



Fetal heart rate monitoring – Is it a waste of time ?

Asma Khalil, Patrick O'Brien

University College London Hospitals, United Kingdom.

The cardiocotograph was invented in early 1960's by Hammacher, working closely with Hewlett Packard. Its introduction into the clinical setting was surrounded by great fanfare and before the end of the decade continuous electronic fetal monitoring (EFM) was in widespread clinical use¹⁻⁴. The general expectation was that within a short time cerebral palsy (CP) would be virtually eliminated. At the time obstetricians felt that the fetal monitor had given them, for the first time, a window through which they could monitor the wellbeing of the fetus antenatally and during labor. Since cesarean section (CS) had become a relatively safe procedure by this time they thought that they had the power to save babies from the potentially catastrophic effects of hypoxia during labor. Sadly, as we now know, this expected fall in the incidence of CP has failed to materialize in spite of the introduction of continuous EFM and its role has been questioned⁵. The aim of this review is to try to understand why and to ask whether continuous fetal monitoring has any role to play in modern obstetrics.

Background

With the benefit of hindsight, perhaps it is not too surprising that continuous intrapartum fetal heart rate (FHR) monitoring has failed to reduce significantly the incidence of CP. After all, the FHR is only an indirect measure of fetal hypoxia. While it has certainly been demonstrated that fetal hypoxia can affect FHR, far more valuable information would be gained if we could measure fetal blood pressure and cerebral flow or cerebral oxygen saturation. Unfortunately, such measurements are technically impossible at the moment, at least in human fetuses, and hence all we have to rely on is the FHR.

In any event, it is now generally accepted that a maximum of only 10% of all cases of CP can be explained by perinatal

events^{6,7}. The other 90% are due to antepartum events such as intrauterine infection, antepartum hemorrhage, etc. This means that even if we had the perfect tool to identify those fetuses at risk of hypoxic brain damage during labor, we could still hope to prevent, at best, only 10% of cases of CP

and the cardiocotograph (CTG) is certainly not the instrument. Several studies of CTG interpretation have shown significant interobserver variation. Even worse, there is also significant intraobserver variation. In other words, when the same CTG is shown to the same expert a few months later, there is a high chance that the interpretation will be different⁸⁻¹⁷. In fact, in the United Kingdom the Confidential Enquiries into Stillbirths and Deaths in Infancy (CESDI) in 1997, 1998 and 2000 stated categorically that poor interpretation of the CTG was a major contributor to intrapartum stillbirths¹⁸⁻²⁰.

Perhaps the most well known trial of continuous FHR monitoring is the Dublin randomized trial from Ireland in 1985²¹. This showed that despite increased intervention, there was no improvement in neonatal outcome when low risk women were continuously monitored. Even more worrying were the findings of Nelson et al²² in 1996. They reviewed women with a highly abnormal CTG in labor i.e. fetal tachycardia with reduced variability and late decelerations. These were the very fetuses traditionally considered to be at the greatest risk of CP and for whom urgent delivery by CS or instrumental delivery was considered mandatory. They found that only 58% of these fetuses with a highly abnormal CTG were acidotic at birth as judged by umbilical artery pH. Moreover, only 0.2% went on to develop CP. In other words, continuous FHR monitoring, when used as a predictor of CP, has a 99.8% false positive rate! It is difficult to imagine any other test in any branch of medicine which has such a high false positive rate, particularly when the intervention is as major a procedure as CS.

RCOG/NICE Guideline

Against this background, the Royal College of Obstetricians and Gynecologists (RCOG) and the National Institute for

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Correspondence :

Dr. Asma Khalil

Senior Research Fellow in Feto-Maternal Medicine
University College, London Hospital, U.K.

Clinical Excellence (NICE) in the United Kingdom decided to review the whole issue of FHR monitoring²³. They convened a large team of interested parties including obstetricians, midwives, statisticians, neonatologists, epidemiologists, politicians, and consumer groups such as the National Childbirth Trust. This expert committee carried out a systematic review of the relevant literature, attempting to address a series of clinical questions. For each clinical question, they made a recommendation based on the available good quality evidence. The strength of the recommendation was categorized as A, B, C or Good Practice Points, depending on the quality of the available evidence (Table 1).

Table 1. Grading of recommendations.

Catagory/Grade	Requirements
A	Requires at least one randomized controlled trial as part of a body of literature of overall good quality and consistency addressing the specific recommendation.
B	Requires the availability of well-conducted clinical studies but no randomized clinical trials on the topic of the recommendation.
C	Requires evidence obtained from expert committee reports or opinions and/or clinical experience of respected authorities indicates an absence of directly applicable clinical studies of good quality.
Good practice point	Recommended good practice based on the clinical experience of the Guideline Development Group.

Table 2. Radomized controlled trials concerning the use of continuous electronic fetal monitoring.

Author / year	Location	Type of population
Haverkamp et al ²⁴ (1976)	Denver	High risk
Renou et al ²⁵ (1976)	Melbourne	High risk
Kelso et al ²⁶ (1978)	Sheffield	Low risk
Haverkamp et al ²⁷ (1979)	Denver	High risk
Wood et al ²⁸ (1981)	Melbourne	Low risk
MacDonald et al ²¹ (1985)	Dublin	Low risk
Neldam et al ²⁹ (1986)	Copenhagen	Low and high risk
Shy et al ³⁰ (1990)	Seattle	High risk
Vintzileos et al ³¹ (1993)	Athens	Low and high risk

The evidence

Most of the evidence analyzed by the RCOG/NICE group comes from nine large randomized controlled trials (Table 2).

However the Dublin RCT dominates because it includes a large number – almost 13,000²¹. The conclusions of the review group are summarized below.

Perinatal outcome

The only advantage associated with continuous EFM is a significant decrease in the incidence of neonatal seizures (RR 0.51, 95% CI 0.32 – 0.82). But this was true only in trials which included fetal blood sampling and those with a high quality score (meaning a well-conducted trial). The RCOG/NICE committee also noted that only the Dublin study gave a definition of neonatal seizures.

However, when this group analyzed the three studies with longer follow up (Dublin, 1985²¹; Denver, 1979²⁷; and Seattle; 1987³⁰) they found that the use of continuous EFM was not associated with a reduction in the incidence of CP^{32,33}. Indeed, one of these studies found an increased frequency among the EFM group³⁰!

There was no other beneficial impact of continuous EFM on perinatal outcome. The incidence of 1 minute apgar scores of less than 4 or less than 7, and of admission to the neonatal intensive care unit were unchanged, as was the overall perinatal mortality rate.

Intervention

The group found that continuous EFM led to a significant increase in the rate of emergency CS. Overall, the relative risk was 1.41 (95% CI 1.23-1.61), compared to that with intermittent auscultation of the fetal heart. If analysis is limited to include only those trials which included fetal scalp blood sampling (FSBS)³⁴, the increased risk of CS was not as great but was still significant (RR 1.24, 95% CI 1.05 – 1.48).

Continuous EFM also increases the rate of operative vaginal delivery the overall relative risk being 1.20 (95% CI 1.11 – 1.30). This increase was most marked in trials which included FSBS.

Adverse effects of EFM

It is clear therefore that continuous EFM leads to significantly more intervention in the form of CS and operative vaginal delivery, but without any benefit to the baby^{34,35}. In addition, it leads to considerable parental anxiety as well as clinician stress³⁶⁻³⁹. There is also an increase in other invasive

procedures such as the application of fetal scalp electrodes and FSBS; these of course carry a risk of maternal and fetal infection, trauma and hemorrhage⁴⁰. In the era of HIV, this consequence must be taken into account.

Financial considerations

The equipment itself—fetal monitors with consumables like paper and contact gel – is expensive. However, these costs are relatively small when compared to the cost of an increase in the CS rate. A calculation in the United Kingdom in 2000 suggests that in obstetric units which don't have access to FSBS the cost of the increased CS rate (RR 1.24) is just over £ 100,000 extra per 1,000 births^{23,29,41}. In units which use FSBS (RR of CS 1.41), the additional cost is only £ 54,000 per 1,000 births. In an average unit in the United Kingdom which delivers 4,000 babies a year, this considerable expense would be enough to fund the salaries of 20 extra midwives.

Shocking as it seems, however, all of this is dwarfed by the cost of the increased litigation associated with the use of continuous EFM. In a medico-legal case where a baby has ended up with CP, the finding of any abnormality in the CTG recording is usually enough to lead to a verdict against the hospital/doctor. The courts rarely take into consideration the fact that we now know that at least 90% of these babies will have sustained cerebral damage even before the labor started. Awards in the United Kingdom for babies affected by CP are counted in millions of pounds and a figure of five or seven million pounds is not uncommon.

NICE Guidelines

The RCOG/NICE committee issued guidelines, where appropriate, based on their review of the evidence.

⌘ Low risk pregnancies

Intermittent auscultation (IA) should be offered and recommended (Level A).

Because the use of continuous EFM in low risk women increased intervention rates without offering any advantage to the fetus IA should not just be offered, but it should be actively recommended. In other words, we should tell low risk women who request continuous EFM that it is an option, but it will not improve the outcome for their baby while it will increase their own risk of operative delivery.

⌘ High risk pregnancies (Table 3)

There is some evidence that continuous EFM improves the outcome in high risk pregnancies, and should be recommended^{24-28,30}. Pregnancy can be classified as high risk according to the presence of maternal fetal or intrapartum risk factors, as depicted in Table 3.

RCOG/NICE also recommended that in units using EFM, there should be ready access to FSBS facilities. This was a level A recommendation because of the good evidence suggesting that FSBS helps to limit the increase in CS rates associated with continuous EFM.

Table 3. Factors which lead to the classification of pregnancy as high risk.

Maternal	Fetal	Intrapartum
Previous cesarean section	Intrauterine growth restriction	Oxytocin augmentation
Preeclampsia	Preterm	Epidural analgesia
Postterm > 42 weeks	Oligohydramnios	Vaginal bleeding
Prolonged rupture of membranes for >24 hours	Abnormal umbilical artery Doppler flow	Maternal pyrexia
Induction of labor	Multiple pregnancy	Fresh meconium liquor
Diabetes mellitus	Meconium stained liquor	Abnormal intermittent auscultation
Antepartum hemorrhage	Breech presentation	
Other medical problems		

Table 4. Guidelines for intermittent auscultation.

Timing
<ul style="list-style-type: none"> ⚡ For a full minute after a contraction ⚡ But at least every <ul style="list-style-type: none"> ⚡ 15 minutes in the first stage ⚡ 5 minutes in the second stage
Criteria for changing to continuous EFM
<ul style="list-style-type: none"> ⚡ Evidence that baseline is > 110 bpm or < 160 bpm ⚡ Evidence of FHR deceleration ⚡ The onset of intrapartum risk factors

EFM = Electronic fetal monitoring FHR = fetal heart rate

bpm = beats per minute

The admission CTG

The NICE guidelines of 2001 concluded that there was no evidence that an admission CTG for low risk women improves perinatal outcome and therefore advised against its use. This recommendation is supported by a subsequent trial which randomized over 8,000 low risk women to have an admission CTG or not to have ⁴². They found no difference in perinatal mortality or morbidity. This of course does not change the recommendation that high risk women should be offered not just an admission CTG, but continuous fetal monitoring throughout labor.

Conclusion

So, is the intrapartum CTG a waste of time ? The answer for most women – who are low risk – is yes. In fact, it's not just a waste of time, it is positively harmful. Continuous EFM should be reserved for high-risk pregnancies only; for all other women, intermittent auscultation should be recommended. However, as the Cochrane review of 2001 concluded with some dejection – there is little evidence that the use of EFM will diminish in the near future ³⁴. It seems that we will have to wait for the advent of new technologies, which will hopefully be more effective (and prove to be so before their widespread introduction) in protecting babies during labor.

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