM or bedpan use

Actions
- Check maternal pulse
- Position left lateral
- Check BP
- Give IV fluids if hypotensive
- Consider VE to exclude cord prolapse

Uterine hyperstimulation (tachysystole or hypertonus) due to:
- Oxytocin infusion
- Vaginal Prostaglandins

Actions
- Cease Oxytocin
- Remove Prostaglandin
- Consider tocolysis

Maternal pyrexia/tachycardia due to:
- Maternal infection
- Dehydration
- Anxiety/inadequate pain relief

Actions
- Screening and treat if T ≥ 38°C
- Check BP and consider fluid replacement
- Offer analgesia

Inadequate CTG quality due to:
- Poor contact from external transducer
- FSE not working or detached

Actions
- Check maternal pulse
- Reposition transducer
- Consider FSE

Assessment
- Review CTG in 30 minutes
- Palpate maternal pulse with FHR
- Identify CTG features:
  - Contractions
  - Baseline FHR
  - Baseline variability
  - Accelerations
  - Decelerations
  - Category
- Note intrapartum events
- Confirm findings
- Escalate if not normal
- Document all findings and actions

Fetal Blood Sampling Guide
Normal:
- pH ≥ 7.25
- lactate < 4.2

Borderline: repeat in 30 minutes
- pH 7.21-7.24
- Lactate 4.2-4.8

Abnormal: expedite birth
- pH ≤ 7.20
- Lactate > 4.8

Abnormal: urgent birth
- pH < 7.15
- Lactate > 5.0

Consider:
- Continuing CTG
- Obstetrician consult
- FBS if available
- Expediting birth

Abbreviations: IA Intermittent Auscultation; BP Blood Pressure; bpm Beats per minute; CTG Cardiotocograph; FHR Fetal Heart Rate; FSE Fetal Scalp Electrode; FBS Fetal Blood Sampling; IV Intravenous; ROM Rupture of Membranes; T Temperature; VE Vaginal Examination; ≥ Greater than or equal to; ≤ Less than or equal to; > Greater than; < Less than; °C Degrees celsius
Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>bpm</td>
<td>Beats per minute</td>
</tr>
<tr>
<td>CEFM</td>
<td>Continuous electronic fetal monitoring</td>
</tr>
<tr>
<td>CS</td>
<td>Caesarean section</td>
</tr>
<tr>
<td>CTG</td>
<td>Cardiotocograph</td>
</tr>
<tr>
<td>FBS</td>
<td>Fetal blood sample/sampling</td>
</tr>
<tr>
<td>FGR</td>
<td>Fetal growth restriction</td>
</tr>
<tr>
<td>FHR</td>
<td>Fetal heart rate</td>
</tr>
<tr>
<td>FSE</td>
<td>Fetal scalp electrode</td>
</tr>
<tr>
<td>GTN</td>
<td>Glyceryl trinitrate</td>
</tr>
<tr>
<td>Hb</td>
<td>Haemoglobin</td>
</tr>
<tr>
<td>IA</td>
<td>Intermittent auscultation</td>
</tr>
<tr>
<td>IFS</td>
<td>Intrapartum fetal surveillance</td>
</tr>
<tr>
<td>IV</td>
<td>Intravenous</td>
</tr>
<tr>
<td>MoM</td>
<td>Multiples of Median</td>
</tr>
<tr>
<td>PaPP–A</td>
<td>Pregnancy associated plasma protein–A</td>
</tr>
<tr>
<td>RANZCOG</td>
<td>Royal Australian and New Zealand College of Obstetricians and Gynaecologists</td>
</tr>
<tr>
<td>UA</td>
<td>Umbilical artery</td>
</tr>
<tr>
<td>US</td>
<td>Ultrasound</td>
</tr>
<tr>
<td>USS</td>
<td>Ultrasound scan</td>
</tr>
<tr>
<td>UV</td>
<td>Umbilical vein</td>
</tr>
<tr>
<td>VE</td>
<td>Vaginal examination</td>
</tr>
</tbody>
</table>

Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission</td>
<td>Admission to the care of a Registered Medical Practitioner or Registered Midwife when in labour regardless of the setting.</td>
</tr>
<tr>
<td>Clinician</td>
<td>Registered Medical Practitioner, Registered Midwife, Medical and Midwifery students under supervision.</td>
</tr>
<tr>
<td>Early labour</td>
<td>Regular painful contractions (i.e. every five minutes and persisting for longer than 30 minutes) which may be associated with a show, intact membranes or some cervical changes (not full effacement), and or less than 4 cm dilatation.</td>
</tr>
<tr>
<td>Established labour</td>
<td>Regular painful contractions (which may be associated with a show, ruptured membranes or cervical changes (full effacement, 4 cm or more dilatation).</td>
</tr>
<tr>
<td>Hypertonus (uterine)</td>
<td>Contractions longer than two minutes or contractions within 60 seconds of each other, without fetal heart rate abnormalities.</td>
</tr>
<tr>
<td>Obstetrician*</td>
<td>Local facilities may differentiate the roles and responsibilities assigned in this document to an “Obstetrician” according to their specific practitioner group requirements; for example to General Practitioner Obstetricians, Specialist Obstetricians, Consultants, Senior Registrars, Obstetric Fellows or other members of the team as required.</td>
</tr>
<tr>
<td>Qualified staff</td>
<td>Registered Midwife, Obstetrician*</td>
</tr>
<tr>
<td>Tachysystole</td>
<td>More than five active labour contractions in 10 minutes without fetal heart rate abnormalities.</td>
</tr>
<tr>
<td>Uterine hyperstimulation</td>
<td>Tachysystole or uterine hypertonus with fetal heart rate abnormalities.</td>
</tr>
</tbody>
</table>
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1 Introduction
The principal aim of intrapartum fetal surveillance is to prevent adverse perinatal outcomes arising from fetal metabolic acidosis related to labour. As the fetal brain modulates the fetal heart rate (FHR) through an interplay of sympathetic and parasympathetic forces, fetal heart rate monitoring can be used as an indicator of whether or not a fetus is well oxygenated.

In the absence of risk factors FHR surveillance by continuous electronic fetal monitoring (CEFM) does not provide proven benefit and may increase the intervention rate in a normal spontaneous labour lasting less than 12 hours in the active phase.

This guideline is congruent with and builds on the Intrapartum Fetal Surveillance Clinical Guideline published by the Royal Australian and New Zealand College of Obstetricians and Gynaecologists.

1.1 Definition
The primary purpose of fetal surveillance is to attempt to prevent adverse fetal outcomes. Fetal surveillance includes intermittent auscultation (IA) of fetal heart rate, cardiotocography (CTG) which measures fetal heart rate and uterine contractions and fetal blood sampling (FBS) for indications of metabolic acidosis (pH and or lactate).

1.2 Clinical practice standards

Table 1. Clinical care

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Comment/consideration/recommendation/good practice point</th>
</tr>
</thead>
</table>
| Antenatal care    | • Offer women information about intrapartum fetal surveillance (IFS) during the antenatal period  
                  • Discuss the advantages and disadvantages of IFS as they pertain to the individual woman  
                  • Encourage the woman to make decisions about the mode of FHR monitoring with her health care provider |
| Intrapartum care  | • The wellbeing and wishes of the woman are respected with regard to monitoring  
                  • All women in active labour including when continuous electronic fetal monitoring (CEFM) is used receive one-to-one midwifery care  
                  • Palpate the maternal pulse with a contraction and simultaneously with FHR by IA or CEFM in order to differentiate between maternal and fetal heart rates  
                  • In the second stage of labour palpate the maternal pulse if there is suspected fetal bradycardia or any other FHR anomaly to differentiate between the two heart rates  
                  • If fetal death is suspected despite the presence of an apparently recordable FHR, then fetal viability is confirmed with real-time ultrasound scan (USS) assessment where available  
                  • During CEFM:  
                    o Review, interpret and escalate findings and document plan of action as per clinical circumstances including stage of labour [Refer to Appendix A: Interpretation of CTG  
                    o Short infrequent interruptions are acceptable for personal care if the preceding monitoring is normal and there have not been any interventions that can be expected to alter the fetal heart (e.g. amniotomy, epidural insertion or top-up)  
                    o Minimise disturbances to the woman, for example keep monitor volume low and do not restrict mobility and position or the use of water for pain relief  
                    o Continue FHR monitoring by IA during unavoidable interruptions (including transfer to operating room) when there is potential fetal vulnerability and recommence CEFM when feasible |

### 1.3 Service standards

Table 2. Facility responsibilities

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Good practice point</th>
</tr>
</thead>
</table>
| **Clinician education** | - Incorporate recognised intrapartum fetal surveillance training programs into clinician training programs<sup>1,12,13</sup>  
- Ensure staff:  
  o Have an understanding of the relevant maternal and fetal pathophysiology and the available fetal surveillance options<sup>1</sup>  
  o Are able to demonstrate competence in the interpretation of fetal surveillance options<sup>1,6,8,13</sup>  
  o Maintain and monitor records of clinician training and competency assessment |
| **Systems**    | - Implement communication pathways for the escalation of concerns regarding fetal wellbeing  
- Ensure CTG interpretation is included in bedside handovers<sup>14</sup>  
  o Refer to Table 8. Cardiotocography  
- Use tools (e.g. stamps or stickers) to assist with CTG interpretation and prompt escalation of abnormal traces<sup>14</sup>  
- Undertake regular audit and action plans to respond to poor audit results<sup>14</sup> |
2 Risk factors

Risk factors that increase the risk of fetal compromise require intrapartum CTG.

Table 3. Risk factors

<table>
<thead>
<tr>
<th>Period</th>
<th>Conditions</th>
</tr>
</thead>
</table>
| **Antenatal**1    | • Abnormal antenatal CTG  
• Abnormal Doppler ultrasound (US) umbilical artery velocimetry  
• Suspected or confirmed fetal growth restriction (FGR)  
• Oligohydramnios or polyhydramnios  
• Prolonged pregnancy greater than or equal to 42 weeks  
• Multiple pregnancy  
• Breech presentation  
• Antepartum haemorrhage  
• Pre-labour rupture of membranes (PROM)—greater than or equal to 24 hours  
• Known fetal abnormality which requires monitoring  
• Uterine scar (e.g. previous caesarean section (CS))  
• Essential hypertension or preeclampsia  
• Diabetes where medication (Insulin or Metformin) is indicated; or poorly controlled; or with fetal macrosomia  
• Current or previous obstetric or medical conditions which may pose a risk of fetal compromise (e.g. cholestasis, isoimmunisation, substance abuse)  
• Fetal movements reduced within the week preceding labour  
• Morbid obesity—Body Mass Index (BMI) greater than or equal to 40 kg/m²  
• Maternal age greater than or equal to 42 years  
• Abnormalities of maternal serum screening (i.e. low Pregnancy associated Plasma Protein–A (PaPP–A) less than 0.4 MoM) associated with an increased risk of poor perinatal outcomes (e.g. stillbirth, infant death, FGR, preterm birth and preeclampsia in a chromosomally normal fetus^{15})  
• Vasa praevia  
| **Intrapartum**1  | • Induction of labour with Prostaglandin  
• Abnormal auscultation or CTG  
• Oxytocin induction/augmentation  
• Regional analgesia (epidural or spinal) and paracervical block  
• Abnormal vaginal bleeding in labour  
• Maternal pyrexia (greater than or equal to 38°C)  
• Meconium or blood stained liquor  
• Absent liquor following amniotomy  
• Prolonged first stage of labour  
  o Less than 0.5 cm per hour in active phase (cervix greater than or equal to 4 cm and effaced)^{7}  
• Prolonged second stage where birth is not imminent  
  o Greater than 1 hour in a multiparous woman^{7}  
  o Greater than 2.5 hours in a primiparous woman^{7}  
• Preterm labour greater than 28°0 weeks and less than 37°0 weeks^{16}  
  o Less than 24 weeks not recommended  
  o 24–28 weeks clinical utility uncertain  
• Uterine hyperstimulation  
• Tachysystole |
2.1 Other indications
Where two or more of the following antenatal or intrapartum indications are present in labour, CEFM is recommended because of the synergistic effect on the woman:

- 41 to 41+6 weeks gestation
- Gestational hypertension
- Gestational Diabetes Mellitus (GDM) without complicating factors
- Obesity (BMI 30–40 kg/m²)
- Maternal age greater than or equal to 40 and less than 42 years
- Maternal pyrexia (temperature 37.8℃ or 37.9℃)
- Prior to epidural block to establish baseline features

3 Fetal heart rate monitoring

3.1 Indication

- Recommend to all women in labour that FHR monitoring occurs whether by CEFM or IA. The technique used must accurately measure the FHR in the individual woman¹
- Routine admission CTG:
  - Insufficient evidence to support the routine use for low risk women
  - Decided according to individual circumstances
  - May increase the CS rate
  - May identify a small number of previously unidentified at risk fetuses where CTG monitoring would not normally be indicated

3.2 Mode of fetal heart rate monitoring

Table 4. Mode of monitoring in labour

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermittent</td>
<td></td>
</tr>
<tr>
<td>Auscultation</td>
<td>- Use in women who, at the onset of labour are identified as having a low risk of developing fetal compromise¹</td>
</tr>
<tr>
<td>CTG</td>
<td>- May be used for women who have a low risk of developing fetal compromise where IA is difficult¹</td>
</tr>
<tr>
<td>Continuous</td>
<td></td>
</tr>
</tbody>
</table>
| External CTG            | - Recommended for women where either risk factors or fetal compromise have been:  
  - Identified antenatally  
  - Detected at the onset of labour  
  - Develop during labour¹  
  - Uses external Doppler US to monitor FHR and pressure transducers strapped to the abdomen to monitor uterine contractions¹¹  
  - Requires physical attachment to CTG machine if telemetry not available  
  - Associated with high false positive results and inconsistent FHR tracing interpretations³ |
| Internal CTG-FSE         | - Recommended when:  
  - Concerns with baseline variability  
  - Difficulty:  
    - Auscultating the fetal heart  
    - Obtaining an adequate fetal heart rate tracing at any time in labour¹  
  - May be used on presenting twin if cephalic and membranes ruptured |
### 3.3 Intermittent auscultation

Table 5. Principles of intermittent auscultation

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Good practice point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>• Use in healthy women at low risk of complications</td>
</tr>
<tr>
<td>Context</td>
<td>• Doppler may be more reliable than a Pinard stethoscope&lt;sup&gt;3,18&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Confirm fetal movement with mother&lt;sup&gt;19&lt;/sup&gt;</td>
</tr>
<tr>
<td>Method</td>
<td>• Use either:</td>
</tr>
<tr>
<td></td>
<td>o Doppler ultrasound (with speaker mode turned on)&lt;sup&gt;1,10,14&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>o Pinard stethoscope (fetoscope)&lt;sup&gt;10,18&lt;/sup&gt;</td>
</tr>
<tr>
<td>Auscultate and record fetal heart</td>
<td>• Evidence for frequency and duration of auscultation from randomised and non-randomised clinical trials not available&lt;sup&gt;20&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Consensus suggests:</td>
</tr>
<tr>
<td></td>
<td>o Towards the end of a contraction and continue for least 30–60 seconds after the contraction has finished&lt;sup&gt;1,10&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>o Every 15–30 minutes in the active phase of the first stage of labour [Refer Queensland Clinical Guideline Normal Birth]&lt;sup&gt;1,7&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>o Towards the end of and after each contraction or at least every 5 minutes in the active second stage of labour&lt;sup&gt;1,10&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• If a fetal heart rate abnormality is suspected palpate the maternal pulse simultaneously to differentiate between the two&lt;sup&gt;11&lt;/sup&gt;</td>
</tr>
<tr>
<td>Good practice points</td>
<td>• Differentiate between maternal pulse and FHR by:</td>
</tr>
<tr>
<td></td>
<td>o Palpating maternal pulse simultaneously each time with FHR auscultation in labour during a contraction&lt;sup&gt;8,11&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Document findings including when accelerations and decelerations are heard&lt;sup&gt;11&lt;/sup&gt;</td>
</tr>
<tr>
<td>Transition to continuous monitoring</td>
<td>• Need for labour augmentation with Oxytocin</td>
</tr>
<tr>
<td></td>
<td>• Development of intrapartum complications&lt;sup&gt;21&lt;/sup&gt; including:</td>
</tr>
<tr>
<td></td>
<td>o Meconium stained liquor</td>
</tr>
<tr>
<td></td>
<td>o Abnormal bleeding during labour</td>
</tr>
<tr>
<td></td>
<td>o Maternal pyrexia (greater than or equal to 38°C on one occasion or 37.8°C or 37.9°C in the presence of other risk factors) [Refer to 2.1 Other indications]&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Abnormal FHR detected by IA including:</td>
</tr>
<tr>
<td></td>
<td>o Baseline less than 110 bpm</td>
</tr>
<tr>
<td></td>
<td>o Baseline greater than 160 bpm</td>
</tr>
<tr>
<td></td>
<td>o Any decelerations after a contraction [Refer also to Appendix B: Description of fetal heart rate patterns]</td>
</tr>
<tr>
<td></td>
<td>o Abnormal FHR detected by IA including:</td>
</tr>
<tr>
<td></td>
<td>o Baseline less than 110 bpm</td>
</tr>
<tr>
<td></td>
<td>o Baseline greater than 160 bpm</td>
</tr>
<tr>
<td></td>
<td>o Any decelerations after a contraction [Refer also to Appendix B: Description of fetal heart rate patterns]</td>
</tr>
</tbody>
</table>
### 3.4 Management during IA

Table 6. Management of abnormal fetal heart rate by intermittent auscultation

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| **Good practice points** | • Re-assess FHR after implementing recommendations  
• Confirm FHR by CTG  
• If no abnormal features on CTG after 20 minutes consider return to IA<sup>10</sup> |
| **Tachycardia<sup>8</sup>**  | • Reposition to increase utero-placental perfusion or alleviate cord compression  
• Exclude fever, dehydration, drug effect or prematurity  
• Correct hypovolaemia |
| **Bradycardia<sup>8</sup>**  | • Reposition woman to increase utero-placental perfusion or alleviate cord compression  
• Perform vaginal examination (VE) to:  
  o Assess for cord prolapse/relieve cord compression  
  o Assess stage and progress of labour  
• Correct hypovolaemia |
| **Decelerations<sup>9</sup>**  | • Reposition  
• Assess for passage of meconium if membranes ruptured  
• Correct hypotension |
| **Additional measures<sup>8</sup>**  | • Consider:  
  o Transition to CEFM  
  o Expediting birth<sup>8</sup> |

### 3.5 Mode of continuous monitoring

Table 7. Modes of Cardiotocography

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| **External**          | • Uses external Doppler US to monitor fetal heart rate and pressure transducers strapped to the abdomen to monitor uterine contractions<sup>17</sup>  
• Requires physical attachment to CTG machine  
• Associated with high false positive results and inconsistent FHR tracing interpretations<sup>6</sup> |
| **Telemetry**         | • When available:<sup>22</sup>  
  o Improves mobility  
  o Aides analgesic positioning  
  o May be used in water  
• May have increased artefact (e.g. maternal pulse/FHR confusion) |
| **Internal Fetal Scalp Electrode(FSE)** | • May be used when external monitoring is unable to be used or when the signal quality is poor<sup>15</sup>  
• Requires rupture of membranes, cervical dilation 2–3 cm and cephalic or breech presentation  
• Requires relative certainty of fetal head position to avoid placement in fontanelles, eyes, sutures or other structures<sup>23,24</sup>  
• Contraindications:  
  o Same as for FBS [Refer to Table 14. Intrapartum fetal blood sampling]  
• Risks:  
  o Same as for FBS [Refer to Table 14. Intrapartum fetal blood sampling] |
3.6 Management during cardiotocography

Table 8. Cardiotocography

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| Good practice point                         | • Review CTG trace every 15–30 minutes depending on stage of labour Refer to Queensland Clinical Guideline Normal birth\(^7\)  
  • Use systematic method for interpretation and intervention including:  
    o Contractions  
    o Baseline, baseline variability, accelerations, decelerations  
    o Other findings and relevant information  
    o Category of trace  
    o Plan of action  
  • Differentiate between maternal pulse and FHR by:  
    o Palpating maternal pulse simultaneously with FHR when CEFM applied and every 30 minutes in labour during a contraction\(^8,11\) |
| Machine settings                            | • Ensure:  
  o Paper speed of 1 cm per minute  
  o Validated date and time settings  
  • Note: Machines from different manufacturers use different vertical axis scales and this can change the perception of FHR variability\(^1\) |
| CTG labelling and documentation\(^1,14\)     | • Include:  
  o Woman’s name  
  o Hospital record number  
  o Date and time of commencement  
  o Maternal observations including heart rate  
  o Contemporaneous noting of any intrapartum events that may affect the FHR (e.g. VE, obtaining FBS, insertion/top-up of an epidural)  
  o Interpretation of trace  
  o Date, time and signatures |
| Communication                                | • Keep woman informed of CTG findings  
  • Include CTG interpretation in bedside handover between clinicians\(^14\) |
| CTG storage of thermal paper images (when electronic storage not available) | • Keep the original in a labelled envelope with the medical record  
  • Include a photocopy\(^25\) when:  
    o There has been significant morbidity for the baby related to labour  
    o Neonatal death or intrapartum stillbirth  
    o Apgar score less than or equal to 5 after 5 minutes  
    o Vaginal birth requiring active resuscitation of neonate including intermittent positive pressure ventilation by bag and mask or intubation and or cardiac massage (i.e. more than suction)  
    o Category 1 CS |
3.6.1 Special Considerations

Table 9. Multiple pregnancy and preterm labour

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Consideration</th>
</tr>
</thead>
</table>
| **Multiple pregnancy** | - Use twin/triplet CTG machine (where available) or separate machines for each fetus  
- Identify and confirm each FHR by assessing and documenting each fetal position and ensuring cables for each fetus are correctly identified  
- Confirm each fetus is being recorded separately according to local protocols  
- Monitor presenting fetus by external Doppler US or FSE if membranes ruptured and second by external Doppler ultrasound  
- Confirm maternal heart simultaneously with both fetal hearts during a contraction |
| **Preterm labour**   | - Preterm fetus:  
  o Physiological control of FHR and resultant CTG trace interpretation differs compared with the term baby, especially at gestations less than 28 weeks  
  o Has lower reserves  
  o Has reduced ability to withstand persistent intrapartum insults  
  o Requires early identification and management of hypoxia  
  o CEFM:  
    o Not recommended at less than 24 weeks gestation  
      ▪ May have more accelerations and decelerations and higher baseline variability  
    o Clinical utility uncertain between 24 weeks and 28 weeks gestation  
      ▪ Absence of high variability or accelerations not abnormal  
    o Has poor positive predictive value  
    o Variation to interpretation can lead to unnecessary intervention  
  o Recommended in labour after 28 weeks  
- Interpretation:  
  o Refer to Table 11. Description of normal FHR  
  o Requires expert clinician input  
  o Refer to Queensland Clinical Guideline Preterm labour and birth and Queensland Clinical Guideline Perinatal care at the threshold of viability |
4 Cardiotocograph

4.1 Features in labour

Table 10. Features of CTG

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiology</td>
<td>• The heart rate pattern, level of activity, and degree of muscular tone of the fetus are all sensitive to hypoxemia and acidemia</td>
</tr>
<tr>
<td></td>
<td>• The FHR is normally controlled by the central nervous system and mediated by sympathetic or parasympathetic nerve impulses originating in the fetal brainstem</td>
</tr>
<tr>
<td></td>
<td>• The presence of intermittent FHR accelerations associated with fetal movement is believed to be an indicator of adequate oxygenation sufficient to maintain normal fetal autonomic nervous system function</td>
</tr>
<tr>
<td></td>
<td>• Factors including prematurity, fetal sleep-wake cycle, maternal medications, and fetal central nervous system abnormalities can also impact biophysical parameters</td>
</tr>
<tr>
<td>Characteristics of maternal heart rate</td>
<td>• Baseline maternal heart rate significantly lower than baseline FHR</td>
</tr>
<tr>
<td></td>
<td>• Maternal 'accelerations':</td>
</tr>
<tr>
<td></td>
<td>o Uniform and rounded off</td>
</tr>
<tr>
<td></td>
<td>o Increases in rate occur at beginning of contraction or pushing effort</td>
</tr>
<tr>
<td></td>
<td>• Fetal accelerations:</td>
</tr>
<tr>
<td></td>
<td>o Differ in duration</td>
</tr>
<tr>
<td></td>
<td>o Have irregular shape</td>
</tr>
<tr>
<td></td>
<td>o Are asymmetric</td>
</tr>
<tr>
<td></td>
<td>o Occur at variable intervals</td>
</tr>
</tbody>
</table>
### 4.2 Normal CTG

Table 11. Description of normal FHR

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Consideration</th>
</tr>
</thead>
</table>
| **Baseline FHR**<sup>1,5</sup> | • Is a resting heart rate not a sleeping rate  
• Is assessed in the absence of fetal movement, accelerations, uterine activity and decelerations  
• It is determined over a time period of 5 or 10 minutes and expressed as beats per minute (bpm)  
• Is more likely to be at the upper limits of normal in a very premature fetus and at the lower limits in a mature or post mature fetus |
| **Baseline variability**<sup>1,6</sup> | • Minor fluctuations in FHR  
• Normal baseline variability shows cyclical fluctuations of 6–25 bpm  
• Assessed by estimating the difference in bpm between the highest peak and the lowest trough of fluctuation in one minute segments of the CTG trace  
• Represents an adequately oxygenated fetal central nervous system |
| **Accelerations**<sup>1</sup>    | • Transient increases in the FHR of 15 bpm or more above the baseline rate, lasting 15 seconds or more, at the baseline  
• Are a fetal response to stimulation  
• Commonly occur as a result of fetal movement  
• May be of lesser amplitude and shorter duration in a premature fetus than a mature fetus  
• Significance of no accelerations on an otherwise normal intrapartum CTG is unclear and may be related to the fetus moving less |
| **Term**<sup>1</sup>             | • Baseline FHR of 110–160 bpm  
• Normal baseline variability present  
• Accelerations may or may not be present  
• No decelerations |
| **Preterm**<sup>27</sup>        | • Baseline fetal heart at 20–24 weeks averages 155 bpm decreasing with advancing gestational age  
• Baseline rate will be around the upper limits of normal  
  • Tachycardia reduces with gestational age  
• Baseline variability may be reduced due to tachycardia in preterm fetus  
• Accelerations frequency and amplitude reduced before 30 weeks gestation and increase with advancing gestation  
• Decelerations (variable) occur more commonly than in term fetus |
### 4.3 Fetal compromise

Table 12. Compromised fetus

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal FHR patterns(^1,5,32)</td>
<td>• Refer Appendix B: Description of fetal heart rate patterns</td>
</tr>
<tr>
<td></td>
<td>• Fetus may be under-perfused</td>
</tr>
<tr>
<td></td>
<td>• May be due to reversible causes [Refer to Table 13. Reversible causes of abnormal CTG]</td>
</tr>
<tr>
<td></td>
<td>• Signs of fetal compromise may include:</td>
</tr>
<tr>
<td></td>
<td>o Reduction in fetal movements</td>
</tr>
<tr>
<td></td>
<td>o Passage of meconium into the amniotic fluid especially in the presence of FHR abnormalities(^33,34)</td>
</tr>
<tr>
<td>Identification(^1)</td>
<td>• Review clinical picture:(^1)</td>
</tr>
<tr>
<td></td>
<td>o Understand the total clinical picture including the indication for monitoring</td>
</tr>
<tr>
<td></td>
<td>o Consider progress of labour with regard to parity</td>
</tr>
<tr>
<td></td>
<td>o Review the clinical history including previous births and investigations</td>
</tr>
<tr>
<td></td>
<td>• Consider any medications including:</td>
</tr>
<tr>
<td></td>
<td>o Intravenous infusions</td>
</tr>
<tr>
<td></td>
<td>o Prescription drugs</td>
</tr>
<tr>
<td></td>
<td>o Over the counter (OTC)</td>
</tr>
<tr>
<td></td>
<td>o Complementary therapies</td>
</tr>
<tr>
<td></td>
<td>o Illicit drugs</td>
</tr>
<tr>
<td></td>
<td>• Review the trace prior to (including antenatal period) and following the abnormality as this is informative in terms of fetal well being</td>
</tr>
<tr>
<td>Interventions</td>
<td>• Identify and review and where required escalate findings of CTG trace(^1,8) with reference to Appendix A: Interpretation of CTG</td>
</tr>
<tr>
<td></td>
<td>• Document as per Table 8. Cardiotocography</td>
</tr>
<tr>
<td></td>
<td>• Identify reversible causes and initiate potential corrective actions based on the possible contributing factors to the abnormal CTG [Refer to Table 13.]</td>
</tr>
<tr>
<td></td>
<td>o Identification and management of reversible FHR abnormalities may prevent unnecessary interventions(^1)</td>
</tr>
<tr>
<td></td>
<td>• Consider further fetal evaluation when CTG features suggestive of:</td>
</tr>
<tr>
<td></td>
<td>o Likely fetal compromise</td>
</tr>
<tr>
<td></td>
<td>o Fetal compromise and abnormality persisting after correcting reversible causes(^1)</td>
</tr>
<tr>
<td></td>
<td>• FBS if in first stage or early second stage (i.e. vaginal birth not imminent)(^1,35)</td>
</tr>
<tr>
<td></td>
<td>o Refer to Table 14. Intrapartum fetal blood sampling</td>
</tr>
<tr>
<td></td>
<td>• Expedite birth(^1) by instrument or CS where:</td>
</tr>
<tr>
<td></td>
<td>o FBS unavailable(^1)</td>
</tr>
<tr>
<td></td>
<td>o CTG indicates:</td>
</tr>
<tr>
<td></td>
<td>• Further assessment required and FBS contraindicated</td>
</tr>
<tr>
<td></td>
<td>• Clinically inappropriate (e.g. prolonged bradycardia less than 100 bpm for greater than 5 minutes)</td>
</tr>
</tbody>
</table>
### 4.4 Management of reversible causes of abnormal CTG

**Table 13. Reversible causes of abnormal CTG**

<table>
<thead>
<tr>
<th>Possible cause of abnormal CTG</th>
<th>Potential contributing factors</th>
<th>Possible corrective actions</th>
</tr>
</thead>
</table>
| Cord compression or reduced placental perfusion | - Maternal position  
- Maternal hypotension  
- Vaginal examination  
- Bedpan use  
- Vomiting or vasovagal episode  
- Epidural siting or top up  
- Rupture of membranes | - Advise maternal position change (encourage adoption of left lateral position)\(^2,21\)  
- If hypotensive: give 500 mL of Crystalloid (maximum 1000 mL)\(^2,8\)  
- Consider VE to exclude cord prolapse or presentation\(^2\) |
| Uterine hyperstimulation (tachysystole or hypertonus) | - Oxytocin infusion  
- Recent vaginal prostaglandins insertion | - Stop Oxytocin infusion\(^2,21\) while reassessing labour and fetal state  
- Remove Prostaglandins (PGE\(_2\)/Cervidil)  
  - Refer to Queensland Clinical Guideline Induction of labour\(^2,21\)  
  - Terbutaline 250 micrograms subcutaneously or intravenously (IV)\(^1,2,11\)  
  - Sublingual Glyceryl Trinitrate* (GTN) spray 400 micrograms\(^1\)  
  - Salbutamol 100 micrograms IV\(^1\) |
| Maternal tachycardia/ pyrexia | - Maternal infection  
- Dehydration  
- Anxiety/pain may cause tachycardia without pyrexia | - If temperature greater than 38°C undertake screening and treatment  
- If dehydrated: give 500 mL Crystalloid\(^2\) |
| Inadequate quality of CTG | - Poor contact from external transducer  
- FSE not working or detached | - Check maternal pulse  
- Reposition external transducer/FSE  
- Consider applying FSE\(^36\) |

*Not currently listed on the Queensland Health List of Approved Medications (LAM)
## 5 Intrapartum fetal blood sampling

Table 14. Intrapartum fetal blood sampling

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Context</strong></td>
<td>• Facilities using CEFM are encouraged to have access to FBS facilities to improve definitive diagnosis of fetal compromise</td>
</tr>
<tr>
<td></td>
<td>• Where available, FBS is undertaken in the presence of a FHR trace which remains abnormal despite appropriate corrective actions</td>
</tr>
<tr>
<td></td>
<td>• Scalp sampling aims to provide:</td>
</tr>
<tr>
<td></td>
<td>o Additional physiological information to that implicit in the CTG</td>
</tr>
<tr>
<td></td>
<td>o Information that will confirm the suspicion of fetal compromise or provide the reassurance necessary to allow labour to continue</td>
</tr>
<tr>
<td></td>
<td>• FBS sampling may reduce the CS rate</td>
</tr>
<tr>
<td><strong>Indications</strong></td>
<td>• Abnormal CTG in first or second stage of labour</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>• Not generally recommended for pregnancies less than 34 weeks</td>
</tr>
<tr>
<td></td>
<td>• CTG suggestive of serious sustained fetal compromise (e.g. prolonged bradycardia greater than 5 minutes)</td>
</tr>
<tr>
<td></td>
<td>• Fetal bleeding disorders (e.g. suspected fetal thrombocytopenia, haemophilia)</td>
</tr>
<tr>
<td></td>
<td>• Breech, face or brow presentation</td>
</tr>
<tr>
<td></td>
<td>• Maternal infection* (e.g. HIV, hepatitis B, hepatitis C, herpes simplex virus and intrauterine sepsis)</td>
</tr>
<tr>
<td></td>
<td>o *Group B Streptococcus carrier does not preclude FBS</td>
</tr>
<tr>
<td><strong>Risks</strong></td>
<td>• Eyelid laceration</td>
</tr>
<tr>
<td></td>
<td>• Neonatal scalp abscess and ulceration</td>
</tr>
<tr>
<td></td>
<td>• Neonatal subarachnoid penetration</td>
</tr>
<tr>
<td></td>
<td>• Acute meningoencephalitis</td>
</tr>
<tr>
<td><strong>Sample collection</strong></td>
<td>• Cervix must be adequately dilated (greater than 4 cm) and membranes ruptured</td>
</tr>
<tr>
<td></td>
<td>• Positioned:</td>
</tr>
<tr>
<td></td>
<td>o Left lateral position or lithotomy with a wedge in place to avoid inferior vena cava syndrome or supine hypotension syndrome</td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td>• FBS is interpreted taking into account:</td>
</tr>
<tr>
<td></td>
<td>o Any previous FBS value, rate of progress in labour and other clinical circumstances</td>
</tr>
<tr>
<td></td>
<td>• Repeat in 30 minutes if the FHR trace remains abnormal despite a normal FBS result</td>
</tr>
<tr>
<td></td>
<td>• Stable FBS sample after second test (lactate or pH remains unchanged)</td>
</tr>
<tr>
<td></td>
<td>o Further testing may be deferred unless additional abnormal features are seen</td>
</tr>
</tbody>
</table>
### 5.1 Interpretation of fetal blood sampling results

#### Table 15. Intrapartum fetal blood sampling results

<table>
<thead>
<tr>
<th>Interpretation</th>
<th>pH (units)</th>
<th>*Lactate (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Greater than or equal to 7.25</td>
<td>Less than 4.2</td>
</tr>
<tr>
<td>Borderline: Repeat in 30 mins</td>
<td>7.21 to 7.24</td>
<td>4.2 to 4.8</td>
</tr>
<tr>
<td>Abnormal: Birth expedited</td>
<td>Less than or equal to 7.20</td>
<td>Greater than 4.8</td>
</tr>
</tbody>
</table>

#### 5.1.1 *Special considerations for fetal scalp lactate measurements*
- Use of scalp lactate rather than pH measurement provides an easier and more affordable adjunct to CEFM for some units.
- Is as effective as scalp pH in predicting fetal outcomes.
- Has a strong negative predictive value for fetal acidemia at birth.
- Requires local decision making to set absolute parameters for interpretation of lactate values as results may vary between machines.
- Requires due diligence with regard to calibration of machine and transcription of results.
6 Paired umbilical cord blood gas or lactate analysis

Table 16. Paired umbilical cord sampling

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Consideration</th>
</tr>
</thead>
</table>
| **Context** | • Collection and analysis of paired cord blood samples allows the detection of respiratory and metabolic acidosis if present at birth \(^{41}\)  
  • Umbilical artery blood:  
    o Provides most accurate information regarding fetal and newborn acid-base \(^{2}\)  
    o Is a tool for quality control of obstetric care \(^{42}\)  
  • Umbilical venous blood reflects maternal acid-base status and placental function  
  • Involves sampling both:  
    o Umbilical artery (UA)—smaller lumen, thicker wall and contains less blood  
    o Umbilical vein (UV) \(^{43}\)  
  • Deferred sampling with or without cord clamping is possible \(^{44,42}\)  
  • Studies inconsistent regarding timing of sampling with or without clamping and cord blood gas results \(^{42,45-48}\)  
  • Procedure as per local practice within 30 minutes of birth |
| **Indications** \(^{1,2,49}\) | • Preterm gestation  
  • Multiple pregnancy  
  • Intrapartum fever (temperature greater than or equal to 38°C)  
  • Meconium stained liquor  
  • Breech birth  
  • Shoulder dystocia  
  • Fetal scalp sampling performed in labour  
  • Operative birth for suspected fetal compromise  
  • Small for gestational age baby /FGR  
  • Intrapartum haemorrhage  
  • Abnormal CTG  
  • Neonatal resuscitation required or Apgar score:  
    o Less than 4 at one minute  
    o Less than 7 at five minutes  
  • All emergency CS  
  • Other at clinician discretion |
| **Interpretation** | • Confirm one venous and one arterial sample  
  • Arterial pH will be less than venous pH (at least 0.022 units)  
  • Arterial pCO2 will be greater than venous pCO2 (at least 5.3 mmHg) \(^{51}\)  
  • Cord blood gas values may vary according to:  
    o Gestation  
    o Type of birth  
    o Time after birth \(^{42,44}\)  
    o Prior pH and lactate \(^{47}\)  
  • Delayed cord clamping occurring when pulsations have ceased spontaneously has significant effect on acid-base parameters in arterial and venous blood in vigorous newborns including \(^{46}\):  
    o Umbilical cord blood gases  
    o Bicarbonate (HCO\(_3\)\(^{-}\))  
    o Base excess (BE)  
    o Lactate  
  • Umbilical arterial and venous lactate levels may be higher from intrapartum scalp lactate levels following vaginal birth because of lactic acid accumulation  
  • Lactate levels are directly associated with gestation and length of second stage of labour  
  • Arterial lactate levels up to 7.5 mmol/L can be normal  
  • Arterial lactate should be 0.6 mmol/L greater than the venous level \(^{50}\) |
Table 17 Cord blood sampling outcome

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management and audit</td>
<td>• Document result as per local protocol</td>
</tr>
<tr>
<td></td>
<td>• Resuscitate baby as per Queensland Clinical Guideline Neonatal Resuscitation</td>
</tr>
<tr>
<td></td>
<td>• Sampling should not interfere with management of the third stage of labour when undertaken as part of a clinical audit regimen</td>
</tr>
<tr>
<td></td>
<td>• Universal umbilical cord blood gas analysis independent of obstetric intervention is associated with a reduction in:</td>
</tr>
<tr>
<td></td>
<td>○ Incidence of acidaemia</td>
</tr>
<tr>
<td></td>
<td>○ Incidence of lactic acidaemia at birth</td>
</tr>
<tr>
<td></td>
<td>○ Neonatal nursery admissions</td>
</tr>
</tbody>
</table>

6.1 Normal cord blood values

Table 18 Normal cord blood gas and lactate (at birth)

<table>
<thead>
<tr>
<th>At term</th>
<th>pH</th>
<th>Base Excess (mmol/L)</th>
<th>pO₂ (mmHg)</th>
<th>pCO₂ (mmHg)</th>
<th>Lactate (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA</td>
<td>7.10 to 7.38</td>
<td>-9.0 to 1.8</td>
<td>4.1 to 31.7</td>
<td>39.1 to 73</td>
<td>Less than 6.1</td>
</tr>
<tr>
<td>UV</td>
<td>7.22 to 7.44</td>
<td>-7.7 to 1.9</td>
<td>30.4 to 57.2</td>
<td>14.1 to 43.3</td>
<td></td>
</tr>
</tbody>
</table>

7 Other methods of fetal monitoring

There is currently insufficient evidence to recommend fetal surveillance during labour by:

- Fetal electrocardiogram (ECG) including ST analysis
- Fetal pulse oximetry
- Near infrared spectroscopy
- Intrauterine pressure catheters
References


## Appendix A: Interpretation of CTG

<table>
<thead>
<tr>
<th>Classification</th>
<th>Baseline</th>
<th>Variability</th>
<th>Decelerations</th>
<th>Accelerations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normal</strong></td>
<td><strong>GREEN</strong></td>
<td>110–160 bpm</td>
<td>Nil</td>
<td>15 bpm* for 15 seconds</td>
<td><strong>Nil</strong></td>
</tr>
<tr>
<td><strong>Low probability fetal compromise</strong></td>
<td></td>
<td>6–25 bpm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unlikely fetal compromise</strong></td>
<td><strong>BLUE</strong></td>
<td>100–109 bpm</td>
<td>Early OR Variable</td>
<td>Absent*</td>
<td>Continue CTG</td>
</tr>
<tr>
<td><strong>May be fetal compromise</strong></td>
<td><strong>YELLOW</strong></td>
<td>&gt; 160 bpm OR Rising</td>
<td>Complicated variable** OR Late</td>
<td>Correct reversible causes</td>
<td></td>
</tr>
<tr>
<td><strong>Abnormal</strong></td>
<td></td>
<td>3–5 bpm for &gt; 30 minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Likely fetal compromise</strong></td>
<td><strong>RED</strong></td>
<td>&lt; 100 bpm for &gt; 5 minutes</td>
<td>&lt; 3 bpm for &gt; 30 minutes OR Sinusoidal</td>
<td>FBS OR Expedite birth</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Persistent <strong>YELLOW</strong> = <strong>RED</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>NOTES:</strong></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <em>Significance of accelerations/no accelerations in an otherwise normal CTG is unclear</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. <strong>Complicated Variable features:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Slow return to baseline FHR after the end of the contraction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Large amplitude (&gt; 60 bpm) and/or long duration (&gt; 60 seconds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Presence of post deceleration smooth overshoots*</td>
<td></td>
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<td>3. All abnormal CTGs require further evaluation and management taking into account:</td>
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<tr>
<td>- Full clinical picture</td>
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<tr>
<td>- Identification of reversible causes</td>
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<tr>
<td>- Initiation of appropriate action including FBS and expediting birth if abnormality persist</td>
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<td>4. Follow local escalation procedures to senior midwifery and obstetric staff when CTG abnormal</td>
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</tbody>
</table>

Adapted from: RANZCOG (2014) Intrapartum Fetal Surveillance Guidelines1, NICE (2014) Interpretation of cardiotocograph traces2 K2 Medical Systems Fetal Monitoring Training System3

**Abbreviations:** bpm beats per minute; > greater than; ≥ greater than or equal to; < less than; CTG cardiotocograph; FBS fetal blood sample; FHR Fetal heart rate
## Appendix B: Description of fetal heart rate patterns

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definition and description</th>
<th>Possible causes</th>
</tr>
</thead>
</table>
| Baseline fetal heart rate    | • Mean level of the FHR<sup>1</sup>  
• Determined over a time period of 5 or 10 minutes and expressed as beats per minute (bpm)  
• Assessed in the absence of fetal movement (accelerations), uterine activity and decelerations  
• Resting heart rate not sleeping heart rate | • A trend to a progressive rise in the baseline is important as well as the absolute values  
• Heart rate may rise slightly and baseline variability may be reduced (or occasionally absent) in a sleeping fetus<sup>5</sup> |
| Normal baseline fetal heart rate | • FHR 110-160 bpm                                                                         | • Premature fetus—baseline rate will be around the upper limits of this range  
• Mature or post mature fetus—baseline rate around the lower limits of the normal range  
• Baseline fetal heart rate within normal range does not imply intrinsically well fetus  
• Features around a baseline, in particular baseline variability, and also accelerations define fetal wellbeing<sup>5</sup> |
| Baseline bradycardia         | • FHR less than 110 bpm                                                                     | • Low inherent rate (e.g. mature fetus)  
• Maternal hypotension  
• Prolonged cord compression  
• Drugs (e.g. high dose beta blockers)  
• Conduction defects or heart block in the fetus  
• Profound fetal hypoxia due to:  
• Prolonged cord depression  
• Maternal hypotension  
• Hypoxia  
• Acute utero-placental insufficiency due to placental abruption or uterine hyperstimulation<sup>5</sup> |
| Baseline tachycardia         | • FHR greater than 160 bpm                                                                  | • Maternal fever/infection  
• Fetal infection i.e. chorioamnionitis  
• Medications e.g. Salbutamol or Terbutaline  
• Maternal medical disorders<sup>56</sup> (e.g. diabetes<sup>57</sup>)  
• Obstetric conditions e.g. bleeding  
• Fetal tachyarrhythmia e.g. Supraventricular Tachycardia (SVT)  
• Very premature fetus<sup>1</sup> |
**Terms** | **Definition and description** | **Possible causes**
--- | --- | ---
**Baseline variability** | • Minor fluctuations in baseline FHR • Assessed by estimating the difference in bpm between the highest peak and the lowest trough of fluctuation in one minute segments of the CTG trace | • Physiological response • Most important feature of the CTG in terms of fetal wellbeing

**Normal baseline variability** | • 6–25 bpm between contractions | • Normal physiological response • Low probability of fetal compromise

**Reduced baseline variability** | • 3–5bpm* for greater than 30 minutes *Exercise caution when interpreting with an external transducer | • Deep fetal sleep • Drugs/medication • Maternal opioid administration • Other medications (e.g. Magnesium Sulphate) • May be associated with significant fetal compromise and require further action

**Absent baseline variability** | • Less than 3 bpm | • Likely to be associated with significant fetal compromise • Require immediate assessment and management • May require urgent birth

**Increased baseline variability** | • Variability greater than 25 bpm | • May be caused by acute hypoxia or mechanical compression of the umbilical cord • Interpreted with reference to entire clinical picture

**Sinusoidal** | • Oscillating pattern—smooth and regular resembling sine wave • Smooth undulating persistent pattern • Relatively fixed period of 2–5 cycles per minute and amplitude of 5–15 bpm above and below the baseline • Baseline variability absent • No accelerations | • Severe anaemia–haemoglobin (Hb) less than 50 gm/L • Reduced fetal movements may be present

**Pseudo–sinusoidal** | • False sinusoidal pattern • Not as smooth or regular • Has some period of normal baseline variability and accelerations | • Fetal thumb sucking

**Accelerations** | • Transient increases in FHR of 15 bpm or more above the baseline and lasting 15 seconds • May be of lesser amplitude and shorter duration in the preterm fetus | • Low probability of fetal compromise

**No accelerations** | • FHR does not rise above the baseline | • Significance in an otherwise normal CTG is unclear
<table>
<thead>
<tr>
<th>Terms</th>
<th>Definition and description</th>
<th>Possible causes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Decelerations</strong></td>
<td>• Transient episodes:</td>
<td>• Dependent on the variant&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>o Decrease in FHR of more than 15 bpm below the baseline</td>
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<tr>
<td></td>
<td>o Lasting 15 seconds or more</td>
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<tr>
<td><strong>Early decelerations</strong></td>
<td>• Uniform repetitive decrease of FHR</td>
<td>• Head compression resulting in mild increase in intracranial compression&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Slow onset early in the contraction</td>
<td>• Typically occur in sleep phase</td>
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<tr>
<td></td>
<td>• Slow return to baseline by the end of the contraction</td>
<td>• Reflect a well oxygenated fetus</td>
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<tr>
<td></td>
<td>• Often associated with reduced or absent baseline variability</td>
<td></td>
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<tr>
<td><strong>Variable decelerations</strong></td>
<td>• Repetitive or intermittent decreasing of FHR</td>
<td>• Cord compression during contraction</td>
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<tr>
<td></td>
<td>• Relative to uterine activity vary in:</td>
<td>• Significance depends on:</td>
</tr>
<tr>
<td></td>
<td>o Depth</td>
<td>o Overall clinical picture</td>
</tr>
<tr>
<td></td>
<td>o Duration</td>
<td>o Specific features of the decelerations themselves</td>
</tr>
<tr>
<td></td>
<td>o Timing</td>
<td>o Other features of the CTG&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Typically rapid descent and rapid recovery</td>
<td></td>
</tr>
<tr>
<td><strong>Complicated variable decelerations</strong></td>
<td>• Slow return to baseline FHR after the end of the contraction</td>
<td>• Cord compression resulting in hypoxia with depth reflecting degree of hypoxia</td>
</tr>
<tr>
<td></td>
<td>• Large amplitude (&gt; 60 bpm) and/or long duration (&gt; 60 seconds)</td>
<td>• During a contraction</td>
</tr>
<tr>
<td></td>
<td>• Presence of post deceleration smooth overshoots&lt;sup&gt;5&lt;/sup&gt;</td>
<td>• Breadth reflects length of cord compression and not necessarily fetal condition&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Late decelerations</strong></td>
<td>• Uniform and repetitive decreasing of FHR</td>
<td>• Transient or chronic utero-placental insufficiency (acute or chronic hypoxia) including&lt;sup&gt;5,6&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Usually slow onset from mid to end of the contraction</td>
<td>o Uterine contractions</td>
</tr>
<tr>
<td></td>
<td>• Nadir more than 20 seconds after the peak of the contraction</td>
<td>o Maternal hypotension from epidural</td>
</tr>
<tr>
<td></td>
<td>• Ends after the contraction</td>
<td>o Uterine tachysystole</td>
</tr>
<tr>
<td></td>
<td>• Includes decelerations less than 15 bpm when non-accelerative trace with baseline variability less than 5 bpm</td>
<td>o Maternal hypoxia</td>
</tr>
<tr>
<td></td>
<td>• Decrease of FHR below the baseline for longer than 90 seconds but less than 5 minutes</td>
<td>• Cord compression&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Prolonged decelerations</strong></td>
<td></td>
<td>• Prolonged contractions</td>
</tr>
<tr>
<td><strong>Prolonged fetal bradycardia</strong></td>
<td></td>
<td>• Uterine hypersystole</td>
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<tr>
<td></td>
<td></td>
<td>• Supine hypotension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Post-epidural insertion</td>
</tr>
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<td></td>
<td></td>
<td>• Vaginal examination</td>
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<tr>
<td></td>
<td></td>
<td>• Placental abruption</td>
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<tr>
<td></td>
<td></td>
<td>• Ruptured uterus</td>
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<tr>
<td></td>
<td></td>
<td>• Supine hypotension</td>
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<tr>
<td></td>
<td></td>
<td>• Hypotension caused by epidural or spinal anaesthesia&lt;sup&gt;5,6&lt;/sup&gt;</td>
</tr>
<tr>
<td>Term</td>
<td>Definition and description</td>
<td>Possible causes</td>
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<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
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<tr>
<td>Pre and post deceleration shouldering</td>
<td>• The FHR then pushes above, before returning, to the baseline(^5,56)</td>
<td>• Normal physiological response to acute hypoxia and possibly hypertension and hypotension</td>
</tr>
<tr>
<td></td>
<td>• Reflects well oxygenated fetus</td>
<td>• Generated by sequential cord compression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Loss of pre and post deceleration shouldering: May reflect a fetus no longer responding appropriately to physiological insults(^5,56)</td>
</tr>
<tr>
<td>Smooth post deceleration overshoots</td>
<td>• Temporary smooth rise in the FHR beyond the baseline rate</td>
<td>• Cord compression resulting in response to reduced oxygenation in the fetus(^5)</td>
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<td></td>
<td>• FHR returns to baseline after the oxygen deficit has been corrected</td>
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<tr>
<td></td>
<td>• Associated rising baseline or baseline tachycardia and reducing baseline variability if uterine activity consistent and fetal oxygen requirements unchanged</td>
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<tr>
<td>Fetal arrhythmia</td>
<td>• Uncommon</td>
<td>• Aetiology: may be complex or benign irregularly irregular making CTG machine interpretation difficult(^5)</td>
</tr>
</tbody>
</table>
Acknowledgements

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