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Manual of
Fetal Monitoring

Right Interpretation for Right Decision

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CHAPTER

DR C BRaVADO: Approach to Interpret Cardiotocography

Chanchal Singh Ahmad

"Treat the patient, not the CTG!"

INTRODUCTION

Cardiotocography (CTG) is an indispensable tool for intrapartum fetal surveillance wherever available. It allows for early recognition of a fetus at stress so that timely intervention can be done. A uniform system of interpretation and classification of the CTG allows for effective communication amongst the laboring woman's caretakers including the obstetrician and neonatologist.

FEATURES OF CTG

The CTG has two components—(1) fetal heart rate (FHR) and (2) uterine contractions. Care must be taken to accurately document patient identification and the correct date and time of recording the CTG. The calibrated paper runs at the speed of 1 cm per hour. Care must be taken to avoid *loss of contact* and get a good quality trace for correct interpretation.

The FHR tracing has four features, namely baseline FHR, variability, accelerations, and decelerations. Each feature is classified into normal/reassuring, nonreassuring, or abnormal **(Table 1)**. The CTG is then classified into normal or reassuring, nonreassuring, or abnormal based on all four features **(Table 2)**.

The acronym *DR C BRaVADO* has been suggested and used to ensure that each feature of the trace is looked at and interpreted in context of the patient **(Table 3)**.

BASELINE FETAL HEART RATE

Baseline fetal heart rate is the mean level of the FHR in the absence of accelerations or decelerations. It is determined over a period of 5–10 minutes and expressed in beats per minute (bpm).

The *normal* baseline FHR varies between 110 bpm and 160 bpm **(Fig. 1)**. *Fetal tachycardia* is defined as baseline FHR above 160 bpm **(Fig. 2)**. This is

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Table 1: NICE classification of fetal heart rate features.

Feature	*Baseline (bpm)*	*Variability (bpm)*	*Decelerations*	*Accelerations*
Normal/ Reassuring	110–160	5–25	None or Early decelerations or Variable decelerations with no concerning features lasting for less than 90 min	Present
Nonreassuring	100–109 or 161–180	<5 for >50 min or >25 for >25 min or Sinusoidal	Variable decelerations (loss of beats <60 bpm, recovery within 60 seconds) with >50% contractions for >90 min or Variable decelerations >60 bpm, >60 sec up to 30 min or Late decelerations up to 30 min	Absence of accelerations with an otherwise normal trace is of unknown significance
Abnormal	<100 or >180 or Sinusoidal pattern ≥10 min	<5 for ≥90 min	Variable decelerations >60 bpm, >60 sec for >30 min or Late decelerations >30 min or Decelerations not responding to conservative measures or Single prolonged deceleration ≥3 min	

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Table 2: Classification of CTG.

Category	*Definition*
Normal/reassuring	All four features are reassuring
Nonreassuring	One nonreassuring feature while rest reassuring
Abnormal	≥2 nonreassuring features or ≥1 abnormal feature

Table 3: Approach to CTG interpretation.

DR	**D**efine **R**isk	Low risk/high risk
C	**C**ontractions	Frequency/duration
BRa	**B**aseline **Ra**te	Normal/bradycardia/tachycardia
V	**V**ariability	Normal/reduced/saltatory
A	**A**cceleration	Present/absent
D	**D**eceleration	Variable/early/late
O	**O**verall	Comment and management

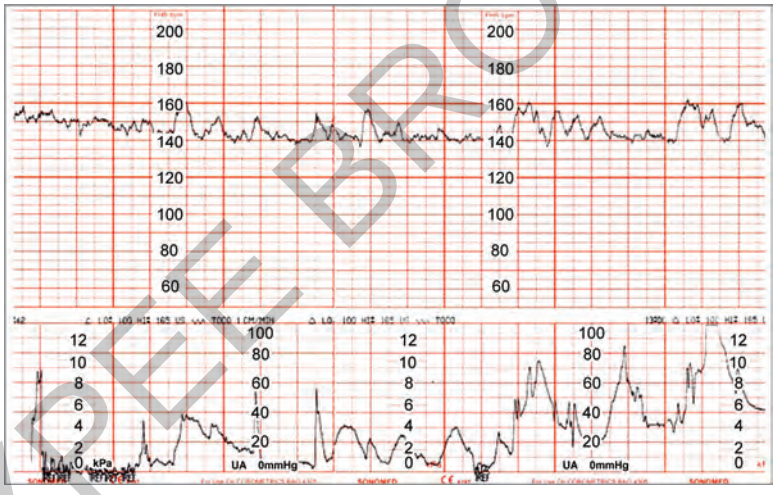

Fig. 1: Normal intrapartum CTG running at 1 cm/min. The baseline is 140 bpm, variability is 10 bpm, there are accelerations and there are no decelerations. The trace also shows three contractions in 10 minutes.

further classified into moderate (160–180 bpm) and abnormal tachycardia (>180 bpm). FHR below 110 bpm is considered *fetal bradycardia*. It is moderate when between 100 bpm and 109 bpm and abnormal when below 100 bpm.

VARIABILITY

Variability is the fluctuation in the baseline FHR occurring at 3–5 cycles per minute. It is measured by estimating the difference between the highest peak

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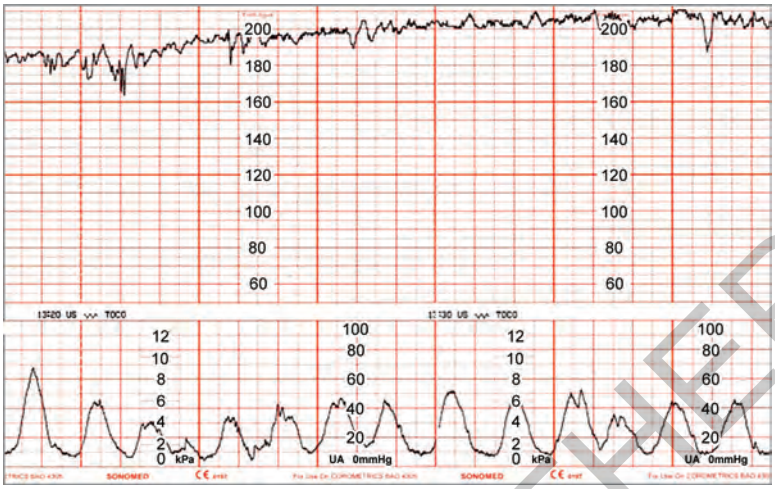

Fig. 2: Abnormal trace with baseline fetal heart rate above 180 bpm. This was a patient with previous cesarean in active labor. Emergency cesarean was done in view of suspected scar dehiscence confirmed intraoperatively.

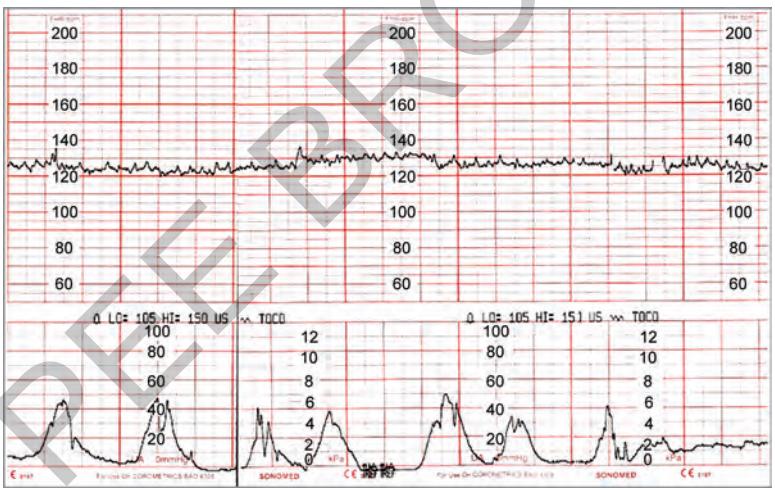

Fig. 3: Nonreassuring trace with variability less than 5 bpm for more than an hour. On review of drug chart, she had received pethidine for pain relief which explained this pattern.

and the lowest trough of fluctuation in a 1-min segment of the trace and is also expressed in bpm. This is the most significant feature of the FHR tracing and signifies the integrity of the autonomic nervous system of the fetus.

Normal variability is between 5 bpm and 25 bpm **(Fig. 1)**. It is considered *suspicious* when reduced (<5 bpm) for 40–90 minutes and abnormal when reduced for more than 90 minutes **(Fig. 3)**. Increased variability for more than 25 bpm has been termed as *saltatory pattern* **(Fig. 4)**. Complete loss of variability results in *sinusoidal pattern* which is considered an ominous trace **(Fig. 5)**.

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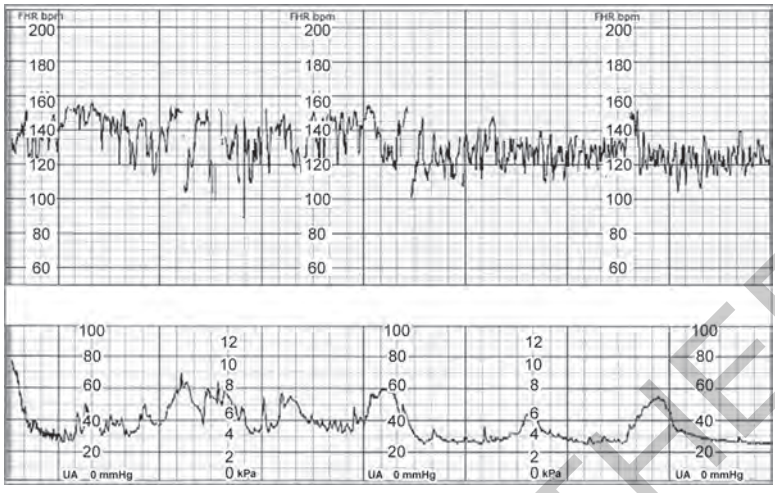

Fig. 4: Saltatory pattern with variability more than 25 bpm.

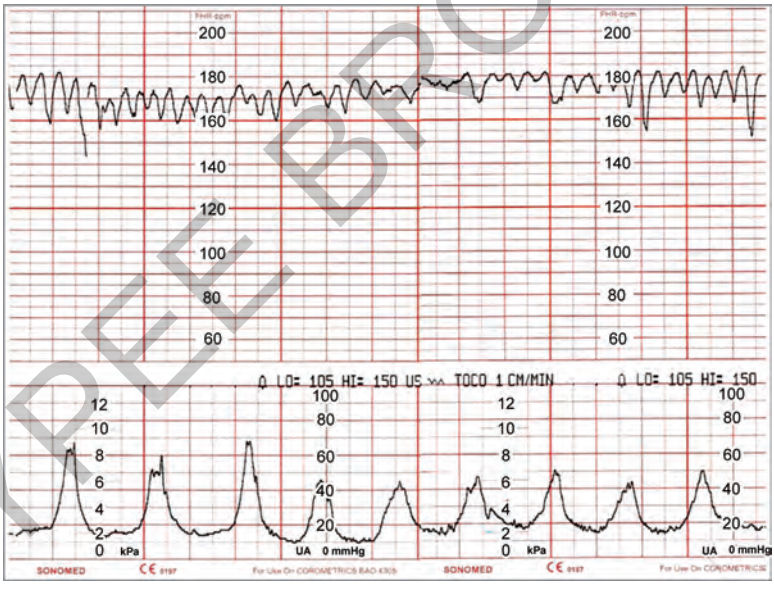

Fig. 5: Sinusoidal trace in a patient with chorioamnionitis.

ACCELERATION

A transient increase in the FHR by 15 bpm above the baseline lasting for at least 15 seconds is qualifies as acceleration. The presence of acceleration is a reassuring feature; their absence in an otherwise normal trace is of unknown significance **(Fig. 1)**.

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DECELERATIONS

A transient decrease in the FHR by 15 bpm below the baseline lasting for minimum 15 seconds is defined as deceleration.

Variable Decelerations

Most decelerations in labor have an abrupt fall and an abrupt rise. These are "variable" decelerations. Decelerations that last for less than 60 seconds with a FHR loss of less than 60 bpm may be considered normal adjustments of the FHR to temporary cessation of fetal blood flow due to cord compression during labor. Decelerations that take longer than 60 seconds to recover and/or where the loss of beats is more than 60 warrant are considered nonreassuring when they last for more than half an hour **(Figs. 6 and 7)**.

Uniform Decelerations

Uniform decelerations are not frequently encountered. These are shallow, regular decelerations which can be timed according to contractions. *Early decelerations* start with the onset of uterine contraction and recover before the end of contraction and are innocuous in nature. *Late decelerations*, however, start after the onset of contraction and have a late recovery. These are ominous especially when present along with fetal tachycardia and may signify chronic hypoxia **(Fig. 8)**.

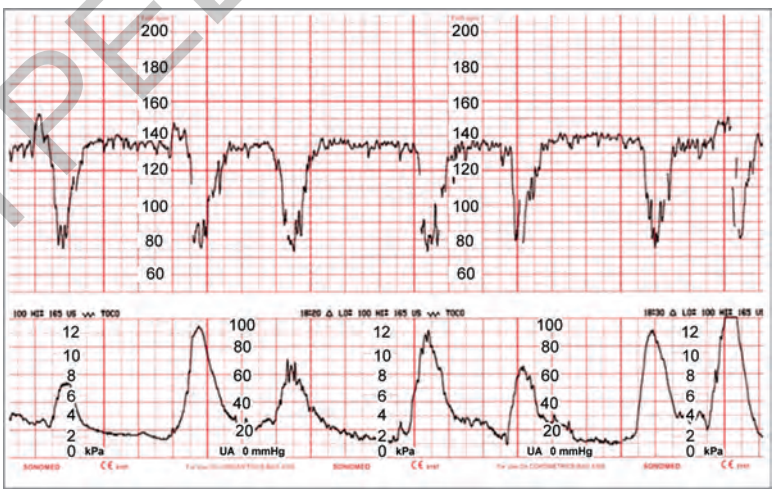

Fig. 6: Variable decelerations which are recovering within a minute but the loss of beats is more than 60. This patient was in second stage of labor and delivered normally within the next 20 minutes. Baby's Apgar score was 8 and 9.

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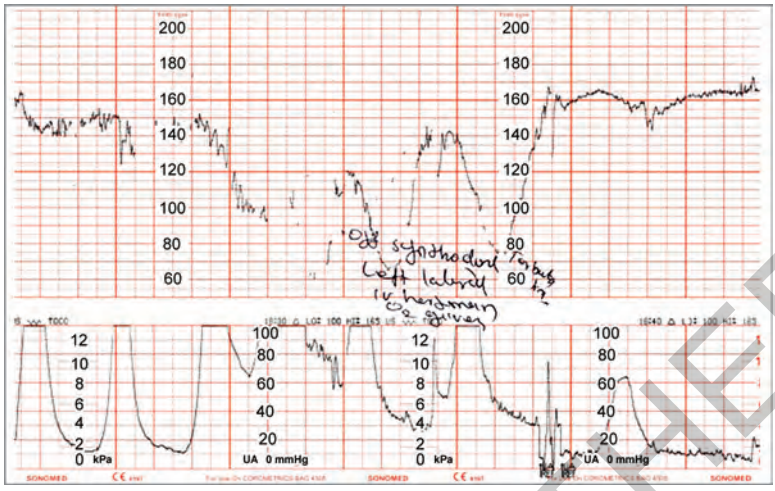

Fig. 7: Prolonged deceleration—fetal heart rate below 100 bpm lasting for more than 3 minutes. In this trace, the cause is hyperstimulation. Oxytocin was stopped and the patient was given IV terbutaline following which the CTG became reassuring.

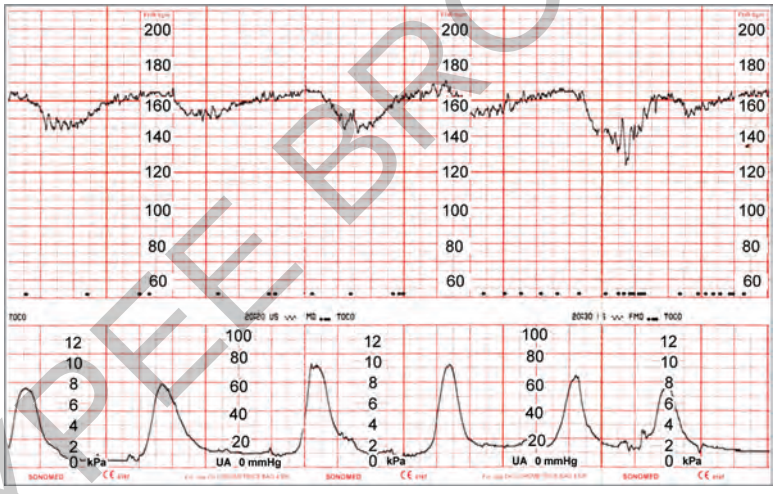

Fig. 8: Late decelerations in a patient with abruption.

INTERPRETING CTG IN A CONTINUUM AND FACTORS AFFECTING IT: THE TRUE ESSENCE OF DR C BRAVADO

A rising or falling baseline, persistent decreased variability and/or absence of accelerations for long periods may be subtle and might be missed when only one segment of CTG is considered. The CTG should be reviewed at least hourly and more frequently if suspicious or pathological *maternal* pyrexia, dehydration and also tocolytics such as nifedipine and salbutamol cause maternal tachycardia which in turn may cause fetal tachycardia. Maternal hypotension secondary to epidural analgesia may cause fetal bradycardia.

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Maternal medications like opioids for pain relief and even dexamethasone may cause reduced variability. Hyperstimulation secondary to labor augmentation may lead to abnormal FHR features and a pathological trace.

The threshold for withstanding intrapartum hypoxia is significantly lower in a preterm and/or growth restricted fetus, multiple pregnancy and in presence of intrauterine infection. Preterm fetuses have a higher baseline FHR. CTG abnormalities must be interpreted with caution in these situations.

Another caveat in reading the CTG is when the transducer picks up the *maternal pulse* rather than the FHR. The distinguishing feature of maternal pulse would be a rise (mimics *acceleration*) with each contraction. It usually occurs in late first stage or second stage of labor when the fetal back moves towards the midline with advancing labor. Maternal pulse rate must always be recorded when interpreting CTG.

CTG IN A PRETERM FETUS

None of the guidelines give clear instructions on interpretation of CTG in a preterm fetus. There are several differences in the *normal* FHR pattern in preterm labor owing to the immaturity of the parasympathetic nervous system. The baseline FHR is higher, the baseline variability may be less and decelerations may occur more frequently. In fact, variable decelerations are found in 70–75% of preterm intrapartum CTGs in comparison to 30–50% in intrapartum CTGs of term patients. In the absence of clear guidance, the same criteria may be used for CTG interpretation and classification.

MANAGEMENT AS PER CTG INTERPRETATION

Suggested management of CTG abnormalities is outlined in **Table 4**. Most CTG abnormalities will recover with simple measures such as changing

Table 4: Suggested management as per intrapartum CTG.

Suspicious trace	• Change maternal position • Correct maternal hypotension • Identify underlying cause: – Rule out abruption, scar dehiscence, cord prolapse – Sitting of epidural anesthesia or top-up – Tocolysis if hyperstimulation – Correct maternal pyrexia – Maternal drugs, e.g. opioids • Do not give maternal oxygen
Pathological trace	• As above • Stop oxytocin • Repeat vaginal examination • "3, 6, 9, 12, and 15 min" action timeline • Identify antenatal and intrapartum risk factors • Consider delivery if persistently pathological trace • Mode of delivery to be guided by vaginal examination findings

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maternal position (preferably left lateral), hydration, and rarely tocolysis. Management would also be guided by the stage and progress of labor. The mode of delivery would be determined by vaginal examination findings. In general, a difficult assisted vaginal delivery should be anticipated and better avoided.

CONCLUSION

All hospitals should have a "standard operating protocol" on use of CTG in labor. DR C BRaVADO is an excellent tool for reading the CTG and ensures that it is interpretedin an individualized manner. Management should consider antenatal risk factors, intrapartum risk factors such as meconium stained liquor, suspicion of intrauterine infection, and progress of labor.

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