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Admission cardiotocography versus intermittent auscultation of fetal heart rate: Effects on neonatal Apgar score, on the rate of caesarean sections and on the rate of instrumental delivery—A systematic review

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Abstract

Objective: The aim of this review was to determine whether intrapartum admission cardiotocography (CTG) in women at low obstetric risk can improve neonatal outcome (in terms of Apgar score) and whether it is associated with an increase in the incidence of instrumental delivery and caesarean section.
Review methods: The Cochrane Library, Medline (1966–November 2005), Embase (1980–November 2005) and the PubMed were searched for randomized control trials and systematic reviews of randomized control trials. Studies were assessed for quality. Outcomes considered the neonatal Apgar score at 5 min after delivery, caesarean section and instrumental delivery. A meta-analysis of the results of the randomized controlled trials was performed.
Results: The pooled relative risk for having an Apgar score less than 7 points at 5 min after delivery was higher in the admission CTG group (RR 1.35, 95% CI 0.85–2.13) but it was not statistically significant. The pooled relative risks for having a caesarean section-delivery (RR 1.2 95% CI 1.00–1.41) and an instrumental delivery (RR 1.1 95% CI 1.00–1.18) were both higher in the admission CTG group. Both these were statistically significant.
Conclusion: Intrapartum admission cardiotocography in women at low obstetric risk increases the risk of caesarean section and instrumental delivery. In addition, there is no evidence for neonatal benefit in terms of Apgar score at 5 min after delivery. A larger sample size would be needed in order to answer this important question.

Keywords: Intrapartum admission cardiotocography; Intermittent auscultation; Apgar score; Caesarean section; Instrumental delivery; Women at low obstetric risk; Meta-analysis

What is already known about the topic?

There is no firm conclusion whether intrapartum admission cardiotocography in women at low obstetric risk improves neonatal and maternal outcomes.

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What this paper adds

Intrapartum admission cardiotocography in women at low obstetric risk increases the risk of caesarean section and instrumental delivery with no evidence for neonatal benefit in terms of Apgar score at 5 min after delivery.

1. Background

Intermittent auscultation and continuous cardiotocography (CTG) are the main methods of monitoring the fetal heart rate and provide an indirect assessment of fetal well being during labour. Intermittent auscultation involves auscultation of the fetal heart rate at determined intervals employing either a Doppler ultrasound device or a Pinard stethoscope and the continuous CTG involves the continuous electronic fetal heart rate monitoring for the evaluation of fetal well being in labour.

Admission CTG is a short, usually 20 min, recording of the fetal heart rate immediately after admission to the labour ward that aims to identify a group of women at greater risk of intrapartum fetal hypoxia.

CTG was introduced 20 years ago with the aim of reducing perinatal mortality and cerebral palsy (Chapman, 2003). The intrapartum and the admission use of the cardiotocographyelectronic fetal monitoring increased rapidly since its introduction. Since then the effectiveness of continuous CTG has been evaluated through randomized control trials (RCTs), which have been systematically reviewed. A Cochrane review of 9 RCTs compared the efficacy and safety of routine continuous CTG during labour with intermittent auscultation and demonstrated an increase in the rate of caesarean sections and instrumental deliveries but no significant differences in Apgar score (Thacker et al., 2001). The UK guidelines on the Use of Electronic Fetal Monitoring (NICE, 2001) recommend that continuous CTG should be offered only to high-risk pregnant women. However, the difficulty has always been adequate identification of who is at high risk. A consequence of this difficulty is the increasing use of intrapartum admission CTG in order to identify which fetuses of low-risk mothers are at greater risk and who might therefore benefit from continuous CTG (Liston et al., 2002; Royal College of Obstetricians and Gynaecologists, 2001; Arulkumaran and Jenkins, 2000).

The aim of this review is to compare the effects of the admission CTG and intermittent auscultation of the fetal heart rate on neonatal and maternal outcomes in women at low obstetric risk. The review was undertaken in order to demonstrate whether the routine use of the admission CTG in low-risk pregnancies should be continued.

The question formulated in order to conduct the review is 'whether the admission CTG can improve the neonatal outcome (in terms of Apgar score) and whether it can cause an increase in the rate of caesarean sections and in the rate of instrumental deliveries in a low-risk obstetric population?'

2. Method

A mini systematic review (Griffiths, 2002) was conducted in order to provide an unbiased overview of good quality research rapidly with limited resources. This review considered only RCTs that compared intrapartum admission CTG with intermittent auscultation of the fetal heart rate or systematic reviews of such studies. Non-randomized study designs were excluded. The population of interest was pregnant women between 37 and 42 gestational weeks who were considered to be at low risk on their admission to the labour ward.

Interventions included the main methods of monitoring of the fetal heart rate on the women' admission: the admission CTG and intermittent auscultation. The following operational definitions were used for the interventions: *admission CTG* was defined as a commonly used screening test consisting of a short, usually 20 min, recording of the fetal heart rate and uterine activity performed on the mother's admission to the labour ward and *intermittent auscultation* was defined as intermittent surveillance of the fetal heart rate at determined intervals using either Pinard stethoscope or a hand-held Doppler performed on the mother's admission to the labour ward (Royal College of Obstetricians and Gynaecologists, 2001). The comparison groups were the intervention group of women, which had an admission CTG and the control group of women, which had an intermittent auscultation at admission. The neonatal outcome was the Apgar score (below 7/10) at 5 min after delivery. Maternal outcomes were the instrumental delivery (forceps or ventouse) and caesarean delivery.

Trials that met the above inclusion criteria were then evaluated for methodological quality, using a structured format for RCTs adapted from Greenhalgh and Donald (2000) (Table 1). Quality assessment and data extraction was conducted by a single reviewer, using these explicit criteria. Lack of blinding has not been considered to undermine the validity of studies because clinicians or women will not have been blind to the intervention. Although it would be appropriate for the data assessor to be blind.

3. Search strategy

Studies were identified by searching the following databases: the Cochrane Library, Medline (1966–November

2005), Embase (1980–November 2005) and the PubMed. These databases were searched using the search strategy shown in Table 2. Other methods of searching, such as hand-searching for key journals, searches for "grey literature", were not carried out.

4. Findings of the review

The initial search generated 82 titles (Fig. 1). Titles and abstracts were examined for relevance to the review question. After the assessment of the titles and abstracts, 76 references were excluded because they were apparently not relevant to the intrapartum admission test. Of the six studies that were identified, 3 were excluded because the study design and/or the study population were not relevant (Blix and Oian, 2001; Kushtagi and Naragoni, 2002; Elimian et al., 2003). These three studies were observational and additionally two (Blix and Oian, 2001; Kushtagi and Naragoni, 2002) of these contained mixed populations (pregnant women at high and low obstetric risk). Three studies were relevant and examined in further detail (Impey et al., 2003; Cheyne et al., 2003; Mires et al., 2001). These three studies that were identified met the inclusion criteria and were included in the systematic review. Characteristics of these studies are shown in Table 3.

Table 1
Quality criteria for this review

1. Randomized control trials, which identified the relevant population, interventions and outcome
2. Evidence of appropriate randomization
3. Evidence of concealed allocation
4. A follow-up rate of $\geqslant 80\%$
5. Intention to treat analysis

5. Included studies

These studies were critically appraised using a structured format for RCTs adapted from Greenhalgh and Donald (2000).

The study by Impey et al. (2003) was a RCT which conducted in UK which aimed to compare the effects of admission CTG and intermittent auscultation of the fetal heart rate on neonatal and maternal outcomes (levels of obstetric intervention). Impey et al. studied 8580 pregnant women at low obstetric risk (no adverse obstetric history, no evidence or suspicion of antenatal fetal compromise). The groups were compared for a number of baseline features. No statistically significant differences were found suggesting that the two groups were homogeneous. Women were randomly allocated either to admission CTG or usual care (intermittent auscultation only) in a ratio of one to one. Assignment was made from a sealed, sequentially numbered envelope. In the admission CTG group, monitoring of the fetal heart rate and uterine activity was performed for 20 min on the mother's admission to the labour ward. In the usual care group, intermittent auscultation was used for 1 min after a contraction every 15 min during the first stage and every 5 min during the second stage of labour. Of the 4320 (50.1%) women randomized to admission CTG group, no follow up data were available for 22 women (0.5%). Of the 4308 (49.9%) women randomized to intermittent auscultation group, no follow up data were available for 26 women (0.6%). The overall follow-up rate was 99.5% and 99.4% accordingly, that is over the 80% that is required for validity of the trial (Greenhalgh and Donald, 2000).

The study by Mires et al. (2001) was a RCT which conducted in UK which aimed to compare the effect of admission CTG and Doppler auscultation of the fetal heart rate on neonatal outcome and levels of obstetric intervention in pregnant women at low obstetric risk. In

Table 2
Search terms used in the study

Population		Intervention		Comparison intervention		Outcomes
Pregnan$	AND	Cardiotoco$ OR Admission Cardiotoco$ OR Fetal monitoring OR Admission EFM	AND	Auscultat$ OR Intermittent auscultat$	AND	Instrumental delivery OR Intervent$ delivery OR Operative delivery OR Caesarean delivery OR Caesarean section AND Neonatal outcome OR Apgar score

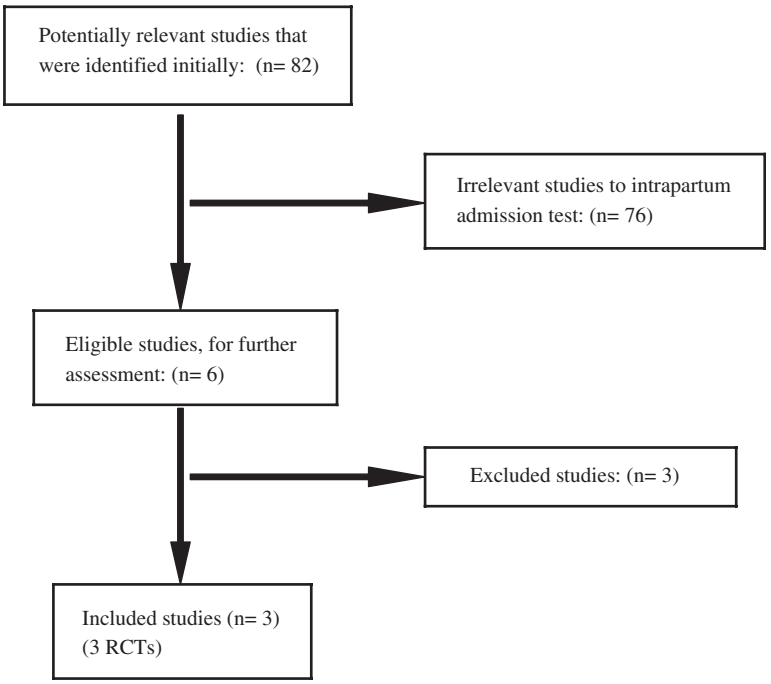

Fig. 1. Selection process of included studies.

Table 3
Characteristics of the included studies

Study/year	Design	Method of intervention	Method of comparison intervention	Population	Sample size	Follow up rate	Concealed allocation	Met all quality criteria?
Impey et al. (2003)	RCT	Admission CTG	Intermittent auscultation	Low risk pregnant women	8580	99.5%	Yes	Yes
Mires et al. (2001)	RCT	Admission CTG	Intermittent auscultation	Low risk pregnant women	2367	Not defined	Yes	Yes
Cheyne et al. (2003)	RCT	Admission CTG	Intermittent auscultation	Low risk pregnant women	312	93.4%	Yes	Yes

the study by Mires et al., 3751 women who met the entry requirements (low-risk pregnancy) gave their consent and were randomly allocated in the third trimester. Women randomized to the admission CTG group or intermittent auscultation group with a commercially available computer randomization program. The allocation was placed in a sealed envelope. The women did not know which group they had been allocated until their admission in labour. The data analysts were blind to the randomization code. Women randomized to the admission CTG group had 20 min of CTG and women randomized to the intermittent auscultation group had fetal heart auscultation during and immediately after a contraction. Between randomization in the third trimester and admission in labour, 1384 women (37%) developed an obstetric complication, thus 2367 women who remained low risk were studied. Of the 2367 women, 1186 women were randomized to the admission CTG group and 1181 women were randomized to the intermittent auscultation group. The groups were compared for a number of baseline features. No statistically significant differences were found suggesting that the two groups were homogeneous.

The study by Cheyne et al. (2003) was a RCT which conducted in UK which aimed to compare the effect of admission CTG and intermittent auscultation of the fetal heart rate on neonatal outcome and especially on levels of obstetric intervention in pregnant women at

low obstetric risk. In the study by Cheyne et al., 157 women (53%) were allocated to the admission CTG group and 177 women (47%) allocated to the intermittent auscultation group. A randomization series was computer-generated in order to allocate the participants equally between the two groups. The randomization scheme delivered in the form of sequentially numbered, sealed envelopes, which contained the allocation to the appropriate group. Following randomization 22 women were found not to be in labour and were discharched. This gave a follow-up rate of 93.4%. Although only 312 women (148 admission CTG group, 164 intermittent auscultation group) were finally included. The groups were compared for a number of baseline features. No statistically significant differences were found suggesting homogeneity of the two groups.

6. Results

Impey et al. (2003) reported that less than 0.4% (17/4298) of infants in the admission CTG group and similarly less than 0.25% (11/4282) of infants in the intermittent auscultation group had Apgar score < 7 at 5th minute after delivery. The relative risk (RR) for having an Apgar score less than 7 points at 5 min after delivery in the admission CTG group was 1.54 (95% CI 0.72–3.28). The RR of having a caesarean section-delivery in the admission CTG group was 1.13 (95% CI 0.92–1.40). It was also reported that 11.5% (493/4298) of women in the admission CTG group and 11.1% (476/4282) of women in the control group had instrumental delivery. The RR of having an instrumental delivery in the admission CTG group was 1.03 (95% CI 0.92–1.16). None of these differences were statistically significant.

Mires et al. (2001) reported that 2.1% (25/1186) of infants in the admission CTG group and similarly 15.2% (18/1181) of infants in the intermittent auscultation group had an Apgar score < 7 at 5 min after delivery thus the RR was 1.39 (95% CI 0.72–2.66). Mires et al. reported that 5% (61/1186) of women in the admission CTG group and 3.6% (43/1181) of women in the intermittent auscultation group had a caesarean section thus the RR of having a caesarean section in the admission CTG group was 1.43 (95% CI 0.95–2.18). These differences were not statistically significant. It was also reported that 21.2% (252/1186) of women in the admission CTG group and 17.2% (204/1181) of women in the intermittent auscultation group had instrumental delivery thus the RR was 1.23 (95% CI 1.04–1.45). This difference was statistically significant.

Cheyne et al. (2003) reported that 1.2% (2/164) of infants in the intermittent auscultation group and none of the babies in the admission CTG group had Apgar score less than 7 points at the 5th minute after delivery and thus the RR was 0.2 (95% CI 0.01–4.6). It was also reported that 7% (11/148) of women in the admission CTG group and 5% (9/164) women in the intermittent auscultation group had a caesarean section. The RR of having a caesarean section in the admission CTG group was 1.35 (95% CI 0.6–3.1). Cheyne et al. also reported that 8% (12/148) of women in the admission CTG group and 13% (21/164) women in the intermittent auscultation group had instrumental delivery. The RR of having an instrumental delivery was 0.63 (95% CI 0.32–1.22). These results were not statistically significant.

A meta-analysis of these trials was conducted using StatsDirect Statistical Software 1.9.15. The results of this meta-analysis are shown in Table 4. Variability in the treatment effects being evaluated in different trials is known as statistical heterogeneity, and is a consequence of clinical and/or methodological diversity among the studies. Statistical heterogeneity manifests itself in the observed treatment effects being more different from each other than one would expect due to random error (chance) alone. Heterogeneity of study results was measured by Cochran's Q measure. There was no evidence of heterogeneity and a fixed effect model was used for the RRs of meta-analysis. The pooled RR for having an Apgar score less than 7 points at 5 min after delivery in the admission CTG group was 1.35 with 95% CI 0.85–2.13. This was not statistically significant. The pooled RR for having a caesarean section-delivery in the admission CTG group was 1.2 with 95% CI 1.00–1.41. The pooled RR of having an instrumental delivery in the admission CTG group was 1.1 with 95% CI 1.00-1.18. Both these were statistically significant.

7. Conclusions

The main justification for admission CTG is that an abnormal trace might indicate a placental deficiency and hence identify potential fetal compromise at an early stage of labour, in order to allow intervention. Although, it has been concluded that the admission CTG may give an indication of fetal well being at the time of admission it cannot predict how the fetus will cope after several hours of labour (Ingermasson et al., 1986). Thus, admission CTG may represent an unnecessary intervention.

The admission CTG can make some parents feel reassured, 'safe and secure' (Sinclair, 2001). Also clinicians often feel reassured that they are able to measure and observe a trace of the fetal heart at the time of admission.

The results of this meta-analysis shows that women at low obstetric risk who had an intrapartum admission CTG were more likely to have an instrumental delivery or a caesarean section than women who had an admission intermittent auscultation Because the result

Table 4
Relative risk meta-analysis

Study	Admission CTG	Intermittent auscultation	Weight (%)	RR	RR (pooled)	95%CI
Neonatal outcome (Apgar score < 7 at 5th minute after delivery)						
Impey et al.	17/4298	11/4282	76.3	1.54		
Mires et al.	25/1186	18/1181	21	1.39		
Cheyne et al.	0/148	2/164	2.77	0.2		
Total events	11259		100		1.35	0.85–2.13
χ^2 (for pooled relative risk) = 1.64 (df = 1) $p = 0.20$						
Test for heterogeneity: Cochran Q = 1.49 (df = 2), $p = 0.474$						
Maternal outcome: rate of Caesarean section						
Impey et al.	180/4298	158/4282	76.3	1.13		
Mires et al.	61/1186	43/1181	21	1.43		
Cheyne et al.	11/148	9/164	2.77	1.35		
Total events	11259		100		1.2	1.00–1.41
χ^2 (for pooled relative risk) = 4.00 (df = 1) $p = 0.045$						
Test for heterogeneity: Cochran Q = 1.05 (df = 2), $p = 0.591$						
Maternal outcome: rate of Instrumental delivery						
Impey et al.	493/4298	476/4282	76.3	1.03		
Mires et al.	252/1186	204/1181	21	1.23		
Cheyne et al.	12/148	21/164	2.77	0.63		
Total events	11259		100		1.1	1.02–1.18
χ^2 (for pooled relative risk) = 4.13 (df = 1) $p = 0.042$						
Test of heterogeneity: Cochran Q = 3.35 (df = 2), $p = 0.186$						

of this meta-analysis concerning the Apgar score was not statistically significant there is no clear evidence whether admission CTG improves the Apgar score.

Although there is no scientific evidence for admission CTG to be used routinely in pregnant women at low obstetric risk, a survey conducted, to evaluate the impact of the NICE Electronic Fetal Monitoring Guideline on clinical practice in England and in Wales found that most maternity units (79%) still reported using admission CTG in the initial assessment of women who were healthy (Thomas et al., 2002).

A limitation in the methods in this review was that only one rater performed the search and critical appraisal of the studies. Also only three outcomes; (Apgar score < 7 at 5 min, incidence of caesarean section and instrumental delivery) were investigated. It would be useful to consider other consequences of admission CTG, and the findings from the Cochrane Review in this area will be welcome when published (Devane et al., 2005).

The findings of this study support the conclusions of the review by NICE, that admission CTG should not be used routinely in labours of women at low risk until the drawing of firm conclusions concerning the effects of the admission CTG on neonatal outcome. Meta-analysis with bigger sample size and with more broad range of outcomes should be conducted in order to collect statistically significant results.

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