Peripartum and intrapartum assessment of the fetus

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Abstract

Perinatal death or cerebral palsy are devastating outcomes of pregnancy for families. In an attempt to prevent these outcomes fetal wellbeing is assessed by a variety of means in the antenatal and intrapartum settings. In this review, the most common means to confirm fetal wellbeing, the rationale for their use and evidence of their efficacy in each of these settings are discussed. With respect to labour, the indications for continuous electronic fetal monitoring are presented, together with a guide to interpretation of cardiotocograph (CTG) or fetal blood samples (FBS).

Keywords Antenatal care; asphyxia; cardiotocography; fetal blood sampling; fetal monitoring; fetal movements; hypoxic–ischaemic encephalopathy; intrapartum care; intrapartum stillbirth

Royal College of Anaesthetists CPD Matrix: 1A03, 2B07, 3B00

Learning objectives

After reading this article, you should be able to:

- understand the reasons underlying monitoring of fetal wellbeing
- be able to describe strategies for monitoring fetal wellbeing in the antenatal and intrapartum settings
- understand the limitations of each method of assessment of fetal wellbeing

Background

The goal of peripartum and intrapartum fetal assessment is to prevent fetal mortality or morbidity, primarily resulting from asphyxia. Perinatal asphyxia is estimated to affect 2–5 per 1000 live births.[1] The outcomes of perinatal asphyxia are poor; in high-income countries up to 40% of infants will die and 30% will have significant long-term neurodisability.[1] These outcomes are not only tragic for the families involved, but they place a significant burden on the NHS as children with hypoxic–ischaemic encephalopathy (HIE) may develop cerebral palsy with lifelong consequences for that family. A recent analysis of 10 years of maternity claims made to the NHS Litigation Authority totalling £3.1 billion found that the most frequent causes of litigation were management of labour (14%), caesarean section (13%) and cerebral palsy (11%).[2] Claims for cerebral palsy and management of labour, along with interpretation of intrapartum monitoring were the most expensive.[2] Thus, improving fetal assessment to prevent cerebral palsy and intrapartum stillbirths is highly desirable. Fetal assessment may be divided into measures instituted before the onset of labour (in the antenatal period) and those used in labour (intrapartum).

Fetal assessment in the antenatal period

Antenatal screening focuses on identifying fetuses at risk of asphyxia, particularly those which have intrauterine growth restriction (IUGR). Current screening for IUGR is initially based on analysis of maternal risk factors which include: pre-existing maternal disease (e.g. hypertension, diabetes), previous IUGR, previous stillbirth resulting from placental disease. These women are offered additional ultrasound assessment of fetal size, liquor volume and umbilical artery Doppler. Women deemed to be low-risk for IUGR are screened using measurement of symphysis-fundal height, and if the baby measures less than the 10th centile or decreased growth rate is noted, ultrasound assessment of fetal size, liquor volume and umbilical artery Doppler should be performed. Unfortunately, this approach has a low sensitivity and specificity, at 27% and 88% respectively.[3] Where IUGR is identified monitoring is based upon assessment of blood flow in the umbilical artery by Doppler ultrasound. Intervention is gestation-dependent, but abnormal blood-flow such as absent or reversed end-diastolic flow in the umbilical artery would be an indication for delivery after 34 weeks' gestation.[4]

Another widely used antenatal measure is maternal awareness of reduced fetal movements (RFM). Although RFM is associated with a two- to threefold increase in stillbirth and IUGR, the majority of pregnancies are uncomplicated. Recent guidelines suggest that women with RFM after 28 weeks of pregnancy are assessed by cardiotocography (see later) and ultrasound assessment of fetal growth and liquor volume if there are risk factors for stillbirth or IUGR.[5] In Norway, this approach reduced perinatal mortality in women with RFM from 4.2% to 2.4%.

Cardiotocography (CTG) is also used in the antenatal period, usually to monitor infants identified to be at greatest risk of intrauterine asphyxia (e.g. IUGR, RFM or hypertension in pregnancy). Assessment of the CTG is carried out using a similar approach to that used in labour (see later), although accelerations should always be present outside labour. Although this CTG is widely used in the antenatal period, meta-analysis shows that it does not reduce perinatal mortality. This potentially results from clinicians deriving false reassurance from normal CTG traces, which only provide information about the fetus for the duration of the recording.[6]

Fetal assessment in labour (intrapartum monitoring)

The aim of fetal monitoring in labour is to prevent asphyxia. Fetal asphyxia and consequent acidaemia are strongly related to complications in the neonatal period, including death, HIE and neurodevelopmental disorders.[7] The bulk of intrapartum fetal monitoring relies on continuous electronic fetal monitoring by CTG. This technique was introduced in the 1970s without robust clinical trials, and subsequent meta-analyses have failed to demonstrate a reduction in perinatal deaths or cerebral palsy with the use of continuous electronic fetal monitoring, although there was a reduction in neonatal seizures.[8] However, the use of continuous electronic fetal monitoring is associated with an increase in

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caesarean section and instrumental vaginal births; this may result from poor specificity of CTG leading clinicians to intervene for an abnormal CTG in the absence of fetal asphyxia/acidaemia.[8]

As with methods in the antenatal period, women are assessed for their risk of intrapartum asphyxia and grouped into those deemed to be low-risk and high-risk. Women who are high-risk should have continuous electronic fetal monitoring by CTG; risk factors are grouped into those present before labour and those which may develop during labour (Table 1).[9] It is important to recognize that women can initially be low-risk, but events occurring late in pregnancy or labour (e.g. prolonged rupture of membranes leading to signs of intrauterine infection) can make them high-risk. Thus, risk should be continuously reassessed and appropriate action taken.

Intermittent auscultation: women who are low-risk for asphyxia should have intermittent auscultation of the fetal heart rate for 60 seconds every 15 minutes after a contraction in the first stage of labour and every 5 minutes after a contraction in the second stage of labour. Intermittent auscultation of the fetal heart is usually achieved with a handheld Doppler device, but a Pinard stethoscope may also be used.

Continuous electronic fetal monitoring by CTG: the fetal heart rate is usually recorded by non-invasive Doppler ultrasound measurement of the fetal heart rate combined with a pressure transducer to measure contractions. If reliable fetal heart rate trace cannot be obtained using this method an electrode may be attached to the fetal scalp. In the UK, the CTG is usually recorded at a speed of 1 cm/minute, with 10-minute intervals being marked on the paper. The external pressure transducer measures the frequency but not the intensity of contractions. The number of contractions is usually expressed as *x* in 10 minutes.

Several aspects of fetal heart rate trace are used to determine whether the CTG is normal. Each individual feature is classified as normal, non-reassuring or abnormal and an overall judgement made whether the CTG is normal, suspicious or pathological. The features of a CTG are: (i) *baseline rate* — the average fetal heart rate; (ii) baseline *variability* — the fluctuations of fetal heart rate (similar to the amplitude of the trace); (iii) the presence of *accelerations* — upward deflections of fetal heart rate for more than 15 beats per minute above the baseline for more than 15 seconds; and (iv) the presence of *decelerations* — downward deflections of fetal rate more than 15 beats per minute beneath the baseline for more than 15 seconds. Decelerations are classified as *early decelerations* when they occur with contractions, *late decelerations* when they commence after the contraction starts, have their nadir after the peak of the contraction and end after the contraction, *variable decelerations* have variable timing and morphology, when they cease to have a typical morphology they are termed *atypical variable decelerations*. Early decelerations are due to head compression so are not viewed as pathological. Late decelerations and atypical variable decelerations result from placental insufficiency and cord compression, these are viewed as pathological and associated with fetal acidaemia.

The classification system proposed in the NICE guideline is shown in Table 2.[9] A normal fetal heart rate trace is shown in Figure 1. This has uterine activity of 4—5:10, a baseline of 135, variability of more than 5, accelerations are present and there are no decelerations. In contrast the CTG in Figure 2 shows a baseline of 160 beats per minute, variability less than 5 and late decelerations, which is a pathological fetal heart rate trace.

A suspicious or pathological fetal heart rate trace requires action. The women can be placed in the left lateral position to optimize venous return, correct hypotension (if present) with intravenous fluid. If there is uterine hyperstimulation (contractions >5:10) in the absence of oxytocin, terbutaline 0.25 mg can be given subcutaneously; if the patient is on oxytocin this can be turned off. In the presence of a pathological trace, a fetal blood sample should be performed. If this is not possible or is contraindicated then delivery should be expedited by the quickest means (caesarean section or instrumental vaginal delivery).[9]

Factors which indicate the need for continuous electronic fetal monitoring in labour

Antenatal period

Maternal	Fetal
Antepartum haemorrhage	Breech presentation
Cardiac disease	Intrauterine growth restriction
Connective tissue disorder	Multiple pregnancy
Diabetes mellitus	Postmature pregnancy (>42 weeks)
Hypertension/preeclampsia	Preterm birth (<37 weeks)
Renal disease	
Previous caesarean section/uterine surgery	

In labour

Maternal	Fetal	Labour
Bleeding in labour	Abnormal fetal heart rate on intermittent auscultation	Augmentation with oxytocin
Epidural analgesia	Meconium-stained liquor	Induction of labour
Signs of infection (pyrexia, offensive liquor)		Prolonged rupture of membranes

Table 1