

Comparison of a Novel Computerized Analysis Program and Visual Interpretation of Cardiotocography

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ABSTRACT

Objective: To compare a novel computerized analysis program with visual interpretation of cardiotocography (CTG) results.

Methods: Sixty-two intrapartum CTG tracings with 20- to 30-minute sections were independently interpreted by a novel computerized analysis program and eight obstetricians' visual interpretations to evaluate the baseline FHR, baseline variability, number of accelerations, number/type of decelerations, uterine contraction (UC) frequency, and the National Institute of Child Health and Human Development (NICHD) 3-Tier categorization.

Results: There was no significant difference in interobserver variation after adding the components of computerized analysis to results from the obstetricians' visual interpretations, with excellent agreement for the baseline FHR (ICC 0.91), the number of accelerations (ICC 0.85), UC frequency (ICC 0.97), and NICHD category I (kappa statistic 0.91); good agreement for baseline variability (kappa statistic 0.68), the numbers of early decelerations (ICC 0.78) and late decelerations (ICC 0.67), category II (kappa statistic 0.78), and overall categories (kappa statistic 0.80); and moderate agreement for the number of variable decelerations (ICC 0.60), and category III (kappa statistic 0.50).

Conclusions: The outcome of this computerized analysis was similar to that of visual interpretation with good agreement for overall NICHD categories. This novel analysis program may improve interobserver variations of visual interpretation.

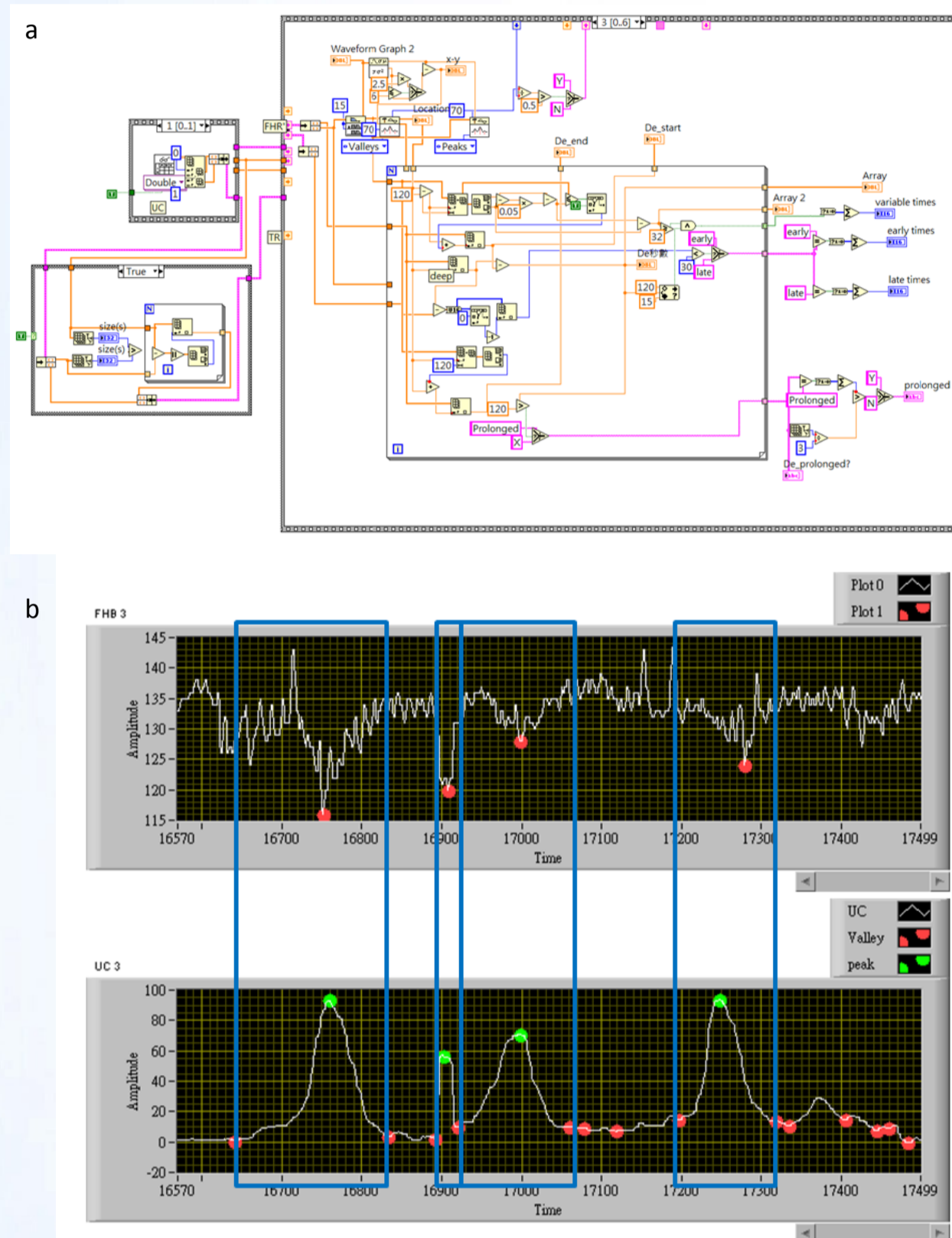


Figure 1 The block diagram (a) and front panel (b) of the LabVIEW software program used to evaluate the number/type of decelerations.

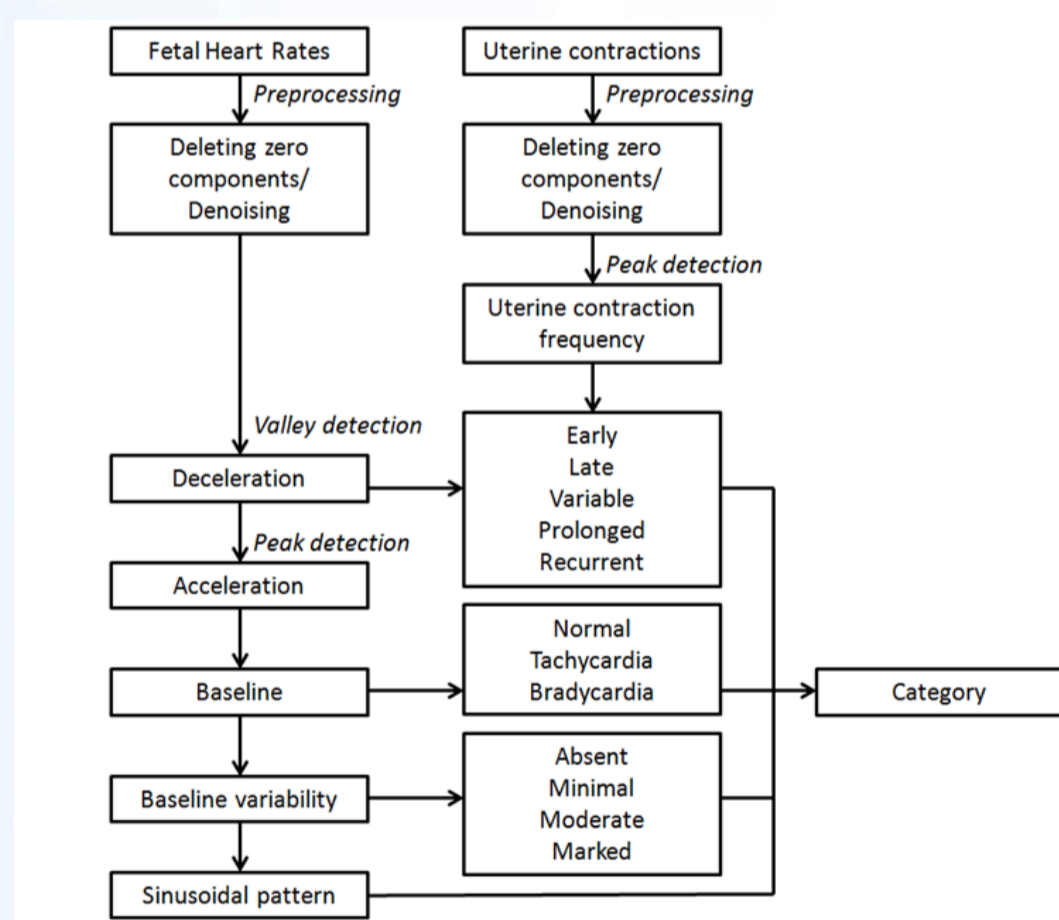


Figure 2 Flow diagram of the software algorithm.

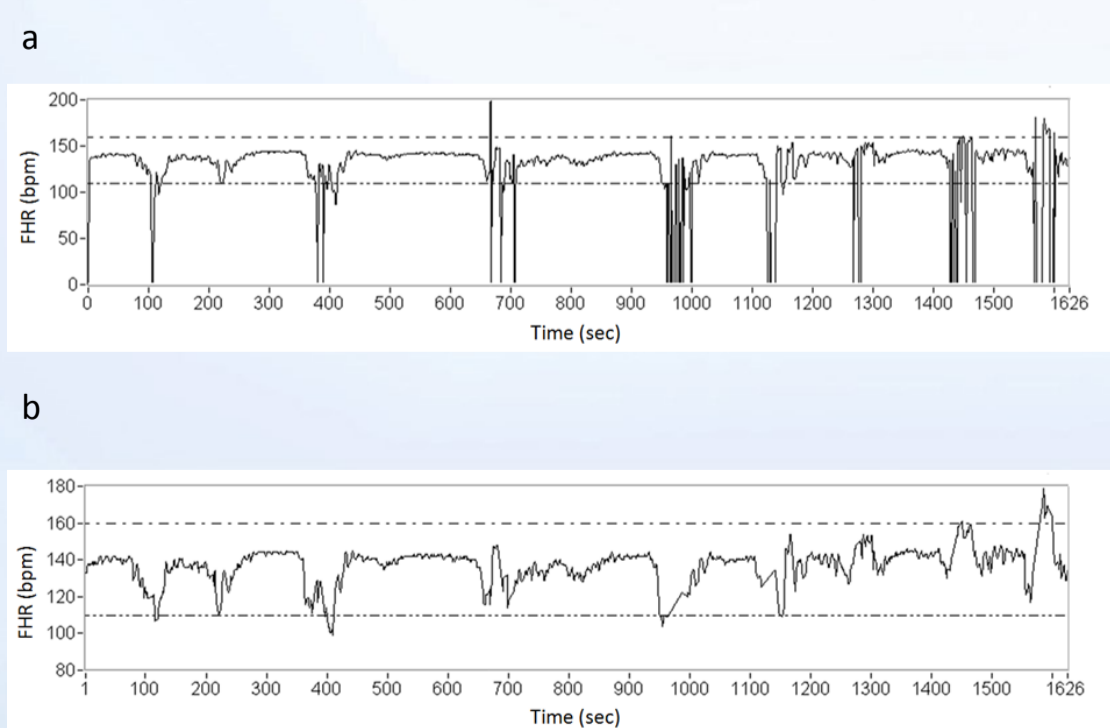


Figure 3 An example of fetal heart rate tracings: (a) the original pattern; (b) the pattern after deleting the lost signal components, eliminating noise, and filling in by linear interpolation.

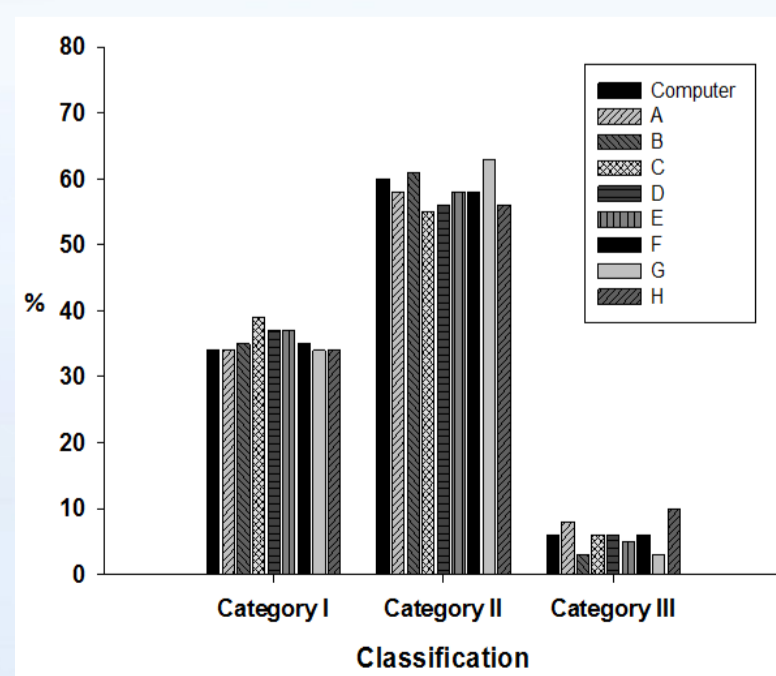


Figure 4 Distribution of cardiotocography tracings by the NICHD 3-Tier classification system.

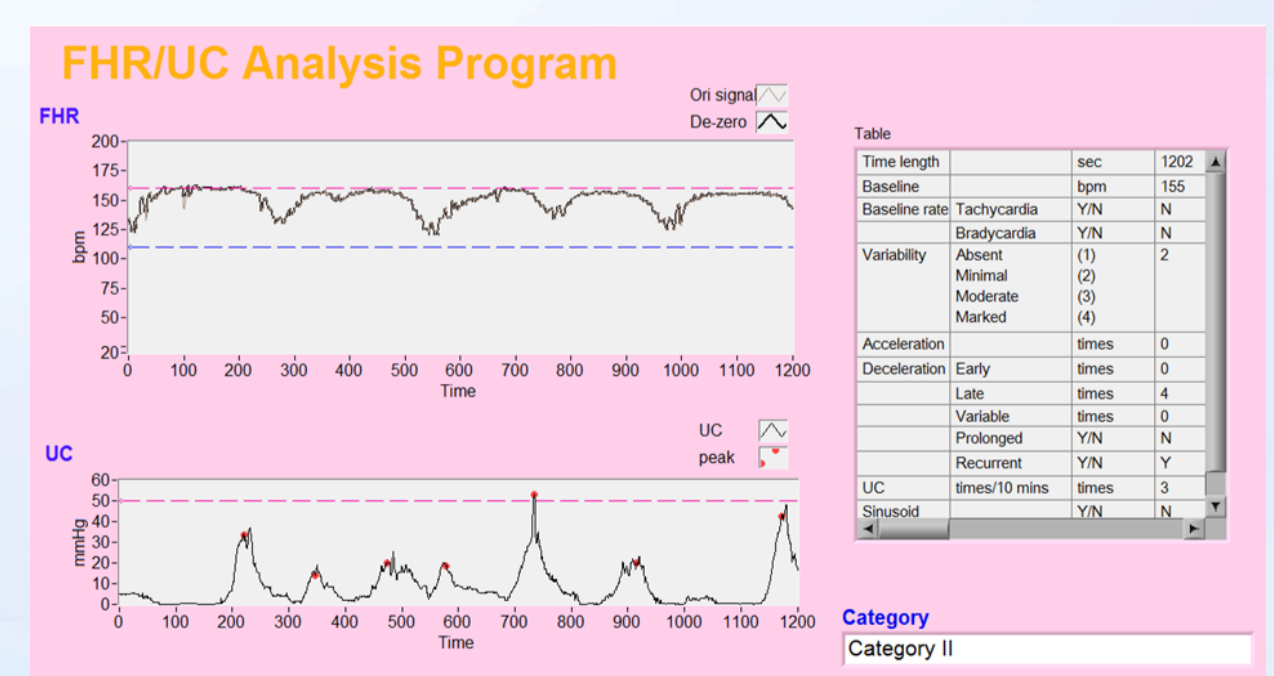


Figure 5 A user-friendly interface from the LabVIEW software program used for prenatal telemedicine.

Table 1 Characteristics of 62 cardiotocography tracings obtained by computerized analysis and visual interpretation by eight obstetricians

	Computer	A	B	C	D	E	F	G	H
Mean baseline FHR (bpm)	147	147	146	146	148	146	147	147	148
Baseline variability									
Absent	6	7	3	5	5	5	5	2	7
Minimal	16	16	18	14	18	16	17	22	19
Moderate	40	39	40	43	39	41	40	38	36
Marked	0	0	1	0	0	0	0	0	0
No. of accelerations	142	133	167	119	129	110	147	164	169
No. of early decelerations	17	13	19	17	12	6	14	8	20
No. of late decelerations	55	58	28	33	69	34	49	46	69
No. of variable decelerations	70	53	83	76	57	76	69	98	81
No. of prolonged decelerations	7	5	7	8	5	6	4	8	6
No. of recurrent decelerations	18	18	14	18	20	17	18	20	22
No. of UCs	443	448	430	455	453	428	458	467	463
Category									
I	21	21	22	24	23	23	22	21	21
II	37	36	38	34	35	36	36	39	35
III	4	5	2	4	4	3	4	2	6

FHR, fetal heart rate; bpm, beats per minute; UCs, uterine contractions.

Table 2 Interobserver variations between results from the eight obstetricians' visual interpretations and the computerized analysis

	Visual interpretation only			Visual interpretation and computerized analysis		
	ICC or Kappa statistic (*)	95% CI	Agreement	ICC or Kappa statistic (*)	95% CI	Agreement
Baseline FHR	0.91	0.88 – 0.94	Excellent	0.91	0.88 – 0.94	Excellent
Baseline variability	0.67*	0.51 – 0.83	Good	0.68*	0.51 – 0.84	Good
Acceleration	0.84	0.79 – 0.89	Excellent	0.85	0.80 – 0.90	Excellent
Early deceleration	0.78	0.71 – 0.84	Good	0.78	0.71 – 0.84	Good
Late deceleration	0.65	0.56 – 0.74	Good	0.67	0.59 – 0.76	Good
Variable deceleration	0.59	0.50 – 0.69	Moderate	0.60	0.51 – 0.70	Moderate
Prolonged deceleration	0.82*	0.58 – 1.00	Excellent	0.82*	0.58 – 1.00	Excellent
Recurrent deceleration	0.82*	0.66 – 0.97	Excellent	0.82*	0.67 – 0.97	Excellent
UC frequency	0.97	0.96 – 0.98	Excellent	0.97	0.96 – 0.98	Excellent
Category						
I	0.90*	0.81 – 1.00	Excellent	0.91*	0.81 – 1.00	Excellent
II	0.78*	0.62 – 0.93	Good	0.78*	0.63 – 0.93	Good
III	0.48*	0.15 – 0.80	Moderate	0.50*	0.17 – 0.83	Moderate
Overall	0.80*	0.66 – 0.93	Good	0.80*	0.67 – 0.94	Good

FHR, fetal heart rate; UC, uterine contraction; ICC, intraclass correlation coefficient; CI, confidence interval.

Table 3 Intraclass correlation coefficients or kappa statistics (*) between results from the computerized analysis and visual interpretation by eight individual obstetricians

	A	B	C	D	E	F	G	H
Baseline FHR	0.98	0.81	0.94	0.92	0.95	0.94	0.94	0.94
Baseline variability	0.72*	0.68*	0.70*	0.78*	0.71*	0.74*	0.59*	0.64*
Acceleration	0.92	0.85	0.82	0.93	0.88	0.85	0.89	0.89
Early deceleration	0.87	0.83	0.84	0.83	0.59	0.78	0.59	0.82
Late deceleration	0.89	0.60	0.60	0.85	0.74	0.82	0.70	0.84
Variable deceleration	0.67	0.74	0.62	0.67	0.45	0.88	0.71	0.46
Prolonged deceleration	0.82*	0.84*	0.92*	0.63*	0.74*	0.70*	0.92*	0.74*
Recurrent deceleration	0.84*	0.75*	0.84*	0.77*	0.88*	0.84*	0.70*	0.71*
UC frequency	0.98	0.96	0.98	0.97	0.95	0.97	0.97	0.98
Category								
I	0.93*	0.82*	0.83*	0.93*	0.86*	0.89*	0.93*	0.93*
II	0.83*	0.70*	0.70*	0.87*	0.77*	0.77*	0.73*	0.87*
III	0.64*	0.30*	0.47*	0.73*	0.55*	0.47*	0.10*	0.78*
Overall	0.85*	0.72*	0.73*	0.88*	0.79*	0.79*	0.75*	0.88*

FHR, fetal heart rate; UC, uterine contraction.