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Review

Expert review – identification of intra-partum fetal compromise

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ABSTRACT

Whilst most cases of cerebral palsy occur as a consequence of an ante-natal insult, a significant proportion, particularly in the term fetus, are attributable to intra-partum hypoxia. Intra-partum monitoring using continuous fetal heart rate assessment has led to an increased incidence of operative delivery without a concurrent reduction in the incidence of cerebral palsy. Despite this, birth asphyxia remains the strongest and most consistent risk factor for cerebral palsy in term infants. This review evaluates current intra-partum monitoring techniques as well as alternative approaches aimed at better identification of the fetus at risk of compromise in labour.

Contents

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Introduction

During labour the feto-placental relationship is tested to its highest degree as uterine contractions can reduce blood flow in the uterine artery by as much as 60% [1]. Whilst in some cases, such as fetal growth restriction, an increased risk of intra-partum compromise may be evident prior to labour, as much as 63% of cases of intra-partum hypoxia occur in pregnancies with no prior antenatal risk factors [2]. Despite improvements in antenatal and intra-partum care, as well as the introduction of continuous fetal monitoring, rates of cerebral palsy have not declined over the last 30 years [3]. Whilst some evidence suggests that ante-partum events are responsible for the majority of cases of cerebral palsy [4,5], intra-partum events may still account for a significant proportion (between 9.6% and 14.5%) [6,7], and possibly as much as 20% in term infants [8]. The debate regarding causality is on-going, with a recent study suggesting that the application of strict diagnostic criteria to hypoxic ischaemic encephalopathy (HIE) revealing intra-partum events as the predominant antecedent in term babies [9]. Furthermore, a recent systematic review concluded that birth asphyxia remained the strongest and most consistent risk factor for cerebral palsy in term infants [10]. These cases are over-represented in obstetric medico-legal claims [11], and often result in a high quantum of damages [12]. Given the spiralling costs of medical malpractice insurance, and the possibility of affected infants requiring a lifetime of medical support, cerebral palsy as well as other neurological sequelae of intra-partum hypoxic ischaemic encephalopathy, represent a significant financial burden to healthcare providers around the world.

With this in mind, much effort has been placed on techniques to identify fetal hypoxia during labour, and to enable delivery of the fetus before neurological damage takes place. fetal cardio-tocography (CTG), ST-segment analysis (STAN©), and pulse oximetry have all been adopted into clinical practice to varying extents in maternity units around the world. The most commonly used technique for intra-partum fetal monitoring (CTG), when compared to intermittent auscultation, has not resulted in a decrease in the incidence of cerebral palsy [13], but is responsible for an increase in the rates of obstetric intervention [13]. Other techniques such as assessment of the fetal biophysical profile and amniotic fluid volume have been adopted in an attempt to identify the fetus at risk of compromise, prior to the onset of labour. Much of the technology currently used for intra-partum fetal monitoring has poor positive predictive value for fetal compromise [14].

This review will consider the evidence supporting the use of these techniques in identifying the fetus at risk of compromise and enabling timely intervention to prevent long term neurological sequelae.

Search strategy and selection criteria

A comprehensive search of PubMed was conducted. All articles indexed on PubMed and published in English were considered eligible for inclusion. Search terms including ‘‘fetal compromise’, ‘‘fetal distress’’, ‘‘caesarean’’, ‘‘neonatal outcomes’’, ‘‘acidosis’’, and ‘‘operative delivery’’ were combined with the names of monitoring techniques to identify relevant articles. Where possible, evidence from meta-analyses/systematic reviews was prioritised for inclusion. All included articles were reviewed by both manuscript authors (TP and SK).

Techniques used for intra-partum monitoring

Cardio-tocography

Fetal electronic cardio-tocography (CTG) was developed in 1957 as a means of continuous monitoring of the fetal heart rate. Almost 60 years later, it remains the primary means of intra-partum fetal monitoring throughout the world, particularly in developed countries. Unfortunately, CTG has not resulted in the expected reduction in cerebral palsy rates [13]. Despite its almost ubiquitous use in current intra-partum care, CTG has been criticised for its high false positive rate for fetal compromise. In some studies this rate is as high as 99.8% [15]. Furthermore its use has paradoxically resulted in an increased incidence of operative delivery for presumed fetal compromise, with 11 extra Caesarean sections being performed to prevent one case of neonatal seizure [13].

A major limitation of the CTG is the subjective nature of its interpretation with significant intra and inter-observer disagreement [16] as well as a lack of discriminatory power in identifying truly hypoxic fetuses. In order to reduce inter-observer disagreement in CTG interpretation, several organisations including FIGO (International Federation of Gynaecology and Obstetrics) [17], the American Congress of Obstetricians and Gynaecologists (ACOG) [18], the Australian and New Zealand College of Obstetrics and Gynaecology [19] and the National Institute for Health and Care Excellence (NICE) in the UK [20], have all published guidelines for accurate CTG interpretation in an attempt to limit bias and subjectivity. Use of such guidelines has been suggested to lead to a reduction in the incidence of hypoxic-ischaemic encephalopathy [21]. Nevertheless, all these documents have disparities in their definitions of different types of fetal heart rate decelerations and their classification of suspicious and pathological heart rate patterns. Despite these guidelines, problems with CTG interpretation and subsequent obstetric management remain by far the leading cause of medico-legal litigation claims in Obstetrics [22]. Methods to quantify CTG recordings using models such as the Fischer score have also been developed and used to help guide management [23], however, subjective interpretation of the CTG is still a pre-requisite for their use.

More recently, computerised CTG analysis has been developed in order to circumvent the problems of poor inter-observer variability of the FHR pattern [24]. These systems use software packages to record and analyse CTG tracings, providing audio and visual alerts according to pre-programmed characteristics. They have been reported to improve accuracy in predicting fetal acidosis at delivery [25], and perform better than obstetricians in identifying compromised fetuses [26]. Whilst these results are promising, robust, multicentre, randomised control trials are likely to be required demonstrating an improvement in neonatal outcomes, before such automated systems are universally adopted. One such trial is currently in progress [27].

Despite a large retrospective population study recently reporting an association between the temporal increase in CTG use in the United States with a reduction in neonatal mortality [28], the value of CTG to identify intra-partum hypoxia and improve neonatal outcomes remains the subjective of considerable debate [29]. However, the use of CTG use does result in a reduction in neonatal seizures [30], and it should be noted that the majority of trials evaluating CTG use included in systematic reviews such as those of Alfirevic et al. [13], and in the preparation of NICE guidance, were conducted some time ago, potentially limiting their ability to be representative of contemporary practice.

Fetal pH and lactate levels

Intra-partum CTG monitoring is frequently augmented by the use of fetal blood sampling (FBS). This procedure involves sampling blood from the fetal scalp, for immediate analysis of the acid–base or lactate status of the fetus. This technique, which has been in use since the 1960s, has a greater specificity for a low Apgar score at 1 min than the CTG [31]. Following FBS, management decisions may be based on fetal pH values, which show a greater correlation