The value of near-infrared spectroscopy during labor in women with non reassuring cardiotocography

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Objective

Cardiotocography (CTG) is used as the gold standard in the follow-up of fetal well-being during the second stage of labor, but it has a low predictive value and a high false positive rate. Since it is not effective in the evaluation of fetal well-being, there is a need for an alternative non-invasive method, which could be used either concomitantly with CTG or by itself. In our study, it has been aimed to find out any contribution placental oxygen saturation measurement obtained via Near-Infrared Spectroscopy (NIRS) device, which is already in use of the measurement of oxygen saturation of biological tissues, might have on CTG's prediction on fetal well-being and whether or not these measurements might contribute to the interpretation of non-reassuring CTG tracings, the most challenging CTG tracing for management.

Methods

In this prospective clinical study of ours, term singleton pregnant women, who are in their active stages of labor and hospitalized, with placental locations other than posterior, whose subcutaneous fat tissue depths, measured by ultrasound, are <4.5 cm have been included between the dates of July, 2020 and October, 2021. During active stages of labor, placental oxygen saturations were measured via NIRS device concomitantly with continuous cardiotocographic evaluations. SPSS 23.0 program was used for statistical analysis.

Results

The results were obtained from 140 patients, but due to lack of CTG tracings and/or NIRS measurements or signal losses and missing fetal blood gas analyses from umbilical cords, only the results obtained from 53 patients and 500 recordings were evaluated. No statistically significant correlation was found between CTG categories (obtained according to American College of Obstetricians and Gynecologists (ACOG) guidelines) and pH values, 5th minute Apgar scores, and delivery types, respectively ($p=0.208$) ($p=0.547$) ($p=0.103$). No statistically significant correlation was found between NIRS mean oxygen saturation values and pH values, 5th minute Apgar scores, and delivery types, respectively ($p=0.850$) ($p=0.514$) ($p=0.253$). No statistically significant correlation was found between the number of NIRS placental deoxygenation events, which determine the decrease of $> 5\%$ from baseline placental oxygenation for the duration of 15-180 seconds, and pH values, 5th minute Apgar scores, and delivery types, respectively ($p=0.805$) ($p=0.393$) ($p=0.257$). Yet again, there was no correlation between CTG categories and the NIRS mean oxygen saturations and between CTG categories and the number of NIRS placental deoxygenation events ($p=0.354$) ($p=0.064$).

Conclusion

It was proven in our study, in accordance with the literature, that the monitorization of fetal well-being through continuous cardiotocographic evaluation of fetal heart rate, which is the most used method in the current practice, during the second stage of labor is weak in predicting fetal outcome. It was being determined that NIRS oxygen saturation measurement, which is being designed to increase the predictive prediction of CTG follow-up or to be an alternative non-invasive method to CTG follow-up, is not a method that increases the predictive prediction, whether it is used alone or in combination with CTG in the evaluation of fetal well-being and prediction of fetal outcome (umbilical blood gas pH value, Apgar 5th minute score and cesarean delivery parameters were taken into account) It is, therefore recommended to continue searching for alternative methods that may be more effective, have lower costs, and whose effectiveness are demonstrated through their application in larger patient populations.
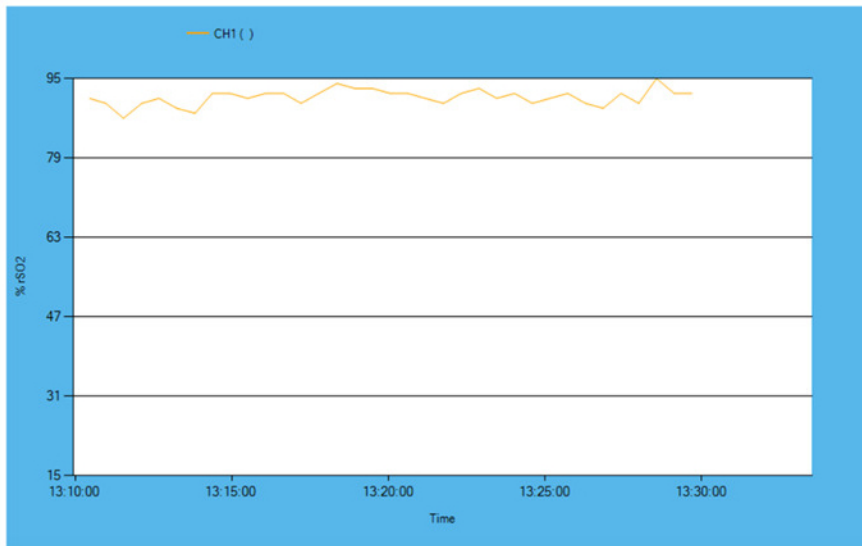
Table 1: Comparison of the patients' CTG categories and pH values, 5th minute Apgar scores, and delivery types.

CTG Category	1 (Reactive) (n=19)	2 (Non-reassuring) (n=19)	3 (Non-reactive) (n=15)	Correlation coefficient*	P*
pH					
≤ 7,20	3	0	2	0,244	0,208
> 7,20	16	19	13		
5th min Apgar score					
< 7	1	0	2	0,151	0,547
> 7	18	19	13		
Delivery type					
C/S	4	3	7	0,293	0,103
NSVD	15	16	8		

*: Cramer's V corelation coefficient; p < 0,05 significant

Table 2: Comparison of the patients' NIRS mean oxygen saturation values and pH values, 5th minute Apgar scores, and delivery types.

NIRS mean oxygen saturation values (%)	≤ 84,50 (n=9)	> 84,50 (n=44)	Correlation coefficient *	P*
pH				
≤ 7,20	1	4	0,026	0,850
> 7,20	8	40		
5th min Apgar score				
< 7	0	2	0,090	0,514
> 7	9	42		
Delivery type				
C/S	1	13	0,157	0,253
NSVD	8	31		

*: Cramer's V correlation coefficient; p < 0,05 significant

Table 3: Comparison of the patients' NIRS placental deoxygenation events, which determine the decrease of ≥ 5% from baseline placental oxygenation for the duration of 15-180 seconds, and pH values, 5th minute Apgar scores, and delivery types.

NIRS placental deoxygenation events	>0	=0	Correlation coefficient *	P*
pH				
≤ 7,20	4	1	0,034	0,805
> 7,20	36	12		
5th min Apgar score				
< 7	1	1	0,117	0,393
> 7	39	12		
Delivery type				
C/S	9	5	0,156	0,257
NSVD	31	8		

*: Cramer's V correlation coefficient; p < 0,05 significant

Table 4: Relation between the CTG categories and the NIRS mean oxygen saturations and between the CTG categories and the number of NIRS placental deoxygenation events.

	N	Correlation coefficient *	P*
CTG categories and NIRS mean oxygen saturations	500	0,244	0,354
CTG categories and the number of NIRS placental deoxygenation events	500	0,206	0,064

*: Cramer's V correlation coefficient; p < 0,05 significant