

# How to Read a CTG

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## What is cardiotocography?

**Cardiotocography** (CTG) is used during pregnancy to monitor fetal heart rate and uterine contractions. It is most commonly used in the third trimester and its purpose is to monitor fetal well-being and allow early detection of fetal distress. An abnormal CTG may indicate the need for further investigations and potential intervention.

Check out our [CTG quiz](#) on the Geeky Medics quiz platform to put your CTG interpretation knowledge to the test.

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## How CTG works

The device used in cardiotocography is known as a **cardiotocograph**. It involves the placement of **two transducers** onto the abdomen of a pregnant woman. One transducer records the **fetal heart** rate using ultrasound and the other transducer monitors the **contractions** of the **uterus** by measuring the **tension** of the maternal **abdominal wall** (providing an indirect indication of **intrauterine pressure**). The CTG is then assessed by a midwife and the obstetric medical team.

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## How to read a CTG

To interpret a CTG you need a structured method of assessing its various characteristics. The most popular structure can be remembered using the acronym **DR C BRAVADO**:

- **DR:** Define risk
- **C:** Contractions
- **BRa:** Baseline rate
- **V:** Variability

- **A:** Accelerations
  - **D:** Decelerations
  - **O:** Overall impression
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## Define risk

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When performing CTG interpretation, you first need to determine if the pregnancy is high or low risk. This is important as it gives more context to the CTG reading (e.g. if the pregnancy categorised as high-risk, the threshold for intervention may be lower). Some reasons a pregnancy may be considered high risk are shown below.<sup>1</sup>

### Maternal medical illness

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- Gestational diabetes
- Hypertension
- Asthma

### Obstetric complications

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- Multiple gestation
- Post-date gestation
- Previous cesarean section
- Intrauterine growth restriction
- Premature rupture of membranes
- Congenital malformations
- Oxytocin induction/augmentation of labour
- Pre-eclampsia

### Other risk factors

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- Absence of prenatal care
  - Smoking
  - Drug abuse
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## Contractions

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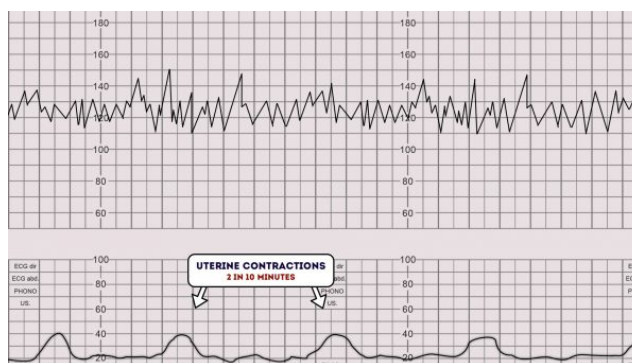
Next, you need to record the **number of contractions** present in a **10 minute period**.

Each **big square** on the example CTG chart below is **equal to one minute**, so look at how many contractions occurred within 10 big squares.

**Individual contractions** are seen as **peaks** on the part of the CTG monitoring uterine activity.

**Assess contractions** for the following:

- **Duration:** How long do the contractions last?
- **Intensity:** How strong are the contractions (assessed using palpation)?
- In the below example, there are 2 contractions in a 10 minute period (this is often referred to as “2 in 10”).



Uterine contractions (CTG)

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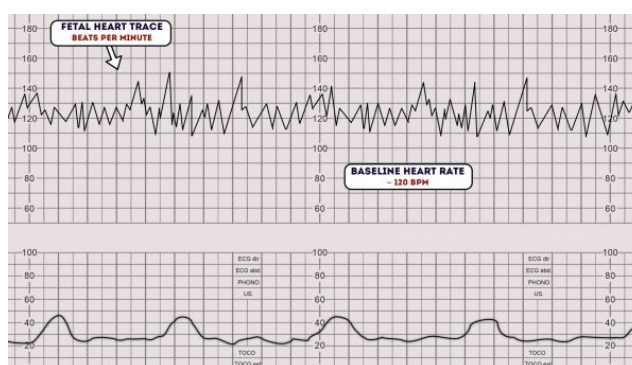
## Baseline rate of the fetal heart

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The **baseline rate** is the **average heart rate** of the **fetus** within a **10-minute window**.

Look at the CTG and assess what the average heart rate has been over the last 10 minutes, ignoring any accelerations or decelerations.

A **normal fetal heart rate** is between **110-160 bpm**.



CTG: Baseline heart rate

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## Fetal tachycardia

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**Fetal tachycardia** is defined as a **baseline heart rate greater than 160 bpm**.

**Causes of fetal tachycardia** include:

- Fetal hypoxia
- Chorioamnionitis
- Hyperthyroidism

- Fetal or maternal anaemia
- Fetal tachyarrhythmia

## Fetal bradycardia

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**Fetal bradycardia** is defined as a **baseline heart rate of less than 100 bpm**.

It is common to have a baseline heart rate of between 100-120 bpm in the following situations:

- Postdate gestation
- Occiput posterior or transverse presentations

Severe prolonged bradycardia (less than 80 bpm for more than 3 minutes) indicates severe hypoxia.

**Causes of prolonged severe bradycardia** include:

- Prolonged cord compression
  - Cord prolapse
  - Epidural and spinal anaesthesia
  - Maternal seizures
  - Rapid fetal descent
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## Variability

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**Baseline variability** refers to the variation of fetal heart rate from one beat to the next.

**Variability** occurs as a result of the interaction between the **nervous system, chemoreceptors, baroreceptors and cardiac responsiveness**.

It is, therefore, a good indicator of how healthy a fetus is at that particular moment in time, as a healthy fetus will constantly be adapting its heart rate in response to changes in its environment.

Normal variability indicates an intact neurological system in the fetus.

**Normal variability is between 5-25 bpm.**<sup>3</sup>

To calculate variability you need to assess how much the peaks and troughs of the heart rate deviate from the baseline rate (in bpm).

## Variability categorisation

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**Variability** can be **categorised** as either **reassuring**, **non-reassuring** or **abnormal**.<sup>3</sup>

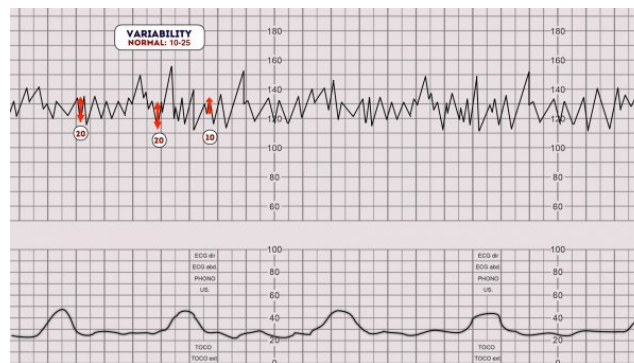
**Reassuring:** 5 – 25 bpm

**Non-reassuring:**

- less than 5 bpm for between 30-50 minutes
- more than 25 bpm for 15-25 minutes

**Abnormal:**

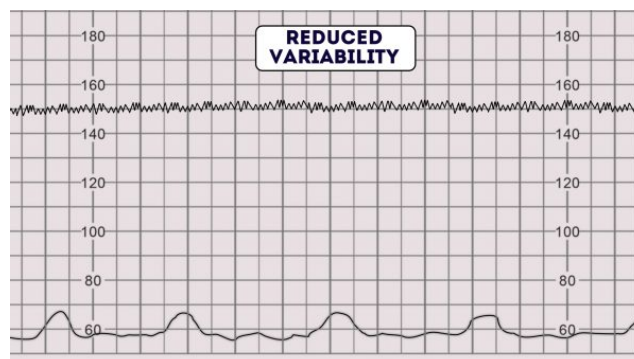
- less than 5 bpm for more than 50 minutes
- more than 25 bpm for more than 25 minutes
- sinusoidal



**CTG:** Variability..

**Reduced variability** can be **caused** by any of the following: 2

- Fetal **sleeping**: this should last **no longer than 40 minutes** (this is the most common cause).
- Fetal **acidosis (due to hypoxia)**: more likely if late decelerations are also present.
- Fetal **tachycardia**
- **Drugs**: opiates, benzodiazepines, methyldopa and magnesium sulphate.
- **Prematurity**: variability is **reduced** at earlier gestation (<28 weeks).
- Congenital heart abnormalities



**CTG:** Reduced variability

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**Accelerations**

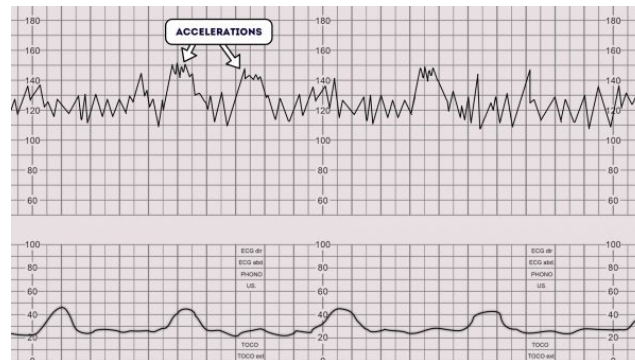
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**Accelerations** are an **abrupt increase in the baseline fetal heart rate of greater than 15 bpm for greater than 15 seconds**.<sup>1</sup>

The presence of **accelerations is reassuring**.

**Accelerations** occurring **alongside uterine contractions** is a sign of a **healthy fetus**.

The **absence of accelerations** with an otherwise **normal CTG** is of **uncertain significance**.



CTG: Accelerations

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## Decelerations

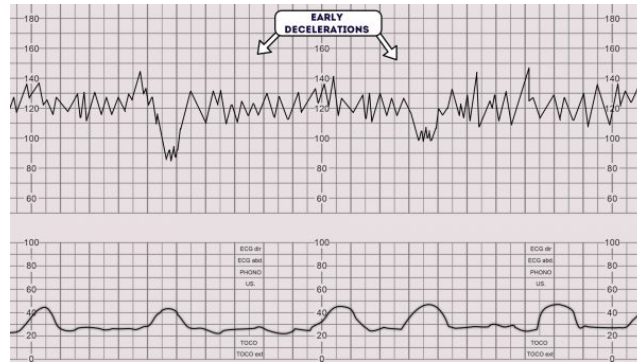
**Decelerations** are an **abrupt decrease in the baseline fetal heart rate of greater than 15 bpm for greater than 15 seconds**.

The fetal heart rate is controlled by the autonomic and somatic nervous system. In response to hypoxic stress, the fetus reduces its heart rate to preserve myocardial oxygenation and perfusion. Unlike an adult, a fetus cannot increase its respiration depth and rate. This reduction in heart rate to reduce myocardial demand is referred to as a deceleration.

There are a number of different types of decelerations, each with varying significance.

### Early deceleration

**Early decelerations** start when the **uterine contraction begins** and **recover** when **uterine contraction stops**. This is due to increased fetal intracranial pressure causing increased vagal tone. It therefore quickly resolves once the uterine contraction ends and intracranial pressure reduces. This type of deceleration is, therefore, considered to be physiological and not pathological.<sup>3</sup>



CTG: Early decelerations

## Variable deceleration

**Variable decelerations** are observed as **a rapid fall in baseline fetal heart rate with a variable recovery phase.**

They are **variable in their duration** and may not have any relationship to uterine contractions.

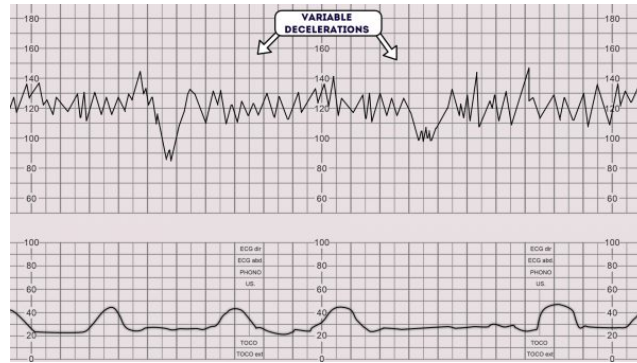
They **are most often seen during labour** and in **patients' with reduced amniotic fluid** volume.

All fetuses experience stress during the labour process, as a result of uterine contractions reducing fetal perfusion. Whilst fetal stress is to be expected during labour, the challenge is to pick up pathological fetal distress.

**Variable decelerations** are usually caused by **umbilical cord compression**. The **mechanism** is as follows: <sup>1</sup>

- 1.** The umbilical vein is often occluded first causing an acceleration of the fetal heart rate in response.
- 2.** Then the umbilical artery is occluded causing a subsequent rapid deceleration.
- 3.** When pressure on the cord is reduced another acceleration occurs and then the baseline rate returns.

The **accelerations before and after a variable deceleration** are known as the **shoulders of deceleration**. Their presence indicates the fetus is not yet hypoxic and is adapting to the reduced blood flow. Variable decelerations can sometimes resolve if the mother changes position. The presence of persistent variable decelerations indicates the need for close monitoring. Variable decelerations without the shoulders are more worrying, as it suggests the fetus is becoming hypoxic.



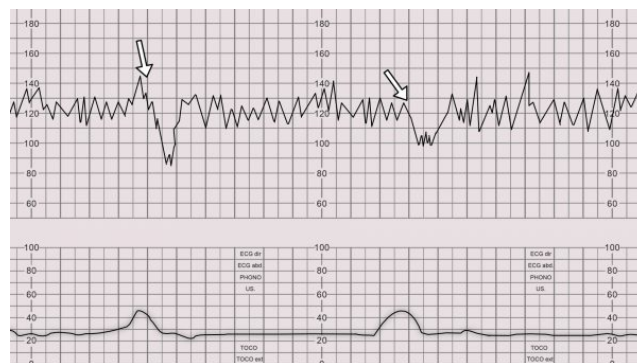
CTG: Variable decelerations

## Late deceleration

**Late decelerations** begin at the **peak of the uterine contraction** and **recover after the contraction ends**. This type of deceleration indicates there is insufficient blood flow to the uterus and placenta. As a result, blood flow to the fetus is significantly reduced causing fetal hypoxia and acidosis.

**Reduced uteroplacental blood flow** can occur due to: <sup>1</sup>

- Maternal hypotension
- Pre-eclampsia
- Uterine hyperstimulation



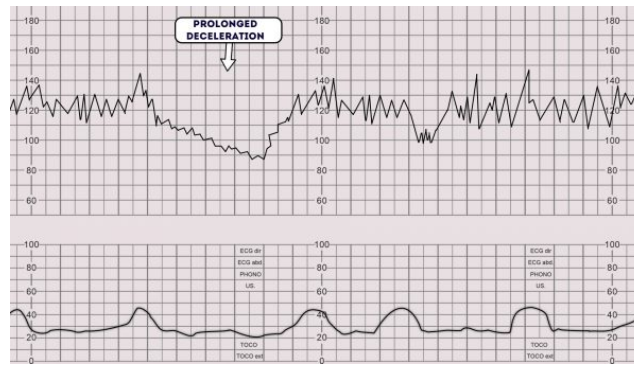
CTG: Late decelerations

## Prolonged deceleration

A **prolonged deceleration** is defined as a deceleration that lasts **more than 3 minutes**:

- If it lasts **between 2-3 minutes** it is classed as **non-reassuring**.
- If it lasts **longer than 3 minutes** it is immediately classed as **abnormal**.





CTG: Prolonged deceleration

## Sinusoidal pattern

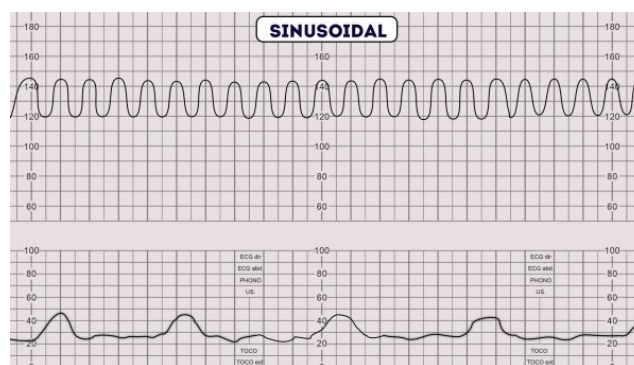
A sinusoidal CTG pattern is **rare**, however, if present it is **very concerning** as it is associated with high rates of **fetal morbidity** and **mortality**.<sup>1</sup>

A **sinusoidal CTG pattern** has the following **characteristics**:

- A **smooth, regular, wave-like** pattern
- Frequency of around **2-5 cycles a minute**
- **Stable baseline rate** around 120-160bpm
- **No** beat to beat variability

A **sinusoidal pattern** usually **indicates** one or more of the following:

- Severe fetal hypoxia
- Severe fetal anaemia
- Fetal/maternal haemorrhage



CTG: Sinusoidal pattern

## Overall impression

Once you have assessed all aspects of the CTG you need to determine your **overall impression**.

The overall impression can be described as either **reassuring, suspicious** or **abnormal**.<sup>3</sup>

Overall impression is determined by how many of the CTG features were either reassuring, non-reassuring or abnormal. The **NICE guidelines** below demonstrate how to decide which category a CTG falls into.<sup>3</sup>

## Reassuring

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### Baseline heart rate

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110 to 160 bpm

### Baseline variability

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5 to 25 bpm

### Decelerations

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- None or early
- Variable decelerations with no concerning characteristics for less than 90 minutes

## Non-reassuring

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### Baseline heart rate

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**Either of the below would be classed as non-reassuring:**

- 100 to 109 bpm
- 161 to 180 bpm

### Baseline variability

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**Either of the below would be classed as non-reassuring:**

- Less than 5 for 30 to 50 minutes
- More than 25 for 15 to 25 minutes

### Decelerations

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**Any of the below would be classed as non-reassuring:**

- Variable decelerations with no concerning characteristics for 90 minutes or more.
- Variable decelerations with any concerning characteristics in up to 50% of contractions for 30 minutes or more.
- Variable decelerations with any concerning characteristics in over 50% of contractions for less than 30 minutes.
- Late decelerations in over 50% of contractions for less than 30 minutes, with no maternal or fetal clinical risk factors such as vaginal bleeding or significant meconium.

## Abnormal

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## Baseline heart rate

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**Either of the below would be classed as abnormal:**

- Below 100 bpm
- Above 180 bpm

## Baseline variability

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**Any of the below would be classed as abnormal:**

- Less than 5 for more than 50 minutes
- More than 25 for more than 25 minutes
- Sinusoidal

## Decelerations

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**Any of the below would be classed as abnormal:**

- Variable decelerations with any concerning characteristics in over 50% of contractions for 30 minutes (or less if any maternal or fetal clinical risk factors [see above]).
- Late decelerations for 30 minutes (or less if any maternal or fetal clinical risk factors).
- Acute bradycardia, or a single prolonged deceleration lasting 3 minutes or more.

Regard the following as **concerning characteristics** of **variable decelerations**:

- Lasting more than 60 seconds
- Reduced baseline variability within the deceleration
- Failure to return to baseline
- Biphasic (W) shape
- No shouldering

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## Reviewer

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## References

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1. AMIR SWEHA, M.D. Interpretation of the Electronic Fetal Heart Rate During Labor. Am Fam Physician. 1999 May 1;59(9):2487-2500. Available from: [\[LINK\]](#).
2. Clinical obstetrics and gynaecology. 2nd Edition. 2009. B.Magowan, Philip Owen, James Drife.

3. Intrapartum care: NICE guideline CG190 (February 2017). Available from: [\[LINK\]](#).
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