Could routine cardiotocography reduce long term cognitive impairment?

NICE recommends that continuous monitoring of the fetal heart with cardiotocography should be restricted to high risk deliveries. But Charlotte Dyson, Topun Austin, and Christoph Lees disagree

Cardiotocographic monitoring of the fetal heart in labour is standard care in most developed and many developing countries. However, in the UK guidance from the National Institute for Health and Clinical Excellence (NICE) in 2007 recommended replacing it with regular auscultation of the fetal heart in low risk deliveries. Cardiotocography is used to detect fetal hypoxia, and although continuous monitoring does not reduce rates of intrapartum death or cerebral palsy, it has been shown to reduce the rate of neonatal seizures. These cause considerable long term developmental and cognitive problems. In this paper we argue the case for a randomised controlled trial of intrapartum cardiotocographic monitoring versus regular auscultation to see if the former results in better neurodevelopmental outcomes in the infants of low risk women.

Neonatal seizures and hypoxia

Neonatal seizures are common—around 1.8–3.5/1000 live births—although they are poorly classified, often underdiagnosed, and difficult to treat. In term infants, neonatal seizures are usually the result of neonatal encephalopathy. This is most commonly caused by lack of blood flow and oxygen to the brain. Other causes of neonatal encephalopathy include fetal metabolic disease, infections, drug exposure, and neonatal stroke. About two thirds of neonatal seizures are associated with hypoxic-ischaemic encephalopathy or cerebrovascular disorders.

Neonatal seizures are not only closely associated with hypoxic-ischaemic encephalopathy, but are independently associated with worse neurodevelopmental outcome. Children who had had neonatal seizures had worse motor and cognitive outcomes at age 4 years compared with children with hypoxic-ischaemic encephalopathy who did not have seizures after severity of injury on magnetic resonance imaging was controlled for; those with more severe seizures had lower scores. Therefore any intervention which reduces the incidence of neonatal seizures will benefit long term neurodevelopment.

Long term outcomes

Most assessments of the effects of term neonatal seizures on development have studied children younger than 5 years and have tended to classify them as either normal or severely disabled. However, evidence suggests longer term effects on cognition and behaviour. In one study of children who had had neonatal seizures, all those who were considered normal in early childhood showed abnormal neuropsychological development in late teenage years as measured by intelligence tests, spelling ability, memory, or independent social and behavioural difficulties. A cohort of 65 seven year olds who were born at term and had had neonatal seizures or encephalopathy also showed serious neuropsychological and educational problems. Special educational needs were more common in those who had had moderate and severe encephalopathy. Importantly, subtle cognitive impairments occurred in the absence of neuromotor impairment, particularly after a more severe clinical course. A study of 15–19 year olds born at term with moderate neonatal encephalopathy found a third had cerebral palsy; 71% of those remaining had cognitive or executive problems interfering with daily life. A review also found that children with moderate hypoxic-ischaemic encephalopathy had difficulties in reading, spelling, and arithmetic and intelligence scores below those with mild hypoxic-ischaemic encephalopathy and age matched peers.

In a retrospective analysis of 40 children with moderate and severe neonatal encephalopathy without cerebral palsy, all developed an abnormal neurological outcome including cognitive impairment, attention deficit hyperactivity disorder, and language impairment. Adverse outcome was associated with severe hypoxic-ischaemic encephalopathy and the number of neonatal seizures. Children aged 8–13 years who had had a 5 minute Apgar score below 4 and signs consistent with neonatal encephalopathy (including seizures) had an increased risk of minor motor impairments, epilepsy, and need of extra resources in kindergarten or school, and had reduced performance in reading and mathematics compared with children with normal Apgar scores and no sign of neonatal encephalopathy. Delayed recall for both verbal and visual information, perceptual motor speed, and tests assessing attention and executive function occurred in 8 year olds who were survivors of moderate or severe neonatal encephalopathy associated with birth asphyxia at term compared with age matched peers.

There is therefore considerable evidence suggesting long term cognitive impairment of term infants with neonatal seizures after intrapartum hypoxia-ischaemia. There is also clear evidence that continuous cardiotocographic monitoring decreases the risk of neonatal seizures.

Importance of cardiotocography

The rationale for cardiotocography in labour is its high sensitivity for hypoxia-ischaemia. A Cochrane review of 12 trials (37 000 deliveries) comparing continuous cardiotocography during labour with intermittent fetal heart auscultation found that relative risk of neonatal seizures in low risk women was significantly lower in women undergoing continuous monitoring (relative risk 0.36, 95% confidence interval 0.16 to 0.81). This effect seems greater in women with low risk pregnancies, probably because cardiotocography facilitates earlier detection of fetal distress, thus allowing timely delivery. Furthermore, a recent US study of nearly two million women showed a significant reduction in both infant mortality and neonatal seizures in infants born to women who had cardiotocographic monitoring.

The potential benefits of cardiotocography on neonatal seizures in the UK can be estimated, although there are no robust data available on the way NICE guidance on cardiotocographic monitoring is applied, nor on the number of high risk cases that are changed to low risk or low risk women who end up having cardiotocographic monitoring during labour. Around
There is clear evidence that continuous cardiotocographic monitoring decreases the risk of neonatal seizures

750,000 babies are born at term in the UK each year.\(^\text{19}\) If we assume an incidence of neonatal seizures of 2.5/1000, about 1900 will have neonatal seizures. Around two thirds of these are likely to have been low risk deliveries, leaving 1250 babies with seizures born to women who, according to NICE guidelines, were not recommended continuous cardiotocography. If we take the relative risk of 0.36 from the Cochrane review for seizures in low risk women with continuous cardiotocography, and apply it to the number of babies who had seizures born to low risk women (1250), continuous intrapartum cardiotocography would potentially prevent 800 babies from having neonatal seizures and the associated long term cognitive and motor effects. This is similar to the number of babies born in England and Wales with Down’s syndrome\(^\text{20}\) and equates to one third of the number of babies born extremely prematurely at 22-27 weeks in the UK each year.\(^\text{21}\)

Although continuous cardiotocography in low risk women might increase the rate of caesarean sections, it is not possible to predict the size of this effect because most of the relevant studies are 20-30 years old. The caesarean section rate has more than doubled since then, and there have been considerable changes in obstetric practice. We need a randomised controlled trial comparing continuous cardiotocography versus intermittent auscultation in labour in low risk women with long term neurodevelopmental function as the primary outcome and frequency of intervention and mode of delivery as secondary outcomes. Assuming moderate or severe cognitive impairment as a likely consequence of hypoxic-ischaemic neonatal seizures and a seizure rate of 2.5/1000 in the control group and 0.9/1000 in the cardiotocography group, we calculate that the study would need a sample size of 3587 women per group. If the study found a significant effect on the burden of neurodisability, it could considerably reduce the resources needed to educate, support, and care for these children not only in the UK but worldwide.

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1 National Institute for Health and Clinical Excellence. NICE guideline: intrapartum care. NICE, 2007


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