

# Comparison between visual and computerized cardiotocography in low risk pregnancy

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## ABSTRACT

**Objective:** To compare between visual and computerized cardiotocography (cCTG) in low-risk pregnant women in predicting pregnancy outcome.

**Methods:** One hundred and fifty-three consecutive computerized fetal heart tracings were recorded from non-laboring pregnant women at  $\geq 30$  weeks gestation. All traces were reviewed by 2 experienced obstetricians. The study was carried out at Al-Ain Medical District, United Arab Emirates, between August 2004 and December 2004.

**Results:** Of the 153 pregnant women, 11 (7.2%) were delivered by cesarean section. The interobserver

agreement was 0.60. The observers cCTG agreement were 0.48 and 0.45. The difference in cesarean section rate was not statistically significant. Observers' interpretation and cCTG did not correlate well with Apgar score at 5 minutes and admission to special care baby unit.

**Conclusions:** Computerized CTG has little advantage over conventional CTG in the prediction of Apgar score and need for neonatal intensive care unit admission in a low-risk population.

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The use of electronic fetal monitoring (EFM) continues to grow as one of the main tools in assessing fetal well-being. However, its diagnostic accuracy remains unsatisfactory. This is mainly due to its poor reproducibility with great intra- and inter-observer variation in its interpretation.<sup>1</sup> Computerized analysis of EFM overcomes these problems by providing quantitative assessment of fetal heart rate (FHR) parameters.<sup>2</sup> However, for computerized cardiotocography (cCTG) to replace the visual assessment of fetal heart tracing in routine obstetrical practice will depend on its capability to predict perinatal outcome. Most of the studies investigating the use of cCTG, have focused on high-risk pregnancies. Few have addressed its predictive value in a low-risk population. The purpose of this study is to compare between visual

and cCTG in the prediction of pregnancy outcome in low-risk non-laboring women.

**Methods.** One hundred and fifty-three consecutive fetal heart tracings were recorded from non-laboring pregnant women. They were all healthy women with uncomplicated singleton pregnancy at  $\geq 30$  weeks gestation. Fetal heart rate was recorded using a computerized Sonicaid Fetal Monitoring System (Oxford 8000). The following FHR indices were evaluated according to Dawes and Redman criteria:<sup>3</sup> Baseline FHR is defined as modal value of pulse interval measured as the mean rate during episodes of low FHR variation where present. Small accelerations are defined as change in FHR 10 beats per minute (bpm) above the

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baseline for at least 15 seconds. Large accelerations are defined as change in FHR 15 bpm above the baseline for at least 15 seconds. Decelerations is defined as change in FHR >10 bpm under the baseline for at least one minute, or 20 bpm for at least 0.5 minute, or 25 bpm for at least 0.25 minute. Short-term variation is defined as a mean of 3.75 seconds epoch-epoch variation. Episode of high FHR variation is defined as at least 5 of 6 consecutive minutes in which the range of pulse interval is >32 milliseconds. Episode of low FHR variation is defined as at least 5 of 6 consecutive minutes in which the range of pulse interval is <30 milliseconds.

Fetal heart tracing was performed for  $\leq 20$  minutes if Dawes and Redman criteria were met. Patients with abnormal FHR traces were referred to the delivery room for further assessment and management. All FHR traces were photocopied and reviewed by 2 experienced obstetricians. They were requested to record their interpretations as acceptable (reactive) or not acceptable (suspicious/pathological). Both observers were blinded from the cCTG analysis and the pregnancy outcome. The delivery notes of all 153 pregnant women were retrospectively reviewed. The mode of delivery and pregnancy outcome were analyzed. Collected data were subjected to statistical analysis using SPSS. For statistical comparison, coefficient and  $\chi^2$  test were measured where appropriate. Significance was set at  $p < 0.05$ . Interpretation of kappa coefficient was according to Landis and Koch.<sup>4</sup> A coefficient less than 0.20 corresponds to poor agreement, 0.21-0.40 corresponds to fair agreement, 0.41-0.60 corresponds to moderate agreement, 0.61-0.80 corresponds to good agreement and 0.81-1.00 corresponds to very good agreement.

**Results.** The total number of patients included in this study was 153 patients. Their mean age was  $28 \pm 5.1$  years, mean parity was  $2.2 \pm 2.3$ , mean gestational age (GA) at fetal heart tracing was  $35 \pm 2.8$  weeks, mean GA at delivery was  $39.2 \pm 1.3$  weeks, mean birth weight was  $3213 \pm 444$  grams and mean Apgar score at one and 5 minutes was  $7.7 \pm 0.8$  and  $8.9 \pm 0.5$ . Of the 153 pregnant women, 140

(96.4%) had normal vaginal delivery, 2/154 (1.3%) had assisted vaginal delivery and 11/153 (7.2%) were delivered by cesarean section. Four (2.6%) neonates were admitted to the neonatal intensive care unit (NICU). No perinatal deaths were reported. Of the 153 FHR traces, 35 (22.8%) traces did not meet Dawes and Redman criteria. The first and second observer recorded 32 (20.9%) and 40 (26.1%) traces as not acceptable. Of the 35 FHR traces that did meet Dawes and Redman criteria, 20/35 (57%) were interpreted by the first observer as not acceptable and 22/35 (62.8%) by the second observer. The agreement between the observers and the cCTG was moderate (**Table 1**). Of the 35 FHR traces that did not meet cCTG criteria, 15/35 (42.9%) and 13/35 (37.1%) were acceptable by the first and second observer. There was good observer-cCTG agreement regarding the evaluation of the FHR baseline, accelerations (small and large) and episodes of high variations; it was poor regarding the assessment of decelerations, episodes of low variations and short-term variations (**Table 2**). The rate of cesarean section among pregnant women that did not meet cCTG criteria was 4/35 (11.4%) compared to 2/32 (6.3%) and 2/40 (5%) in those interpreted as not acceptable by first and second observers. The difference in cesarean section

Table 2 - Fetal heart rate indices in traces not meeting Dawes and Redman criteria but interpreted as normal by observers.

Fetal heart rate indices	cCTG	Observer 1	Observer 2
Small accelerations	1.91 $\pm$ 1.78	2.46 $\pm$ 1.84*	2.76 $\pm$ 1.78†
Large accelerations	0.57 $\pm$ 0.73	0.66 $\pm$ 0.89	0.92 $\pm$ 0.86
Decelerations	0.09 $\pm$ 0.28	0.07 $\pm$ 0.28	0.08 $\pm$ 0.27
Episodes of high variations	0.57 $\pm$ 1.85	1.26 $\pm$ 2.63†	1.00 $\pm$ 2.44‡
Episodes of low variations	9.51 $\pm$ 7.23	8.53 $\pm$ 7.04	10.84 $\pm$ 6.81
Short term variations	6.82 $\pm$ 2.45	7.08 $\pm$ 1.55	6.30 $\pm$ 1.61

\* $p=0.01$ , † $p=0.001$ , ‡ $p=0.03$   
cCTG - computerized cardiotocography

Table 1 - Kappa values for interobserver and observer-computerized cardiotocography (cCTG) agreement.

Observers	cCTG	Observer 1	Observer 2
cCTG	-	0.48	0.45
Observer 1	0.48	-	0.60
Observer 2	0.45	0.60	-

Table 3 - Apgar score and special care baby unit admissions (SCABU).

Observers	N of traces did not meet the criteria (%)	Apgar 1 minute <7 n=10	Apgar 5 minutes <7 n=2	SCABU admission n=4 (%)
cCTG	35 (22.8)	2	1	2 (2.8)
Observer 1	32 (20.9)	0	1	2 (6.3)
Observer 2	40 (26.1)	0	1	2 (5.0)

rate was not statistically significant. Observers' interpretation and cCTG did not correlate well with Apgar score at 5 minutes, and admission to special care baby unit (Table 3).

**DISCUSSION.** The level of agreement among observers in the interpretation of FHR tracing is poor. Computerized CTG was introduced to provide an objective and reproducible tool of FHR assessment.<sup>5</sup> Acceleration and deceleration, which are the main focus of visual analysis, have shown to be a poor predictor of perinatal outcome.<sup>6</sup> The use of a computerized system provides exact values for most CTG parameters.<sup>7</sup> The interobserver agreement (kappa value = 0.61) was better than between the observer-cCTG agreement (kappa = 0.48 and 0.45). However, the overall level of agreement was moderate according to Landis interpretation. Bracero et al<sup>8</sup> reported a poor interobserver and observer-cCTG level of agreement, with kappa values as low as 0.28. However, their study group was high-risk pregnancies, while our study was carried out on healthy pregnant women with uncomplicated pregnancies. The level of interobserver and observer-cCTG agreement tends to be higher in a low-risk population compared to a high-risk group.<sup>9</sup> The level of observer-cCTG agreement is related to the observer experience, with higher level of agreement with experienced observers.<sup>10</sup> In our study, the 2 observers were experienced obstetricians. However, the level of agreement was moderate. We observed a poor observer-cCTG agreement in the assessment of decelerations, episodes of low variations and short-term variations. This might be of clinical significance since FHR variation is a good predictor for fetal acidemia and perinatal outcome.<sup>11</sup> In intrauterine growth restricted (IUGR) fetuses, the duration of the episodes of low variation and short- and long-term variations are significantly associated to umbilical artery pH.<sup>12</sup> Other investigators observed that the only cCTG variable that is significantly associated with umbilical artery acid-base status at birth is accelerations. Accelerations are correlated to HCO<sub>3</sub> levels, which reflect the immediate compensatory changes to alterations of the acid-base status, before affecting pH. The short-term (beat-to-beat) heart rate variability is mainly a reflection of fluctuating parasympathetic tone.<sup>13</sup> Our study showed that cCTG is superior to observers in detecting decelerations, episodes of low variations and short-term variations. However, cCTG was not better in predicting low Apgar score and need for NICU admission. This questions the advantage of cCTG over conventional CTG in a low-risk population. Obstetricians should rely both on clinical features and on the computerized interpretation, to make decisions on management.<sup>14</sup>

We conclude from the above results that the level of interobserver and observer-cCTG agreement is

moderate in a low-risk population. Computerized CTG is superior to observers in detecting decelerations, episodes of low variations and short-term variations. Computerized CTG has little advantage over conventional CTG in the prediction of Apgar score and need for NICU admission in a low-risk population.

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