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EDITORS' CHOICE

STAN in clinical practice—The outcome of 2 years of regular use in the city of Gothenburg

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KEY WORDS
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Objective: The purpose of this study was to monitor the introduction of the STAN-methodology (Noventa Medical, Moelndal, Sweden).

Study design: This was a prospective observational study covering the total population of deliveries at term during 2 years. Four thousand eight hundred and thirty out of 14,687 term pregnancies were monitored using the STAN S 21 fetal heart monitor and the associated clinical guidelines. Cord artery metabolic acidosis, neonatal outcome, and rates of operative deliveries for fetal distress were assessed.

Results: The annual rate of STAN usage increased from 28.1% to 37.7% and was associated with a significant reduction in metabolic acidosis rate in the total population from 0.76% to 0.44% ($P < .05$). The compliance with the clinical guidelines increased in cases requiring intervention. The rates for moderate/severe hypoxic neonatal encephalopathy were consistently low, 0.55 and 0.68 per 1000 deliveries, respectively, and corresponding to previous findings. The rate of operative delivery did not change during the 2 years in the total population.

Conclusion: Increasing STAN usage provided consistent improvements in fetal outcome equalling those noted in the Swedish randomized controlled trial (RCT) without increasing operative interventions for fetal distress.

It is the aim of intrapartum fetal monitoring to identify early the fetus that is compromised and at risk for neonatal and long-term morbidity. In this respect, the value of electronic fetal monitoring (EFM) is still in debate.[1] Interpretation of cardiotocographic data is subject to intra- and interobserver differences and failure to interpret heart rate traces correctly is a common finding in intrapartum event-related asphyxia.[2,3]

A recent development in EFM has combined assessments of the standard fetal heart rate (FHR) tracing with an automated analysis of the fetal electrocardiogram (ST-waveform analysis, STAN, Neoventa Medical, Moelndal, Sweden). In a randomized controlled multicenter study performed in 3 Swedish labor units (SRCT), significantly lower rates of umbilical artery metabolic acidosis and operative delivery for fetal

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Table I Classification of CTG patterns

CTG-classification	Baseline heart rate	Variability reactivity	Decelerations
Normal	110-150 beats/min	5-25 beats/min Accelerations	Early decelerations Uncomplicated variable decelerations with a duration <60 s and beat loss <60 beats/min
Intermediary	100-110 beats/min	>25 beats/min without accelerations	Uncomplicated variable decelerations with a duration <60 s and beat loss >60 beats/min
	150-170 beats/min Short bradycardia episode A combination of several intermediary observations will constitute an abnormal CTG	<5 beats/min >40 min	
Abnormal	150-170 beats/min and reduced variability	<5 beats/min >60 min	Repeated late decelerations
	>170 beats/min Persistent bradycardia	Sinusoidal pattern	Complicated variable decelerations with a duration >60 s
Preterminal	Total lack of variability and reactivity with or without decelerations or bradycardia		

distress were associated with the use of FHR monitoring combined with ST-waveform analysis when compared to the use of FHR monitoring alone.[4] Most importantly, the study also documented a significant reduction in term neonates suffering from moderate/severe neonatal encephalopathy.[5]

Our department participated in a European Community multicenter project on the dissemination of knowledge regarding the STAN-methodology–based on the Centre of Excellence structure.[6]

The aim of the EU project was to evaluate the introduction of the STAN methodology in 10 European obstetric centers. As part of this project, we have analyzed the outcome over 2 years in a large population. The current analysis includes data obtained from all term deliveries monitored, either with STAN (FHR + ST) or by conventional CTG during labor, and that occurred in the city of Gothenburg and surrounding area during a period of 24 months, when the STAN concept of intrapartum fetal monitoring and obstetric management was introduced.

Material and methods

The 2 maternity wards located at Sahlgren's University Hospitals; Oestra and Moelndal cover a population of 870,000 and were equipped with 8 STAN S 21 units from August to September 2000 after the educational process had been ongoing during the summer months. An additional 3 STAN units were used during the last 6 months of the study. These are large labor ward units, with approximately 4000 deliveries per year each and 300 members of staff. Continuous fetal monitoring (conventional EFM) is the norm during second stage of labor. One labor ward participated in the SRCT.[4]

The training consisted of lectures, written information, and multimedia-based teaching, including a simulator that displayed previously recorded cases.

The general indications for using STAN were 36 completed gestational weeks and situations where internal monitoring was the preferred method of fetal surveillance. Specific indication included high-risk pregnancies, women with suspicious or abnormal external CTG antenatally or in early labor, labor induction, oxytocin augmented labor, and presence of meconium stained amniotic fluid. Additional STAN use also became part of the training aspect.

STAN clinical guidelines[4] provide detailed information on the definition of normal, intermediary, abnormal, and preterminal FHR patterns (Table I). In case of an intermediary or abnormal FHR pattern, ST analysis was used as an adjunct to indicate when intervention is required (Table II). Fetal scalp pH was also used as an additional source of information both among CTG and STAN cases. During the study period labor ward personnel was systematically instructed about the (patho-) physiology of asphyxia and the interpretation of CTG- and ST-changes during labor.

Each ward had 1 part-time midwife responsible for the education and data collection. Assessment of the condition of the child at birth was based on cord-artery and vein acid-base status (pH, PCO_2, and base deficit, mmol/L) and Apgar scores. Base deficit in the extra cellular fluid compartment was calculated with the Siggaard-Andersen Acid Base Chart algorithm.[7] Metabolic