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Intrapartum fetal surveillance

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Summary In spite of the significant increase in obstetric and neonatal interventions aimed at reducing asphyxia there is no reduction in the rate of cerebral palsy (CP). Metabolic acidosis occurs in 2% of all births and over 90% of such infants do not develop CP. About 10% of cases of CP are due to pathological events that occur after birth, 10–20% of cases are related to intrapartum events, and identifying the cause of the remaining 70% is an ongoing challenge for obstetricians and paediatricians. The original aim of continuous electronic fetal monitoring (EFM) was to prevent harm by detection of fetal hypoxia before it led to disability or death. It was soon realised that EFM had a high false-positive rate and there were no significant differences in outcome measures when compared with intermittent auscultation. The increased operative intervention rates associated with EFM were reduced if fetal scalp blood sampling (FBS) was performed to measure the pH. However, fetal blood sampling used for the diagnosis of intrapartum fetal hypoxia is time consuming and may be associated with equipment failure or inability to obtain a sample. As it is a single measurement it needs to be repeated, with consequent inconvenience to the woman and the staff. Additional or alternative methods are needed to help mothers and babies who, despite abnormal fetal heart rate patterns and clinical findings during labour and delivery, would not benefit from intervention. New methods of pulse oximetry and fetal ECG waveform analysis explore the possibility of continuous surveillance as an adjunct to EFM. Recent studies suggest that maternal pyrexia is associated with increased adverse fetal outcome. Monitoring of maternal temperature and its normalisation should be part of intrapartum care, to avoid fetal neurological injuries.

Introduction

The fetus is able to adapt to hypoxaemia by invoking multiple defence mechanisms. The decreasing oxygen content is counteracted by cardiovascular compensation that increases blood flow

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to the most important organs: the brain, the heart and the adrenals. The second line of defence involves the metabolic compensatory mechanism. Asphyxia develops, with a possibility of neurological damage when these compensatory mechanisms are insufficient. The condition of the fetus before labour and events during labour may affect its ability to mobilise these defence mechanisms.

Some pregnancies are more at risk than others. National guidelines on intrapartum electronic fetal monitoring (EFM) recommend the use of intermittent auscultation (IA) in low-risk labour and continuous EFM for high-risk labour (NICE/RCOG). Maternal or fetal antepartum high-risk factors include: intrauterine growth restriction (IUGR), prematurity, congenital malformation, breech presentation, preeclampsia, multiple pregnancies and maternal medical conditions. The intrapartum risk factors include vaginal bleeding in labour, intrauterine infections, meconium staining of the liquor, prolonged membrane rupture of over 24 h, post-term pregnancy, previous Caesarean section and use of oxytocin to either induce or augment labour.

These risk factors may occur in combination and in varying degrees that may reduce the capacity of the fetus to cope with the stress of labour. The fetus with thick meconium and scanty fluid ('pea-soup meconium') is at a greater risk for meconium aspiration syndrome in the presence of an abnormal cardiotocograph (CTG): hence the need for clinical vigilance and early delivery.

Intermittent auscultation

Intermittent surveillance of the fetal heart rate (FHR) during labour using a Pinard stethoscope or a hand-held Doppler ultrasound device every 15 min during the first stage and every 5 min during the second stage for 60 s immediately after a contraction is recommended in low-risk labour. There should be defined clinical interventions when non-reassuring findings occur during labour such as abnormal FHR findings of decelerations and FHR $\leqslant$110 or $\geqslant$160 bpm. In such situations IA should be converted to EFM.

Systematic reviews comparing IA with continuous EFM showed that continuous EFM was associated with an increase in operative delivery rates and a reduction in neonatal seizures, but there was no difference in Apgar scores or admission to neonatal intensive care units and no demonstrable reduction in perinatal mortality. The cost estimates show that continuous EFM is more costly than IA because of the higher cost of equipment and the increased rate of Caesarean section.

Electronic fetal monitoring

EFM during labour was developed to detect FHR patterns thought to indicate hypoxia. The early recognition of hypoxia would alert clinicians to potential problems and enable quick intervention to prevent fetal death or irreversible brain injury. It was hoped that its use would prevent the majority of birth injuries due to hypoxia or asphyxia, thus greatly reducing the frequency of cerebral palsy (CP) and intellectual impairment.

Features of the CTG trace

(1) Baseline rate (BLR)
With advancing gestation there is a fall in FHR baseline, and an increase in the variability and number of accelerations. The normal range of FHR pattern is a lower limit of 110 bpm and an upper limit of 160 bpm. Uncomplicated (i.e. a trace with accelerations, normal baseline variability (BLV) and no decelerations) bradycardia of 100–110 bpm and tachycardia of 160–180 bpm have a poor predictive value for umbilical artery cord pH $<$ 7.20, but the predictive value is increased with the duration and degree of baseline abnormality. At a FHR of less than 110 bpm there is a need to ensure that the fetal monitor is picking up the FHR and not the pulse of the mother.

(2) Baseline variability
Reduced BLV is not uncommon during fetal sleep cycles and may occur for up to 40 min during labour and in a small percentage of cases for up to 90 min. A cut-off of 5 bpm for amplitude and 5 cycles per min for frequency for BLV maximises the sensitivity for detection of neonatal acidosis (cord artery pH $<$7.20) or 5-min Apgar score of less than 7. Reduced BLV is associated with increased risk of CP.

(3) Accelerations (reactivity and 'cycling')
Accelerations are abrupt increases in the baseline FHR of more than 15 beats for more than 15 s. The presence of accelerations is a good indicator of good perinatal outcome. CTGs with more than two accelerations in a 20-min window are called *reactive* traces and have a sensitivity of 97% for an Apgar score greater than 7 at 5 min. In the absence of fetal birth trauma a reactive intrapartum FHR pattern is not associated with intrapartum fetal asphyxia. The neurological injuries seen in