



Fetal tococardiography

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INTRODUCTION

- Normal human labor is characterized by regular uterine contractions and repeated episodes of transient interruption of fetal oxygenation. Most fetuses tolerate this process well, but some do not.

- The fetal heart rate (FHR) pattern helps to distinguish the former from the latter as it is an indirect marker of fetal cardiac and central nervous system responses to changes in blood pressure, blood gases, and acid-base status
- The rationale for intrapartum FHR monitoring is that identification of FHR changes potentially associated with inadequate fetal oxygenation may enable timely intervention to reduce the likelihood of hypoxic injury or death

NST interpretation



•Name



•Date



•Time

- **What is the baseline rate?**
- **Describe the variability**
- **Are there accelerations present?**
- **Are there decelerations present?**
- **Are contractions present?**
- **What category is this tracing?**
- **Is this fetal tracing reassuring?**

- the choice of vertical and horizontal scaling greatly affects the appearance of the fetal heart rate. Scaling factors recommended by the workshop are 30 beats per minute (beats/min or bpm) per vertical cm (range, 30 to 240 bpm) and 3 cm/min chart recorder paper speed

Setting the CTG machine

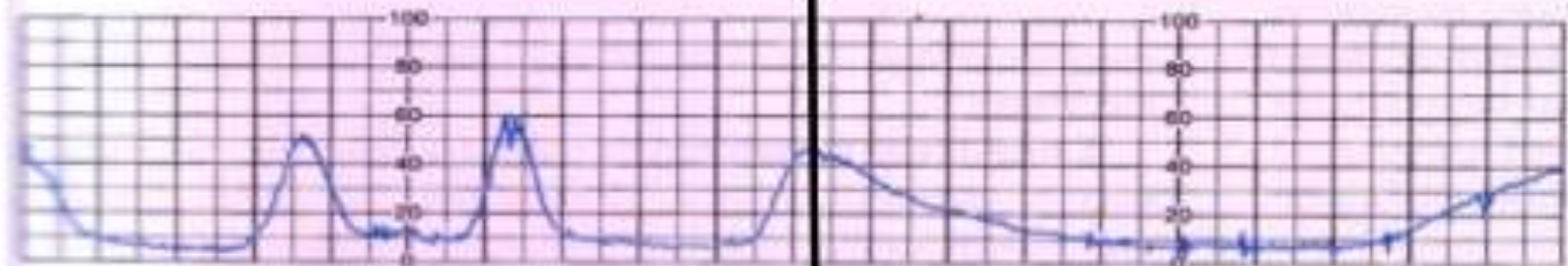
1cm / min

3cm / min



F
H
R

3 small vertical spaces / cm
10 beats / small space



Ut.
Cont.

NICHD definitions of FHR characteristics and patterns

Variability
Fluctuations in baseline that are irregular in amplitude and frequency
Absent = amplitude undetectable
Minimal = amplitude 0 to 5 bpm
Moderate = amplitude 6 to 25 bpm
Marked = amplitude over 25 bpm
Measured in a 10-minute window. The amplitude is measured peak to trough. There is no distinction between short-term and long-term variability.
Baseline rate
Bradycardia = below 110 bpm
Normal = 110 to 160 bpm
Tachycardia = over 160 bpm
The baseline rate is the mean bpm (rounded to 0 or 5) over a 10-minute interval, excluding periodic changes, periods of marked variability, and segments that differ by more than 25 bpm. The baseline must be identifiable for two minutes during the interval (but not necessarily a contiguous two minutes); otherwise, it is considered indeterminate.
Acceleration
An abrupt* increase in the FHR. Before 32 weeks of gestation, accelerations should last ≥ 10 sec and peak ≥ 10 bpm above baseline. As of 32 weeks gestation, accelerations should last ≥ 15 sec and peak ≥ 15 bpm above baseline.
A prolonged acceleration is ≥ 2 minutes but less than 10 minutes. An acceleration of 10 minutes or more is considered a change in baseline.
Late deceleration
A gradual* decrease and return to baseline of the FHR associated with a uterine contraction. The deceleration is delayed in timing, with the nadir of the deceleration occurring after the peak of the contraction. The onset, nadir, and recovery usually occur after the onset, peak, and termination of a contraction.
Early deceleration
A gradual decrease and return to baseline of the FHR associated with a uterine contraction. The nadir of the FHR and the peak of the contraction occur at the same time. The deceleration's onset, nadir, and termination are usually coincident with the onset, peak, and termination of the contraction.
Variable deceleration
An abrupt decrease in FHR below the baseline. The decrease is ≥ 15 bpm, lasting ≥ 15 secs and < 2 minutes from onset to return to baseline. The onset, depth, and duration of variable decelerations commonly vary with successive uterine contractions.
Prolonged deceleration
A decrease in FHR below the baseline of 15 bpm or more, lasting at least 2 minutes but < 10 minutes from onset to return to baseline. A prolonged deceleration of 10 minutes or more is considered a change in baseline.

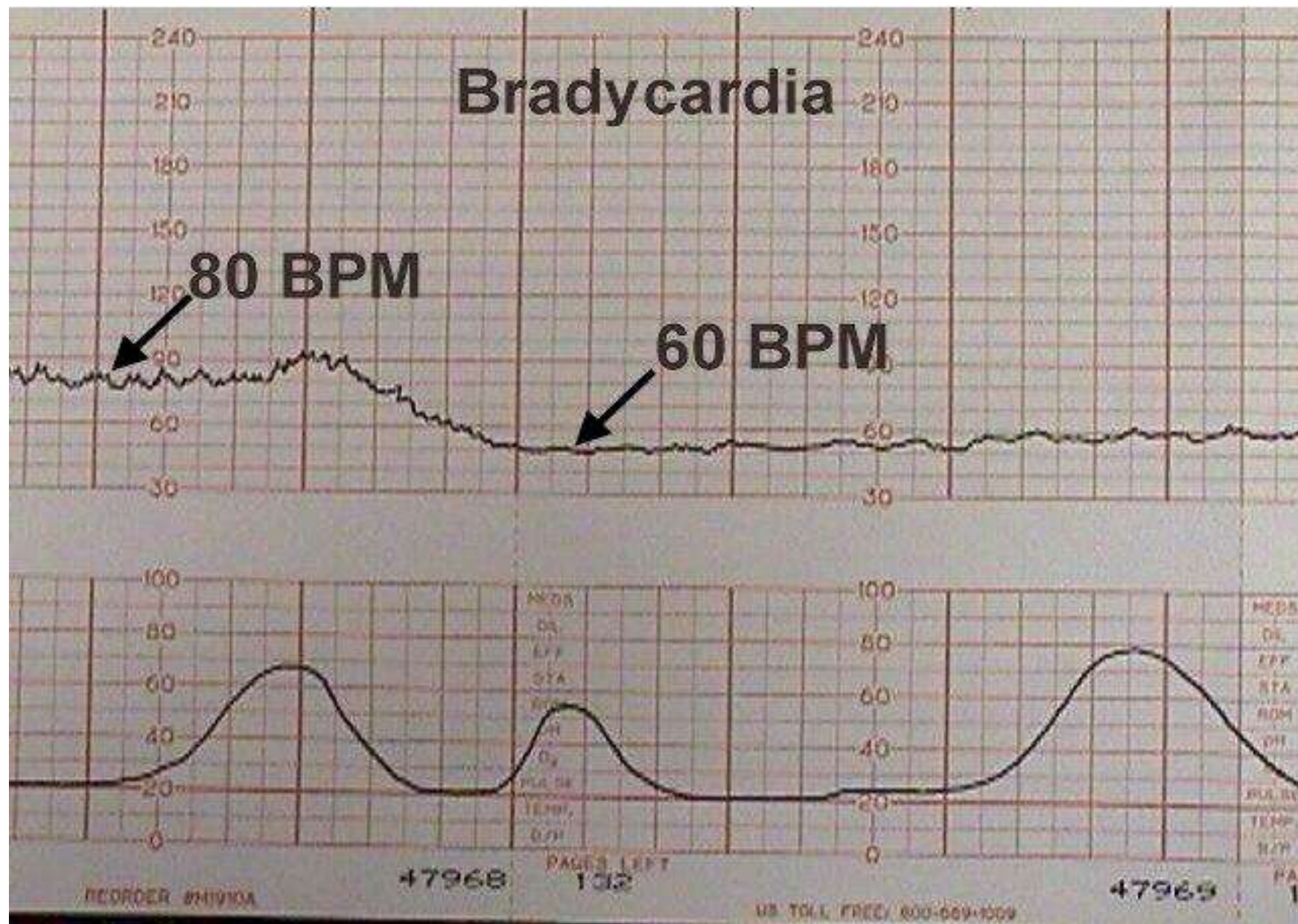
Baseline

- In any 10-minute window, the minimum interpretable baseline duration must be at least 2 minutes.
- If the baseline fetal heart rate is less than 110 bpm, it is termed *bradycardia*. If the baseline rate is greater than 160 bpm, it is termed *tachycardia*.

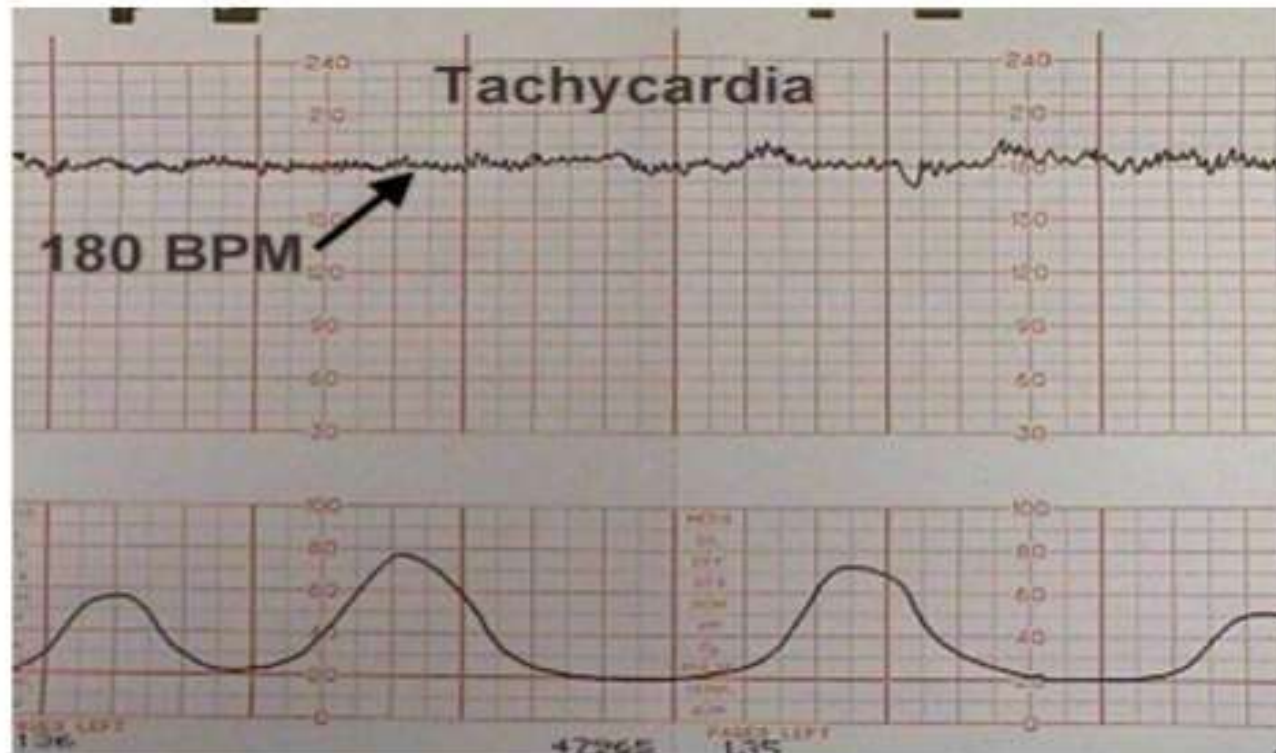
Bradycardia

80 BPM

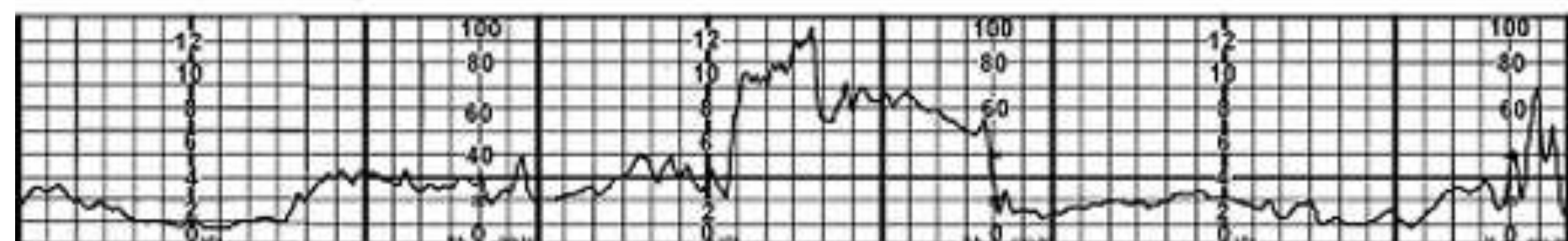
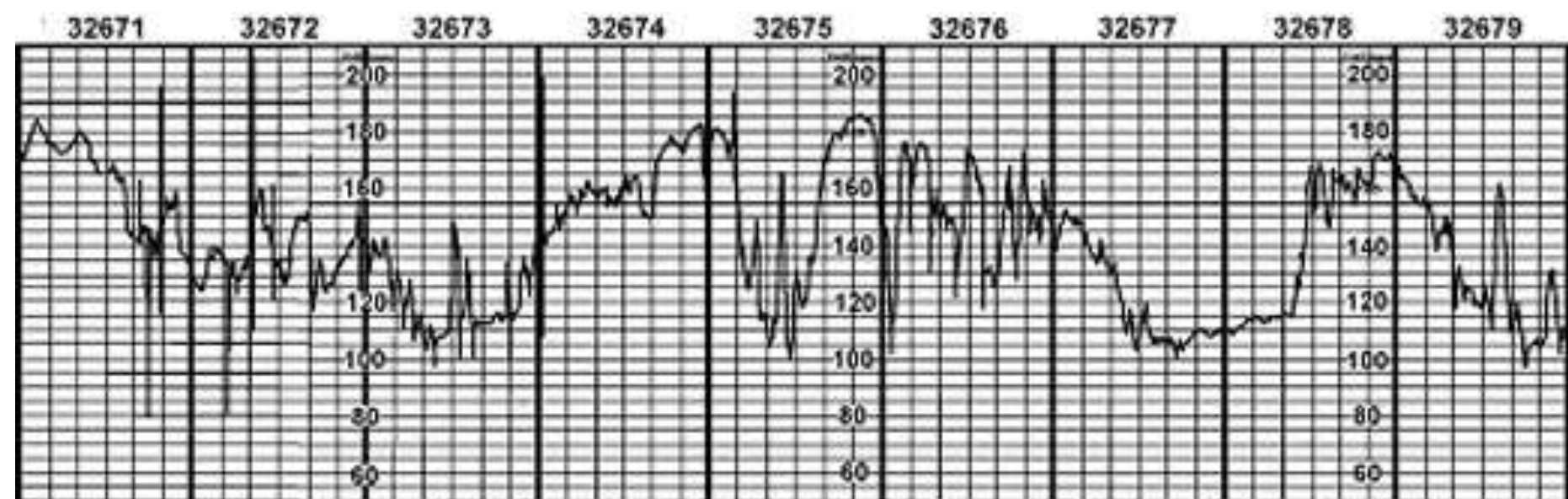
60 BPM



BASELINE FETAL TACHYCARDIA (>160 BPM)



- **Wandering Baseline.** This baseline rate is unsteady and “wanders” between 120 and 160 bpm. This rare finding is suggestive of a neurologically abnormal fetus and may occur as a preterminal event.



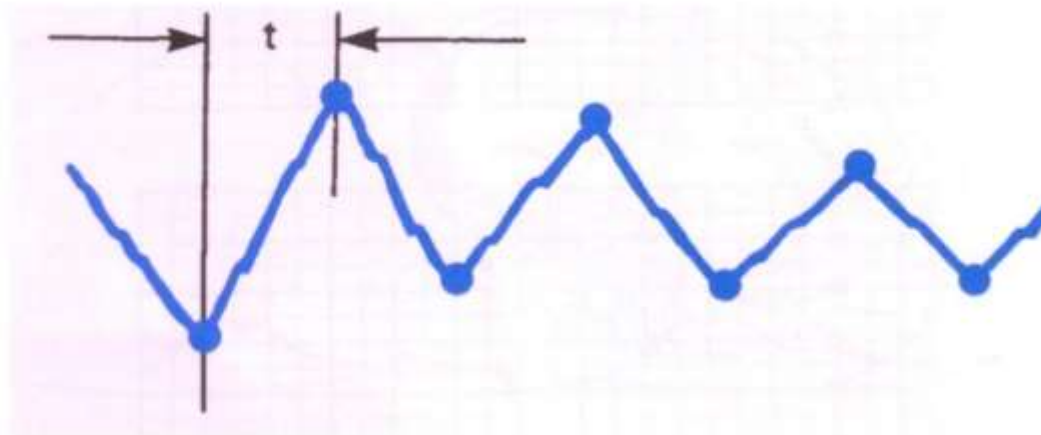
Beat to beat variability

- **Measured in 10 min**
- **The amplitude is measured peak to trough**

تغییرپذیری ضربه به ضربه:

به انواع کوتاه مدت و دراز مدت قابل تقسیم می باشد. 

تغییرپذیری کوتاه مدت:  بازتابی از تغییر آنی ضربان قلب جنین از یک ضربه (یا موج R) به ضربه بعدی است. این تغییرپذیری معیاری از فاصله زمانی بین سیستول های قلبی است. این تغییرپذیری با بیشترین قابلیت اعتماد فقط زمانی طبیعی تلقی می شود که سیکل های الکتریکی قلب مستقیماً با الکتروکاردیوگرام مورد بررسی قرار گرفته باشد.



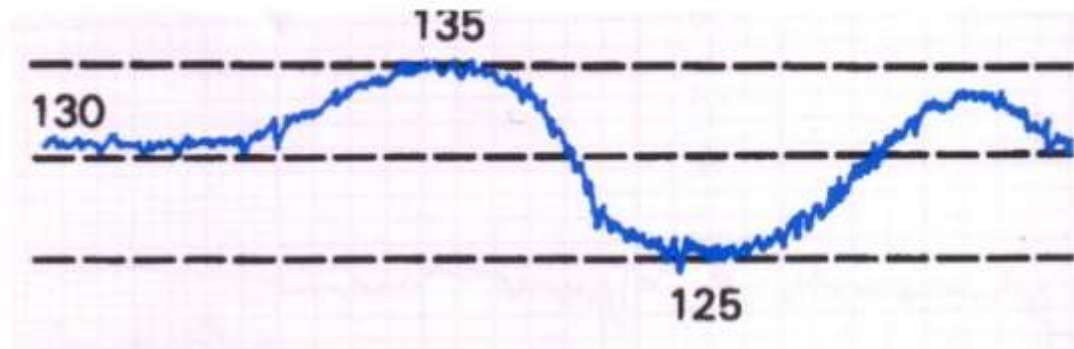
Short-term beat-to-beat variability
measured by a fetal scalp electrode
(t = time interval between successive fetal R
waves).

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تغییرپذیری ضربه به ضربه:

👉 تغییرپذیری طولانی مدت: تغییرات نوسانی که در مدت یک دقیقه رخ می دهند و سبب موجی شدن خط پایه می شوند. تعداد طبیعی این امواج ۳-۵ سیکل در دقیقه است.

👉 در حال حاضر شواهدی وجود ندارد که نشان دهد افتراق تغییرپذیری کوتاه مدت از طولانی مدت، از نظر بالینی حائز اهمیت است. چون در تجربه عملی، هر دوی آن ها در دید ظاهری به عنوان یک واحد تعیین می شوند.



long-term beat-to-beat variability
ranging between 125 and 135 bpm).

تغییرپذیری ضربه به ضربه:

- نوسان های FHR خط پایه که دامنه و تعداد نامنظمی دارند.
- تغییرپذیری به صورت چشمی به عنوان ارتفاع "قله تا دامنه" برحسب bpm تعیین می شود:
- * - فقدان: میزان ارتفاع غیرقابل سنجش است.
- * - جزئی: ارتفاع قابل سنجش است اما در حد ۵ bpm یا کمتر است.
- * - متوسط (طبیعی): ارتفاع در حد ۶-۲۵ bpm است.
- * - شدید: ارتفاع بیش از ۲۵ bpm است.

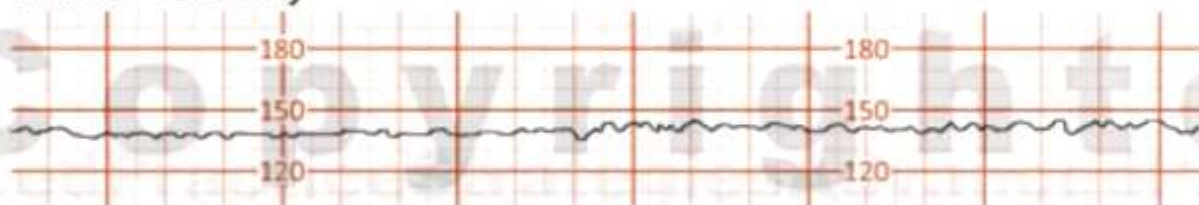
Beat to Beat Variability

Absent Variability



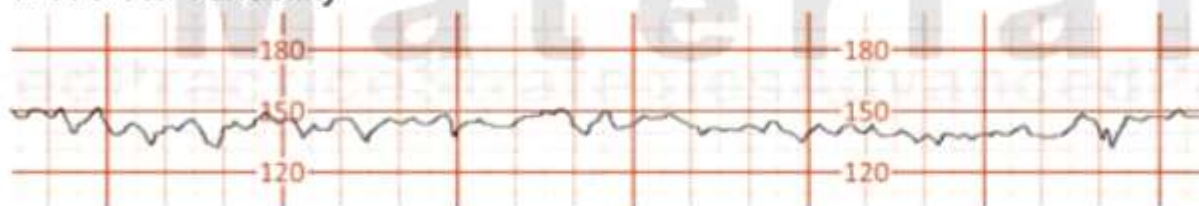
Amplitude
range
undetectable

Minimal Variability



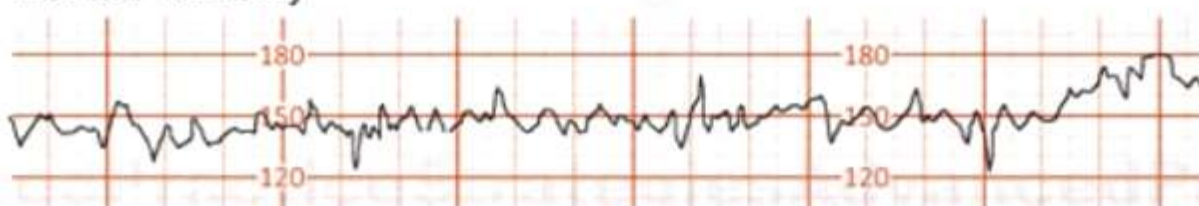
Amplitude
> undetectable
(visually
detectable)
but ≤ 5 bpm

Moderate Variability



Amplitude
range
6 to 25 bpm

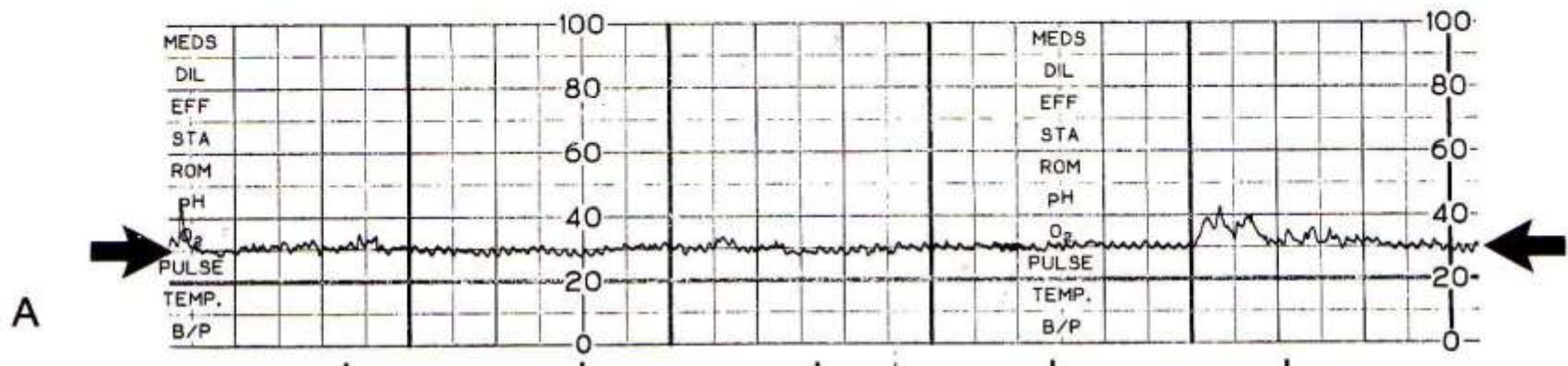
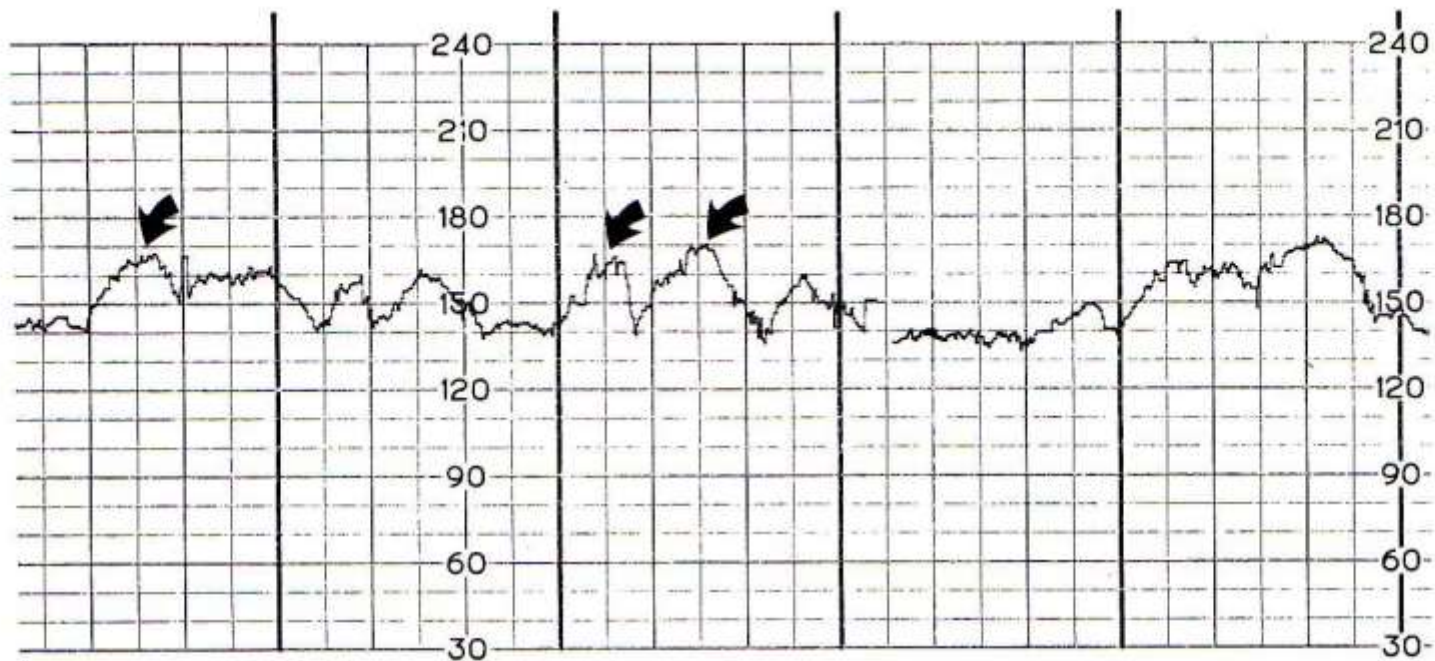
Marked Variability



Amplitude
range >25 bpm

Accelerations

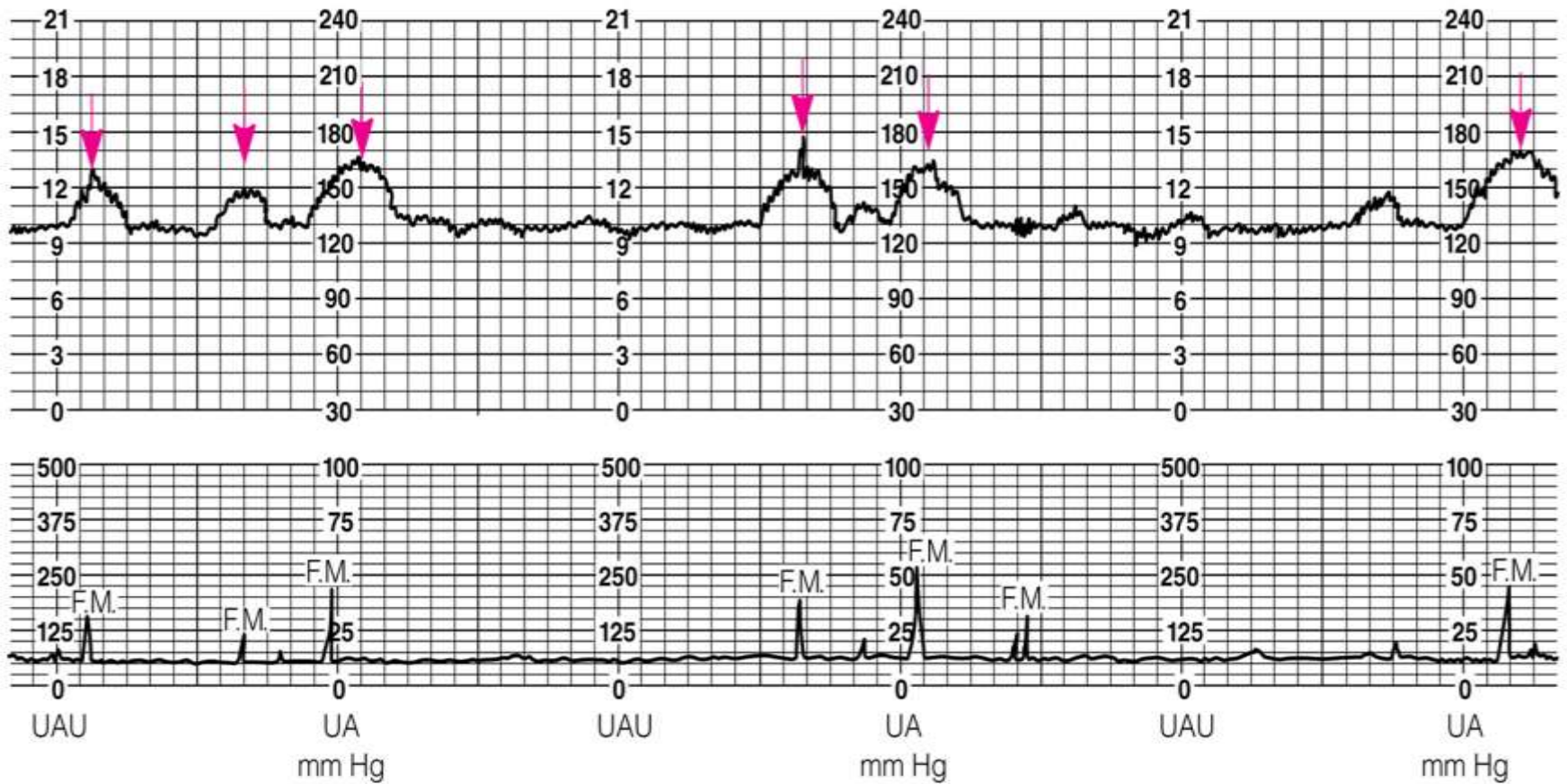
- * <32 weeks' : ≥ 10 BPM above baseline for ≥ 10 seconds.
- * >32 weeks' : ≥ 15 BPM above baseline for ≥ 15 seconds (less than 2 minutes).
- * An acceleration ≥ 2 minutes but less than 10 minutes in duration is called a **prolonged acceleration**. An acceleration lasting ≥ 10 minutes is a baseline change.



A

Reactive NST (Acceleration)

Reactive NST:

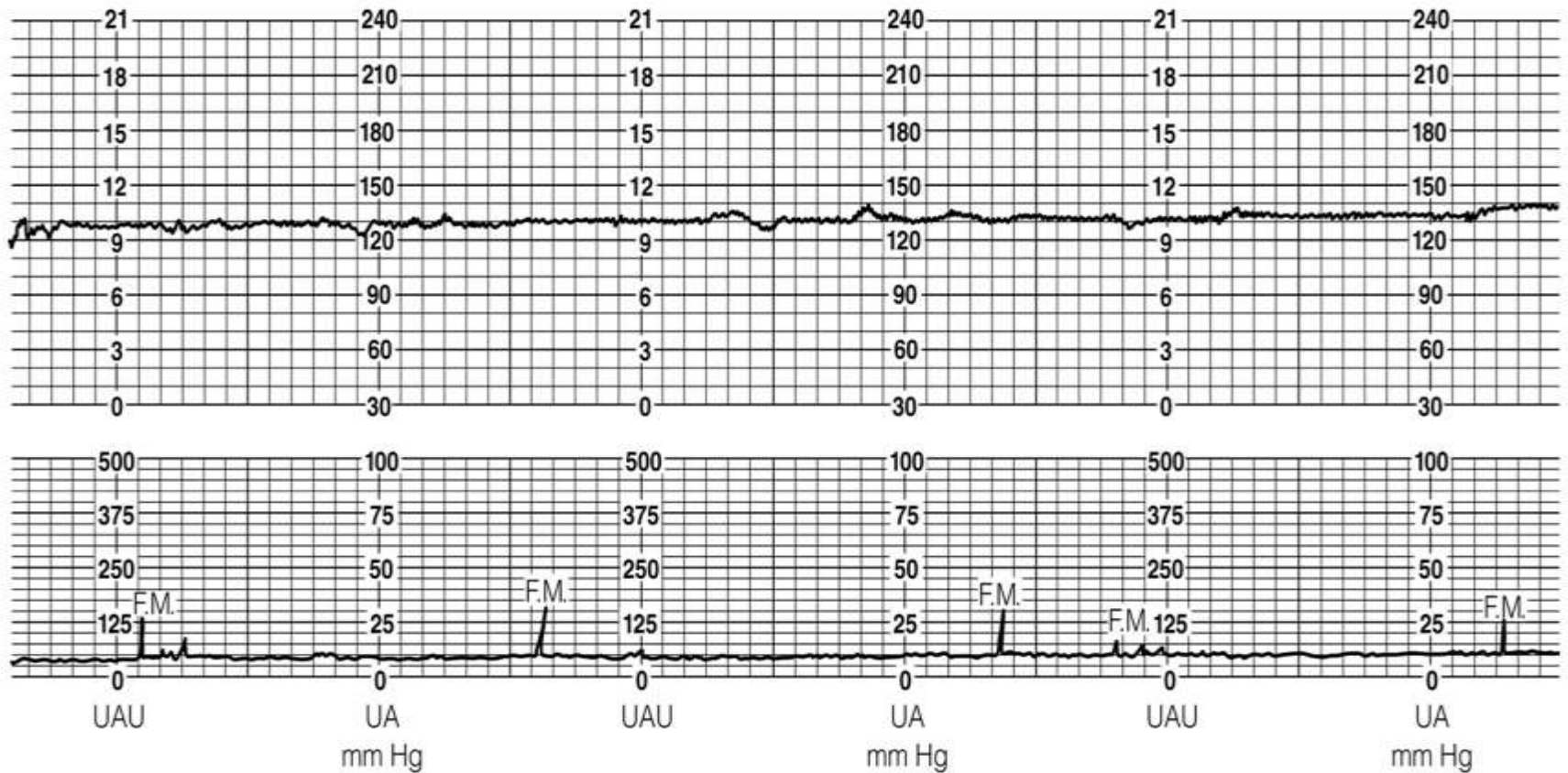




B

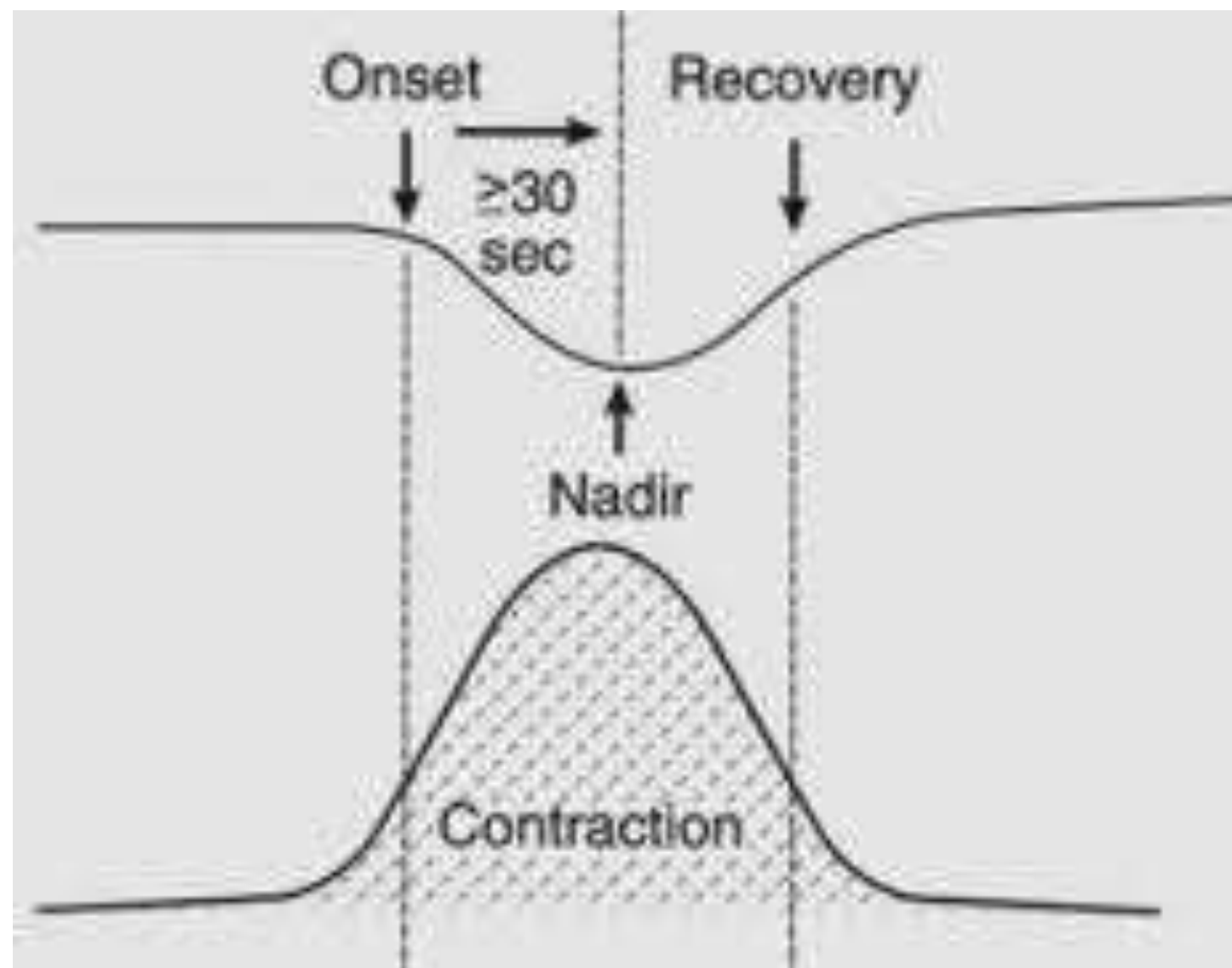
- Non Reactive NST (Lack of Acceleration)
- Fetal sleep
- Medication
- Hypoxia

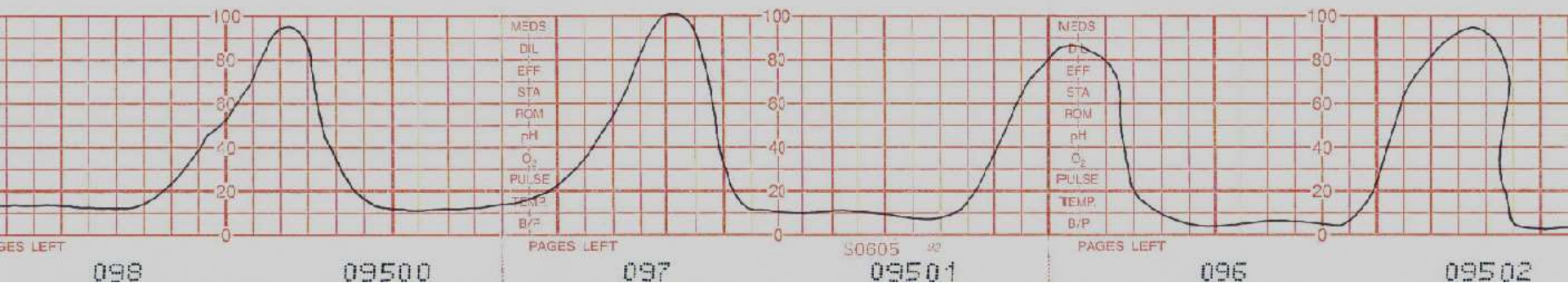
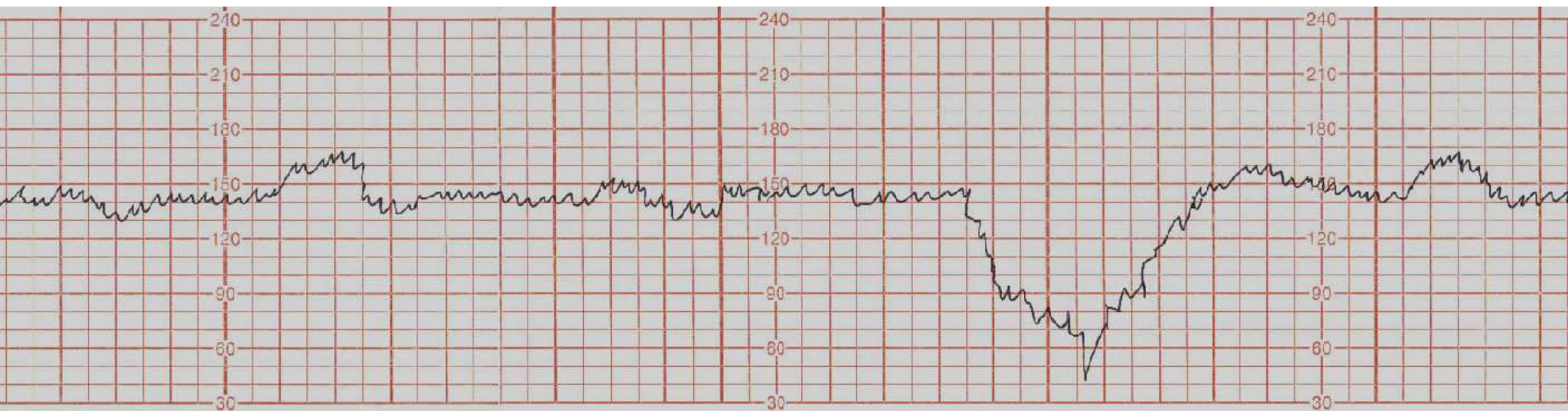
Nonreactive NST:



Decelerations:

- **Early decelerations:**
- In early and late decelerations, the slope of fetal heart rate change is gradual, resulting in a curvilinear and uniform or symmetrical waveform





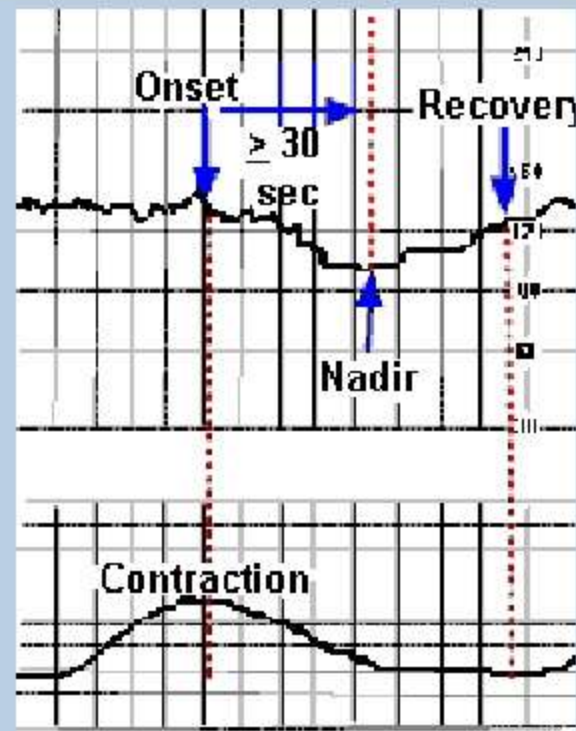
REASONS:

- **Head compression** probably causes vagal nerve activation as a result of dural stimulation, and this mediates the heart rate deceleration

- early decelerations as those generally seen in active labor **between 4 and 7 cm** dilatation.
- the degree of deceleration is generally proportional to the contraction strength and rarely falls below 100 to 110 bpm or 20 to 30 bpm below baseline.
- Such decelerations are common during active labor and **not** associated with tachycardia, loss of variability, or other fetal heart rate changes.
- Importantly, early decelerations are **not** associated with fetal hypoxia, acidemia, or low Apgar scores.

LATE DECELERATION

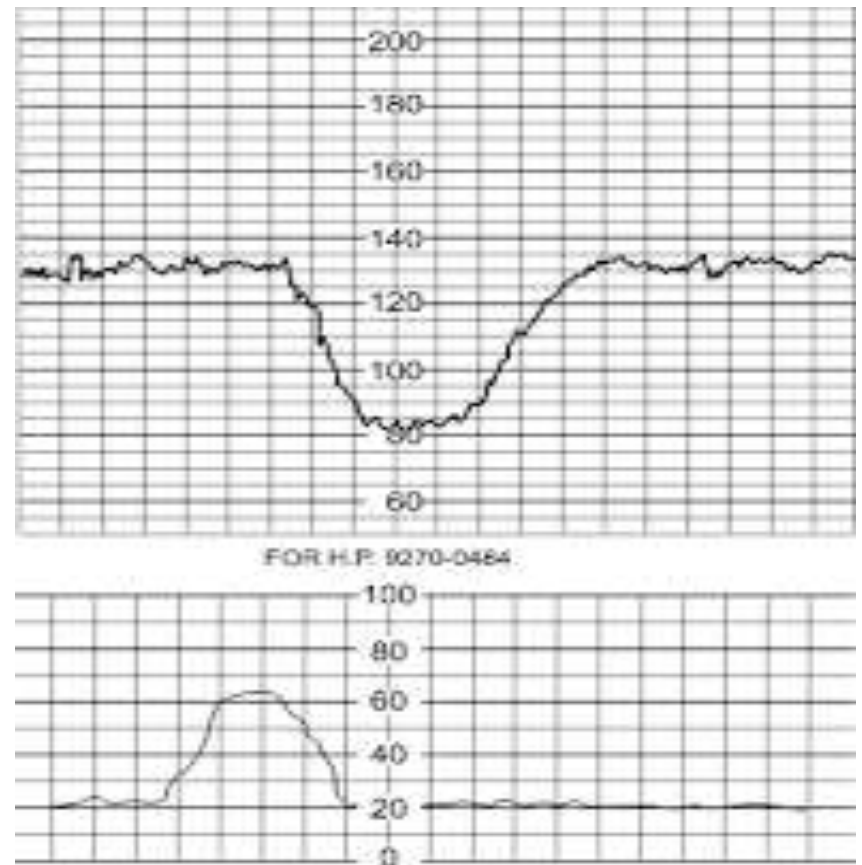
Gradual decrease in FHR with onset of deceleration to nadir ≥ 30 seconds. Onset of the deceleration occurs after the beginning of the contraction, and the nadir of the fetal heart occurs after the peak of the contraction.



Late Deceleration

- *A late deceleration is a smooth, gradual, symmetrical decrease in fetal heart rate beginning at or after the contraction peak and returning to baseline only after the contraction has ended.*
- *A gradual decrease is defined as 30 seconds or more from the onset of the deceleration to the nadir. In most cases, the onset, nadir, and recovery of the deceleration occur after the beginning, peak, and ending of the contraction, respectively.*

- than 10 to 20 bpm. Late decelerations usually are not accompanied by accelerations
- *The magnitude of late decelerations is seldom more than 30 to 40 bpm below baseline and typically not more*



- Generally, any process that causes **maternal hypotension**, excessive uterine activity, or placental dysfunction can induce late decelerations. The two most common causes are hypotension from **epidural analgesia and uterine hyperactivity caused by oxytocin stimulation**. Maternal diseases such as **hypertension, diabetes, and collagen-vascular disorders** can cause **chronic placental dysfunction**.
- **Placental abruption** can cause **acute late decelerations**

Variable Deceleration

- Visually apparent **abrupt** decrease in FHR
- An abrupt FHR decrease is defined as from the onset to the FHR **nadir of < 30 sec**
- The decrease in FHR is ≥ 15 bpm, lasting ≥ 15 sec, and < 2 min in duration
- When variable decelerations are associated with uterine contraction, their onset, depth, and duration commonly **vary** with successive uterine contractions

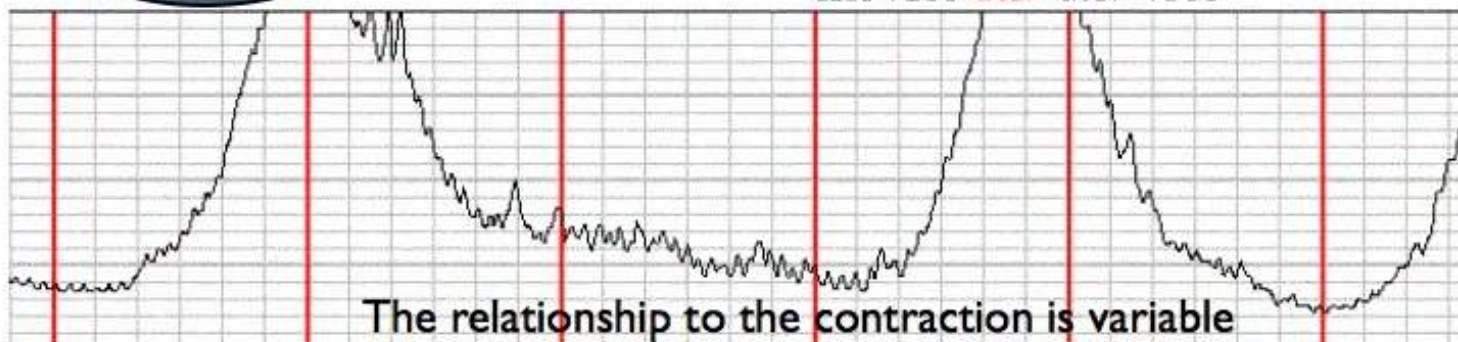
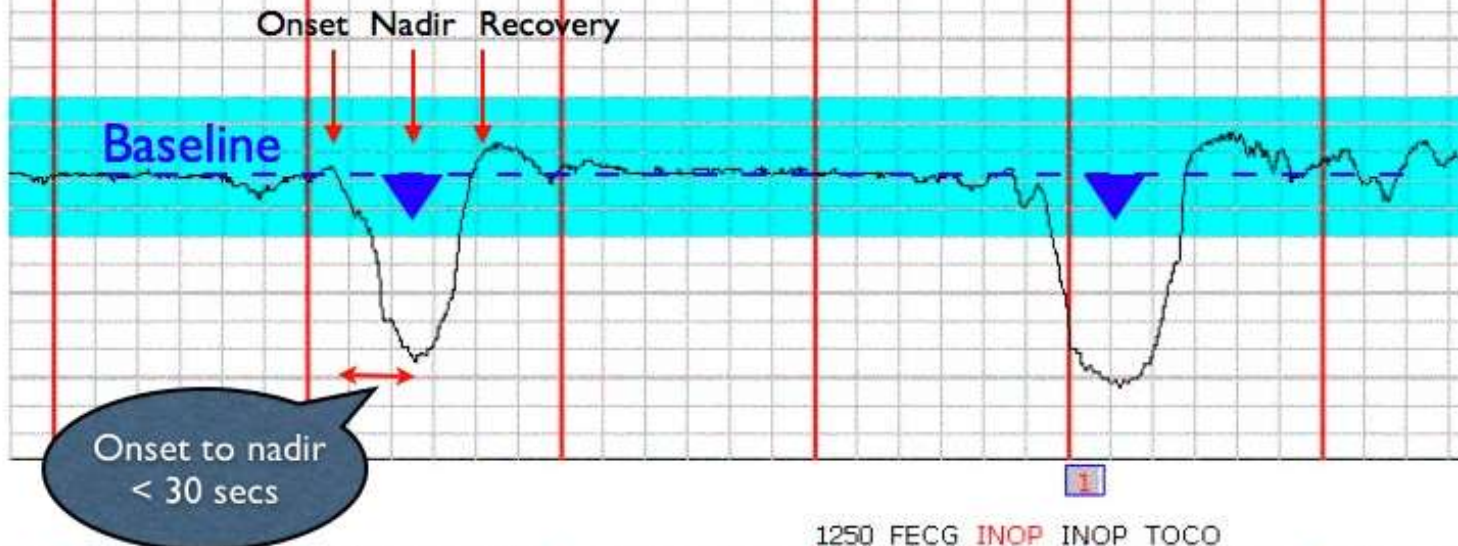
- According to the American College of Obstetricians and Gynecologists (2013a), recurrent variable decelerations with minimal to moderate variability are *indeterminate*, whereas those with **absent** variability are *abnormal*.

▼ = 15 bpm/15 secs

Variable Deceleration

01/31/0

Abrupt onset to nadir < 30 secs, with drop of 15 bpm below baseline for ≥ 15 secs but < 2 min



- Variable decelerations are classified as severe when they last more than 60 seconds, fall below 70 beats/min, or have a drop of 60 beats/min below the baseline rate.

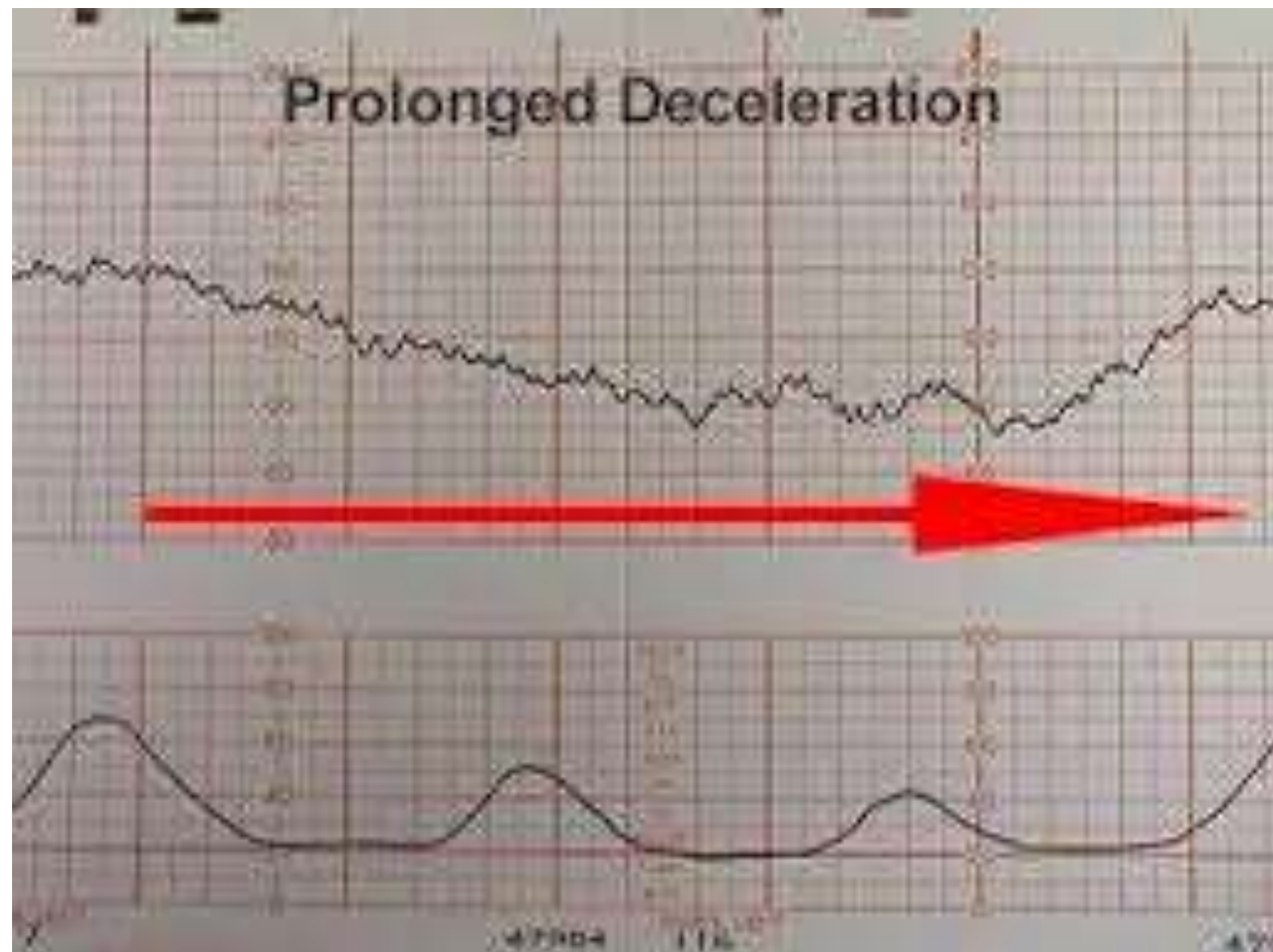
Prolonged Deceleration

- This pattern, is defined as an isolated deceleration greater than 15 bpm lasting 2 minutes or longer but < 10 minutes from onset to return to baseline. Some of the more common causes include cervical examination, uterine hyperactivity, cord entanglement, and maternal supine hypotension.

- Epidural, spinal, or paracervical analgesia may induce prolonged deceleration of the fetal heart rate.
- Other causes of prolonged deceleration include maternal hypoperfusion or hypoxia from any cause, placental abruption, umbilical cord knots or prolapse, maternal seizures including eclampsia and epilepsy, application of a fetal scalp electrode, impending birth, or even maternal Valsalva maneuver

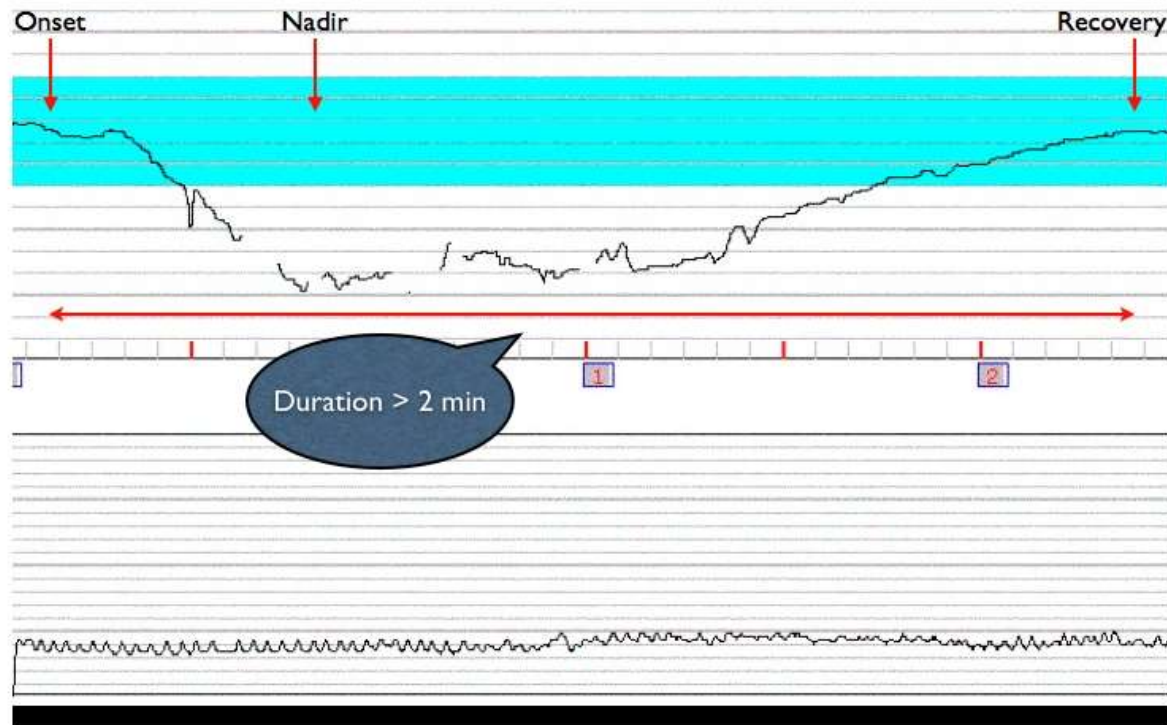
- Occasionally, such self-limited prolonged decelerations are followed by loss of beat-to-beat variability, baseline tachycardia, and even a period of late decelerations, all of which resolve as the fetus recovers.

Prolonged Deceleration



Prolonged Deceleration

Decel is ≥ 15 bpm and > 2 min but < 10 min



NICHD criteria for category I, II, and III FHR tracings

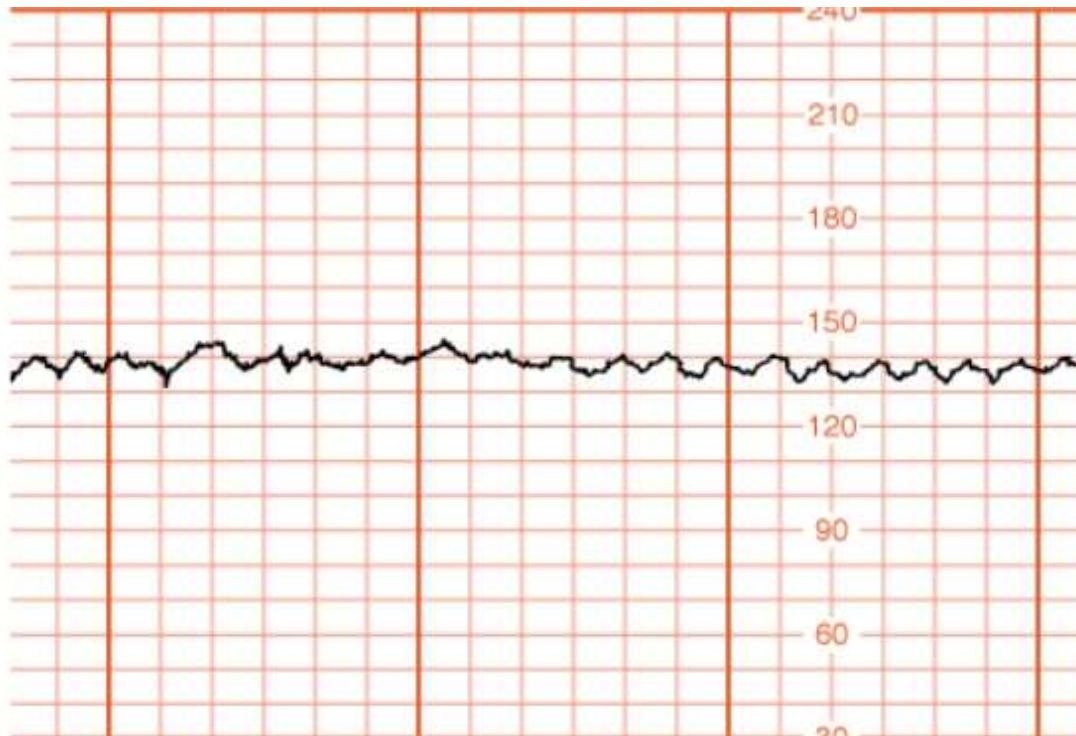
Category I
All of the following criteria must be present. Tracings meeting these criteria are predictive of normal fetal acid-base balance at the time of observation.
Baseline rate: 110 to 160 bpm
Moderate baseline FHR variability
No late or variable decelerations
Early decelerations may be present or absent
Accelerations may be present or absent
Category III
Category III tracings are predictive of abnormal fetal acid-base status at the time of observation. Prompt evaluation is indicated and most parturients will require expeditious intervention, such as provision of supplemental oxygen, change in position, treatment of hypotension, and discontinuation of any uterotonic drugs being administered. Category III tracings include either (1) or (2) below.
(1) Absent baseline FHR variability and any of the following:
▪ Recurrent late decelerations
▪ Recurrent variable decelerations
▪ Bradycardia
(2) Sinusoidal pattern
Category II
FHR tracing does not meet criteria for either category I or III and is considered indeterminate.

NICHD: National Institute of Child Health and Human Development; FHR: fetal heart rate; bpm: beats per minute.

Data from: Macones GA, Hankins GD, Spong CY, et al. The 2008 National Institute of Child Health and Human Development Workshop Report on Electronic Fetal Monitoring: Update on Definitions, Interpretation, and Research Guidelines. *Obstet Gynecol* 2008; 112:661.

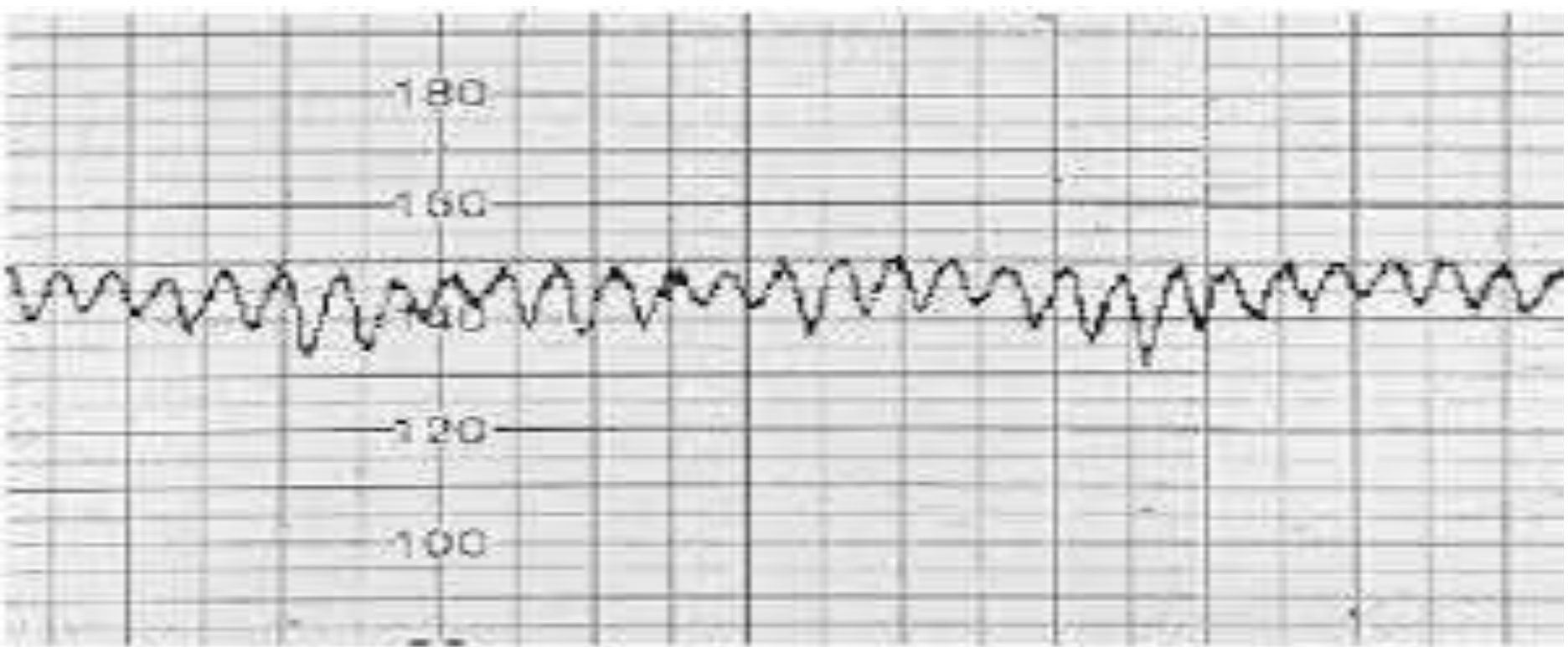
Sinusoidal Heart Rate

- *A true sinusoidal pattern with fetal intracranial hemorrhage, with severe fetal asphyxia, and with severe fetal anemia from Rh alloimmunization, fetomaternal hemorrhage, twin-twin transfusion syndrome, or vasa previa with bleeding*
- *Insignificant sinusoidal patterns have been reported following administration of meperidine, morphine, alphaprodine, and butorphanol*
- *A sinusoidal pattern also has been described with chorioamnionitis, fetal distress, and umbilical cord occlusion*



- Sinusoidal fetal heart rate pattern associated with maternal intravenous meperidine administration.
- Sine waves are occurring at a rate of 6 cycles/min.

Aboubakr Elnashar



1. Stable baseline heart rate of 120 to 160 bpm with regular oscillations,
2. Amplitude of 5 to 15 bpm (rarely greater),
3. Long-term variability frequency of 2 to 5 cycles per minute,
4. Fixed or flat short-term variability,
5. Oscillation of the sinusoidal waveform above or below a baseline, and
6. Absent accelerations

● American College of Obstetricians and Gynecologists

- Either continuous electronic FHR monitoring or intermittent auscultation is acceptable in uncomplicated patients.
- High-risk pregnancies (eg, preeclampsia, suspected growth restriction, type 1 diabetes mellitus) should be monitored continuously during labor.

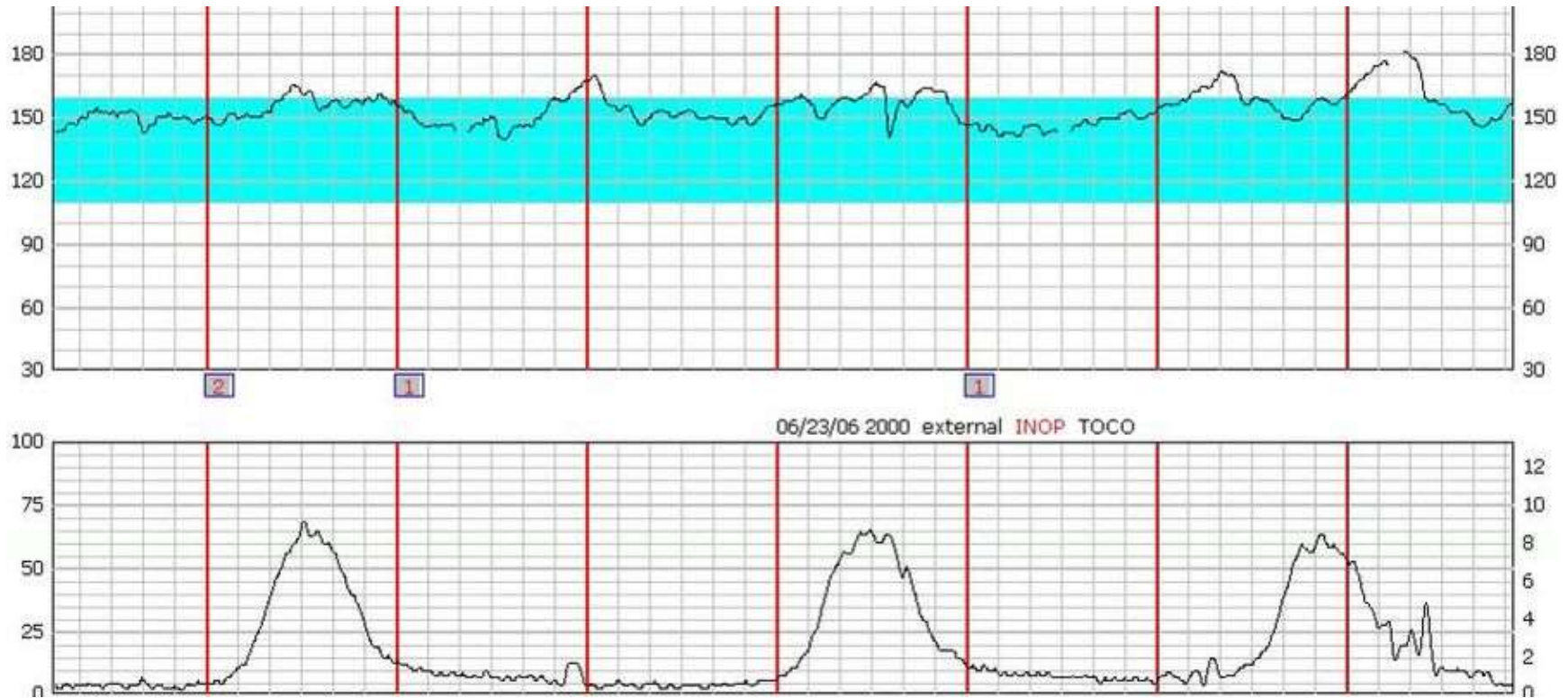
In utero resuscitation

The following general measures for management of **category II and III** tracings are aimed at improving uteroplacental perfusion and maternal/fetal oxygenation :

VAGINAL EXAM(R/O OF CORD PROLAPS)

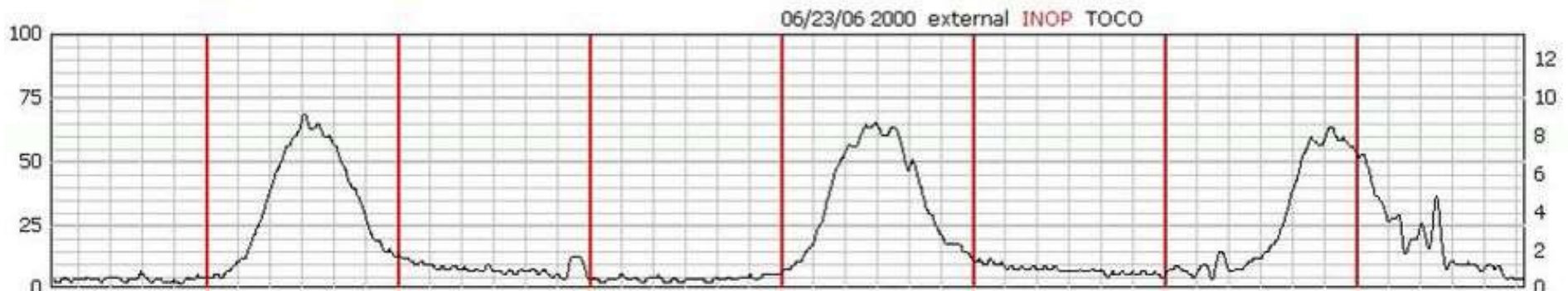
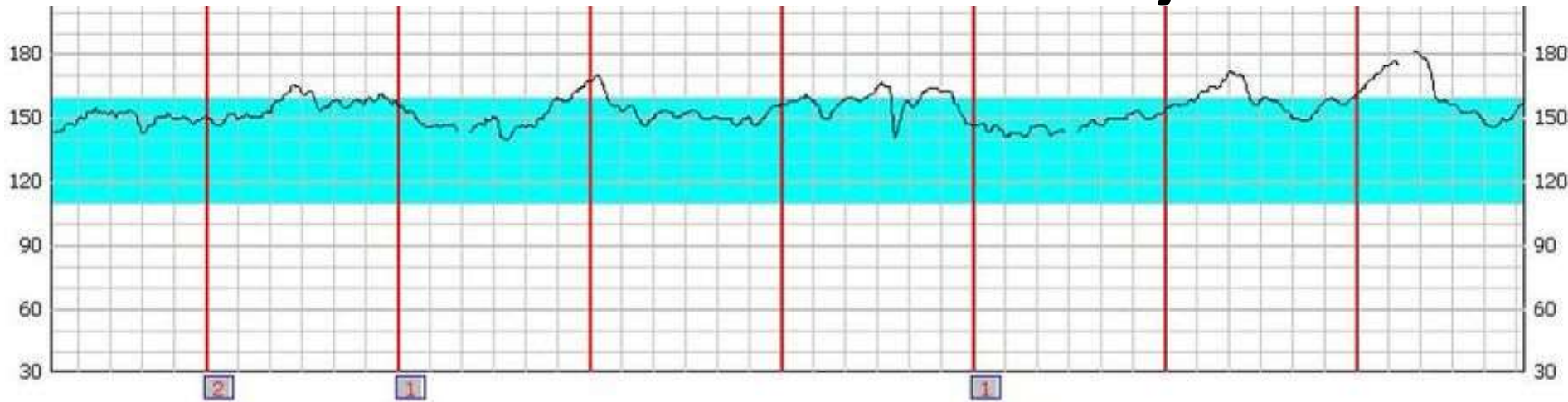
- **Reposition** the patient onto her left or right side
- **Administer oxygen** (eg, 8 to 10 L/min of oxygen via mask)
- Administer an **intravenous (IV) fluid bolus** (eg, 500 to 1000 mL of lactated Ringer's or normal saline solution)
- Discontinue **uterotonic** drugs
- Administer a **tocolytic** drug (eg, terbutaline 250 mcg subcutaneously)

What is the baseline rate?



- 140
- 145
- 150
- 155
- 160

Describe the variability.

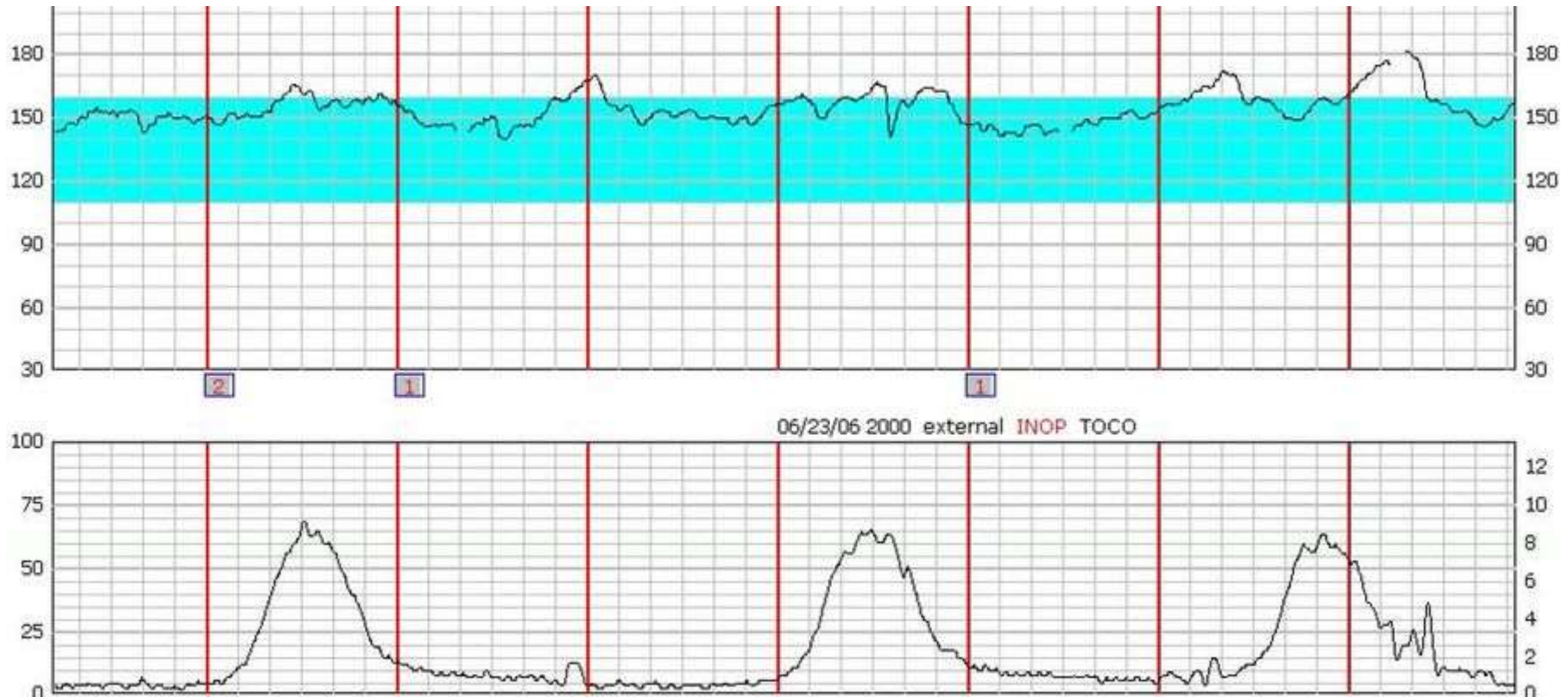


.ABSENT

.MINIMAL

.MODERATE

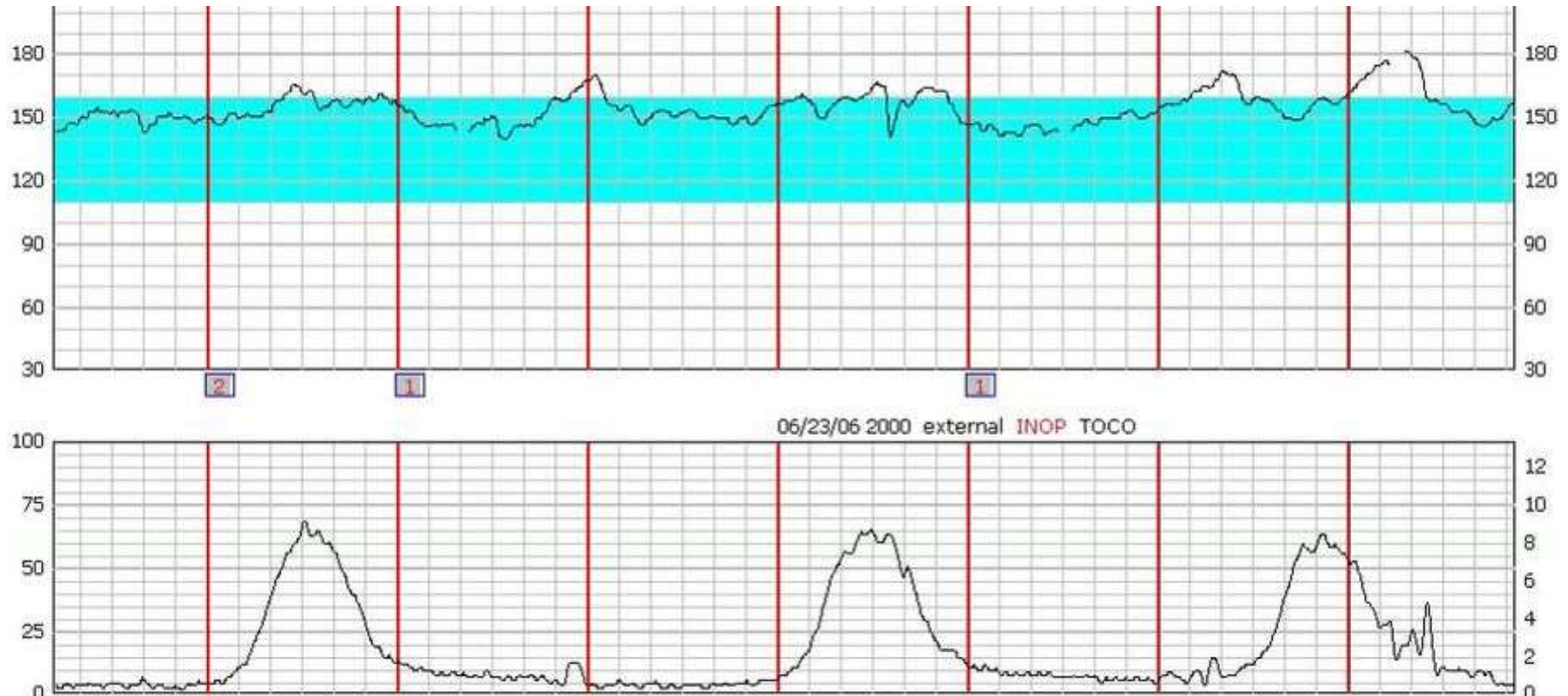
Are there accelerations present?



Answer: yes

Are there decelerations present?

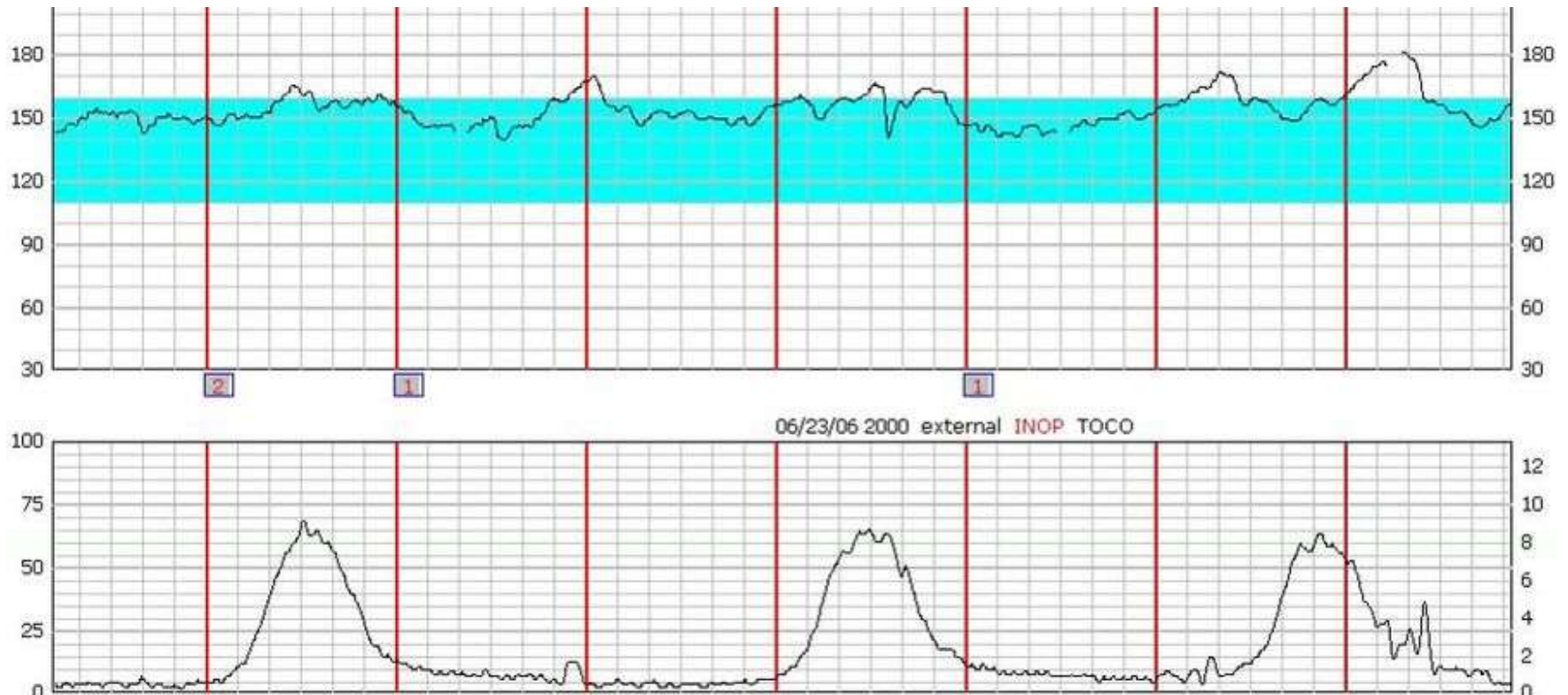
Are contractions present?



*No
regular*

What category is this tracing?

Is this fetal tracing reassuring

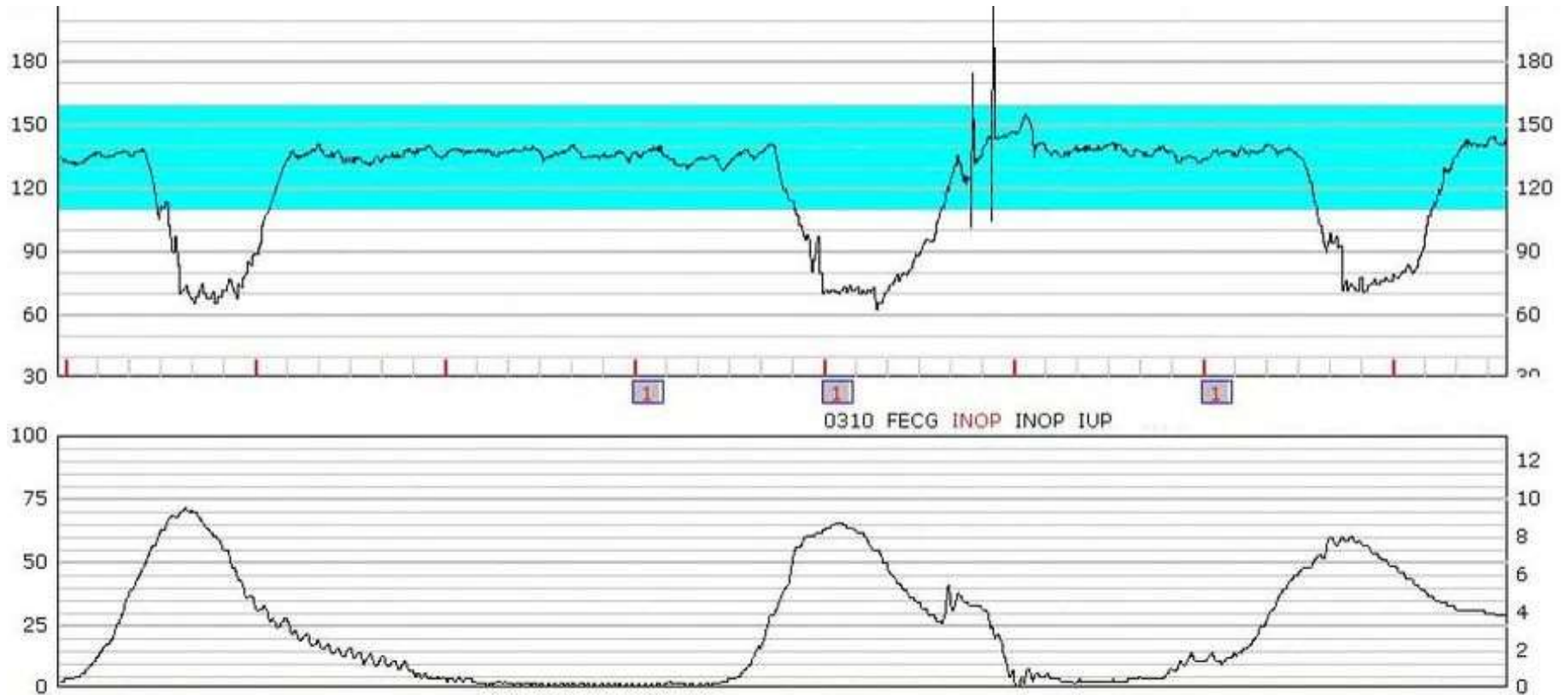


- **Category 1**
- **Yes. It is reassuring and reactive**



What is the baseline rate?

Describe the variability

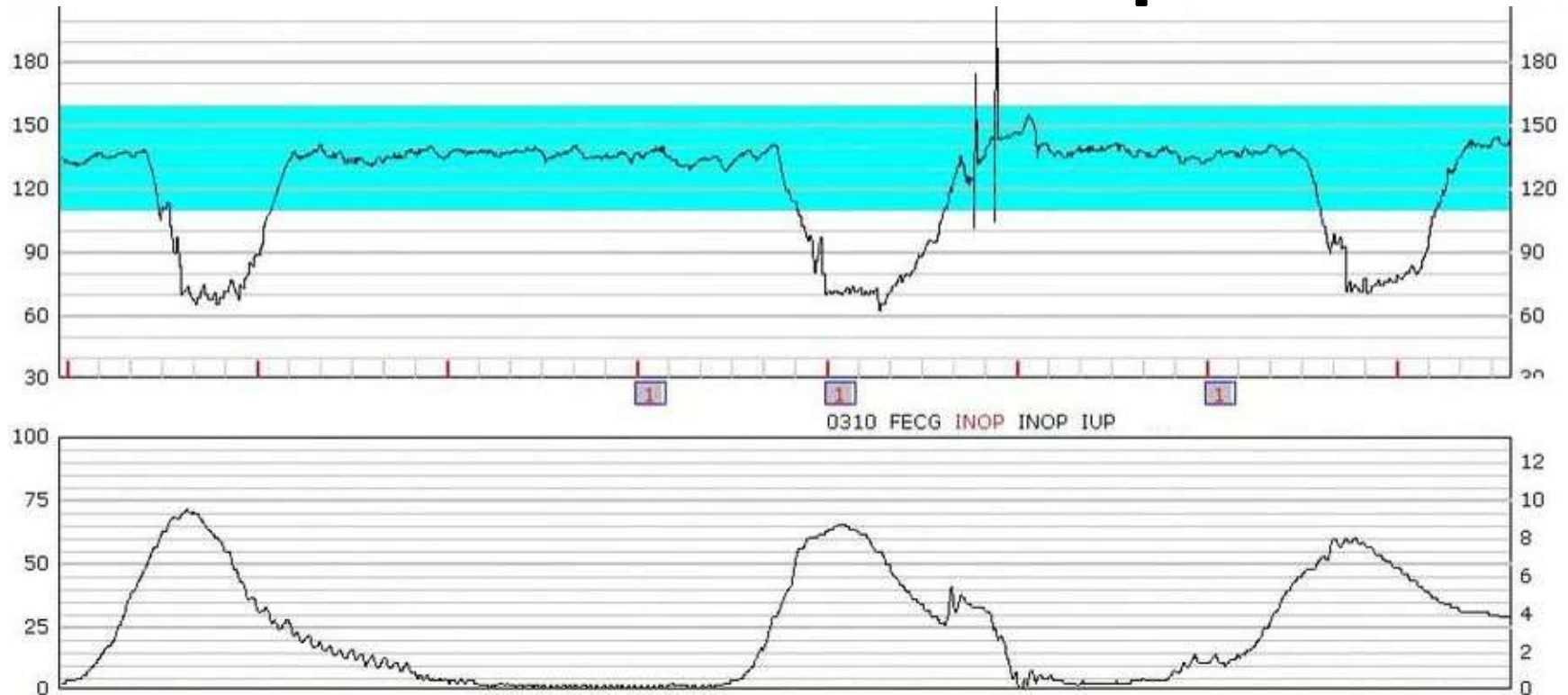


135

Moderate

Are there accelerations present?

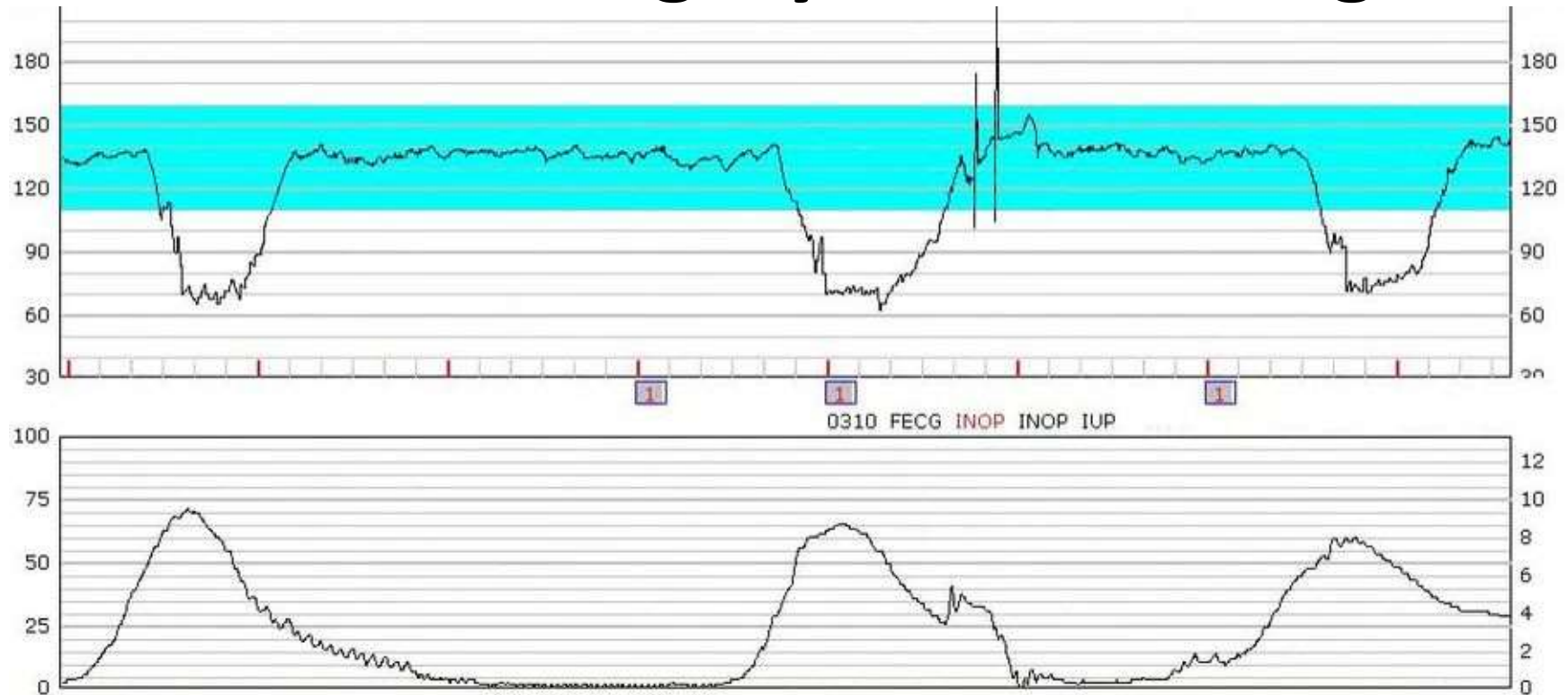
Are there decelerations present?



no
variable

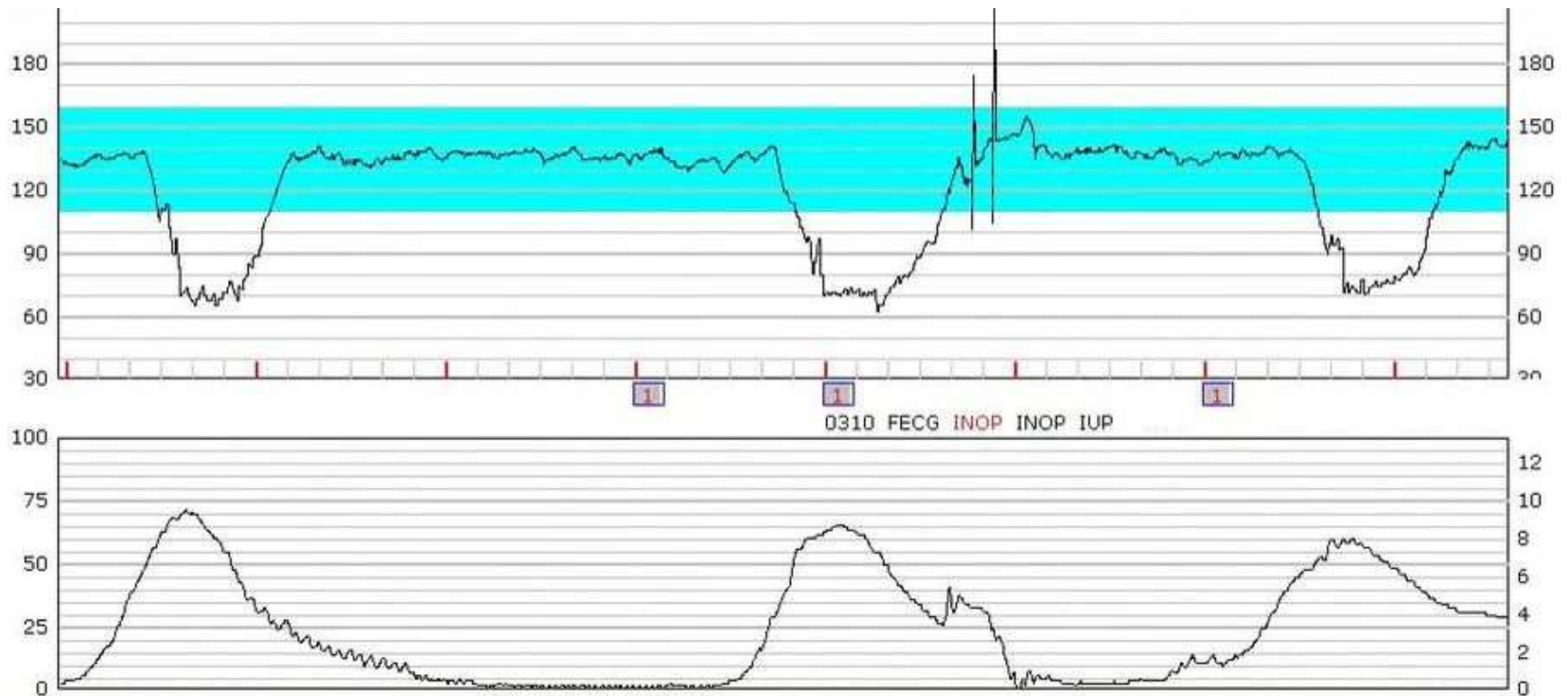
Are contractions present?

What category is this tracing?



Regular.
Category 2.

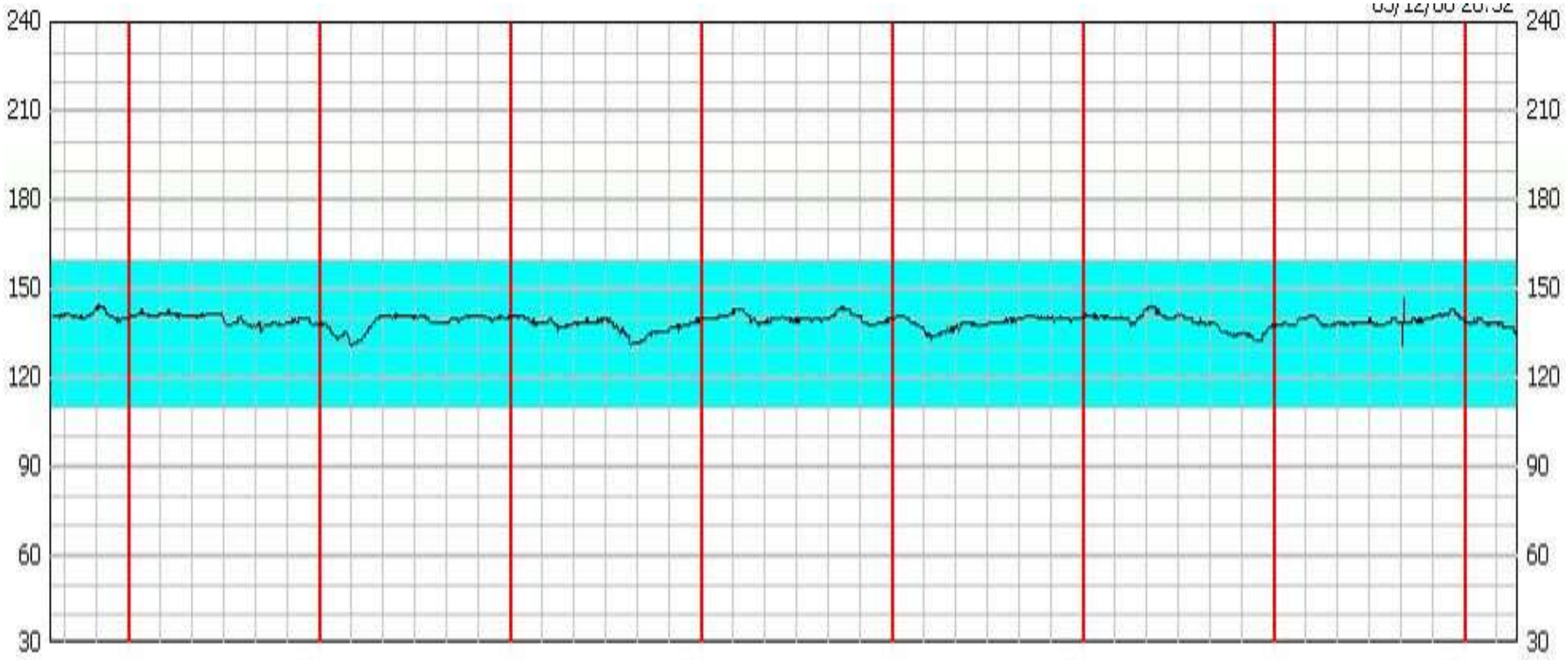
Is this fetal tracing reassuring



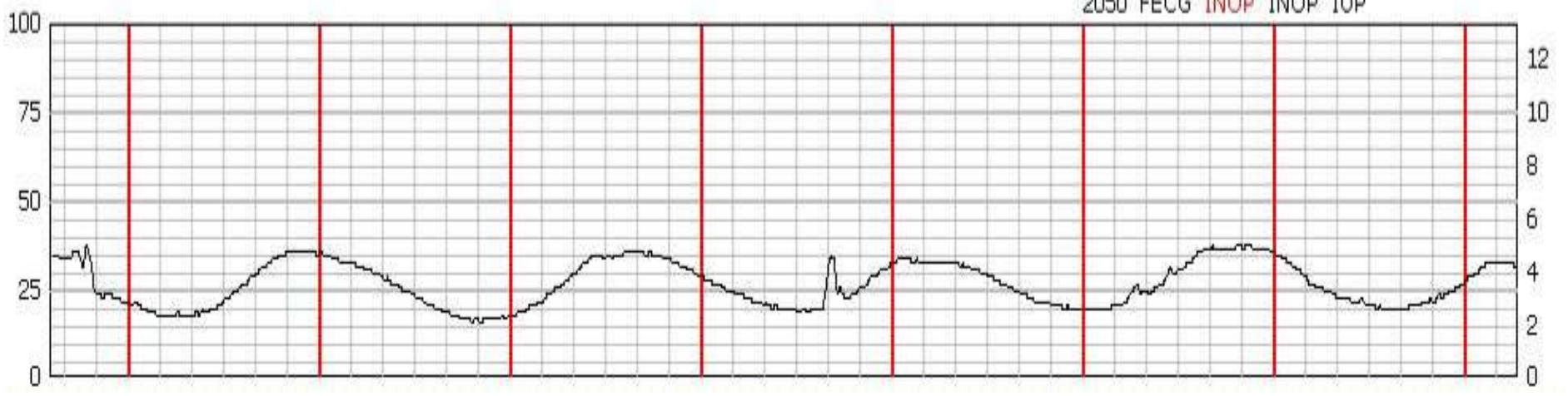
- This tracing is not reassuring and requires intervention
- This tracing may be tolerable if delivery is imminent. An amnioinfusion may correct this pattern in earlier labor. Cord compression is the likely etiology.



03/12/00 20:02



2050 FECG INOP INOP IUP



➤ 1. What is the baseline of the FHT?

- 140
- 145
- 150
- 155
- 160

➤ 2. Describe the variability.

- Absent.
- Minimal.
- Moderate.
- Marked.

➤ 3. Are there accelerations present?

- No.
- Yes.
- Yes, and the strip is reactive.

➤ 4. Are there decelerations present?

- None.
- Variable.
- Early.
- Late.
- Prolonged.

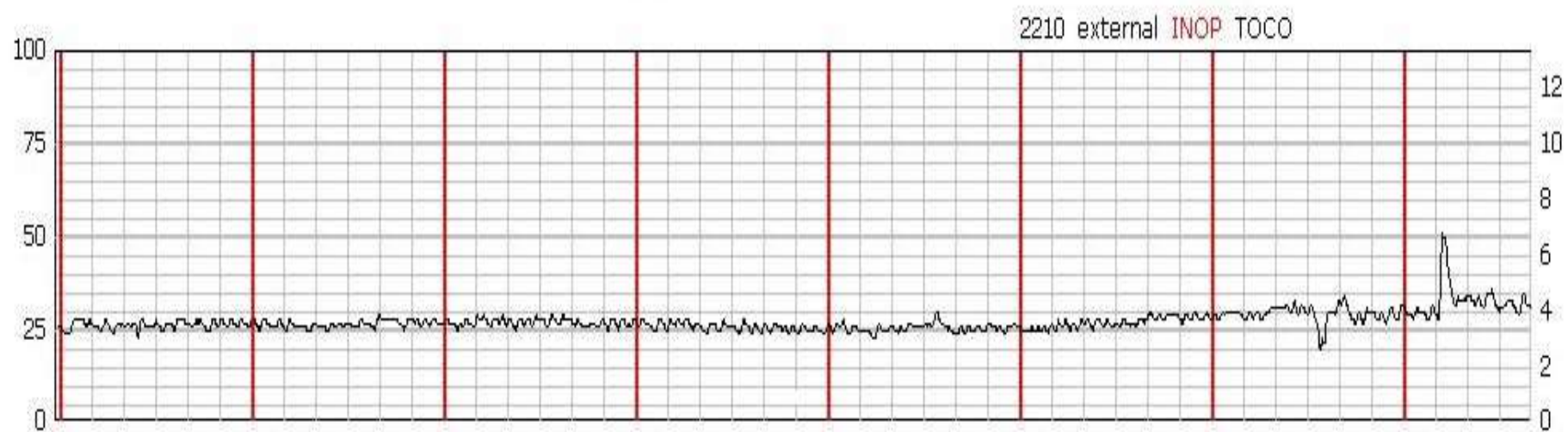
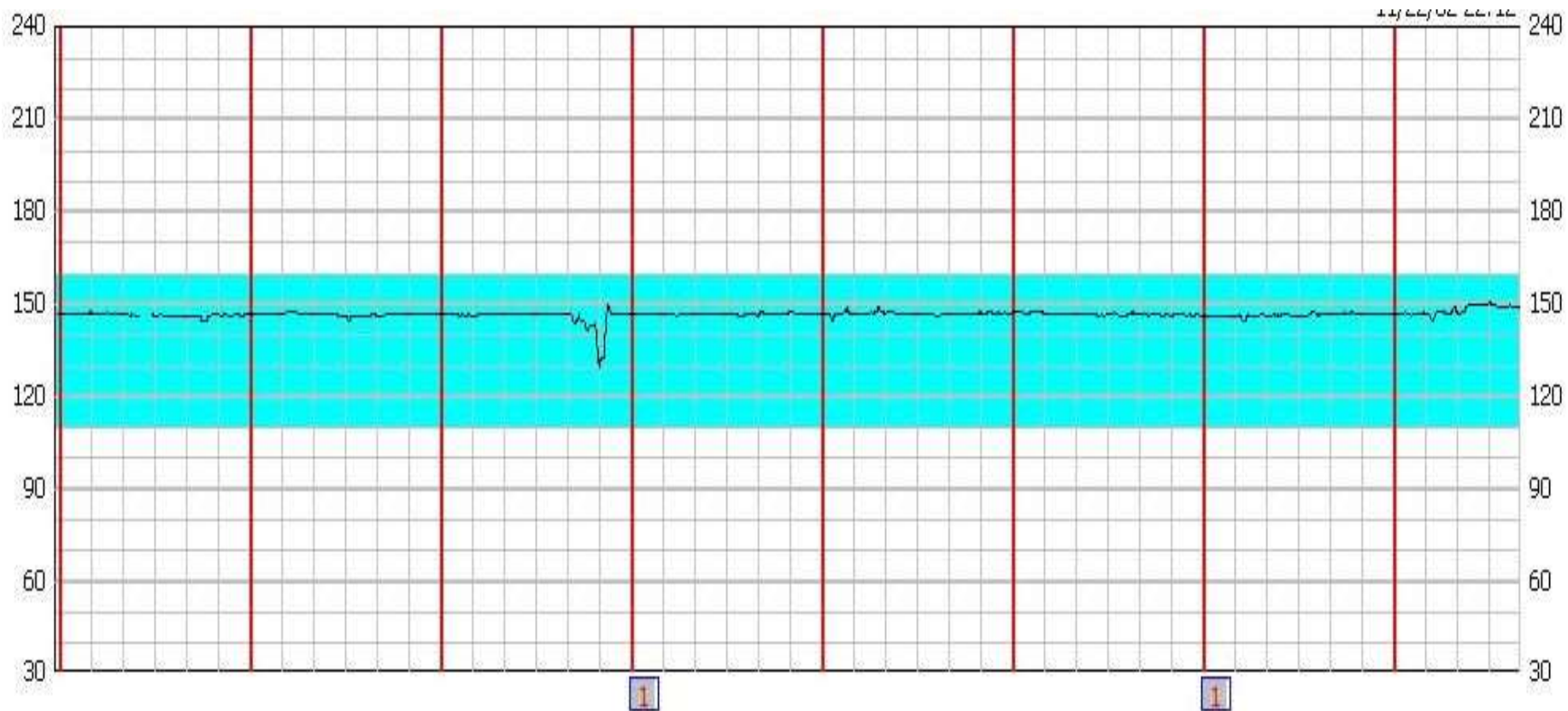
➤ 5. Are contractions present?

- None.
- Occasional.
- Regular.
- Hyperstimulation.

➤ 6. Is this FHT reassuring?

- Yes. It is reassuring and reactive.
- It is overall reassuring, but not reactive.
- This tracing is nonreassuring and requires intervention.
-
-

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 - 155
 - 160
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- 3. Are there accelerations present?
 - No.
 - Yes.
 - Yes, and the strip is reactive.
- 4. Are there decelerations present?
 - None.
 - Variable.
 - Early.
 - Late.
 - Prolonged.
- 5. Are contractions present?
 - None.
 - Occasional.
 - Regular.
 - Hyperstimulation.
- 6. Is this FHT reassuring?
 - Yes. It is reassuring and reactive.
 - It is overall reassuring, but not reactive.
 - This tracing is nonreassuring and requires intervention.



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- Yes, and the strip is reactive.

➤ 4. Are there decelerations present?

- None.
- Variable.
- Early.
- Late.
- Prolonged.

➤ 5. Are contractions present?

- None.
- Irritability.
- Occasional.
- Regular.
- Hyperstimulation.

➤ 6. Is this FHT reassuring?

- Yes. It is reassuring and reactive.
- It is overall reassuring, but not reactive.
- This tracing is nonreassuring and requires intervention

➤ 1. What is the baseline of the FHT?

- 140
- 145
- 150
- 155
- 160

➤ 2. Describe the variability

- .Absent.
- Minimal.
- Moderate.
- Marked.

➤ 3. Are there accelerations present?

- No.
- Yes.
- Yes, and the strip is reactive.

➤ 4. Are there decelerations present?

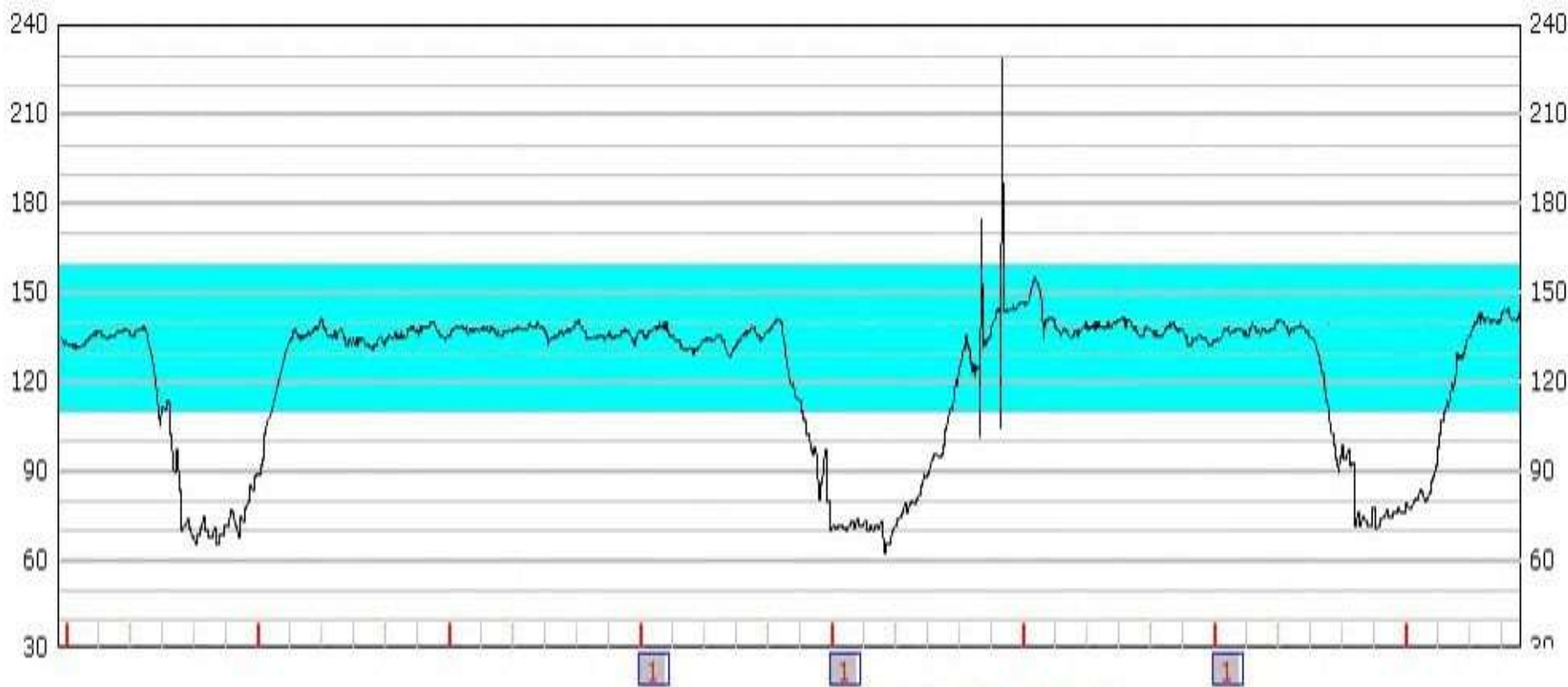
- None.
- Variable.
- Early.
- Late.
- Prolonged.

➤ 5. Are contractions present?

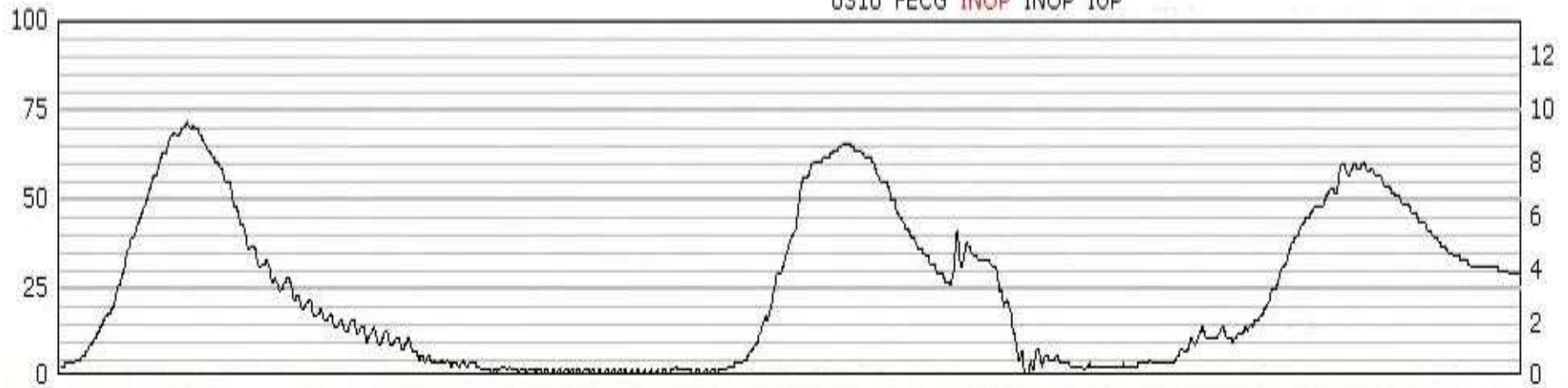
- None.
- Irritability.
- Occasional.
- Regular.
- Hyperstimulation.

➤ 6. Is this FHT reassuring?

- Yes. It is reassuring and reactive.
- It is overall reassuring, but not reactive.
- This tracing is nonreassuring and requires intervention



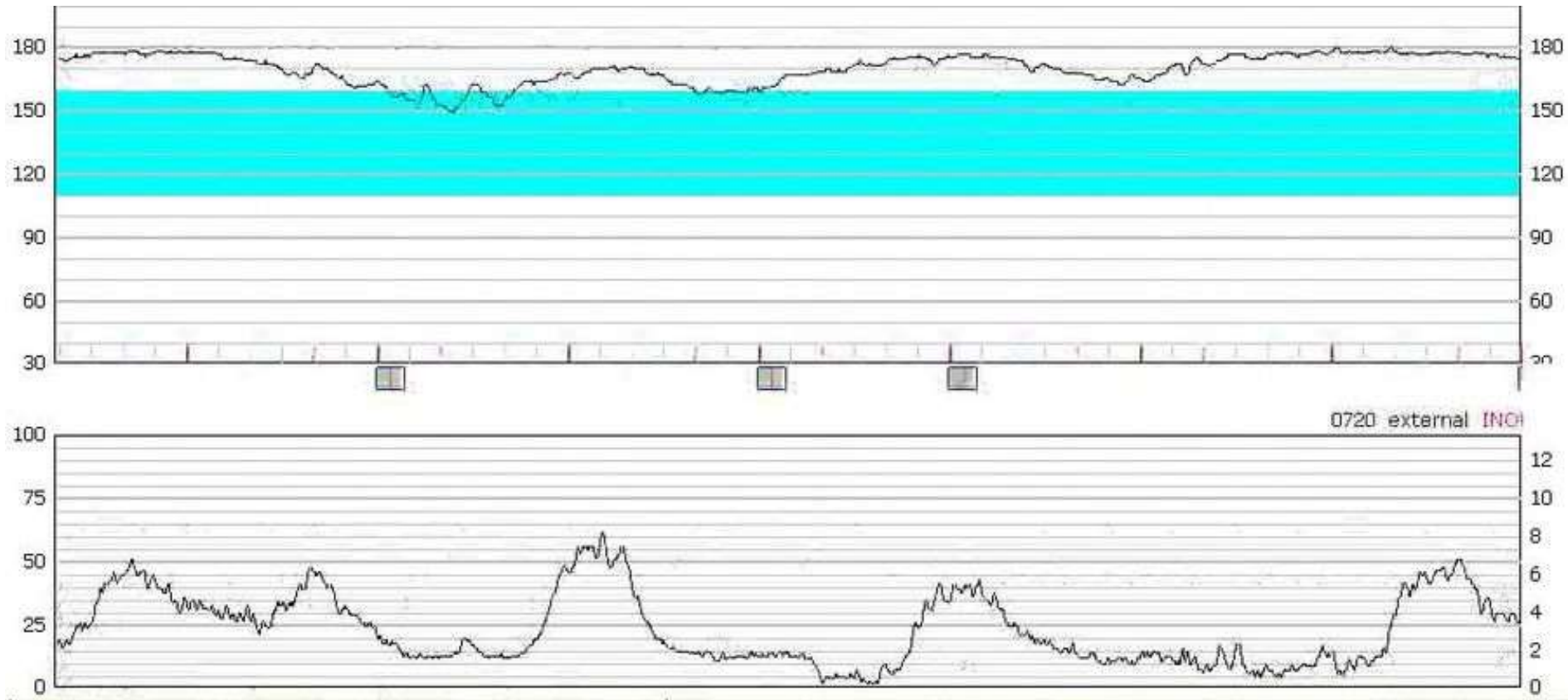
0310 FECG INOP INOP IUP



- 1. What is the baseline of the FHT?
- 120
- 125
- 130
- 135
- 140
- 2. Describe the variability?
- Absent.
- Minimal.
- Moderate.
- Marked.
- 3. Are there accelerations present?
- No.
- Yes.
- Yes, and the strip is reactive.
- 4. Are there decelerations present?
- None.
- Variable.
- Early.
- Late.
- Prolonged.
- 5. Are contractions present?
- None.
- Occasional.
- Regular.
- Hyperstimulation.
- 6. Is this FHT reassuring?
- Yes. It is reassuring and reactive.
- It is overall reassuring, but not reactive.
- This tracing is nonreassuring and requires intervention.

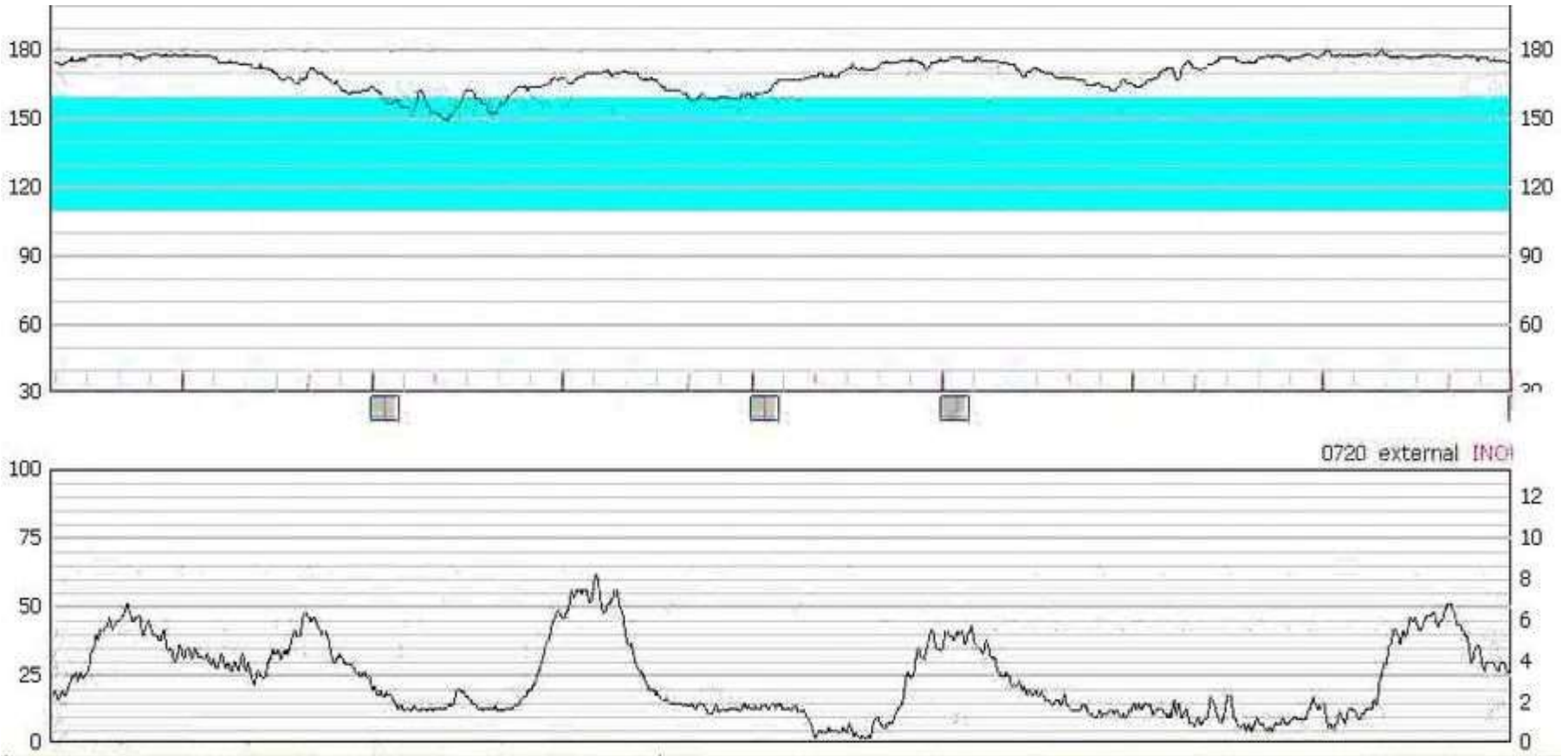
1. What is the baseline of the FHT?**Correct.** Remember, the baseline is the average heart rate rounded to the nearest five bpm.
 - 120
 - 125
 - 130
 - **135**
 - 140
2. Describe the variability.**Correct.** Historically, this has been called average variability and it is considered normal in a term fetus.
 - Absent.
 - Minimal.
 - **Moderate.**
 - Marked.
3. Are there accelerations present?**Correct.** There are no accelerations present.
 - **No.**
 - Yes.
 - Yes, and the strip is reactive.
4. Are there decelerations present?**Correct.** There are repetitive variables present (with each contraction). These should be further described by their depth and duration (e.g., to 70 bpm lasting up to one minute).
 - None.
 - **Variable.**
 - Early.
 - Late.
 - Prolonged.
5. Are contractions present?**Correct.** Her contractions are every 3-4 minutes.
 - None.
 - Occasional.
 - **Regular.**
 - Hyperstimulation.
6. Is this FHT reassuring?**Correct.** This pattern may be tolerated only when delivery is imminent. Amnioinfusion may help correct this pattern earlier in labor.
 - Yes. It is reassuring and reactive.
 - It is overall reassuring, but not reactive.
 - **This tracing is nonreassuring and requires intervention.**
 -

What is the baseline rate?



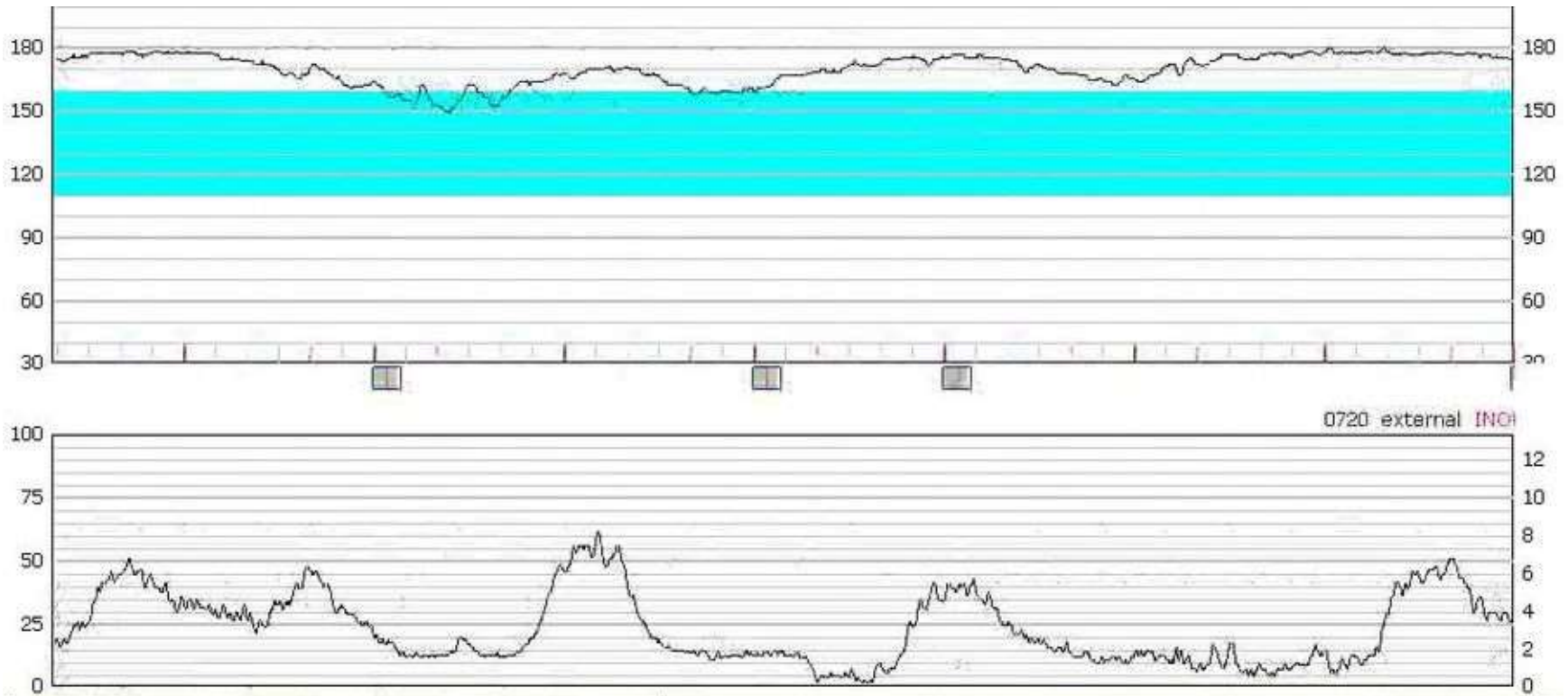
180

Describe the variability.



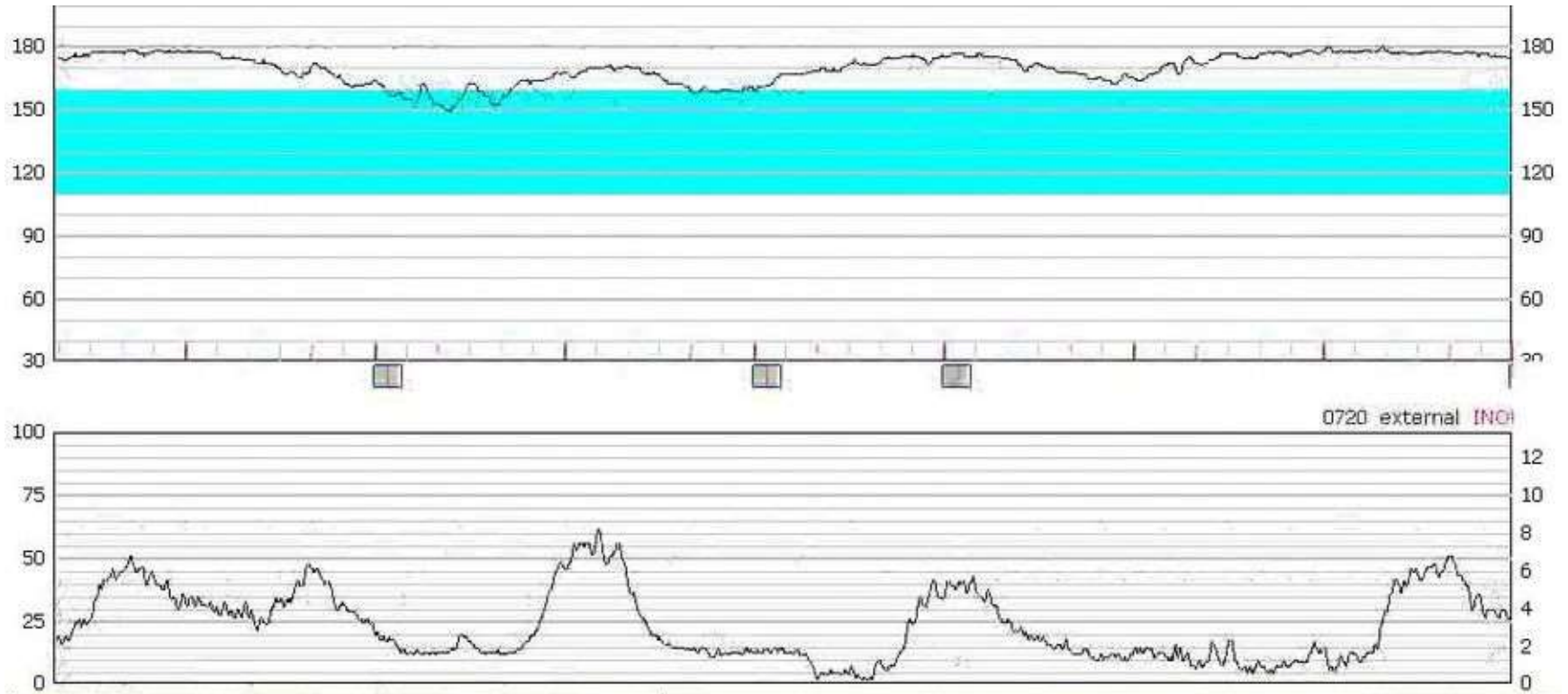
minimal

Are the accelerations present:
Are there decelerations present?



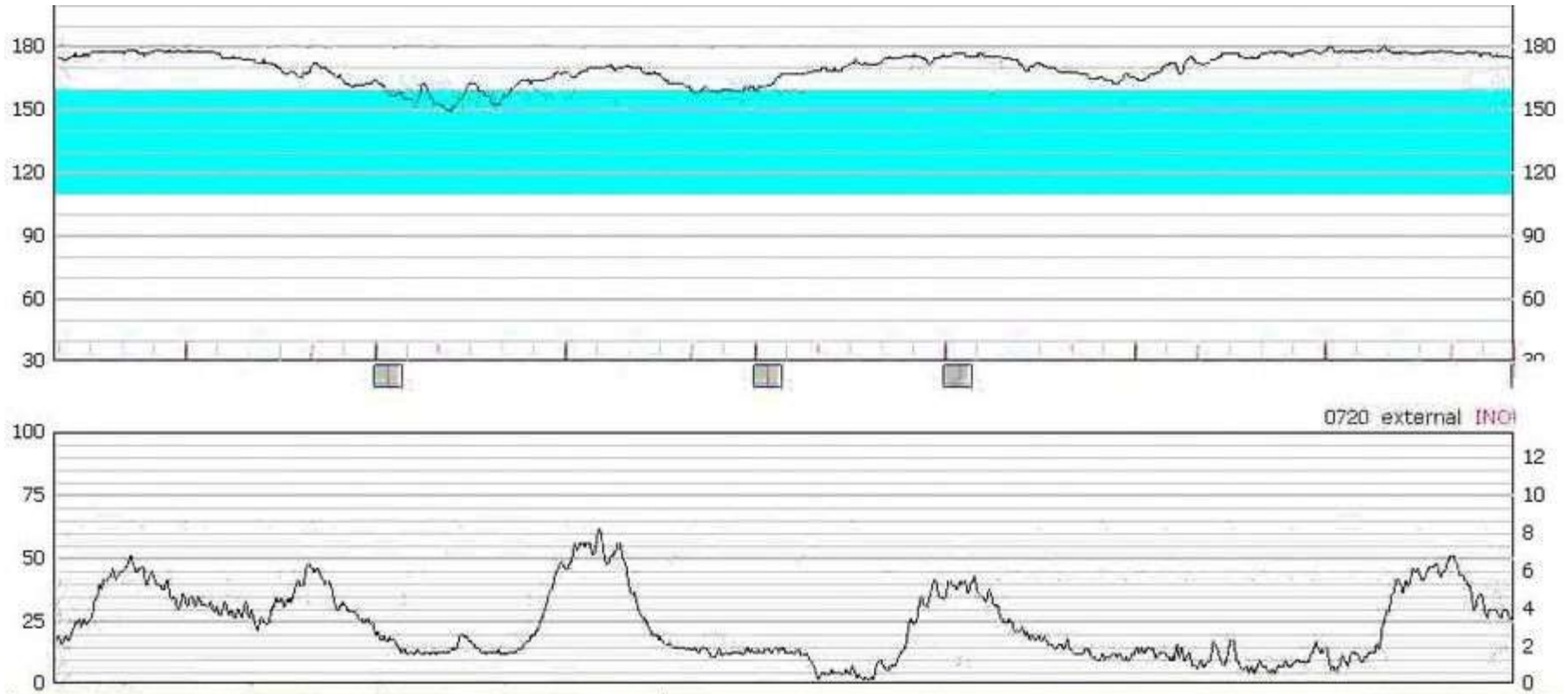
No
late

Are contractions present?



**The contractions are regular
and occurring every 2
minutes**

What category is this tracing?

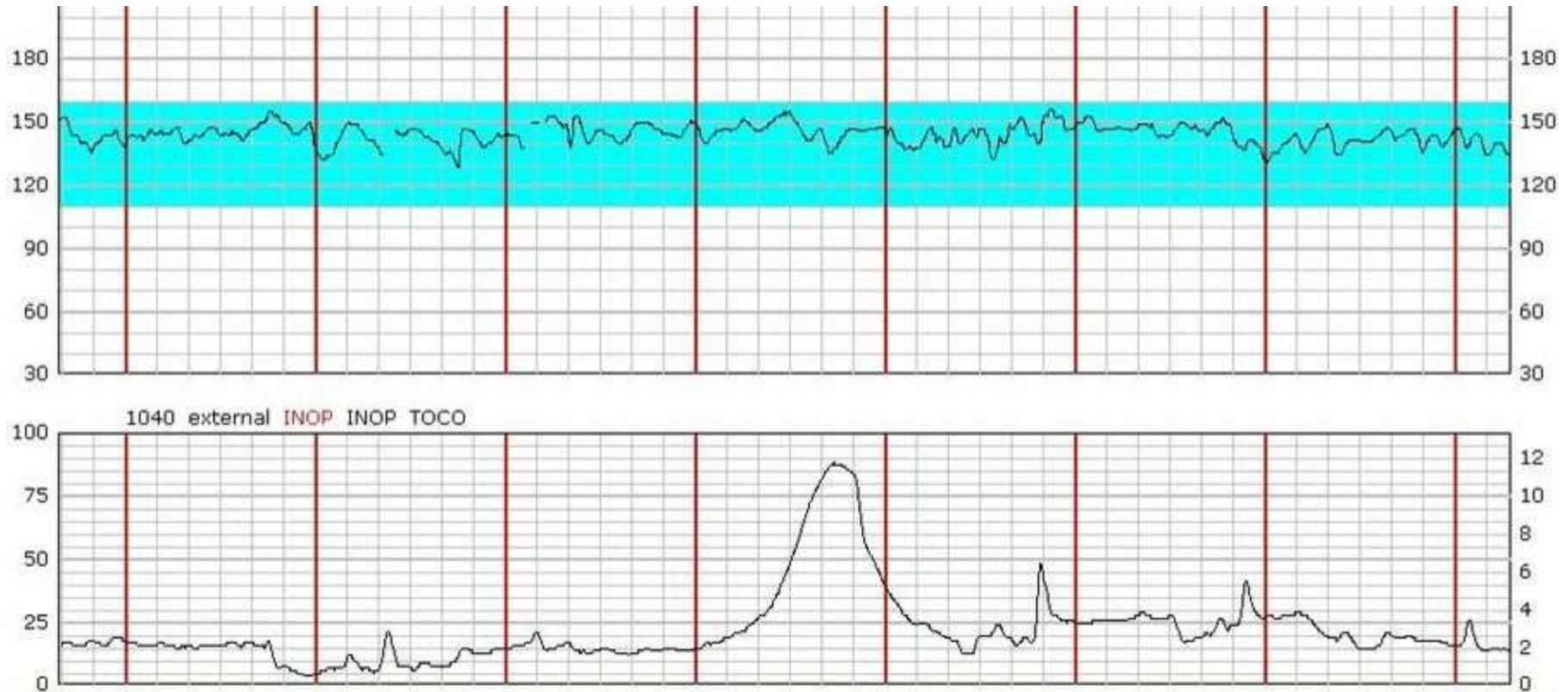


Category 2.

Is this fetal tracing reassuring?

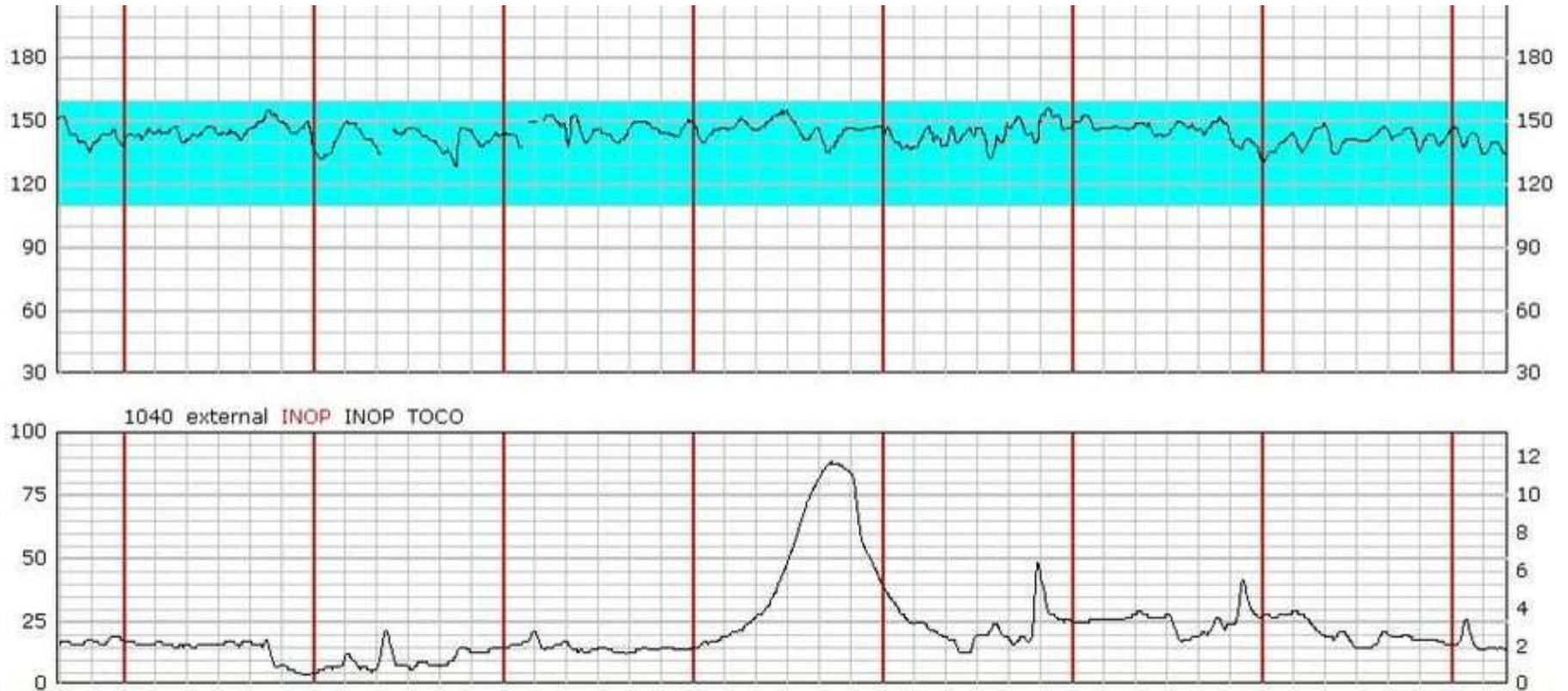
- **This tracing is not reassuring and requires intervention**

What is the baseline rate?



145

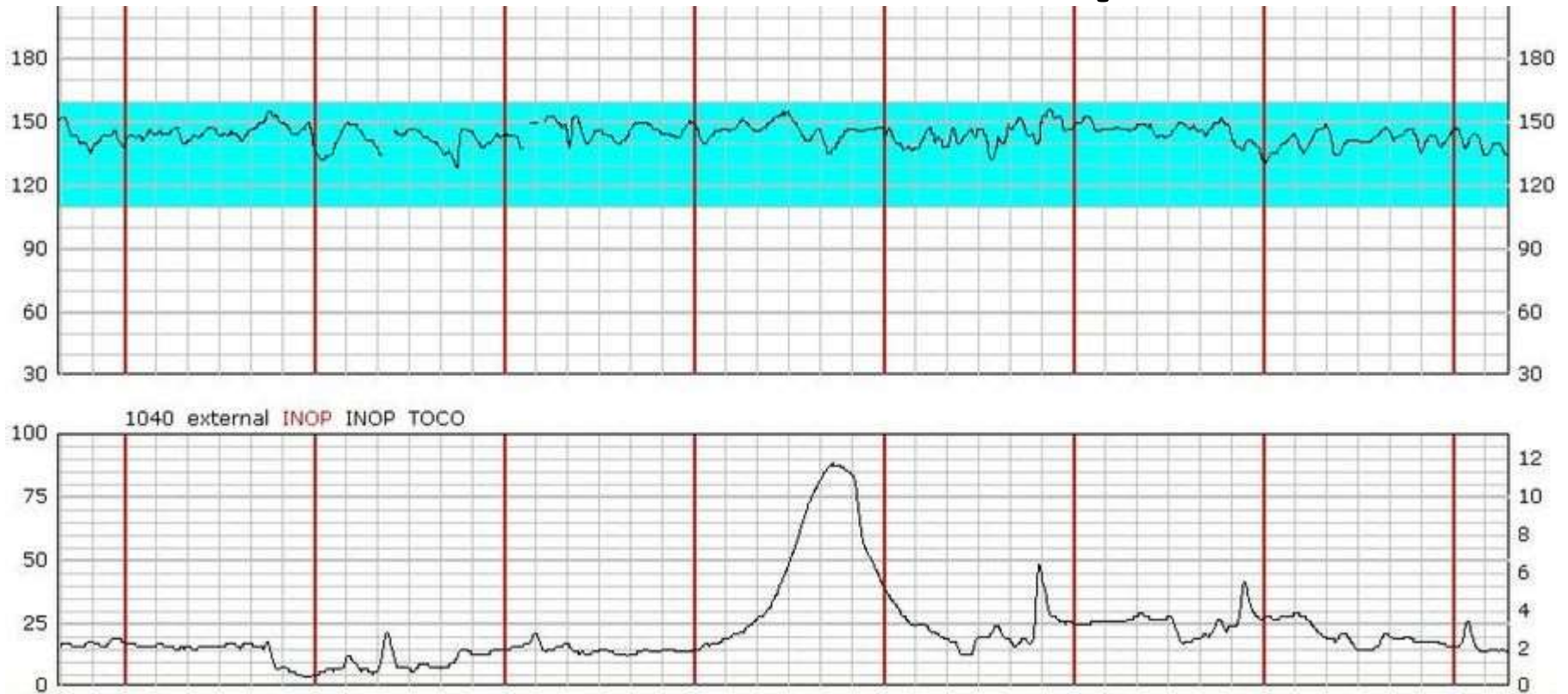
Describe the variability



Moderate

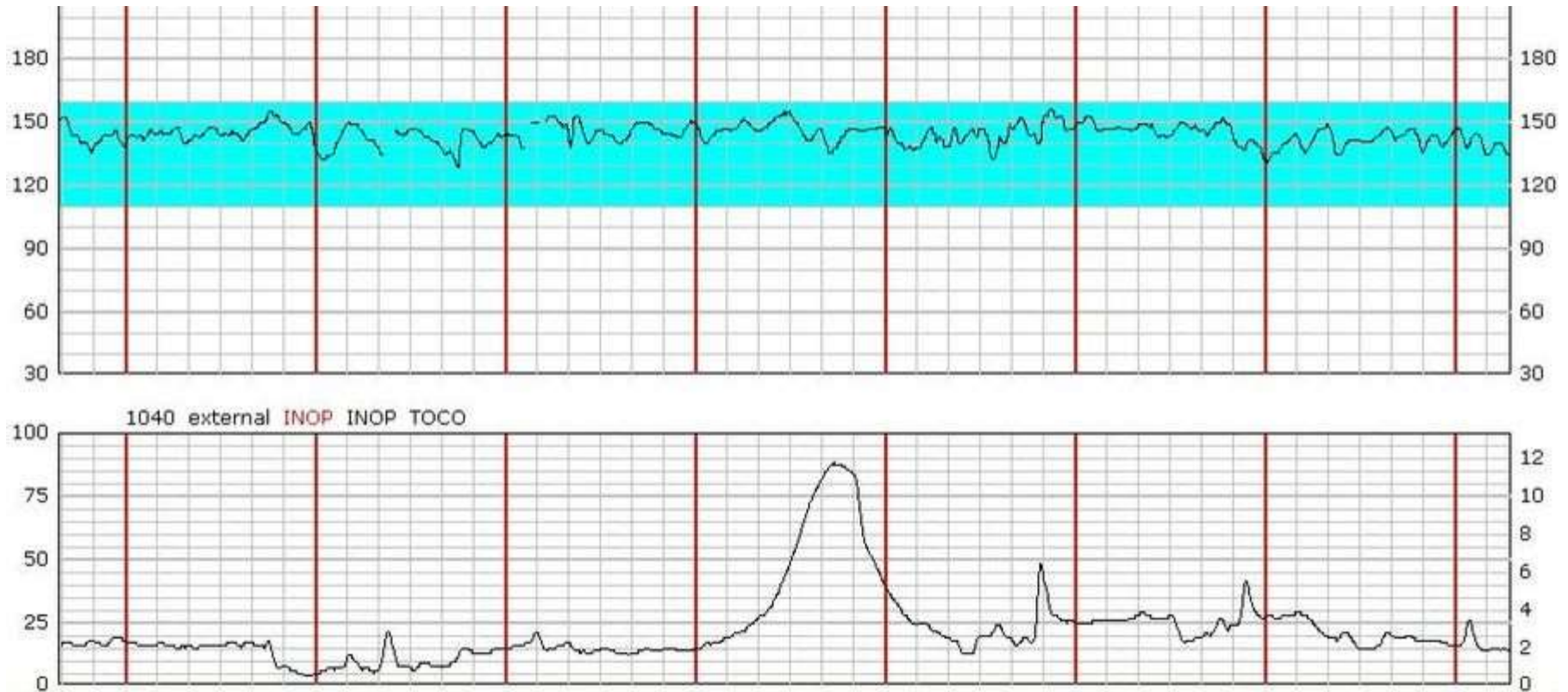
Are there accelerations present?

Are there decelerations present?



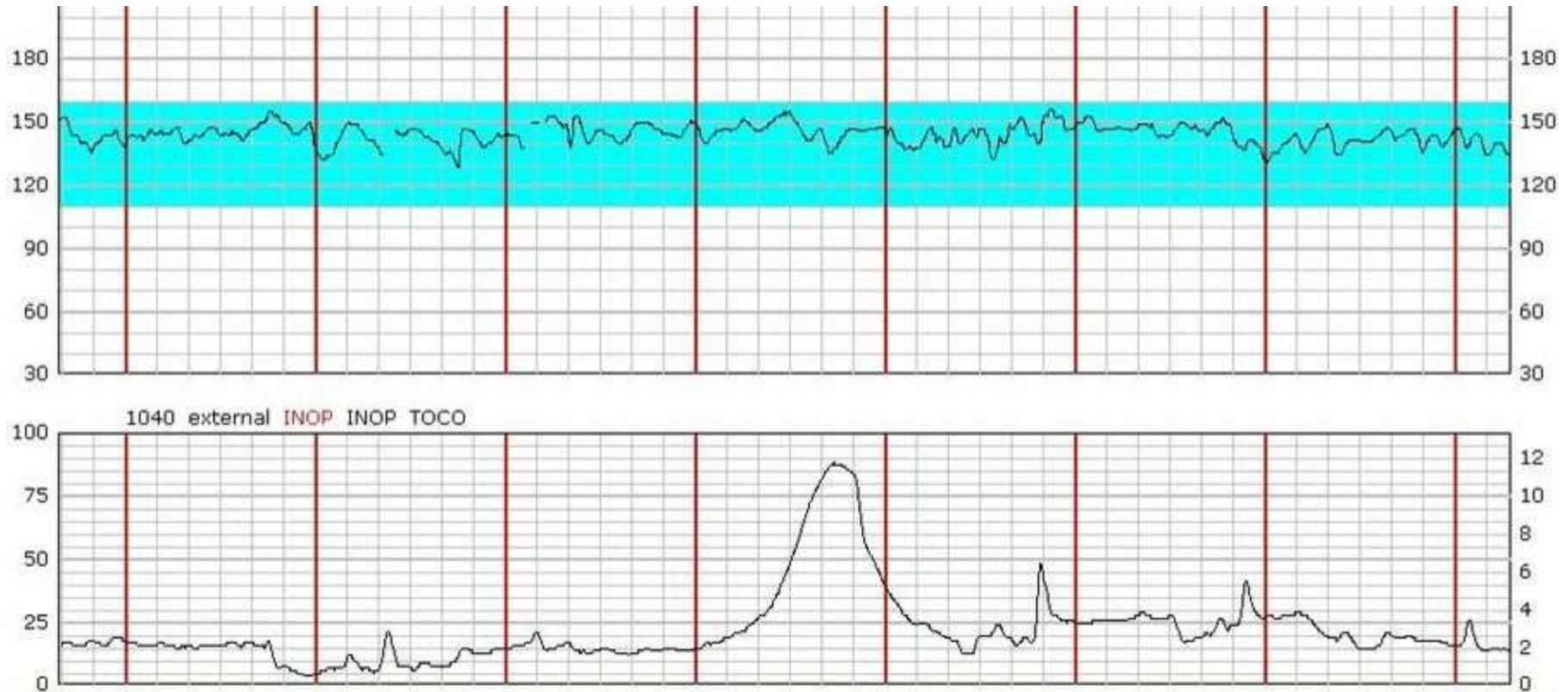
No
None.

Are contractions present?



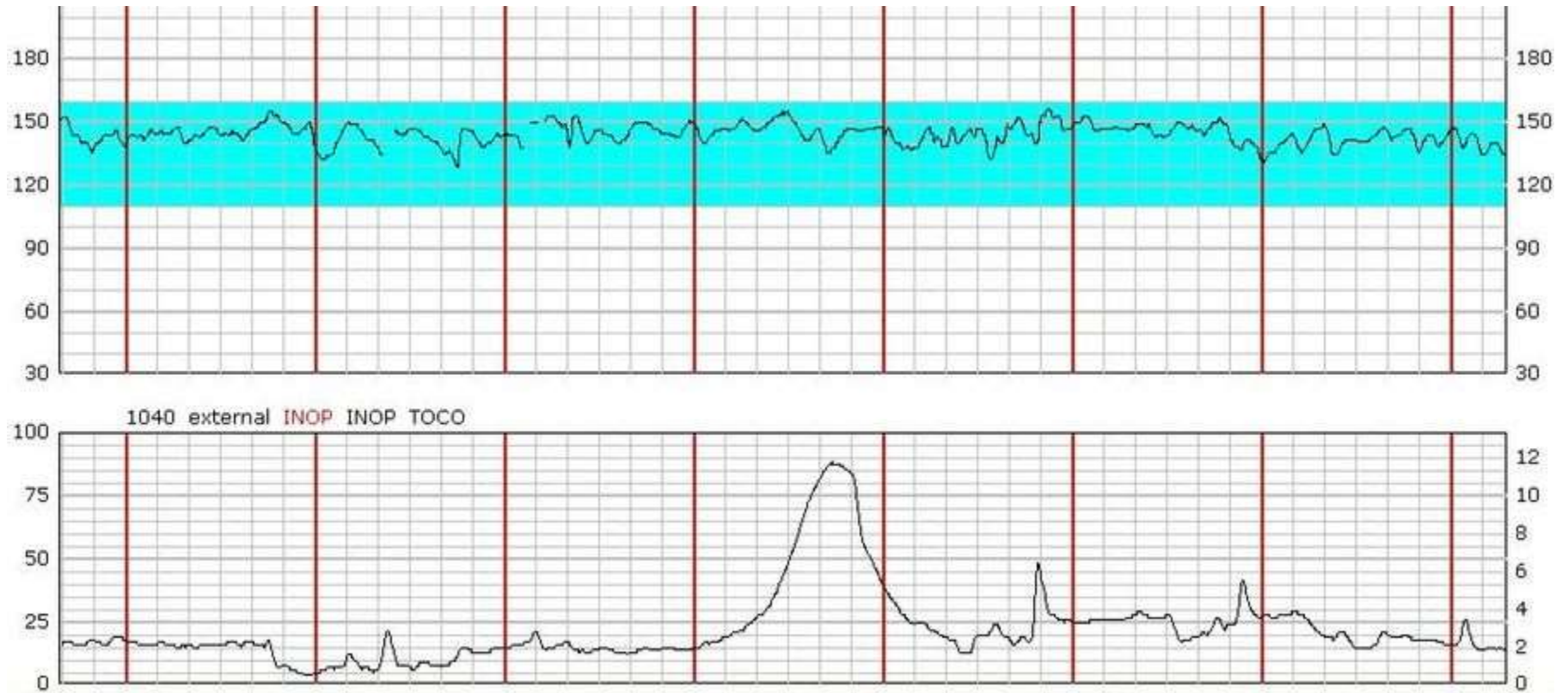
**Her contractions
are irregular**

What category is this tracing?



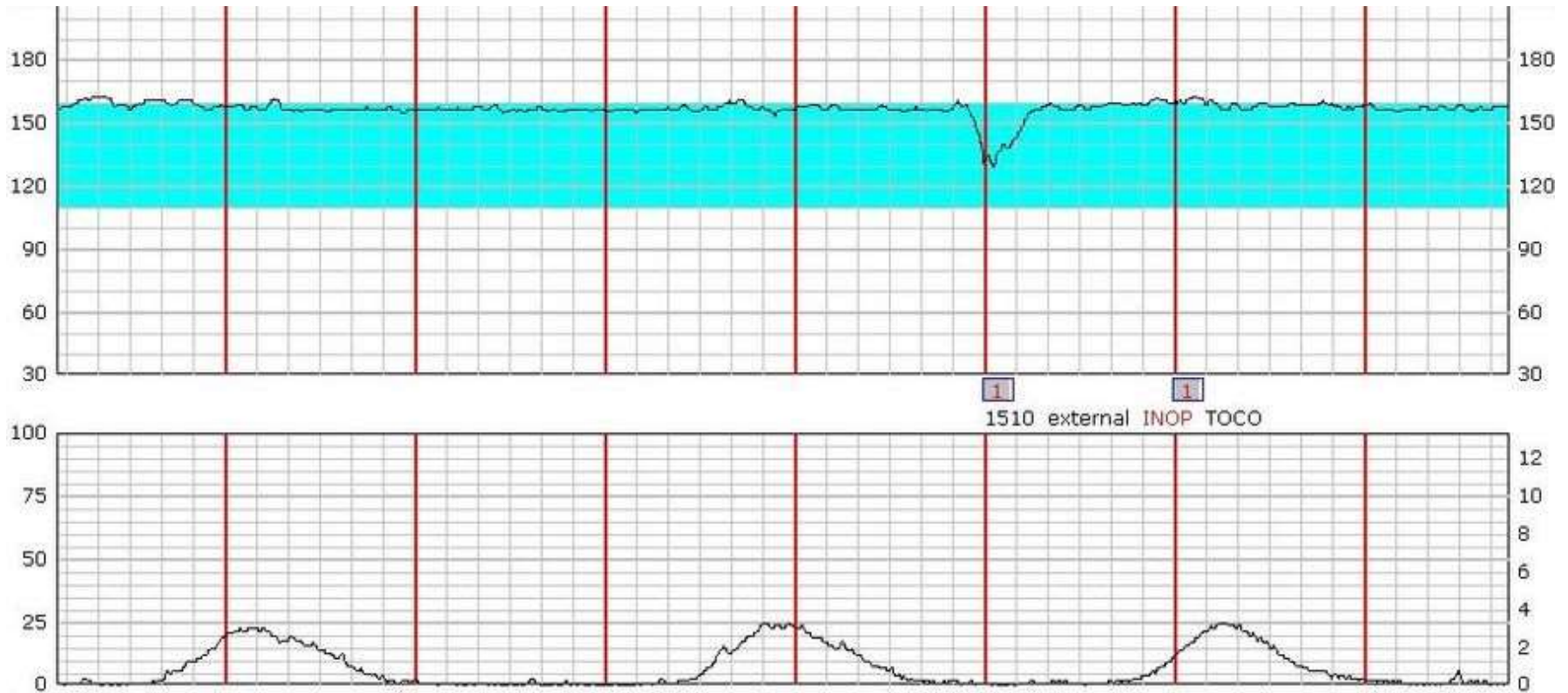
Category 1.

Is this fetal tracing reassuring?



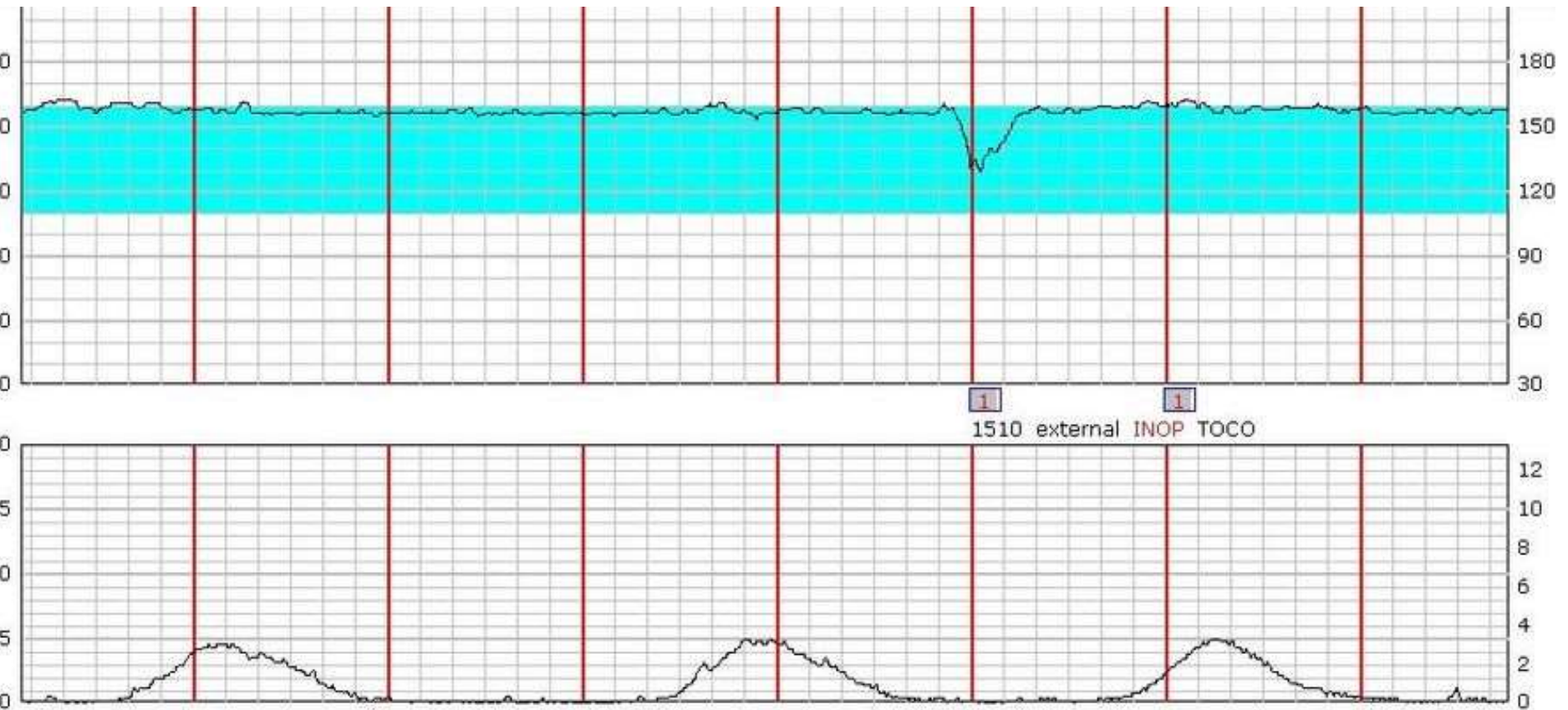
**It is overall reassuring,
but not reactive**

What is the baseline rate?



155

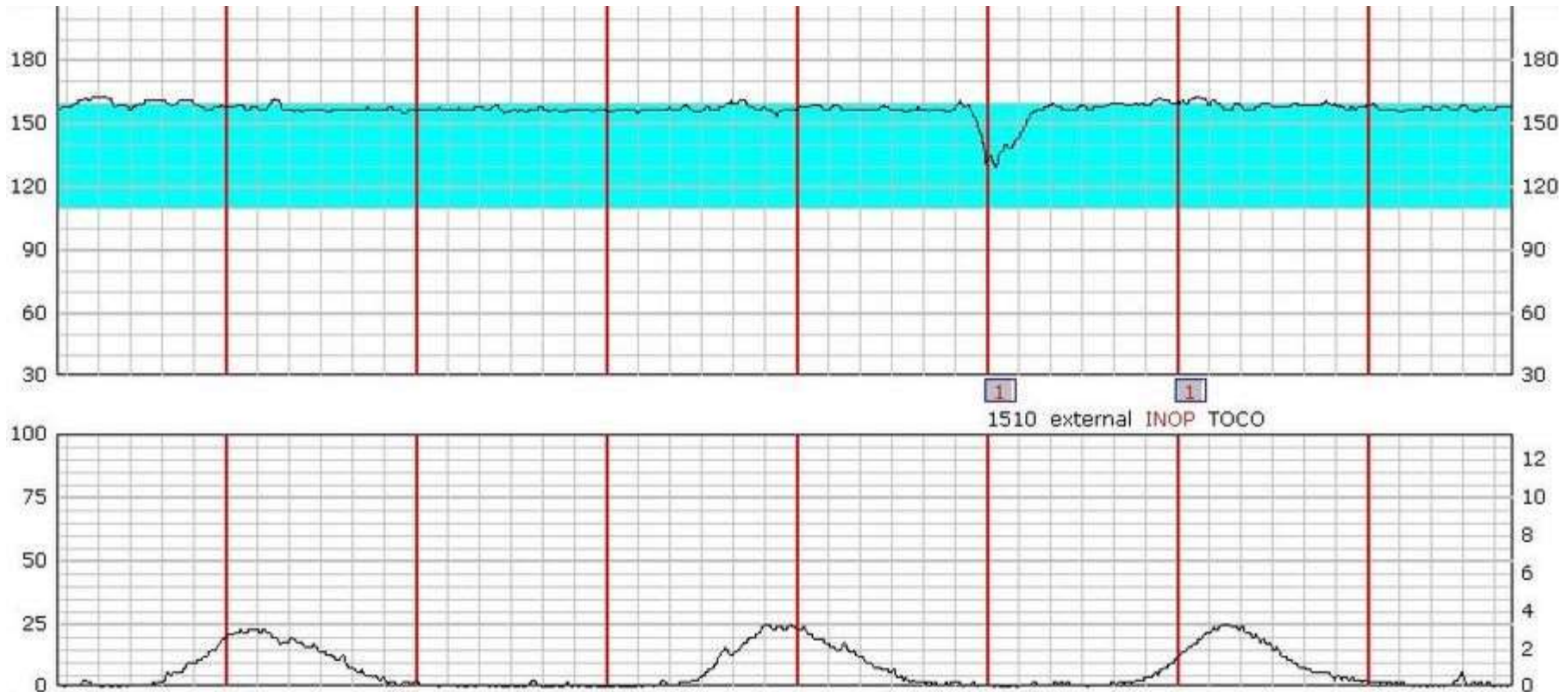
Describe the variability.



Minimal

Are there accelerations present?

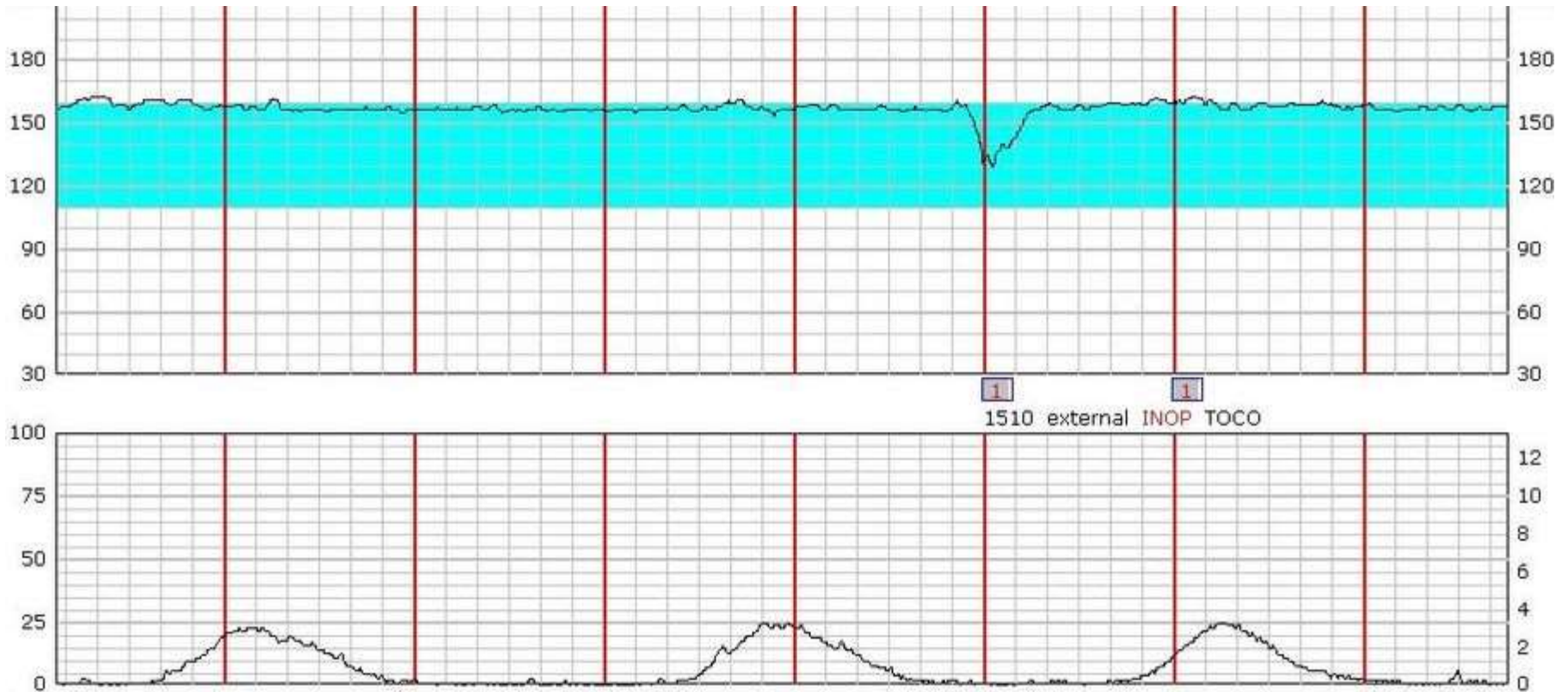
Are there decelerations present?



No

There is a single variable deceleration present. These should be further described by their depth and duration (e.g., to 130bpm lasting about 25 seconds).

Are contractions present?

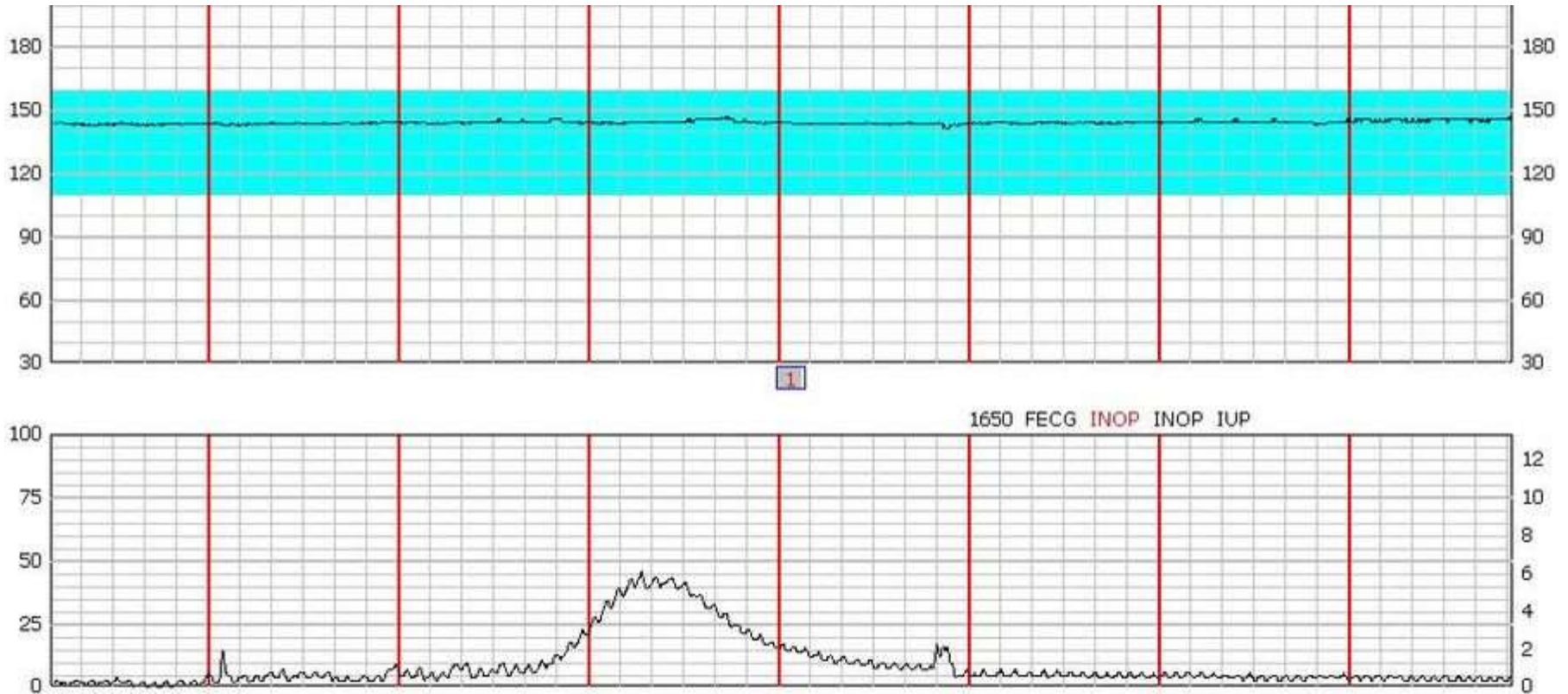


Regular

What category is this tracing?

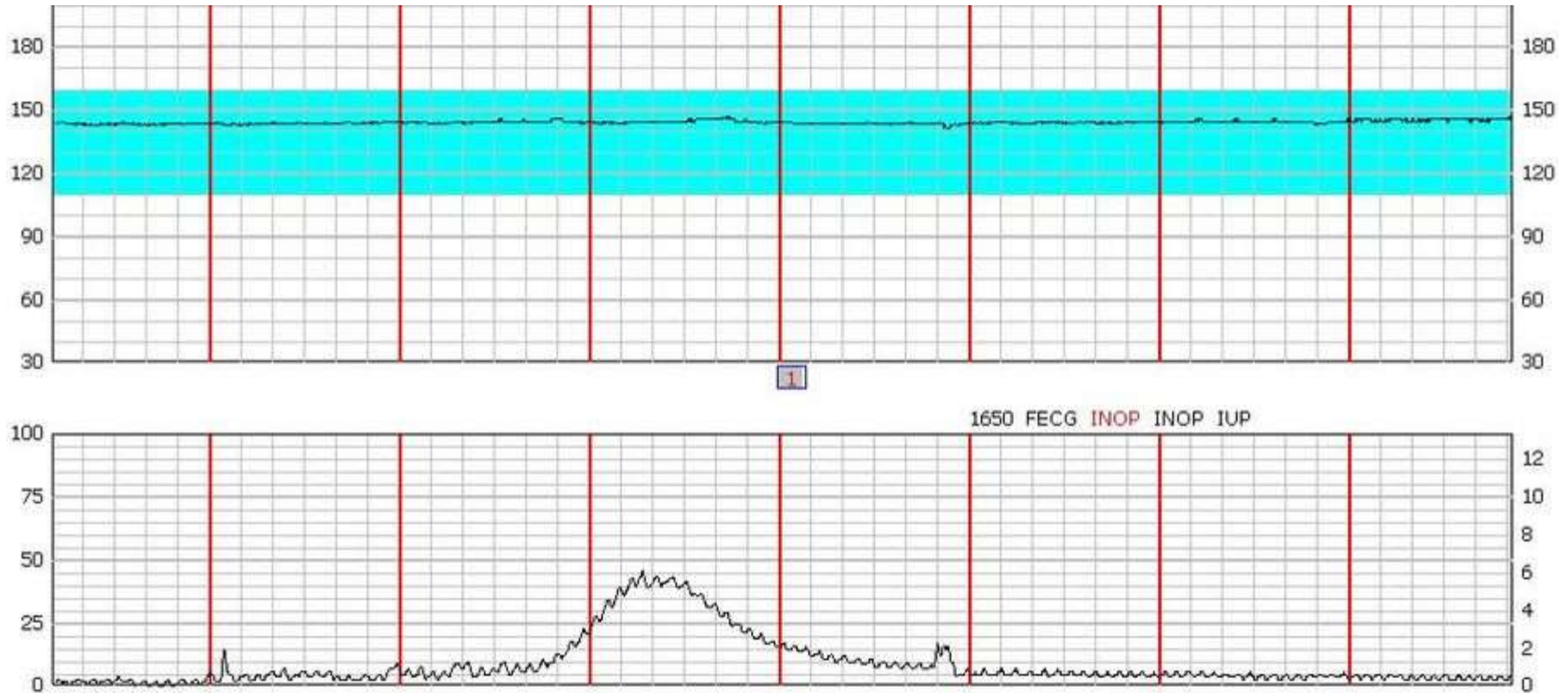
- **CATEGORY 2**
- **Is this fetal tracing reassuring?**
- **It is overall reassuring, but not reactive**

What is the baseline rate?



145

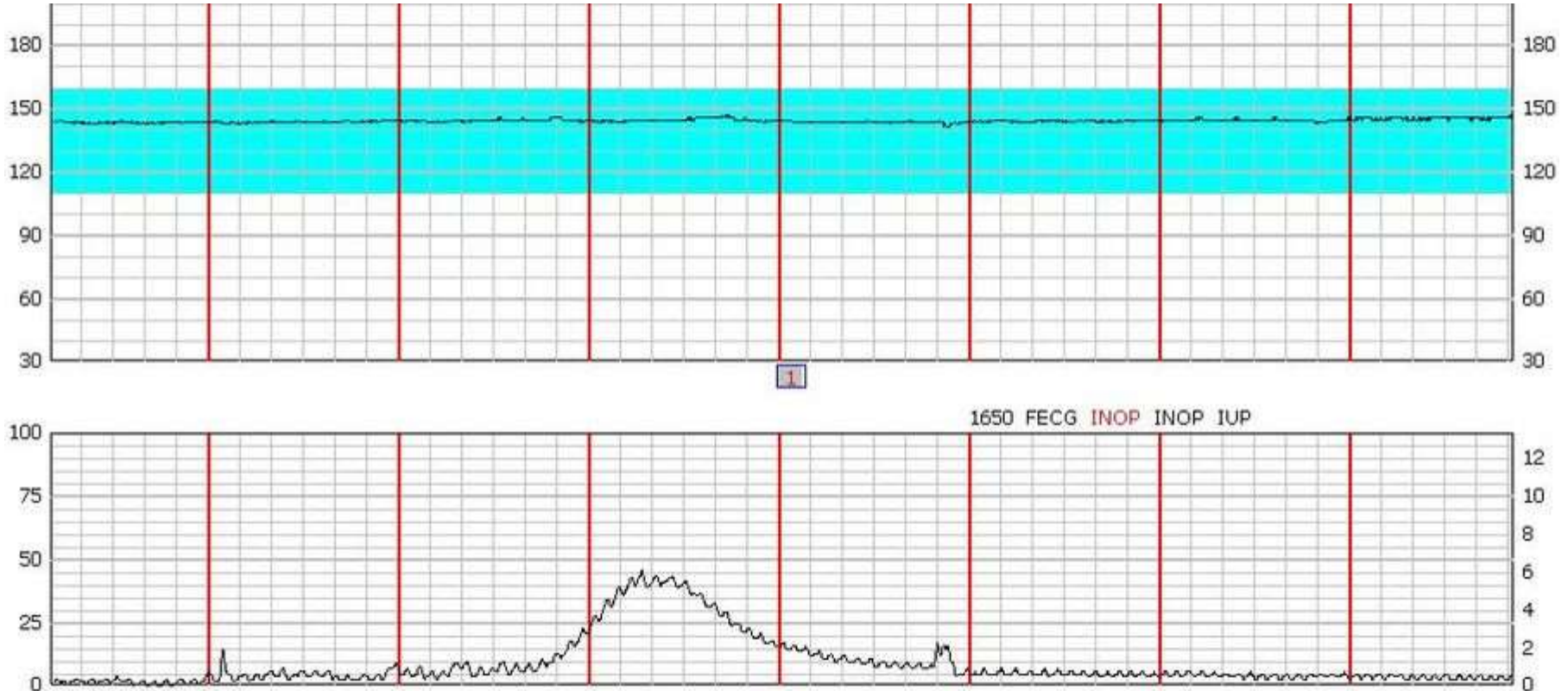
Describe the variability.



Absent

Are there accelerations present?

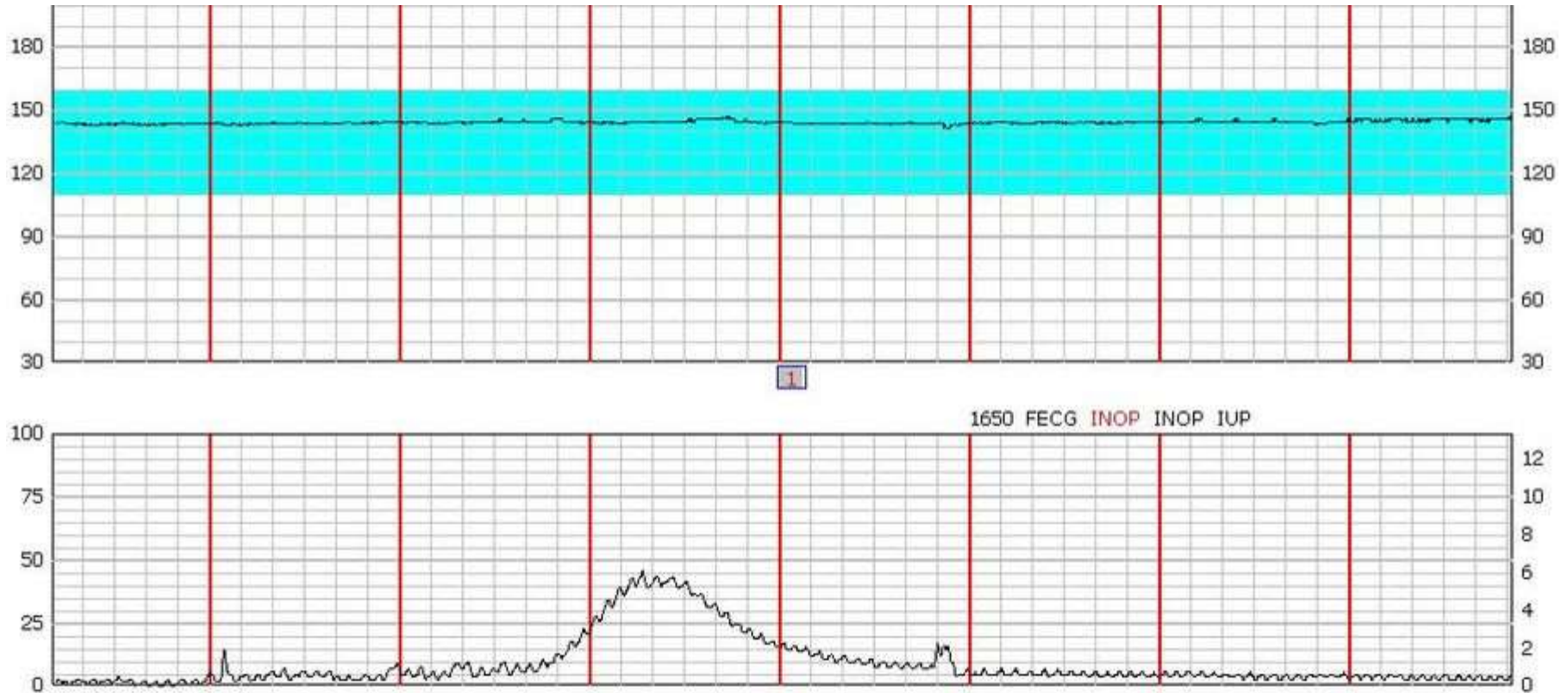
Are there decelerations present?



NO

NO

Are contractions present?



Occasional.

What category is this tracing?

- **Category 2.**
- **Is this fetal tracing reassuring?**
- **This tracing is not reassuring and requires intervention**