

Antenatal transabdominal fetal ECG for heart rate monitoring: Quality assessment of a renewed monitoring technique



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Background

Non-invasive fetal heart rate (FHR) monitoring using the fetal ECG (fECG) signal as obtained from the maternal abdomen has several advantages compared to FHR monitoring using ultrasound. Main advantage of this method is its potential of obtaining prolonged non-invasive recordings. Previously, antepartum fECG-monitoring has been hampered by technical difficulties (poor signal pickup due to noise, and a decline in signal quality around the formation of a vernix caseosa between gestational ages 28-32 weeks). Most technical problems appear to have been solved now.

We report on our experience with an renewed fECG-monitor. We hypothesized that recording quality would be better during the night.

Methods

120 women with singleton pregnancies (GA 20-40 wks) were included for a single overnight recording. A fetal ECG monitor, AN24 Monica Healthcare, was attached to the maternal abdomen using 5 disposable ECG electrodes (Figure 1-3). During 15 consecutive hours (5 pm – 8 am) fetal heart rate was recorded either in hospital (n=40) or at home (n=80). Fetal and maternal heart rate was calculated using successive R-R intervals.

Primary outcome was the recording quality (RQ in %), defined as the proportion of epochs during which valid data were available, when data reduction over 3.75 seconds was performed. A recording was considered to be of sufficient quality when RQ was $\geq 60\%$ ¹. Secondary outcomes were the effect of timing of the recording (total recording 5pm - 8am versus night recording 11pm - 7am) and the effect of gestational age on recording quality.

Results

When total recording time was considered, 103/120 (86%) recordings were of sufficient quality. This percentage increased to 92% (111/120 recordings) when only the night part (11pm - 7am) was considered.

Figure 4 contains the median RQ for each recording per hour. Notice how the recording quality rises from approximately 9 pm onwards. In order to show the large differences in RQ per hour for each recording, the interquartile variation over 120 recordings is also displayed.

Figure 5 shows median recording quality during the night over gestation. RQ was high at 20-26 weeks gestation, followed by lower values (and wider variation) at 26-31 weeks, with a gradual improvement thereafter.

Conclusions

Our findings demonstrate the feasibility of a renewed fetal monitoring technique using the transabdominally obtained fetal ECG signal. Quality was optimal when the recording was performed overnight. Although RQ declined transiently between GA 26-31 weeks, the median night RQ remained far above the required minimum of 60%¹.

The main advantage of this non-invasive monitoring technique is the prolonged recording time. In the future this fECG monitor could be most applicable in high risk pregnancies, such as intrauterine growth restriction, diabetes mellitus, fetal arrhythmias and in pregnancies with decreased fetal movements. Another application of the fetal ECG monitor could be to study the fetal effects of maternal medical treatment (antihypertensive drugs, antidepressants).

¹ G.S. Dawes, G.H.A. Visser, J.D.S. Goodman, C.W.G. Redman, *Numerical analysis of the human fetal heart rate: The quality of ultrasound records*. Am.J.Obstet.Gynecol.Vol 141;1981, Sept 1

Figure 1: AN24 Fetal ECG Monitor (Monica Healthcare)



Figure 2: Positioning of the electrodes

● Fetal Electrodes ● Maternal electrode

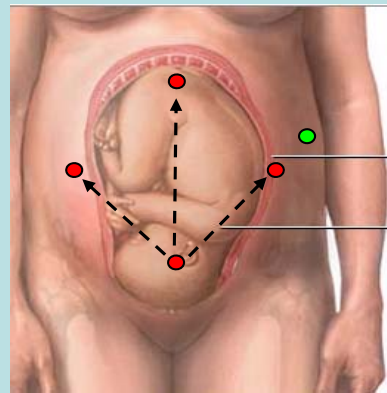


Figure 3: Fetal monitoring with the AN24 in a patient at 27 weeks of gestation.



Figure 4: Median Recording Quality and interquartile variation per hour of recording (n=120)

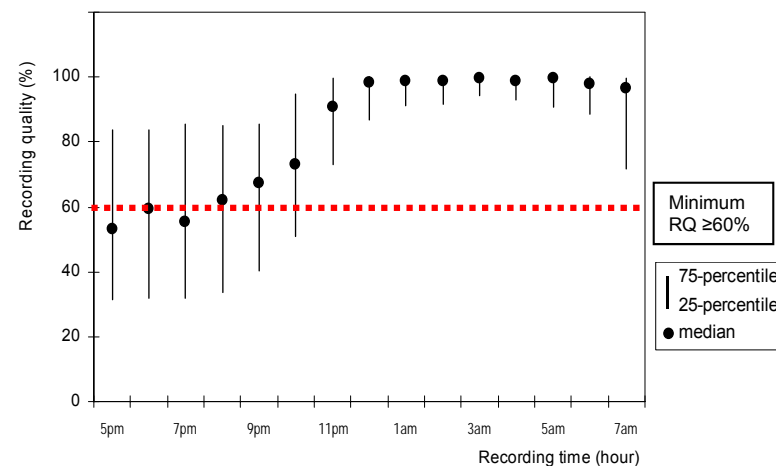


Figure 5: Median Recording Quality and interquartile variation (night recording) over gestation (n=120)

