

ORIGINAL ARTICLE

Cardiotocography in labor: an exploratory analysis of fetal heart rate (FHR) interpretative uniformity in Alto Adige

Running title: analysis of fetal heart rate (FHR) interpretative uniformity

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ABSTRACT

Objective. Cardiotocography (CTG) is a screening tool to monitor fetal well-being during labor and delivery. The overall process of interpreting CTG during labor is known to be subject to significant inter-observer and intra-observer variability and the need to reduce this variability of interpretation has not only a clinical and care role but is of considerable importance for medical-legal reasons. We have reported an exploratory analysis of the interpretational variation of the same FHR-tracing recorded during labor by different clinical figures.

Materials and Methods. The aim of this study was to evaluate the uniformity of interpretation of a CTG-tracing in labor performed by medical and obstetrical personnel in a single Italian health-district (Alto Adige).

Results. 40 health-care professionals responded to the questionnaire, 11 of whom were physicians specialized in gynecology (27.5%) and 29 were in the profession of midwifery (72.5%).

There was a non-coincidence among all participants in terms of prioritization of potential cardiotocographic indices of fetal non-wellness. Our study confirmed that the interpretation of the CTG pattern is highly subjective, irrespective of the guideline adopted, and CTG-misinterpretation represents the major determinant for increased frequency of obstetrical intervention during labor.

Conclusions. A difference in the interpretation of CTG-tracks exists, has been described in the literature and highlighted by our study. Advanced continuous training on the interpretation of CTG in labor, cases audit and debriefing, involving all the team, is certainly the best method to implement the knowledge of fetal heart rate tracing interpretation and to standardize the labor and delivery management.

Key words

Cardiotocography; labour; obstetric; audit; debriefing

INTRODUCTION

Cardiotocography (CTG) is a screening tool to monitor fetal well-being during labor and delivery,

recording both Fetal Heart Rate (FHR) and uterine contractions (UC) using an electronic fetal monitor.

Its interpretation is performed by obstetricians or midwives following guidelines [1] and several classification systems have attempted to classify CTG traces into “category I, category II, and category III” (United States), [2] “normal, suspicious, and pathological” (National Institute for Health and Care Excellence [NICE] [3] and International Federation of Gynecology and Obstetrics [FIGO] [1], “normal, intermediary, and abnormal” (ST analysis [STAN]), [4] and a 5-tier classification system, [5] in addition to several other guidelines produced by national societies and academic bodies. The individual parameters included within each classification system are divided into different categories with different durations regarding when these parameters become critical, therefore meriting an intervention. This illustrates the ongoing confusion concerning CTG interpretation because of over-reliance on the classification of decelerations into different categories based on their morphology to determine the severity of intrapartum hypoxic stress, without considering the features suggestive of central organ oxygenation on the CTG trace.

In past decades, based on the fetal physiological FHR responses and adaptations to oxygen deprivation during labor, a new approach to FHR interpretation has been proposed. This interpretation is based on the major aspects of the physiology of oxygen supply to the fetus and the main goals of intrapartum fetal monitoring: [1] timely identification of fetuses that are being inadequately oxygenated, to enable appropriate action before the occurrence of injury; and [6] reassurance on adequate fetal oxygenation to avoid unnecessary obstetric interventions. [7]

The overall process of interpreting CTG during labor is known to be subject to significant inter-observer and intra-observer variability [8,9].

The need to reduce this variability of interpretation has not only a clinical and care role but is of considerable importance for medical-legal reasons.

The cardinal driver of cerebral palsy (CP) litigation is CTG: despite its suboptimal performance in reducing the occurrence of intrapartum brain injury, its ex-post interpretation is widely used to evaluate the liability of the labor ward personnel in trials and most caregivers are convicted based on this. [10]

We report an exploratory analysis of interpretational variation of the same FHR tracing recorded during labor by different clinical figures working in the same Italian setting in Alto Adige.

MATERIALS & METHODS

The aim of this study was to evaluate the uniformity of interpretation of CTG tracing in labor performed by medical and obstetrical personnel in a single Italian health-district (Alto Adige).

A quantitative questionnaire was developed to answer the questions through the Microsoft Forms platform (forms.office.com) and, from July to September 2022, this was administered to midwives and gynecological physicians in the Health District of Bolzano, Merano, Bressanone and Brunico (Alto Adige) (File Supplementary 1). The questionnaire consisted of 52 items, including 5 open-ended and 47 multiple-ended. The first questions were related to the participant's professional figure, his years of experience in the delivery room, and the classification he used to evaluate CTG tracings. The second part included five cardiotocographic tracings of varying lengths of at least 40 minutes. Study participants were asked to classify the presented tracings and their parameters.

Extracts of the tracings and their clinical cases were downloaded from <http://www.stancases.com/>. Of the 24 tracings on the site, 5 were selected following the subsequent criteria: good visibility and integrity of the tracing and a minimum length of 40 minutes. The selected traces presented high complexity, creating criticality for all operators.

To assess the concordance of the interpretation parameters of the CTG tracing in labor, we arbitrarily decided to follow the following judgment:

A: very low concordance: <20%

B: low concordance: >20-30%

C: medium-low concordance: >30-40%

D: medium-high concordance: >40-60%

E: high concordance: >60-80%

F: very high concordance: >80%

We included among in utero fetal resuscitation maneuvers those women who reported oxytocin withdrawal, change of position, administration of fluids and tocolytics or what is generically defined as conservative maneuvers as "Other." These are in utero fetal resuscitation maneuvers, and since it was beyond the scope of this thesis, the reasons why some of the participants did not classify them as such were not investigated.

The choice of performing the delivery in a short time frame was reported as "Other" when performing the delivery.

Data was analyzed both globally and then by taking two groups into consideration: physicians and midwives.

RESULTS

40 health professionals responded to the questionnaire, 11 of whom were physicians specialized in gynecology (27.5%) and 29 were in the profession of midwifery (72.5%); each of the participants provided all the answers to the questions in the questionnaire.

Regarding the years of experience in the delivery room, 20% (8) had less than 5 years experience, 27.5% (11/40) between 5 and 10 years, and 52.5% (21/40) reported experience of more than 10 years (*Table 1*).

Classification and indicators of fetal well-being

Regarding the type of classification used by the participants, the most common was the FIGO 2015 classification, which was used by 25 participants (62.50%); 7 (17.50%) participants reported using the SIGO Italian Guidelines (June 2018), 6 (15.00%) the NICE 2014 classification, and only 2 (5.00%) other health care classifications (*Figure 1*).

Table 2 reports the indicators of fetal well-being and non-fetal well-being considered for each specific category.

There was a non-coincidence in terms of prioritization of potential cardiotocographic indices of fetal non-wellness among medical and obstetrical staff. In fact, medical staff favored prolonged bradycardia (72.7% - 8 participants), while obstetrical staff favored no variability (48.28% - 14 participants).

Analysis of CTGs

From the analysis of the responses, the parameter with the highest percentage of "I can't evaluate it" responses was identified as the presence of cyclicity, followed by the evaluation of the type of deceleration.

Specifically, the inability to evaluate was reported for the following parameters:

- **Baseline:** 3/40 participants (7.5%) concerning case 1, 1 /40 (2.5%) concerning case 2, and 17/40 participants (42.5%) concerning case 4.
- **Presence of variability:** 2/40 participants (5%) concerning case 2 and 4/40 (7.5%) concerning case 4.
- **Presence of accelerations:** 3/40 participants (7.5%) in relation to case 1, 2/40 (5%) in relation to case 2, 1 /40 (2.5%) in relation to case 3, 10/40 (25%) in relation to case 4 and 3/40 (7.5%) in relation to case 5.
- **Presence of cyclicity:** 7/40 participants (17.5%) in relation to case 1, 9/40 (22.5%) in relation to case 2, 10/40 (25%) in relation to case 3, 12/40 (30%) in relation to case 4 and 7/40 (17.5%) with relation to case 5.
- **Presence of decelerations:** 2/40 participants (5%) in relation to case 1, 4/40 (10%) in relation to case 2, and even 7/40 (17.5%) in relation to case 4.
- **Type of decelerations:** 8/40 participants (20%) concerning case 2, 1/40 (2.5%) concerning case 3, 7/40 (17.50%) concerning case 4, and 3/40 (7.5%) concerning case 5.
- **Management:** 2/40 participants (5%) concerning case 1, 3/40 (2.5%) concerning case 3, 2/40 (5%) concerning case 4, and 2/40 (5%) concerning case 5.

Regarding the concordance in the responses, only one case (case 3) and only one parameter (presence of decelerations) obtained a 100% concordance in the response. Evaluation of the responses by individual parameter with reference to each of the 5 cases showed:

- **Baseline:** there was concordance of 47.50% (19/40 participants) in case 1, 60% (24/40 participants) in case 2, 50% (20/40 participants) in case 3, 42.5% (17/40 participants) in case 4, and 62.5% (25/40 participants) in case 5. In case 4, the concordance was related to the response "I cannot evaluate it." Concordance attributed: medium-high.
- **Presence of variability:** there was 95% (38/40 participants) concordance in case 1, 60% (24/40 participants) in case 2, 97.50% (39/40 participants) in case 3, 47.50% (19/40 participants) in case 4, and 80% (32/40 participants) in case 5. Concordance attributed: high (medium-high/very high).
- **Presence of acceleration:** there was concordance of 77.50% (31/40 participants) in case 1, 55% (22/40 participants) in case 2, 77.50% (31/40 participants) in case 3, 55% (22/40 participants) in case 4 and 70% (28/40 participants) in case 5. Concordance attributed: high (medium-high/high).
- **Presence of cyclicity:** there was concordance of 67.50% (27/40 participants) in case 1, 57.50% (23/40 participants) in case 2, 40% (16/40 participants) in case 3, 37.50% (15/40 participants) in case 4, and 57.50% (23/40 participants) in case 5. Concordance attributed: medium (low-medium / medium-high / high)
- **Presence of decelerations:** there was concordance of 92.50% (37/40 participants) in case 1, 87.50% (35/40 participants) in case 2, 100% (40/40 participants) in case 3, 80% (32/40 participants) in case 4, and 97.50% (39/40 participants) in case 5. Concordance attributed: very high.
- **Type of decelerations:** there was concordance of 55% (22/40 participants) in case 1, 37.50% (15/40 participants) in case 2, 40.00% (16/40 participants) in case 3, 45% (18/40 participants) in case 4, and 75% (30/40 participants) in case 5. Concordance attributed: average.
- **CTGs classification:** there was concordance of 47.50% (19/40 participants) in case 1, 80% (32/40 participants) in case 2, 45% (18/40 participants) in case 3, 75% (30/40 participants) in case 4, and 55% (22/40 participants) in case 5. Concordance attributed: high.

The percentage of parameter concordance for each case is specified in Figure 2.

Regarding parameter and case, it can be inferred that the rating concordance was generally in the medium-high/high range. The final classification of the CTG tracing in toto also saw medium-high/high concordance.

In no case and for no parameter was very low and/or low concordance found.

CTG-based clinical management.

Regarding the management of the clinical case in labor in relation to the evaluation of the same CTG tracing, in no case was there a single choice as to whether it was essential to carry out the birth or not. Regarding the option to wait and do nothing, regardless of the dilation, in two out of three clinical cases (subjected to evaluation) this was not a suitable option for any of the participants, the majority of whom agreed to a rapid completion of the birth.

Specifically, we found that the decision to:

- **Perform the delivery (cesarean section or vaginal operative delivery)** was the option chosen by 35% (14/40 participants) in case 1, 15% (6/40 participants) in case 2, 17.50% (7/40 participants) in case 3, 67.5% (27/40 participants) in case 4 and by 62.50% (25/40 participants) in case 5. The greater uniformity and agreement regarding the decision to carry out the birth was identified in cases 4 and 5.
- **perform fetal resuscitation maneuvers in utero:** this was the option chosen by 30% (12/40 participants) in case 1, by 32.5% (13/40 participants) in case 2, by 47.50% (19/40 participants) in case 3, by 12.5% (5/40 participants) in case 4 and by 17.50% (7/40 participants) in case 5. The greater uniformity and agreement related to the decision to perform fetal resuscitation maneuvers in uterus was identified in case 3.
- **do nothing if the dilatation is advanced:** this was the option chosen by 7.5% (3/40 participants) in case 1, by 12.5% (5/40 participants) in case 2, by 7.50% (3/40 participants) in case 3, from 0% (0/40 participants) in case 4 and from 12.50% (5/40 participants) in case 5. The greater uniformity and concordance related to the decision to do nothing in case of advanced dilatation was seen in case 4, where none of the participants chose this option.
- **do nothing regardless of dilation:** this was the option chosen by 7.5% (3/40 participants) in case 1, by 25% (10/40 participants) in case 2, by 2.50% (1/40 participants) in case 3, by 0% (0/40 participants) in case 4 and by 0% (0/40 participants) in case 5. The greater uniformity and agreement related to the decision to do nothing in the case regardless of the dilation was seen in cases 4 and 5, where none of the participants chose this option.
- **increase contractile activity with oxytocin:** this was the option chosen by 2.5% (1/40 participants) in case 1, by 2.5% (1/40 participants) in case 2, by 0% (0/40 participants) in case 3, by 0% (0/40 participants) in case 4 and by 0% (0/40 participants) in case 5. The greater uniformity and agreement regarding the decision to increase the contractile activity with oxytocin was seen in cases 3, 4 and 5, where none of the participants chose this option.

Advanced training in the interpretation of CTG in labor

The majority of participants (35/40 participants- 87.5 %) expressed their need for greater knowledge in the interpretation of cardiotocography in labor; this need for reinforcement training appeared to be greater among the category of midwives rather than among the category of physicians, although for both categories this need appeared to be high.

Only 5/40 (12.5 %) did not feel they had this need for training reinforcement.

CONCLUSIONS

There are numerous papers related to the correct interpretation of CTG in labor, while there are few studies that compare the homogeneity of interpretation.

Interpretative comparisons through the use of different classifications have been reported by Zamora Del Pozo et al. [11] and Santo et al. [12]

In the first study [13], the authors aimed to analyze the predictive ability and inter-observer uniformity in the latest versions of the following international classifications of CTG: FIGO, ACOG, NICE and the guidelines developed by Chandraharan. They found that the different cardiotocographic classifications have variable specificity and sensitivity. The Chandraharan classification achieved the highest sensitivity (78.79%), while the ACOG classification achieved the highest specificity (95.73%). The degree of uniformity among the three observers was assessed by the Fleiss Kappa coefficient and was rated highest with the FIGO classification ($\kappa = 0.35$; 95%CI, 0.28-0.41) and lowest with the ACOG classification ($\kappa = 0.23$; 95%CI, 0.16-0.30).

Although all the classifications have a moderate ability to predict neonatal acidemia, the Chandraharan classification was rated as having the highest ability, underscoring the need for an interpretative approach based more on fetal physiology, keeping in mind that fetal hypoxia seems to represent the physiological adaptation of the fetus to uterine contractions and the source of most decelerations. In fact, decelerations should not be classified as pathological or benign but should be interpreted considering the fetal metabolic condition pre-labor. [14]

In the study published by Santo et al. [10], the results showed that, even if the ACOG category II presents greater uniformity (PA=0.73 95%CI 0.70-76), the same classification reports low reliability, sensitivity and high specificity in the prediction of fetal acidemia. The FIGO and NICE classifications show more reliability, a trend towards higher sensitivity and lower specificity in predicting fetal acidemia.

In relation to the interpretative uniformity of the parameters of Cardiotocographic tracings, the study of Amadori et al. [12] aimed to evaluate intra- and inter-operator consensus in the evaluation of CTG tracings using the 2015 FIGO classification and to understand whether experience and knowledge of anamnestic data could influence the interpretation of CTG tracings. The results obtained regarding intra-observer variability show that midwives were more uniform in their assessment (77.05%) than gynecologists (65.75%). Referring to the inter-operator interpretative uniformity, the results indicated a moderate uniformity in the classification of traces considered normal while there was no consensus in the classification of suspicious or pathological traces. Gynecologists appeared to be more influenced by data and clinical context than obstetrician staff, and these two factors tended to have an impact on the interpretation of the CTG. In this regard, cooperation between medical and obstetric staff is encouraged to optimize CTG reading and improve maternal and fetal outcomes. Another study published by Rei et al. in 2016 evaluated consistency in CTG interpretations using the 2015 FIGO classification. In this study, 151 fetal electrode CTG traces with a duration greater than 60 minutes were interpreted by six operators, including three with more than five years of delivery room experience and the other three with five or fewer years of experience. The results showed good interpretative uniformity in most parameters but not in bradycardia, reduced variability, saltatory pattern and absence of accelerations or decelerations. No differences were found in interpretations based on work experience, except in the identification of accelerations, which was better in the more experienced group. The final results showed a better general interpretative uniformity of the tracing compared to that reported in previous studies; observer experience did not appear to play a significant role [13].

Our study therefore appears to be among the few that have evaluated the differences between delivery room workers.

Compared to the data literature, our study has confirmed that the interpretation of the CTG pattern is highly subjective, irrespective of the guidelines adopted, and CTG misinterpretation represents the major determinant for the increased frequency of obstetrical intervention during labor [10,12, 15]. In line with our study, several studies

evaluating the intra and interoperator reproducibility of CTG analysis have demonstrated a high variability, irrespective of the level of experience. [8, 15,16]. A study involving 3 experienced obstetricians demonstrated a fair interobserver agreement (proportions of agreement [pa], 0.56-0.71) in the event of normal CTG features according to the FIGO classifications. However, the agreement in the event of abnormalities of the FHR pattern was shown to be exceedingly poor (pa, 0.14- 0.45). [17] Concerning the variability in the interpretation of the FHR parameters, a study by Schiermeier et al demonstrated that only the baseline FHR showed a fair agreement (pa, 0.49- 1.01) among 43 different obstetricians [18] and this has been corroborated by similar studies involving experts. [19]

The main limitation of our study was certainly represented by the size of the sample, 40 healthcare professionals (11 gynecologists and 29 obstetricians).

Compared to the literature data the results highlight that no parameters were identified to homogeneously evaluate all the different participants in the study. The parameter for which the highest percentage of responses "I can't evaluate it" was found was identified in the presence of cyclicity. The assessment of the deceleration type also showed a high number of "I can't rate that" responses. As far as regards theoretical agreement without considering the individual parameters in individual cases, seems to be an insufficient assessment. The parameter for which a predominantly very high agreement was found was the evaluation of the presence of decelerations. The parameter for which the predominantly high agreement was found was variability. The parameter for which there was predominantly medium-high agreement was the baseline. In no case or for any parameter was a very low and/or low agreement found.

In relation to the same tracing, in no case was the completion of the birth or not the only choice found. Regarding the option to wait without doing anything regardless of dilation was not a suitable option for any of the participants in two clinical cases out of three; the majority agreed to a rapid completion of the birth. In fact, for most providers, the presence of variability is the primary indicator of fetal well-being while prolonged bradycardia is the main indicator of fetal unwellness. Furthermore, there was a difference between medical personnel, who indicated prolonged bradycardia, and obstetric personnel, who indicated no variability.

The data published by us certainly provides a starting point to implement the interpretative uniformity of CTG in labor. The first point that emerges from the study carried out is the need for advanced and continuous training expressed by healthcare personnel. By organizing homogeneous training courses for all personnel, it is possible to develop a method of interpreting cardiotocography in labor that can be shared by all obstetric personnel in service in the delivery room. Furthermore, greater uniformity in the interpretation of cardiotocography can also be achieved by developing a single and shared protocol as far as regards the interpretation of cardiotocography in labor within the same delivery room. In addition, the periodic discussion of particularly relevant cases between all members of the same team could be a point of reflection, sharing and support. In conclusion, it is important to remember and be aware that cardiotocography is a method that has its limits and does not replace the final clinical judgment of the operator.

From the analysis carried out on the answers to the questions provided by the participants, there is evidence of knowledge and agreement among the operators in the delivery room of the individual parameters to be evaluated in cardiotocography. However, the data that stands out from the evaluation is a percentage, albeit low, declared by the health professionals of being unable to express a judgment, and consequently an evaluation. Furthermore, no case was found among those examined in which the clinical choice was identical for all participants. The same participants reported a very high

percentage of the need for training improvement regarding the interpretation of cardiotocography in labor.

Many of the critical aspects related to pregnancy and childbirth can result in adverse neonatal outcomes and therefore result in medical-legal litigation [20]; among the situations presumed to be the basis of potential neonatal harm there are vaccinations during pregnancy [21], the use of drugs [22], the use of contrast agents and ionizing radiation [23], some methods of childbirth such as waterbirth [24] and the failure to identify the causes of antenatal intracranial hemorrhage [25].

Certainly, our study has limitations. The small number of participants and not being conducted in a center with a high birth rate represent limitations regarding the strength of the study. However, the professional heterogeneity of the interpreters has allowed us to highlight the different interpretations of the cardiotocographic tracing, not only based on the experience of individual operators but also on cultural background.

The difference in interpretation of CTG-tracks exists, has been described in the literature and highlighted by our study.

Our study certainly sheds light on the difference in conventional interpretation of the cardiotocographic tracing among different professional figures, emphasizing the necessity for a universal renewal that considers the physiology of labor as well as a more objective interpretation of it.

In future planning, in addition to identifying more objective criteria to make the interpretation of the tracing universal, the use of artificial intelligence with the development of interpretation algorithms will surely be helpful in reducing observer variability, providing an objective analysis with significant medicolegal implications.

Advanced continuous training on the interpretation of CTG in labor, cases audit and debriefing, involving the team, is certainly the best method to implement the knowledge of fetal heart rate tracing interpretation and to standardize labor and delivery management.

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STUDY REGISTRATION

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DISCLOSURE OF INTERESTS

All authors declare that they have no conflicts of interest.

ETHICAL APPROVAL

Not applicable.

INFORMED CONSENT

None

DATA SHARING

None

AUTHORS CONTRIBUTIONS

Conceptualization: M.R, A.V, A.S, N.G, M.D, A.F.C; Data curation: A.S, F.P, N.G, M.B, R.F, M.P; Methodology: M.R, A.V, A.S, M.D, G.S, A.F.C; Supervision: M.R, G.S, A.F.C; Validation: M.R, A.V, M.D, G.S, A.F.C; Visualization: N.G, M.B, R.F, M.P; Writing – original draft: M.R, A.V, A.S, F.P, M.D; Writing – review&editing: M.R, M.P, M.D, G.S, A.F.C. All authors: revising and final approval of the manuscript.

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Table 1 Years of delivery room experience of participants

Years of experience	All participants N° (%)	Gynecologist N° (%)	Midwife N° (%)
<5	8 (20.0)	1 (9.1)	7 (24.1)
5-10	11 (27.5)	3 (27.3)	8 (27.6)
> 10	21(52.5)	7 (63.6)	14 (48.3)

Table 2 Priority indicators of fetal well-being and non-fetal well-being in the assessment between medical staff and obstetrical staff.

Indicators	All participants N° (%)	Gynecologist N° (%)	Midwife N° (%)
<i>Fetal well-being</i>			
• Presence variability	24 (60.0)	6 (54.5)	18 (62.1)
• Presence of cyclicity	6 (15.0)	1 (9.1)	5 (17.3)
• Baseline between 110-160 bpm	5 (12.5)	2 (18.2)	3 (10.3)
• Presence of acceleration	4 (10.0)	1 (9.1)	3 (10.3)
• Absence of decelerations	1 (2.5)	1 (9.1)	0 (0.0)
<i>Non-fetal well-being</i>			
• Prolonged bradycardia	19 (47.5)	8 (72.7)	11 (37.9)
• Absence of variability	16 (40.0)	2 (18.2)	14 (48.2)
• Prolonged tachycardia	3 (7.5)	1 (9.1)	2 (6.9)
• Lack of cyclicity	1 (2.5)	0 (0.0)	1 (3.5)
• Presence of decelerations	1 (2.5)	0 (0.0)	1 (3.5)

Figure 1 Classification used in the delivery room

FIGO: International Federation of Gynecology and Obstetrics; SIGO: Società Italiana di Ginecologia e Ostetricia; NICE: National Institute for Health and Care Excellence

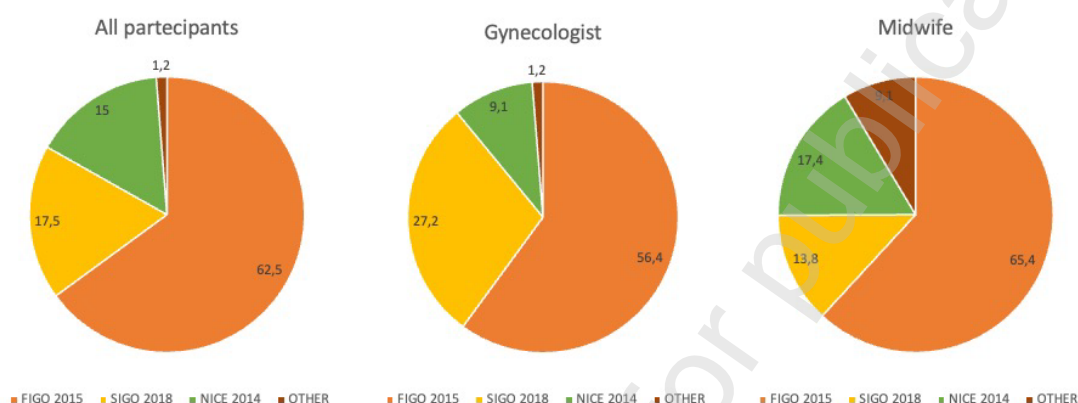


Figure 1 Classification used in the delivery room

FIGO: International Federation of Gynecology and Obstetrics; SIGO: Società Italiana di Ginecologia e Ostetricia; NICE: National Institute for Health and Care Excellence

Figure 2 Concordance attributed to the parameters by individual case.

A: very low concordance: <20%; B: low concordance: >20-30%; C: medium-low concordance: >30-40%; D: medium-high concordance: >40-60%; E: high concordance: >60-80%; F: very high concordance: >80 %

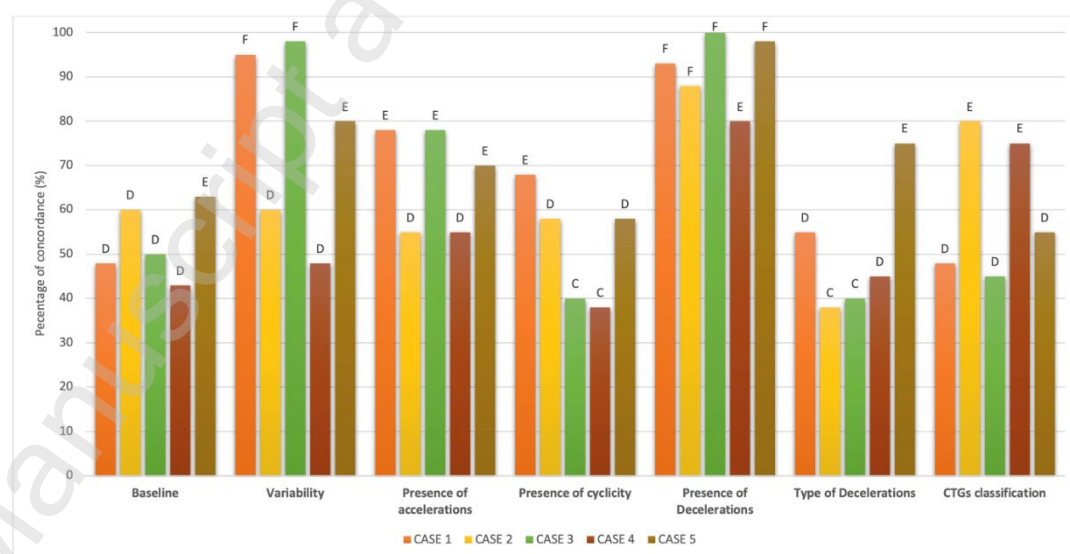


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ATTACHMENT N. 1

The interpretative uniformity of cardiotocography in labor

Surveillance of fetal well-being with cardiotocography during labor is the subject of conflicting opinions. While it is intended to avoid unfavorable neonatal outcomes, it can also lead to an increase in operative vaginal deliveries or caesarean sections.

The questionnaire is structured as follows: in the first part general data are collected and in the second part you will find 5 CTG plots to analyze. The purpose of this questionnaire is not to collect data on track analysis skills, but to analyze the uniformity of the analyses and propose measures to make them more uniform.

Your participation is very important to me! Thank you very much again for your time.

* Required

CONSENT TO THE PROCESSING OF DATA

The data collected will be used only for scientific purposes and may only be disseminated in statistical form and/or published in scientific journals. The results of the survey will be analyzed in aggregate form by the authorized subjects that make up the research group and in compliance with the legislation on the protection of personal data and in compliance with Legislative Decree no. 196 of 30 June 2003 "Personal Data Protection Code" and the European Data Protection Regulation EU 2016/679 (GDPR) processed ensuring the anonymity of participants. To maintain anonymity, simply check the "I agree" box. By submitting the completed declaration of consent online, you expressly consent to your anonymous participation in the study and data processing. *

GENERAL QUESTIONNAIRE

1. What is your professional profile? * ☐
Midwife
☐ Gynaecologist
1. How many years of work experience do you have? *
☐ < 5 years
☐ 5 - 10 years
☐ 10 - 15 years
☐ 1.15 years
2. In which health district/region do you work? *
☐ Bolzano
☐ Merano (includes Schlanders)
☐ Bressanone

- ☐ Bruneck
3. How many years have you been working in the delivery room? *
4. ☐ < 5 years
- ☐ 5 - 10 years
- ☐ 10 - 15 years
- ☐ 1.15 years
5. What type of classification is normally used in the delivery room where you work for the classification of the CTG trace in labor? *
- ☐ NICE 2014 (updated February 2017)
 - ☐ FIGO 2015
 - ☐ Italian guidelines (June 2018)
 - ☐ Others
6. Which do you consider to be the most reassuring element of fetal well-being in labor? *
- ☐ the presence of accelerations
 - ☐ the presence of variability
 - ☐ baseline between 110-160 bpm
 - ☐ presence of cyclicity
 - ☐ the absence of deceleration
7. On the other hand, what do you consider to be the most worrying element regarding fetal well-being in labor? *
- ☐ prolonged bradycardia

- ☐ prolonged
tachycardia
- ☐ lack of cyclicity
- ☐ absence of variability
- ☐ Presence of decelerations

8. Are you familiar with the STaN method (ST analysis)? *

- ☐ yes, I used it
- ☐ Yes, but very vaguely
- ☐ No, it's the first time I've heard of him

9. Do you think that the STaN method could help you in the evaluation of suspicious CTG traces? *

- ☐ Yes
- ☐ No
- ☐ I don't know

10. As a professional, do you feel the need to strengthen your knowledge of CTG track interpretation? *

- ☐ Yes
- ☐ No
- ☐ I never thought about it

11. Then you will find five cardiotocographic traces. What type of classification will you use to classify them? *

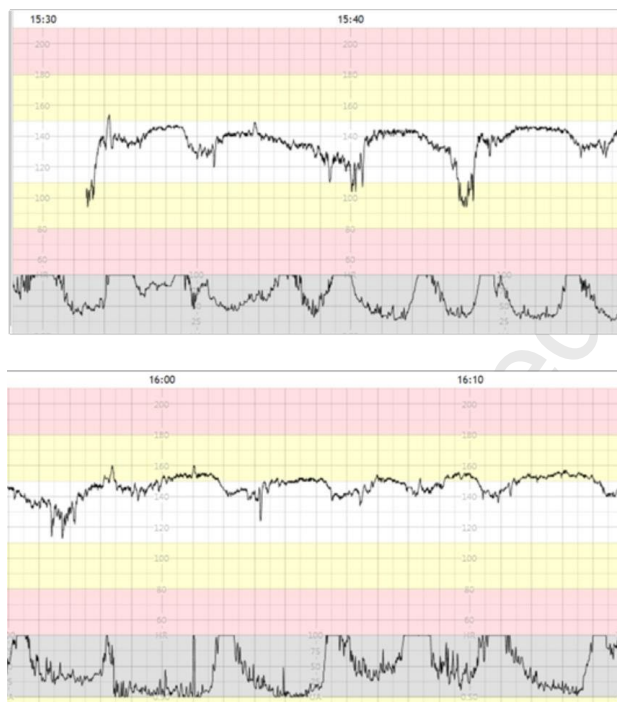
- ☐ NICE 2014 (updated February 2017)
- ☐ FIGO 2015
- ☐ Italian Guidelines (June 2018)

☐ Other

CTG PLOT ANALYSIS #1

Medical history: Primigravida nulliparous woman 32 years old, hospitalized at 12:00 for spontaneous labor at 40 + 3. Physiological pregnancy.

PROM at 06:00, irregular contractions from 10:00. On arrival, dyed amniotic fluid.



2. Baseline: *

- ☐ < 110 bpm
- ☐ 110 bpm
- ☐ 120 bpm
- ☐ 130 bpm
- ☐ 140 bpm

- ☐ 150 bpm
- ☐ 160 bpm
- ☐ > 160 bpm
- ☐ I can't rate it

3. Variability: *

- ☐ normal
- ☐ Increased (jumping pattern)
- ☐ Restricted
- ☐ Based
- ☐ I can't rate it

4. Accelerations are present? *

- ☐ Yes
- ☐ No
- ☐ I can't rate it

5. Cyclicity is present? *

- ☐ Yes
- ☐ No
- ☐ I can't rate it

6. Decelerations are present? *

- ☐ Yes
- ☐ No
- ☐ I can't rate it

7. If you answered YES to the previous question, it is a matter of decelerations:

- ☐ Late
- ☐ Typical Variables
- ☐ Atypical Variables
- ☐ I can't rate it

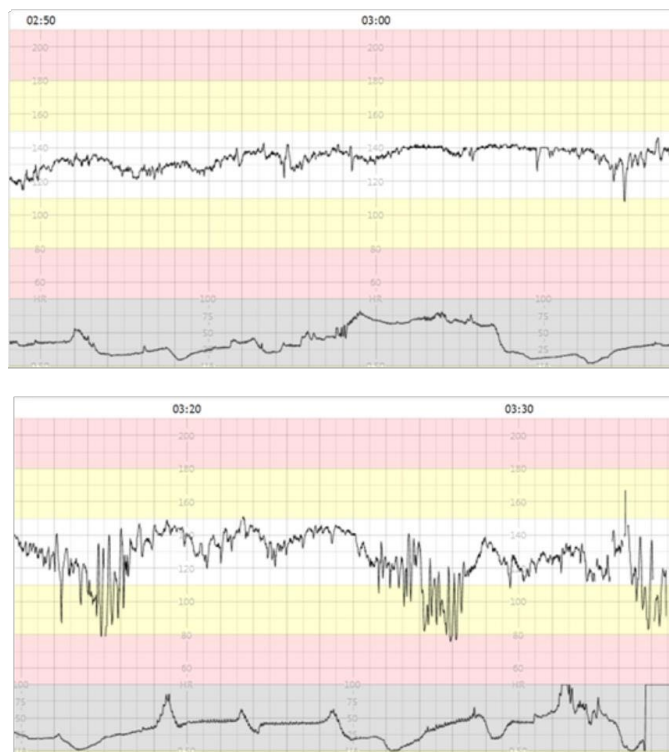
8. How to classify the CTG? *

9. How do you decide to proceed? *

- ☐ I do nothing and continue labor regardless of dilation
- ☐ I do nothing and continue labor only if dilation is advanced
- ☐ Increased contractile activity with oxytocin
- ☐ I immediately perform cesarean section
- ☐ I perform fetal resuscitation maneuvers in utero and re-evaluate
- ☐ if possible, I perform operative delivery with a suction cup
- ☐ I can't rate it
- ☐ Other

CTG PLOT ANALYSIS #2

Medical history: 24-year-old second-year tertigravid woman, gestational week 41+ 2. Physiological pregnancy. She was admitted to hospital at 10:45 p.m. for PROM (clear liquid) and irregular contractions. At 3:15 a.m., epidural anesthesia is placed at the woman's request.



10. Baseline: *

- ☐ < 110 bpm
- ☐ 110 bpm
- ☐ 120 bpm
- ☐ 130 bpm
- ☐ 140 bpm
- ☐ 150 bpm
- ☐ 160 bpm
- ☐ > 160 bpm
- ☐ I can't rate it

11. Variability: *

- ☐ normal

- ☐ Increased (Jumping Pattern)
- ☐ Restricted
- ☐ absent
- ☐ I can't rate it

12. Are there any accelerations? *

- ☐ Yes
- ☐ No
- ☐ I can't rate it

13. Is cyclicity present? *

- ☐ Yes
- ☐ No
- ☐ I can't rate it

14. Are there any decelerations? *

- ☐ I can't rate it
- ☐ Yes
- ☐ No

15. If you answered YES to the previous question, it is a matter of decelerations:

- ☐ Late
- ☐ Typical Variables
- ☐ Atypical Variables
- ☐ I can't rate it

16. How do you classify the track? *

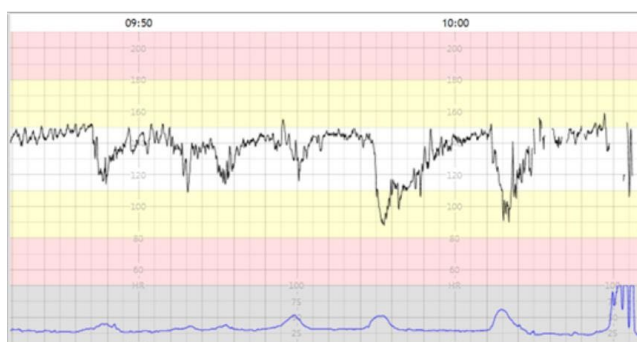
17. How do you decide to proceed? *

- ☐ I do nothing and continue labor regardless of dilation
- ☐ I do nothing and continue labor only if dilation is advanced
- ☐ Increased contractile activity with oxytocin
- ☐ I immediately perform cesarean section
- ☐ I perform fetal resuscitation maneuvers in utero and re-evaluate
- ☐ if possible, I perform operative delivery with a suction cup
- ☐ I can't rate it
- ☐ Other

CTG PLOT ANALYSIS #3

Medical history: 21-year-old nulliparous primigravida woman, gestational week 40+ 6. Physiological pregnancy. She was admitted to the hospital at 7:05 a.m. for regular contractions and intact membranes.

Rupture of the membranes at 08:05 a.m., clear liquid.



18. Baseline: *

- ☐ < 110 bpm
- ☐ 110 bpm
- ☐ 120 bpm
- ☐ 130 bpm
- ☐ 140 bpm
- ☐ 150 bpm
- ☐ 160 bpm
- ☐ > 160 bpm
- ☐ I can't evaluate it

1. Variability:*

- ☐ normal
- ☐ Increased (Jumping Pattern)
- ☐ Restricted
- ☐ absent
- ☐ I can't rate it

19. Accelerations are present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

20. Cyclicity is present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

21. Decelerations are present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

22. If you answered YES to the previous question, it is deceleration:

- ☐ Early
- ☐ Late
- ☐ Typical Variables

☐ Atypical variables

☐ I can't rate it

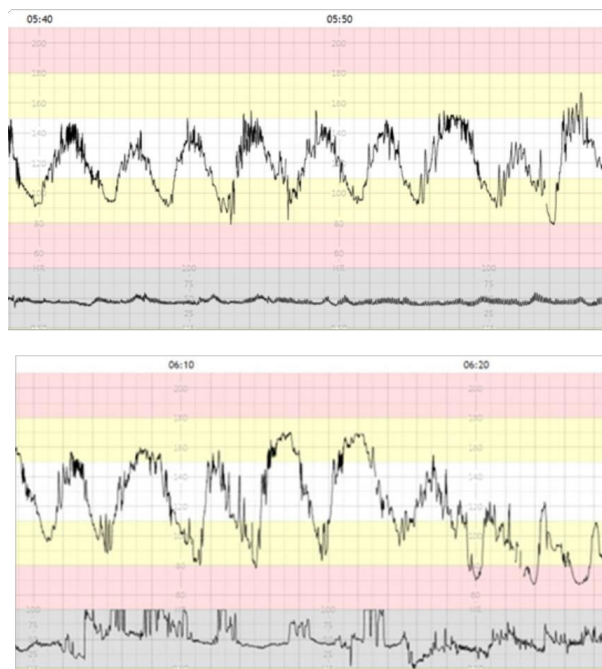
23. How to classify the track? *

24. How do you decide to proceed? *

- ☐ I do nothing and continue labor regardless of dilation
- ☐ I do nothing and continue labor only if dilation is advanced
- ☐ Increased contractile activity with oxytocin
- ☐ I immediately perform cesarean section
- ☐ I perform fetal resuscitation maneuvers in utero and re-evaluate
- ☐ if possible, I perform operative delivery with a suction cup
- ☐ I can't rate it
- ☐ More

CTG PLOT ANALYSIS #4

Medical history: 23-year-old nulliparous primigravida woman, gestational week 40+ 2. Physiological pregnancy. She was admitted to the hospital at 7 p.m. for PROM (clear liquid) and irregular contractions. At 8:30 p.m., peridural anesthesia is placed at the woman's request; At 9:41 p.m., oxytocin infusion begins for slow progression



25. Baseline: *

- ☐ < 110 bpm
- ☐ 110 bpm
- ☐ 120 bpm
- ☐ 130 bpm
- ☐ 140 bpm
- ☐ 150 bpm
- ☐ 160 bpm
- ☐ > 160 bpm
- ☐ I can't evaluate it

26. Variability:*

- ☐ normal
- ☐ Increased (Jumping Pattern)
- ☐ Restricted
- ☐ absent
- ☐ I can't rate it

27. Accelerations are present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

28. Cyclicity is present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

29. Decelerations are present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

30. If you answered YES to the previous question, it is deceleration:

- ☐ Early
- ☐ Late
- ☐ Typical Variables

☐ Atypical variables

☐ I can't rate it

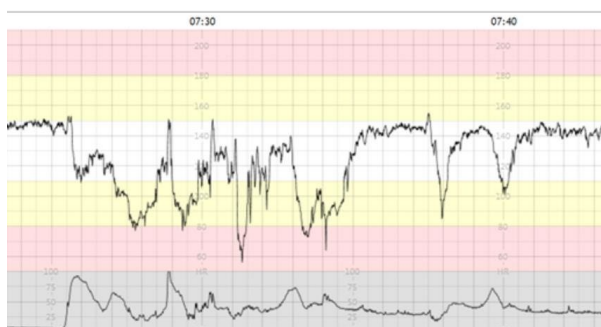
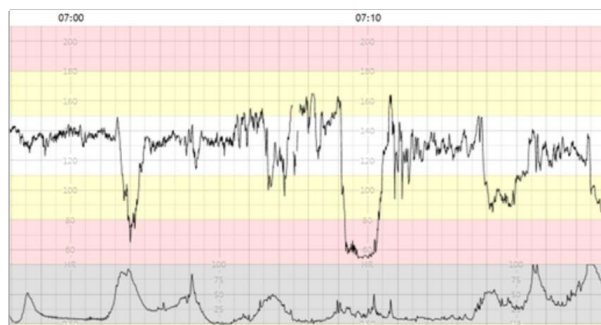
31. How to classify the track? *

32. How do you decide to proceed? *

- ☐ I do nothing and continue labor regardless of dilation
- ☐ I do nothing and continue labor only if dilation is advanced
- ☐ Increased contractile activity with oxytocin
- ☐ I immediately perform cesarean section
- ☐ I perform fetal resuscitation maneuvers in utero and re-evaluate
- ☐ if possible, I perform operative delivery with a suction cup
- ☐ I can't rate it
- ☐ More

CTG PLOT ANALYSIS #5

Medical history: 34-year-old nulliparous tertigravid woman, gestational week 41+ 3. Physiological pregnancy. Hospitalized for irregular contractions. At 8:18 p.m., peridural anesthesia is placed at the woman's request. Rupture of the membranes at 00:08, grade 1 dyed liquid.



33. Baseline: *

- ☐ < 110 bpm
- ☐ 110 bpm
- ☐ 120 bpm
- ☐ 130 bpm
- ☐ 140 bpm
- ☐ 150 bpm
- ☐ 160 bpm
- ☐ > 160 bpm
- ☐ I can't evaluate it

34. Variability:*

- ☐ normal
- ☐ Increased (Jumping Pattern)
- ☐ Restricted
- ☐ absent
- ☐ I can't rate it

35. Accelerations are present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

36. Cyclicity is present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

37. Decelerations are present? *

- ☐ No
- ☐ Yes
- ☐ I can't rate it

38. If you answered YES to the previous question, it is deceleration:

- ☐ Early
- ☐ Late
- ☐ Typical Variables

☐ Atypical variables

☒ I can't rate it

39. How to classify the track? *

40. How do you decide to proceed? *

- ☐ I do nothing and continue labor regardless of dilation
- ☐ I do nothing and continue labor only if dilation is advanced
- ☐ Increased contractile activity with oxytocin
- ☐ I immediately perform cesarean section
- ☐ I perform fetal resuscitation maneuvers in utero and re-evaluate
- ☐ if possible, I perform operative delivery with a suction cup
- ☐ I can't rate it
- ☐ More