South Australian Perinatal Practice Guideline

Fetal Surveillance (Cardiotocography)

Note:

This guideline provides advice of a general nature. This statewide guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. The guideline is based on a review of published evidence and expert opinion.

Information in this statewide guideline is current at the time of publication.

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Health practitioners in the South Australian public health sector are expected to review specific details of each patient and professionally assess the applicability of the relevant guideline to that clinical situation.

If for good clinical reasons, a decision is made to depart from the guideline, the responsible clinician must document in the patient's medical record, the decision made, by whom, and detailed reasons for the departure from the guideline.

This statewide guideline does not address all the elements of clinical practice and assumes that the individual clinicians are responsible for discussing care with consumers in an environment that is culturally appropriate and which enables respectful confidential discussion. This includes:

- The use of interpreter services where necessary,
- Advising consumers of their choice and ensuring informed consent is obtained,
- Providing care within scope of practice, meeting all legislative requirements and maintaining standards of professional conduct, and
- Documenting all care in accordance with mandatory and local requirements

Explanation of the aboriginal artwork:
The aboriginal artwork used symbolises the connection to country and the circle shape shows the strong relationships amongst families and the aboriginal culture. The horse shoe shape design shown in front of the generic statement symbolises a woman and those enclosing a smaller horse shoe shape depicts a pregnant women. The smaller horse shoe shape in this instance represents the unborn child. The artwork shown before the specific statements within the document symbolises a footprint and demonstrates the need to move forward together in unison.

Australian Aboriginal Culture is the oldest living culture in the world yet Aboriginal people continue to experience the poorest health outcomes when compared to non-Aboriginal Australians. In South Australia, Aboriginal women are 2-5 times more likely to die in childbirth and their babies are 2-3 times more likely to be of low birth weight. The accumulative effects of stress, low socio economic status, exposure to violence, historical trauma, culturally unsafe and discriminatory health services and health systems are all major contributors to the disparities in Aboriginal maternal and birthing outcomes. Despite these unacceptable statistics the birth of an Aboriginal baby is a celebration of life and an important cultural event bringing family together in celebration, obligation and responsibility. The diversity between Aboriginal cultures, language and practices differ greatly and so it is imperative that perinatal services prepare to respectively manage Aboriginal protocol and provide a culturally positive health care experience for Aboriginal people to ensure the best maternal, neonatal and child health outcomes.

Purpose and Scope of Perinatal Practice Guideline (PPG)

The purpose of this guideline is to provide clinicians with information on the rationale for and use of cardiotocography (CTG) to monitor fetal heart rate (FHR) in both antenatal and intrapartum environments. It also provides clinicians with information on the interpretation of FHR patterns and associated management in the context of abnormal FHR recordings, including referral for advice.

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Table 1: Indications for performing a CTG in the Antenatal Period

Indications for CTG
Abdominal trauma
Abnormal Doppler umbilical artery velocimetry
Abnormal Doppler studies
Antepartum haemorrhage (in excess of a 'show' ≥ 50mL)
Diabetes requiring stabilisation
Intrauterine Growth Restriction (suspected or confirmed)
Known fetal abnormality that requires monitoring
Maternal medical condition that constitutes a significant risk of fetal compromise
Maternal Obstetric condition (e.g. cholestasis)
Oligohydramnios (Amniotic fluid index (AFI) <5cm)
Polyhydramnios (Amniotic fluid index (AFI) > 25 cm)
PPRoM (>24 hours)
Prolonged pregnancy ≥ 42 weeks
Previously abnormal antenatal CTG
Prior to and following attempted external cephalic version (ECV)
Reduced fetal movements
Rhesus isoimmunisation
Severe hypertension or preeclampsia

Table 2: Indications for Intrapartum CTG Monitoring[3]

Antenatal Indications for Intrapartum CTG
Abnormal antenatal CTG
Abnormal cerebroplacental ratio ** (recommended by RANZCOG[1] but remains experimental)
Abnormal Doppler umbilical artery velocimetry
Abnormal maternal serum screening results associated with an increased risk of poor perinatal outcome (e.g. PAPP-A <0.37 MoM) **
Abnormal placental cord insertion (e.g. velamentous cord insertion) **
Antepartum Haemorrhage
Diabetes (on medication, or poorly controlled or fetal macrosomia)
Hypertension / preeclampsia (current pregnancy)
Intrauterine growth restriction (suspected or confirmed)
Known fetal anomaly which requires monitoring
Maternal age ≥ 42 years **
Maternal medical conditions that constitute a significant risk of fetal compromise (e.g. severe anaemia, cardiac disease, cholestasis, hyperthyroidism, renal disease, iso-immunisation, substance abuse, vascular disease)
Morbid obesity (BMI ≥40)
Multiple pregnancy
Oligohydramnios or polyhydramnios
Reduced fetal movements (within preceding week unless investigated and FM now normal)
Uterine scar / previous caesarean section
Indications at the Onset of Labour
Breech presentation
Post-term pregnancy (≥ 42^{+0} weeks)
Preterm labour
Prolonged rupture of membranes (≥ 24 hours)
Labour Indications for Intrapartum CTG
Absent liquor following amniotomy
Chorioamnionitis
FHR abnormalities on auscultation (bradycardia, tachycardia, decelerations)
Maternal pyrexia ≥ 38 ˚C
Meconium-stained or blood-stained liquor
Prolonged active first stage labour (> 12 hours regular uterine contractions with cervical dilatation > 3 cm)
Prolonged second stage of labour (> 1 hour active pushing)
Regional anaesthetic (epidural or spinal) (including just before insertion)
Uterine tachysystole, hypertonus or hyperstimulation
Vaginal bleeding in labour (in excess of a “show” ≥ 50 mL)
Indications associated with the use of interventions
Before and for at least 20 minutes after administration of prostaglandin or cervical-ripening balloon catheter
Use of oxytocin for either induction or augmentation of labour
Regional anaesthesia: epidural, spinal (including prior to and at the time of insertion)

** RANZCOG[1] include these indications, however if appropriate antenatal investigation / serial ultrasound / maternal investigation has been undertaken and is reassuring, then the woman and her unborn baby should not be inappropriately pathologised, and should be managed as ‘normal’ without the need for continuous CTG unless other indications are present or arise.

Table 3: RANZCOG definition and classification of fetal heart rate (FHR) using cardiotocography (CTG)[3]

Term	Definition
Baseline FHR	The mean of the stable FHR determined in the absence of uterine activity, fetal movements (accelerations) or decelerations over 5 to 10 minutes. Expressed in beats per minute (bpm) Calculated on resting heart rate, NOT sleeping heart rate *It is expected that the FHR of preterm fetuses may be in the upper range*
Normal baseline	FHR 110-160 bpm
Baseline bradycardia	FHR less than 110 bpm
Baseline tachycardia	FHR more than 160 bpm
Baseline variability	The minor baseline FHR fluctuations measured by estimating the difference in bpm between the highest peak and lowest trough of fluctuation in 1 minute segments of the CTG trace between contractions
Normal baseline variability	FHR fluctuates 6-25 bpm between contractions
Reduced baseline variability	FHR fluctuates 3-5 bpm for > 30 minutes
Absent baseline variability	FHR fluctuates less than 3 bpm
Increased baseline variability	FHR fluctuates > 25 bpm
Saltatory Pattern	FHR amplitude changes > 25 bpm with an oscillatory frequency > 6 per minute for a minimum of one minute in duration
Sinusoidal	A regular oscillation of the baseline FHR resembling a sine wave. Persistent, smooth and undulating pattern with relatively fixed period of 2-5 cycles per minute and amplitude of 5-15 bpm above and below the baseline. Baseline variability and FHR accelerations are absent
Accelerations	Transient increases in FHR of 15 bpm or more above the baseline and lasting 15 seconds *Accelerations in the preterm fetus may be of lesser amplitude and shorter duration*
Decelerations	Transient episodes of decrease of FHR below the baseline lasting at least 15 seconds and conforming to one of the patterns below:
Early decelerations	Uniform, repetitive decrease of FHR where there is a slow onset early in contraction with a slow return to baseline prior to the end of the contraction
Variable decelerations	Repetitive or intermittent decrease in FHR with rapid descent and rapid recovery. Timing may be variable but usually simultaneous with contractions
Complicated variable decelerations	Slow return to baseline FHR after the end of the contraction Large amplitude of > 60 bpm and/or long duration > 60 seconds Presence of smooth post deceleration overshoots (temporary smooth increase in FHR above baseline)
Late decelerations	Uniform, repetitive decreasing of FHR usually with slow onset mid to end of the contraction with nadir > 20 seconds after the peak of the contraction and ending after the contraction
Prolonged decelerations	Decrease of FHR below the baseline for > 90 seconds but < 5 minutes
Bradycardia	Decrease of FHR below the baseline for ≥ 5 minutes

Table 4: Definition and classification of fetal heart rate (FHR) using **STan Guidelines**[2]

Classification of CTG

The intended use of this CTG classification system is to suggest clinical conditions in which adjunctive use of ST waveform changes may aid the interpretation of specific CTG patterns.

	Baseline heart frequency	Variability Reactivity	Decelerations
Normal CTG	• 110–150 bpm	• Accelerations • 5–25 bpm	• Early uniform decelerations • Uncomplicated variable decelerations with a duration of <60 sec and loss of *<60 beats*
Intermediary CTG	• 100–110 bpm • 150–170 bpm • Short bradycardia episode (<100 bpm for ≤3 min)	• >25 bpm (saltatory pattern) • <5 bpm >40 min with absence of accelerations	• Uncomplicated variable decelerations with a duration <60 sec and loss of *>60 beats*
	A combination of several intermediary observations will result in an abnormal CTG		
Abnormal CTG	• 150–170 bpm and reduced variability • >170 bpm • Persistent bradycardia (<100 bpm for >3 min)	• <5 bpm for >60 min • Sinusoidal pattern	• Complicated variable decelerations with a duration of >60 sec • Repeated late uniform decelerations
Preterminal CTG	• Total lack of variability (<2 bpm) and reactivity with or without decelerations or bradycardia		

Table 5: Descriptors for documentation of CTG traces[7]

Baseline	Baseline rate and presence of any change
Variability of baseline	Language includes Normal, increased, reduced or absent
Accelerations	State: Present or absent
Decelerations	Four components: **Type**: early, late, prolonged or variable **Duration**: describe in time (seconds or minutes), include shortest and longest deceleration. Describe in detail. **Depth**: describe in bpm the depth of deceleration, compare shallowest to deepest **Frequency**: use terms regular or frequent, persistent or isolated
Uterine activity	Four components: • Strength • Duration • Frequency (per 10 minutes) • Any period of rest, hypertonia

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Summary of Practice Recommendations

CTG competency training is recommended for all practitioners and is mandated in SA.

Analysis of the CTG must be made using a combination of pattern recognition, review of the individual's woman's antenatal/intrapartum history, identification of any risk factors and consideration of fetal physiology.

Antenatal CTG implies that a pregnancy risk has been identified and medical referral is required.

Fetuses less than 32 weeks will not demonstrate a mature reactive pattern.

Intermittent auscultation is equally as effective as continuous CTG monitoring for low risk women in labour.

Continuous CTG is recommended when risk factors for fetal compromise are detected during pregnancy, at the onset of labour, or at any time during labour.

Continuous cardiotocography should not be used as a substitute for a midwife.

Maternal heart rate should be checked and recorded at the commencement of monitoring the fetus to ensure the CTG is monitoring FHR.

At all times a clinician must be assigned to observe the CTG whether in the room or via a centralised monitoring system.

Any abnormalities or non-reassuring/abnormal signs should be reported, and appropriate management initiated.

Abbreviations

ACOG	American College of Obstetricians and Gynaecologists
BMI	Body mass index
bpm	Beats per minute
cm	Centimetre
CTG	Cardiotocography
cCTG	Computerised cardiotocography
EFM	External fetal monitoring
ECG	Electrocardiogram
e.g.	For example
FBS	Fetal blood sampling
FHR	Fetal heart rate
FSE	Fetal scalp electrode
HIV	Human immunodeficiency virus
IP	Intrapartum
min	Minute
mL	Millilitre(s)
MoM	Multiples of the median
NICE	National Institute for Clinical Excellence
PAPP-A	Pregnancy associated plasma protein A
PPROM	Preterm prelabour rupture of membranes
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
RCOG	Royal College of Obstetricians and Gynaecologists
RCT	Randomised controlled trial
SA	South Australia
STAN	ST analysis

Cardiotocography (CTG)

Background Physiology

Cardiotocography (CTG) Is an electronic method of simultaneously recording fetal heart rate (FHR), fetal movements and uterine contractions as a method of assessing fetal well-being, predominantly in pregnancies with increased risk of complications[1,2,3]. The aim of the CTG is to identify the fetus(s) who may be hypoxic, to guide potential assessments of fetal wellbeing and mode of birth[1].

To accurately interpret a CTG a sound foundational knowledge of fetal physiology including fetal oxygenation is essential[4,5]. Key points to remember when interpreting a CTG are:

- A fetus is unable to increase its own oxygen supply. To prevent myocardial hypoxia and /or mechanical stress the fetus will decrease its heart rate[5, 6] which is heard as a deceleration.
- Fetal oxygenation is dependent on adequate utero-placental circulation and placental reserve[6].
- A fetus is able to protect itself from hypoxia in normal situations by:
    1. increasing O_2 delivery by stimulating the sympathetic nervous system to increase its heart rate and therefore flow through the placenta and increase O_2 uptake[7,8]
    2. increasing O_2 delivery to target organs, heart, brain and adrenal glands, by increasing sympathetic stimulation to redistribute blood flow[7,8]
    3. reducing O_2 consumption by decreasing movements[7,8]
- Fetal heart rate is controlled by both autonomic and somatic components of the central nervous system. Understanding the parasympathetic and sympathetic involvement in fetal heart rate control facilitates the practitioner to identify normal and abnormal features in the fetal heart rate pattern in the CTG recording[8]
- Chemoreceptors and baroreceptors within the carotid artery, aortic arch and brain stem also actively play a role in controlling the fetal heart by stimulating the sympathetic and parasympathetic nervous systems to help control fetal heart rate, cardiac output and blood pressure to maintain an environment that is optimal for the fetus to maintain functionality and oxygenation[7,8]
- A fetus generates energy from glucose, in the form of adenosine triphosphate (ATP)[9].
- A well oxygenated fetus has the following metabolism: Glucose →pyruvate →CO2 + H2O + 38 ATP[9]
- A poorly oxygenated fetus has the following metabolism: glucose →pyruvate →lactic acid + H+ + 2 ATP[9]

Antenatal Use of CTG

The CTG is an evaluation tool widely used in antenatal care for assessment of fetal wellbeing [2,3,5,7].

Tests of fetal wellbeing have to be interpreted in the context of risk assessment and fetal physiology.

A Cochrane systematic review of 1636 high risk women concluded:

1. The use of antenatal CTG has no effect on the risk of caesarean section for women[10]
2. Antenatal CTG has no beneficial effect on rates of perinatal mortality or morbidity[10]

Currently there is not a single best-performing test of fetal wellbeing. It is thought that CTG has limited value for the assessment of antenatal fetal wellbeing as it is good at identifying well fetuses, but poor at identifying unwell fetuses[11]. It is therefore commonly used in conjunction with ultrasound assessment of fetal and placental Dopplers in high risk pregnancy[2,12].

Use of an antenatal CTG implies that a pregnancy risk has been identified and medical referral is required. See Table 1 for indications to perform antenatal CTG.

Antenatal CTG only provides assessment of the *immediate* fetal condition.

Antenatal CTG should not be conducted if the result will not be acted upon; for example a pre-viable fetus.

Antenatal CTGs on fetuses < 32 weeks need to be interpreted with the understanding that the fetus will not demonstrate a mature reactive pattern[2,13]. The TRUFFLE Study compared computerised CTG (cCTG) and abnormal ductus venosus (DV) measurement in use with preterm foetuses 26-32 weeks that had fetal growth restriction (FGR) as a trigger for preterm birth. Conclusions stated an abnormal DV was associated with adverse outcome; fetal decelerations were not present on 6 of the 7 fetuses that died. Recommendations are that cCTG changes should not be used in isolation to determine birth timing with preterm fetuses[14].

The duration of the recording need only be **10 minutes** and discontinued if the CTG trace meets the criteria for a normal CTG[3].

Intrapartum fetal surveillance

Intermittent auscultation is equally as effective as continuous CTG monitoring for ***low risk*** women in labour[1]. In ***low risk*** women, the incidence of intrapartum fetal compromise is low[1,5].

CTG is thought to have a 30% positive predictive value for intrapartum fetal hypoxia[16]. A good knowledge of fetal physiology is essential in the interpretation and management of a CTG[17].

The strength of intrapartum (IP) CTG is the reliability of its ability to predict the absence of hypoxic neurologic injury and absence of metabolic fetal acidaemia[18,19].

Aims of IP CTG are to avoid adverse outcome from intrapartum acidotic / hypoxic insult[3,5].

Continuous CTG provides a record of change over a period of time.

Analysis of the CTG must be made within the context of the clinical picture and consideration of all risk factors. It is suggested that the isolated classification of a CTG on pattern recognition alone may lead to fetal and maternal damage[16].

A Cochrane Review of the literature[1] found no new trials had been conducted on IP CTG. The results were:

1. Compared with intermittent auscultation of the FHR, continuous CTG had no significant improvement in perinatal mortality. It was associated with a higher caesarean section rate and instrumental birth. There was little difference in the incidence of cord blood acidosis.
2. There was no significant difference between intermittent and continuous CTG and the caesarean section rate.
3. CTG use in labour is linked to a reduction in neonatal seizures, but no clear difference in the incidence of cerebral palsy or infant mortality[1,20,21].

Two large multisite RCTs were conducted in the USA evaluating fetal ECG ST analysis (STan)[22] and fetal pulse oximetry. The trials did not show any clear benefit in reducing caesarean section rate or neonatal outcomes[23].

Use of computerised decision making systems to interpret FHR patterns on CTG during labour remains controversial, with some concluding that an electronic decision making tool does not improve outcomes or detect abnormal traces effectively[24,25]. Human factors in the interpretation and response to the alerts on computerised programs may result in poor outcomes, however multiple trials have suggested that the benefit of computerised programs to assist in the decision making process of assessing abnormal trace findings of clinical benefit[1,3,11,25].

Similarly, a comparison between computerised interpretation of CTG and traditional CTG (visual interpretation) showed a significant reduction in perinatal mortality with computerised CTG but no difference in potentially preventable deaths[1]. Computerised CTGs augmented by fetal ECG ST segment analysis (STAN)[26] *during labour* have been introduced at the Women's and Children's Hospital in South Australia as part of an ongoing trial. For further information on STAN see www.neoventa.com. ST segment analysis (STan) classification is available in Table 4.

Indications for continuous CTG intrapartum

Continuous CTG is recommended when risk factors for fetal compromise are detected during pregnancy, at the onset of labour, or at any time during labour (see Table 2)[16]. However, if antenatal risk factors have been appropriately investigated via antenatal investigation, serial ultrasound and/or maternal investigation and are reassuring, then the woman and her unborn baby should not be inappropriately pathologised, and should be managed as normal.

If there is difficulty obtaining an adequate fetal heart rate tracing at any time in labour, consider the fetal heart rate being monitored via a fetal scalp electrode[5].

When possible, CTG monitoring should also be commenced prior to the insertion of a regional anaesthetic to establish baseline fetal heart rate characteristics.

Interruptions to fetal heart rate monitoring

Where continuous CTG is required for labour, and if the CTG to date is considered to be normal, monitoring may be interrupted for short periods of up to 15 minutes to allow personal care (e.g. shower, toilet). Such interruptions should be infrequent and not occur immediately after any intervention that could impact on the wellbeing of the fetus (e.g. amniotomy, epidural insertion, or epidural top-up).

Intermittent auscultation during unavoidable interruptions to continuous CTG monitoring or at times of potential fetal vulnerability is recommended (e.g. epidural insertion, transfer to operating theatre and birth of the fetus).

Interruptions to fetal heart rate monitoring should be minimised whenever possible.

Consider intrapartum cardiotocography if several of the following conditions are present[3]

- Pregnancy gestation 41+0 to 41+6 weeks gestation
- Gestational hypertension
- Gestational diabetes mellitus without complicating factors
- Obesity (BMI 30-40)
- Maternal age 40 – 41 years
- Maternal pyrexia ≥ 37.8 and < 38 °C
- Borderline AFI (5-8cm)

Indications associated with the use of interventions

- Any use of oxytocin whether for induction or for augmentation of labour
- Before and for at least 20 minutes after administration of prostaglandin or cervical ripening balloon catheter
- Epidural analgesia (including at the time of inserting an epidural block)

Performing a CTG

CTG setting recommendations

There are no internationally agreed practice recommendations[13]. In SA we recommend[3]:

- CTG paper speed at 1cm/minute
- Sensitivity displays at 20 beats per minute/cm
- Set FHR range display at 50 – 210 bpm
- Date and time settings on CTG tracings are validated whenever used

Health professionals should be aware that machines from different manufacturers use different vertical axis scales, and this can change the perception of fetal heart rate variability.

General recommendations when performing a CTG

For antenatal CTG, the woman should be in an upright position, reclining at 45° or lying on her side to prevent postural hypertension[11].

With the use of telemetry, women can labour with minimal restriction on their activity.

The woman should indicate fetal movements with the appropriate marker (do not rely on the CTG machine to accurately record fetal movements).

Maternal heart rate should be checked and recorded at the commencement of monitoring the fetus to ensure the CTG is monitoring FHR [2,3].

Maternal heart rate should be checked with 'loss of contact', when the CTG is reapplied and checked 15 – 30 minutely in labour[2,3,5].

CTG traces should be observed for the first 5 minutes to ensure transducers are correctly situated and monitoring the fetus prior to the woman being left if centralised monitoring is available.

If there is no centralised fetal monitoring the clinician should remain present throughout the tracing. At all times a clinician must be assigned to observe the CTG.

Any abnormalities or non-reassuring/abnormal signs should be reported, and appropriate management initiated [3,7].

Monitoring should continue if the indication for monitoring is maternal pain, bleeding or contractions or if the trace is non-reassuring or abnormal.

Twins should be monitored simultaneously, where possible a monitor 'twin offset function' should be used[27].

On commencement of CTG monitoring, women should be advised, in general terms, the elements of their CTG trace.

Fetal Heart Rate Monitoring Modes

A CTG is achieved via three different modes in SA: external, internal – via a fetal scalp electrode (FSE) or via (STan)[2,3,25,26,28].

External CTG

The transducer is located externally on the maternal abdomen, ideally placed over the anterior shoulder of the fetus[3,5]. The toco-transducer, which is pressure-sensitive, is placed over the top of the fundus, as this is the most contractile segment of the uterus. It is important to note that the toco-transducer will inform the length (time) of the uterine contraction (if positioned correctly), but not interpret the strength of the uterine contraction[3,5,7].

External CTG monitoring can be less reliable than internal monitoring due to loss of signal, detection and recording of maternal heart rate. It can also pick up signal artefact, particularly in the second stage of labour[3,5,7].

Internal CTG

An internal fetal scalp electrode (FSE) is applied to the presenting part of the fetus. It can be applied to the scalp (preference) but also the buttock[5]. The FSE has an electrode which when applied to the fetus detects the fetal ECG and calculates a FHR[5]. The FSE can only be applied when the cervix is sufficiently dilated and the membranes have been ruptured. In most situations the cervix needs to be 2 – 3 cm dilated to allow for correct attachment. FSE should be applied over fetal bone and not over a suture lines or fontanelles[7,19].

The toco-transducer remains on the maternal abdomen, as with external CTG monitoring[3,5,19].

Internal FSE monitors can be inadvertently applied to the maternal cervix or other tissue and therefore detect the maternal heart rate. Additionally, when there has been a fetal death, the maternal heart rate can be conducted through the fetus and be recorded[5].

FSE should not be used when contraindicated. Contraindications include the presence of infection (e.g. HIV, Hepatitis B, Hepatitis C, active genital herpes) or sepsis to prevent vertical transmission[5, 6,9,13]. Internal CTG should also be avoided in situations where there are fetal bleeding disorders, malpresentation or an unstable lie of the fetus or intact membranes [3, 5, 7].

ST-segment analysis (STan)

STan is an internal CTG, using a specialised gold tip FSE. This electrode is able to detect and record a fetal ECG. This computerised technology assesses the fetal oxygenation of the fetus by monitoring the T/QRS ratio [1,17,26,28].

Additional monitoring techniques

Intrauterine pressure catheters inserted into the intrauterine cavity. They can detect pressure strength and timing unlike the toco-transducer. They require the membranes to be ruptured so that the catheter can be inserted into the uterine cavity[3,7,16].

Fetal pulse oximetry[3,7]: RANZCOG[3] reviewed the RCT's of STan monitoring, intrauterine pressure catheters and fetal pulse oximetry and found there to be no benefit to traditional external or internal CTG monitoring. Currently they do not recommend their use for routine intrapartum fetal surveillance[3].

Documentation of CTG

The clinician who performs the CTG tracing should record the features of the tracing in the woman's hospital record.

Documentation of the CTG should be recorded 30 minutely to hourly within the woman's case notes as required. Documentation on the CTG recording itself includes[3]:

- The mother's name, date, time commenced, hospital record number and maternal observations
- Intrapartum events that may affect the FHR (e.g. starting or changing oxytocin regimen, vaginal examination, obtaining fetal blood sample or insertion of an epidural) should be noted contemporaneously both on the CTG and in the maternal case notes, including date, time and signature
- Document on the report when CTG is performed within 30 minutes of cigarette smoking, self-medication of illicit substances or administration of any prescribed medications.
- Document significant maternal events such as change of position to relieve aortocaval compression[26].
- Loss of contact and audible decelerations should be marked on the CTG by the attending clinician and actions taken to ensure that the CTG recording has good contact and uterine activity is clearly recorded.

Documentation of **ANY** abnormal features should be described in detail as per Table 5[3,7]. Where the features indicate **fetal compromise**, continual CTG monitoring and recording is recommended. Medical review should also be sought [3,7].

Description of fetal heart rate patterns using CTG

The CTG should be interpreted using a combination of pattern recognition, review of the individual's woman's antenatal/intrapartum history, identification of any risk factors and consideration of fetal physiology [2,3,5,11,16].

Each hospital will have its own documentation policy; practitioners must ensure they are familiar with their own policy.

10 % of CTGs may be uninterpretable due to:

- Gestational age
- Normal cycling (rest) phases (may be up to 90 minutes)
- The use of certain medications (e.g. central nervous system sedatives)[3]
- Changes in heart rate patterns associated with circadian rhythms

Classification of the CTG

A systematic approach to interpreting the CTG trace is recommended (see classification of CTG)[29].

The CTG should be classified and analysed on the following criteria. This is the same terminology used to document and describe the CTG[3, 7]

- Baseline Fetal Heart Rate
- Accelerations
- Variability: normal, reduced, absent, salutatory pattern
- Decelerations: early, late, variable – complicated or uncomplicated, prolonged

Definitions of the terms are listed in Table 3. A list of descriptors to help explain the elements of the CTG are provided in Table 5.

Physiologically based assessments of antenatal CTG traces support the following classification of antenatal traces:

1. Reactive: 2 accelerations in 10 minutes within a recording period of 120 min
2. Unreactive: no accelerations seen in 120 minutes of tracing
3. Decelerative: presence of repetitive decelerations on an otherwise unreactive trace

Above classification reduces high rate of false-positive traces for recordings of 40 minutes or less[2].

Review of language and consistent definitions and implementation of 'normal' and 'abnormal' has reduced false positive rate for fetal compromise[2].

Normal CTG

A reassuring (normal) CTG is associated with a low probability of fetal compromise and has the following features[3, 5]:

- Baseline FHR 110-160 bpm
- Baseline FH variability of 6-25 bpm
- FH accelerations
- No decelerations

All other CTGs are by this definition abnormal and require further evaluation in the context of the full clinical picture.

Fetal Compromise (Abnormal CTG)

The following features are unlikely to be associated with fetal compromise when occurring in isolation[3,5,7]

- Baseline rate 100-109 bpm
- Absence of accelerations
- Early decelerations
- Variable decelerations without complicating features

The following features may be associated with significant fetal compromise and require further action[3,5,7]

- Baseline fetal tachycardia > 160 bpm
- Reduced or reducing baseline variability (3-5 bpm)
- Rising baseline fetal heart rate
- Complicated variable decelerations
- Late decelerations
- Prolonged decelerations

The following features are likely to be associated with significant fetal compromise and require immediate management, which may include urgent birth[3,5,7]

- Prolonged bradycardia (<100 bpm for > 5 minutes)
- Absent baseline variability (< 3 bpm)
- Sinusoidal pattern
- Complicated variable decelerations with reduced or absent baseline variability
- Late decelerations with reduced or absent baseline variability

Action in the context of an abnormal CTG

Conservative measures[4]

If there are any concerns about fetal wellbeing, think about possible underlying causes (e.g. infection) and start one or more of the following conservative measures, based on the most likely cause/s:

- Encourage the woman to mobilise or adopt a left lateral position, and in particular avoid being supine
- Give intravenous fluids
- Offer paracetamol if the woman's temperature is raised
- Assess contraction frequency / reduce oxytocin (if being used) if uterine hyperstimulation
- Inform midwife coordinator and obstetrician
- Do not use maternal facial oxygen for intrauterine fetal resuscitation, only administer supplementary oxygen to safely manage maternal signs and symptoms of hypoxia[38].

Maternal Oxygenation

Cochrane reviewed the literature on maternal oxygenation in labour and second stage. No conclusive benefit to the fetus was determined based on current evidence[30]. In review of supplemental maternal oxygenation at caesarean section, there was statistically a higher umbilical and artery and vein partial pressure of oxygen, but no clinical significance or benefit to the woman or fetus. Cochrane have stated that there is no evidence to suggest supplemental maternal oxygenation as either beneficial or harmful to either mother or baby[31]. In 2018, a RCT of hyperoxygenation in second stage for fetal distress was conducted. Recommendations of this trial are to not use maternal hyperoxygenation to treat fetal distress. Further studies in neonatal outcomes are recommended to determine the risk or benefit to the fetus in using maternal oxygenation[32].

Fetal blood sampling (FBS)

Fetal blood sampling is a peripheral test of fetal wellbeing[33]. The fetal scalp is accessed to collect a sample of fetal blood. This allows for the fetal scalp lactate analysis to determine the presence of fetal academia [3,33]. RANZCOG recommends that centres using electronic fetal monitoring should have access to fetal blood sampling and that a lactate measurement should be obtained in preference to a pH measurement [3].

It is possible that the availability of fetal blood sampling in labour lessens the increase in caesarean section rate associated with continuous CTG; however it should not be instituted in cases where it may delay birth and thereby worsen outcomes[3]. For further information on fetal blood sampling see the *Fetal Acid Base Balance Assessment* PPG at www.sahealth.sa.gov.au/perinatal.

Introduction of STan monitoring has seen as reduction in fetal blood sampling by 48% in some centres globally[23].

Communication and consultation[3]

Medical staff are responsible for the review of all CTGs they order.

The midwife should refer women with CTG tracing with features of fetal compromise to a medical officer for immediate review[3,5,7].

Local facilities should establish clear communication channels that enable midwives / medical officers to inform or seek advice from an obstetrician. This may include consultation with an obstetrician at another facility if required.

Details of the CTG transmitted to the obstetrician must be documented in the woman's case notes, including the date and time, and a description of the features of the CTG.

Outpatient CTGs of all non-booked women should be sighted and reviewed by senior medical staff. The referring doctor should be telephoned and advised of the CTG findings.

Review and management advice for abnormal CTGs (Wider SA)

Clinical advice is available via the SA Perinatal Advice Line. An obstetrician and neonatologist are on roster 24 hours a day. Refer to *Perinatal advice and emergency transport* PPG available at www.sahealth.sa.gov.au/perinatal for further information.

Medical officers from country hospitals may directly contact referral hospitals for a second opinion / review of CTG tracings.

When CTGs are forwarded to a referral hospital for review by specialist staff, the following information should be included:

- Indications for referral
- Clinical details
- Demographic details
- Contact details of the referring doctor
- Verbal communication must be made with the Obstetrician by the referring staff within a short timeframe. i.e. 10 minutes to ensure review and management advice are received

Case notes specific to the information and advice given by the obstetric medical officer on- call should be created so that a permanent record exists

Referring medical officers must document in the woman's case notes, details of the CTG transmitted to the obstetric medical officer at the referring hospital, including the date and time, a description of the features of the CTG, name of the obstetric medical officer on-call they liaised with and management plan.

The referring medical officer will be notified via phone of the review and suggested management plan as soon as possible. If no communication has occurred within 30 minutes, the referring medical officer should contact the referral hospital and discuss with the on-call registrar (obstetric medical officer)

Storage of CTG tracings[3]

File all CTG tracings in the woman's case record with the appropriate hospital report or archive, including details that link with the woman's case record.

If notes are to be microfilmed, provision should be made for the storage of CTG traces. For example, short traces may need to be microfilmed whilst long traces may need to be stored in their original format in heat protected envelopes (not plastic sleeves). Consider electronic storage of traces. e.g. optical disc.

CTG recordings should be stored for the same period of time as medical records (33 years).

CTGs from centrally monitored systems (e.g. Tracevue) may be initially stored on the hard disc of the server and subsequently archived to a permanent medium.

CTG competency assessment

CTG competency training is mandated for all practitioners using and interpreting CTGs in SA Health facilities[38]. Evidence suggests that a physiological based training rather than pattern recognition is beneficial[11,34].

RANZCOG[3,7] recommend that all clinicians using and interpreting CTGs should have current knowledge of:

- Fetal physiological responses to hypoxia
- Good pattern recognition skills
- The ability to integrate the theory of fetal physiology to each clinical situation

Continuing professional development in the application and interpretation of fetal monitoring should be completed by all clinicians using and interpreting CTG's[7,11,35]: For example:

- RANZCOG Online Fetal Surveillance Education Program (OFSEP)[35].
  Available at www.fsep.edu.au
- K2[37]
  Available at:
  http://www.sahealth.sa.gov.au/wps/wcm/connect/11bdf1804c210b85af28ffb3172da4a1/16012.3-K2+Fetal+MonitoringFS%28V1%29.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-11bdf1804c210b85af28ffb3172da4a1-m08lEny

Regular case review of individual CTGs with corresponding outcomes at local unit level is recommended.

Governance of competency for CTG application and interpretation is described in the SA Health *Perinatal Emergency Education Strategy* Policy Directive, 2018[38].

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Write Group Lead

Vanessa Tilbrook

Write Group Members

Rebecca Smith
Dr Feisal Chenia
John Coomblas
Dr Anupam Parange

Contributors to original PPGs

Allison Rogers
A/Prof Rosalie Grivell
E/Prof Jeffrey Robinson
Dr David Morris

SAPPG Management Group Members

Sonia Angus
Lyn Bastian
Dr Elizabeth Beare
Elizabeth Bennett
Corey Borg
Dr Feisal Chenia
John Coomblas
Dr Vanessa Ellison
A/Prof Rosalie Grivell
Dr Sue Kennedy-Andrews
Jackie Kitschke
Dr Kritesh Kumar
Dr Anupam Parange
Rebecca Smith

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