

Intrapartum Fetal Monitoring (CTG)

- **5th year Medical Students**
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- **July/2025**

OBJECTIVES

- **Discuss the modality used to monitor fetal wellbeing in labor**
- **How to read a normal CTG?**
- **List causes of abnormal CTG in labor**

Fetal Heart Rate (FHR) Monitoring

- Fetal heart rate (FHR) monitoring can be done by:

1st stage of labor

every half an hour

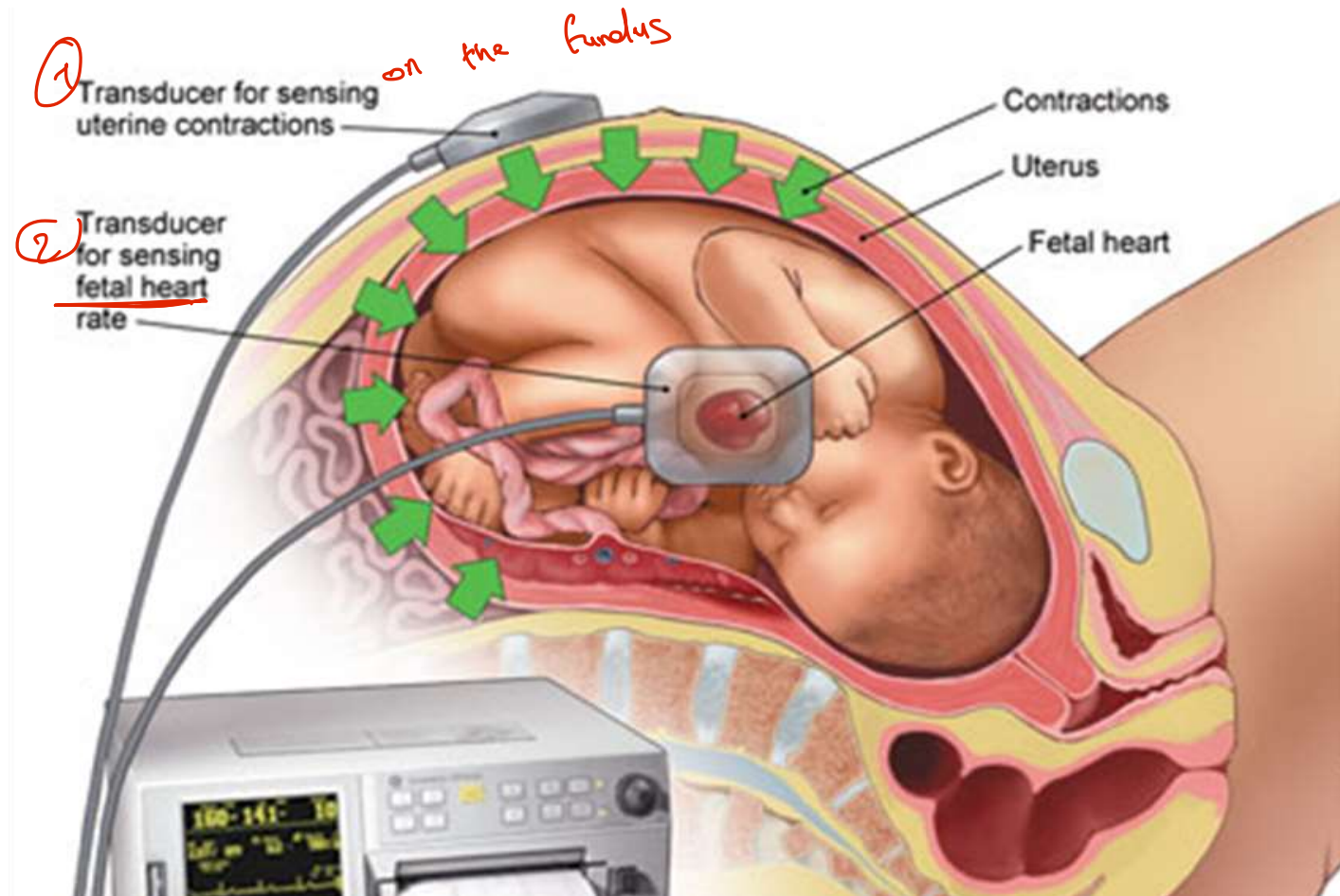
- Structured Intermittent Auscultation

- Continuous Electronic Fetal Monitoring (EFM) ^{for high risk pts}

- 1) External ^{mostly used}

- 2) Internal
 → to the scalp of the baby
 ↳ morbid pts

External Electronic Continuous Fetal Monitoring



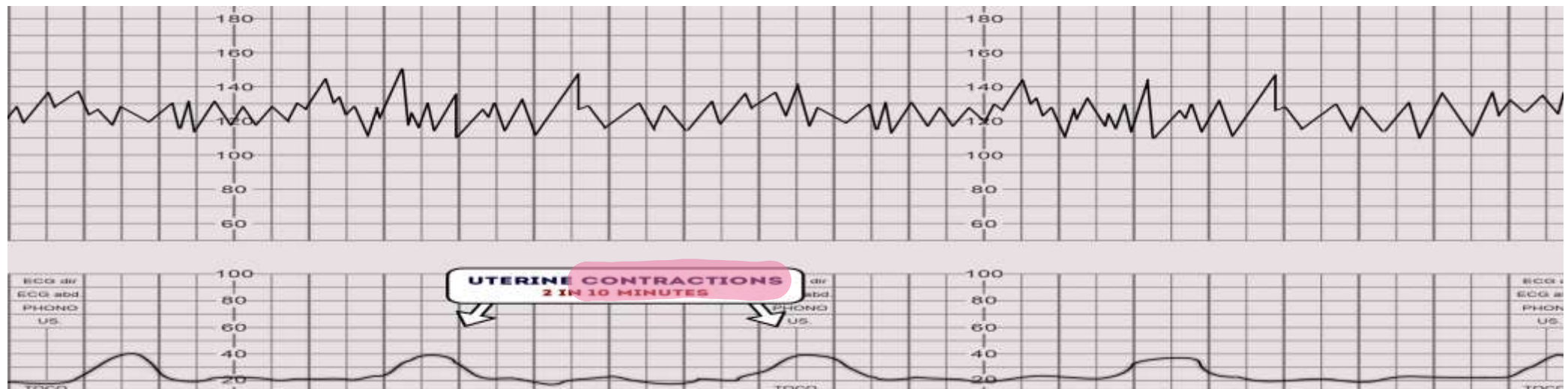
CTG

- The CardioTocoGraph (CTG) has two components:
- Contractions
- Fetal Heart

Normal CTG

A normal cardiotocograph (CTG), showing a baseline fetal heart rate of approximately 120 bpm, frequent accelerations, baseline **variability of 10–15 bpm** and **no decelerations**.

The uterus is contracting approximately ^{frequency} once every 5 minutes ^{baby heart rate} [110–160]



How to read a CTG?

- Name of the patient & Date
- Define the risk
- Contractions (frequency & duration)
- Baseline FHR (normal 110 bpm – 160 bpm)
- FHR variability (beat to beat variation) [5-25]
- Acceleration (present or absent)
- Deceleration (Early, Late & Variable, Prolonged)
- Assessment & plan of management
- The overall impression can be described as either reassuring, suspicious or abnormal.

Assessment of uterine contractions

- The lowest intrauterine pressure between contractions is called **resting tone**.
- Normal resting tone is 5-10 mmHg, but during labor it may rise to 10-15 mmHg. *in labor*
- Pressure during contractions rises to **~25-100 mmHg** (**varies with stage**).
- A resting pressure above 20 mmHg causes decreased uterine perfusion.

Montevideo Units

- Montevideo Units (MVUs) are a standardized way to quantify the **strength** of uterine contractions **during labor**.
 - It is calculated by **internally (not externally)** measuring **peak** uterine pressure amplitude (in mmHg).
 - MVUs = The **sum** of contraction intensities (in mmHg) **above baseline tone** during a **10-minute window**.
 - Subtracting the resting tone of the contraction, and adding up the numbers in a 10-minute period.
- ~~★~~ Generally, above **200 MVUs** is considered necessary for adequate labor during the active phase

if less not efficient $\Rightarrow$ we give oxytocin

Contractions

- The number & duration of contractions in a 10-minute period is recorded.
- Hyperstimulation : **More than 5 contractions in 10 minutes.** → bec overdose of oxytocin
- Hyperstimulation can result in hypoxia, acidosis & abnormal fetal heart rate



CTG

- Comment on:

- Baseline (110-160 bpm)
- Variability (5-25 bpm)
- Acceleration
- Deceleration (Early (I), Variable (II), Late (III), Prolonged)

10 week → we see it
11 week → we don't see
cat-fis

25 million
is the lowest count of
spells

matal → hyperemesis gravidarum

after 1 day

BASELINE RATE

- **Normal fetal heart rate: Between 110-160 bpm**

Accelerations: Abrupt increase in the fetal heart rate above the baseline.

نبوغ البيني

Gestational Age Specific:

^{five}
≥32 weeks: 15 bpm for ≥15 seconds

<32 weeks: 10 bpm for ≥10 second

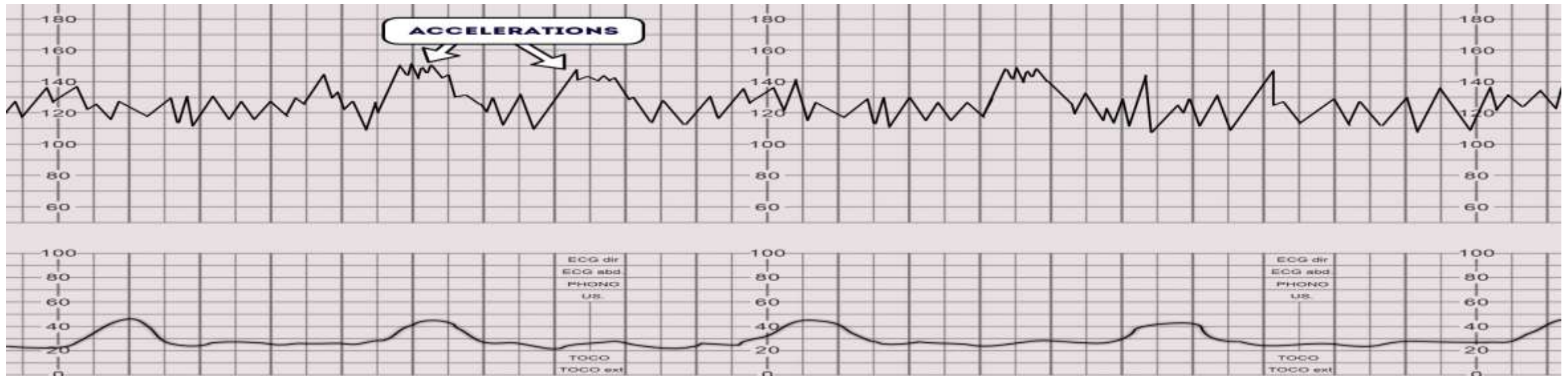
non-stress test → to assess fetal health antepartum

(not in label)

The presence of accelerations is reassuring

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

we must have at least 2 acceleration within 20 minutes

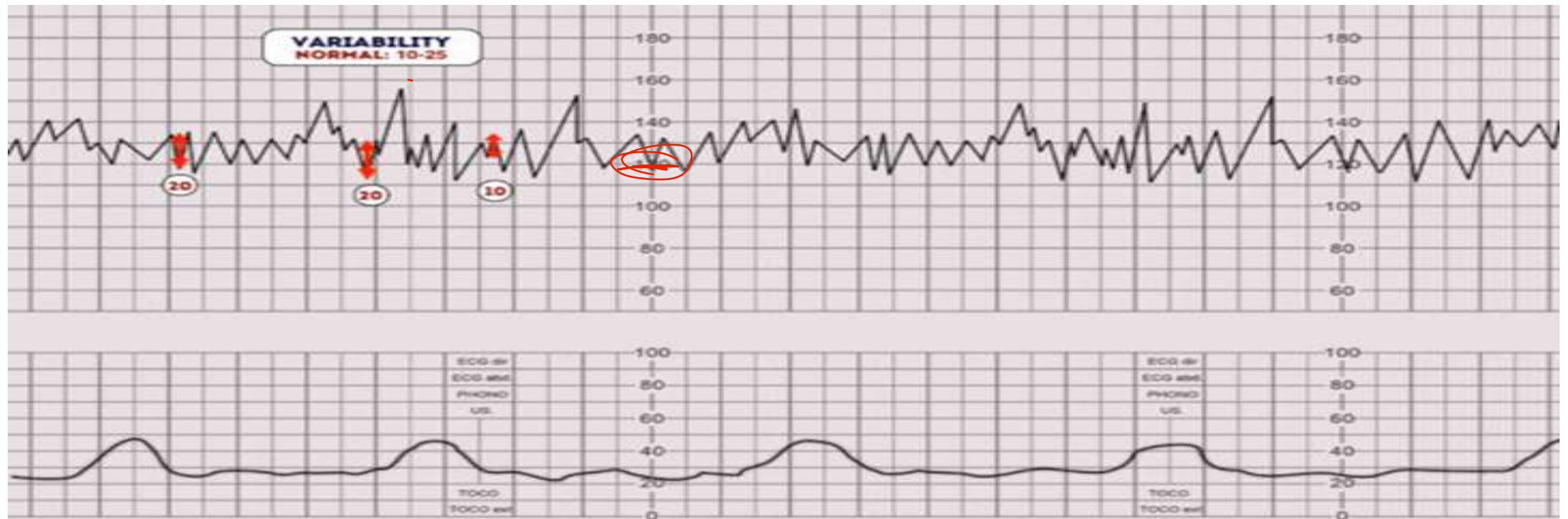


Variability

- It refers to the fluctuations in the baseline FHR.
- **Variability** occurs as a result of the interaction between the nervous system, chemoreceptors, baroreceptors and cardiac responsiveness.
- Normal variability indicates an intact neurological system in the fetus
- Persistently minimal or absent FHR variability appears to be the most significant intrapartum sign of fetal compromise. unless the baby is sleeping (40 min تقريباً)
- Normal variability is between 5-25 bpm.
- Absent variability = Amplitude range undetectable
- Minimal = < 5 BPM ✓
- Moderate = 6 to 25 BPM ✓
- Marked = > 25 BPM ✓

Normal Variability

Normal: (5-25 bpm)



Reduced variability



Reduced variability

MCQ

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

- **Fetal sleeping:** this should last no longer than 40 minutes (this is the most common cause) MC

- **Fetal acidosis (due to hypoxia):** more likely if **late** decelerations are also present

- **Fetal tachycardia** → so less variability

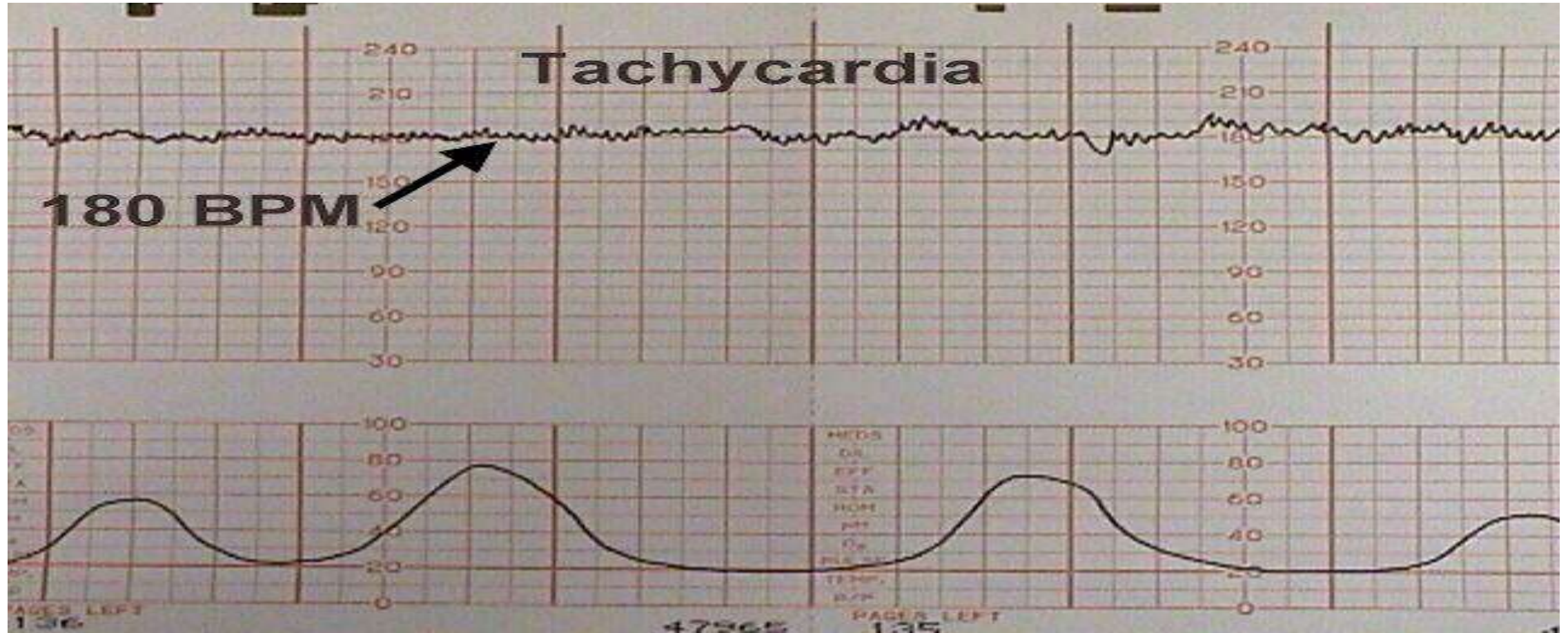
- **Drugs:** opiates, benzodiazepines, methyldopa, dexamethasone and **magnesium sulphate.** → present and treat eclampsia + used in pre-term

أبوة احتمال التوتة

- **Prematurity:** variability is reduced at **earlier gestation** (<28 weeks)

- **Congenital heart abnormalities**

Fetal Tachycardia



Fetal Tachycardia

- **Tachycardia: A baseline value above 160 bpm lasting more than 10 minutes.**

- Causes of fetal tachycardia include:

any fever → **Maternal pyrexia (infection, chorioamnionitis)** *MC*

Chorioamnionitis (also called intra-amniotic infection) is a bacterial infection of the fetal membranes (chorion and amnion), amniotic fluid, and sometimes the placenta. It typically occurs before or during labor, especially with prolonged rupture of membranes.

- Fetal hypoxia.

- Medications: (beta-agonist (Ritodrine (Yutonar) *present* Terbutaline (Bricanyl) *pre-term labor*) (drugs used for tocolysis) (Atropine) (Sympathomimetic drugs) (Parasympatholytic drugs) *tocolytic agents*

- Fetal arrhythmias (SVT).

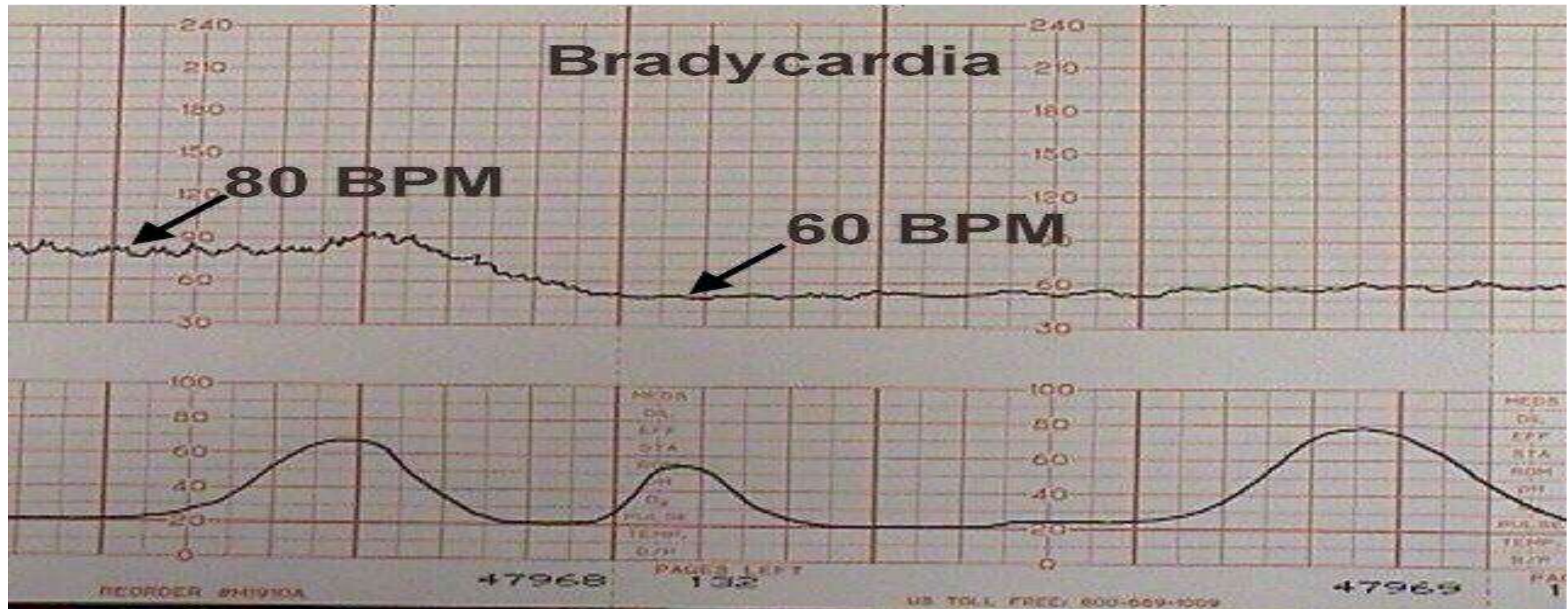
- Fetal or maternal anemia.

- Fetal hypoxia

- Hyperthyroidism

- **Prematurity**

Fetal Bradycardia



Fetal Bradycardia

- **Bradycardia: A baseline value below 110 bpm lasting more than 10 minutes.**
- Values between 100 and 110 bpm may occur in normal fetuses, especially in **postdate pregnancies.**
- **Causes of fetal ~~tachycardia~~ ^{Bradycardia} include:**
 - Maternal hypothermia, Hypotension, Hypoglycemia
 - Administration of beta-blockers
 - **Fetal arrhythmias such as atrioventricular block**
 - (SSA/Ro positive pregnancies (systemic lupus erythematosus (SLE) and Sjögren's syndrome (SS)) associated with heart block)
 - Fetal metabolic acidosis ^{Late hypoxia} ^{AV block}

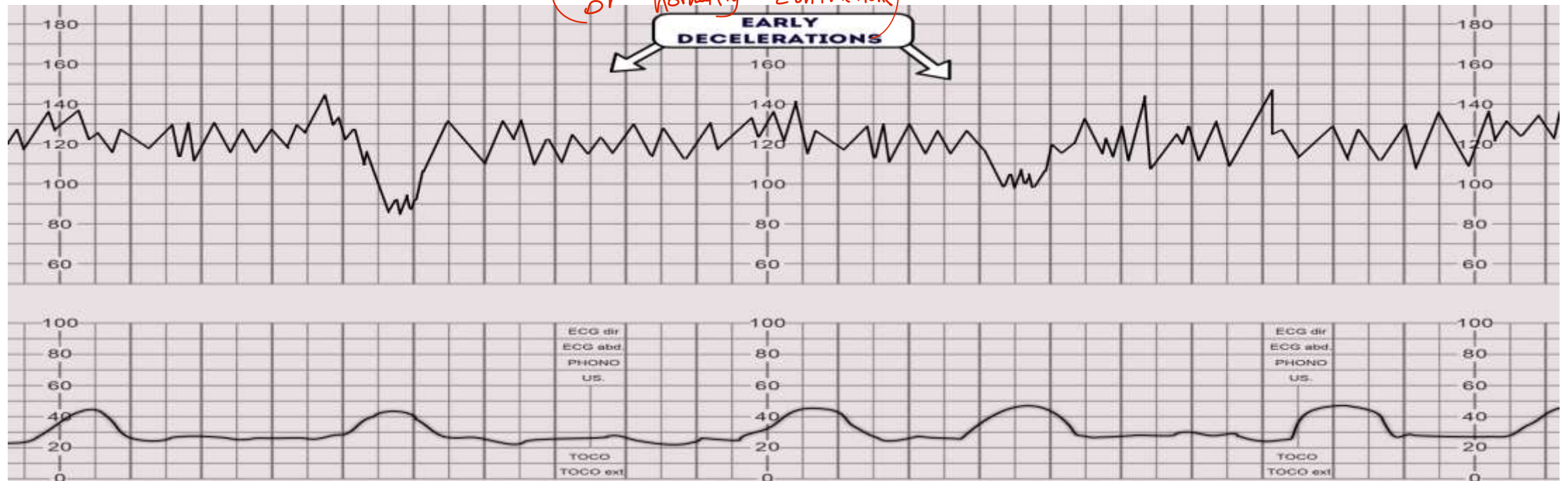
Decelerations

- Decelerations are an abrupt decrease in the baseline fetal heart rate of greater than 15 bpm for greater than 15 seconds.
- Early (Type I) ↓ 60 F → 60
- Variable (Type II)
- Late (Type III)
- Prolonged decelerations

- **Early deceleration caused by head compression**

It is considered to be physiological and not pathological

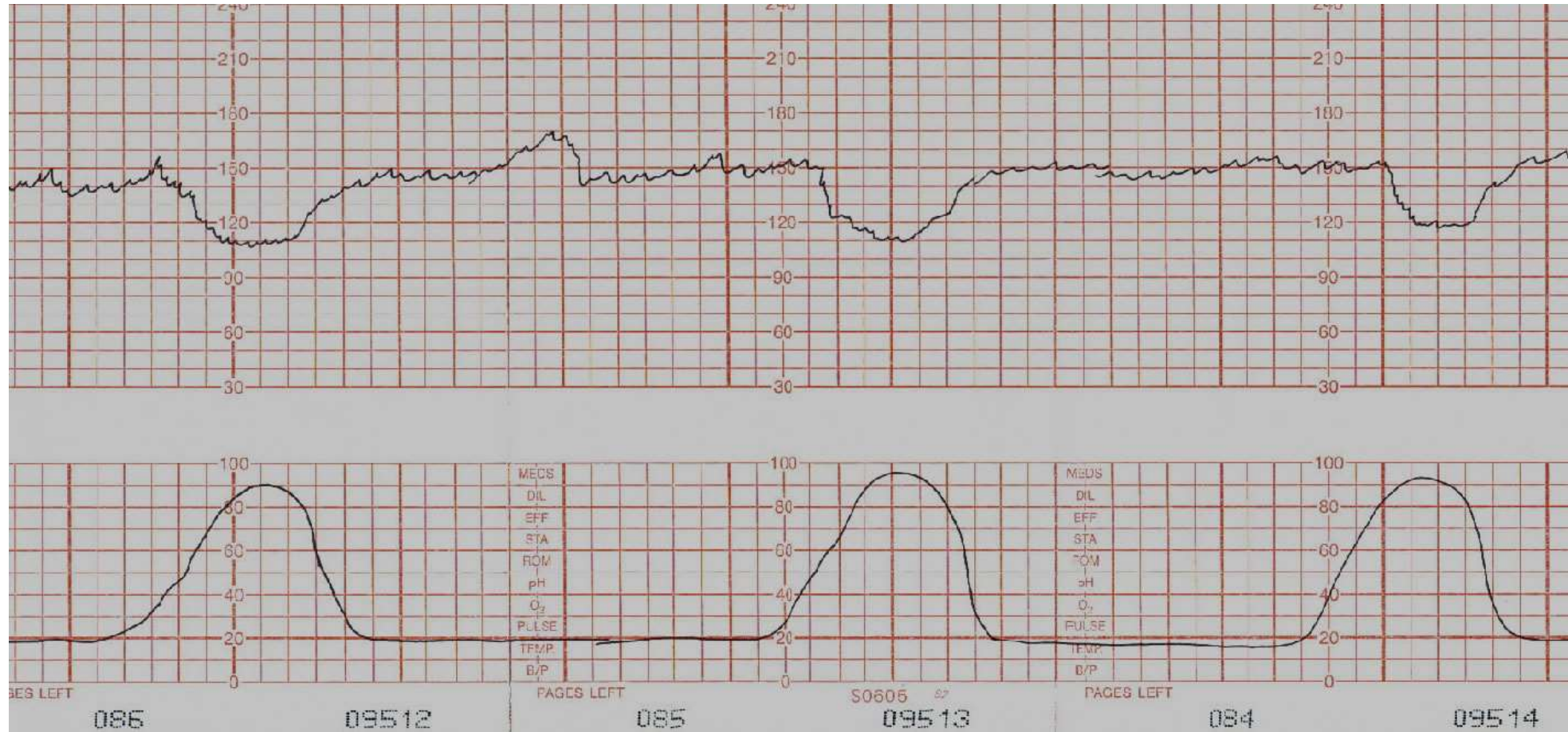
mostly $\downarrow$
 due to head compression $\rightarrow \uparrow$ ICP $\rightarrow$ vagal stimulation $\rightarrow$ bradycardia
 (or normally contractions)



Early decelerations

— baseline FHR —
which is normal

- good beat to beat variation
- no acceleration (not abnorm)
- deceleration and its type



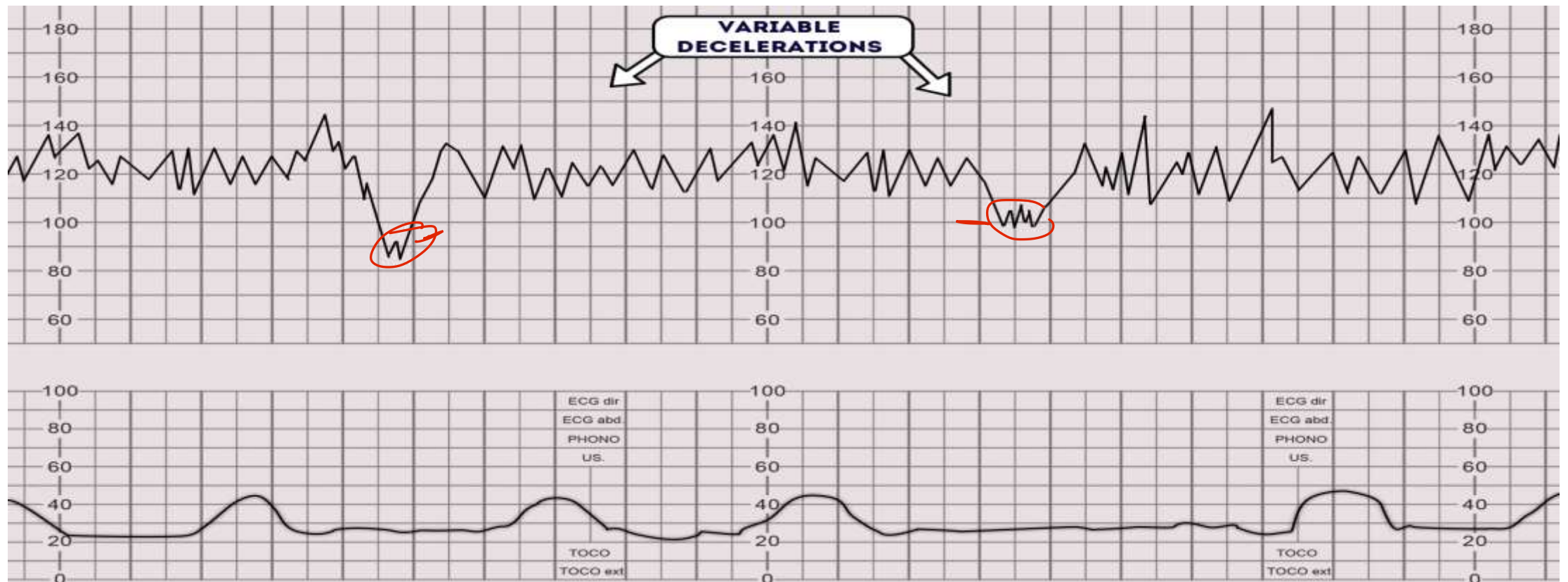
Variable decelerations caused by umbilical cord compression

variable in 3-

- location

- shape

- depth



Variable Decelerations

- Variable decelerations are **V-shaped**. Variable in **onset**, **duration** and depth. They may occur with contractions or between contractions.
- Typically, they have an abrupt onset and **rapid recovery** (in contrast to other types of decelerations which gradually slow and gradually recover).
Transient

Variable Decelerations

- The accelerations before and after a variable deceleration are known as the **shoulders of deceleration**. *cord compression*
good sign ⇒ The baby is compensating and not in hypoxia
- Their presence indicates the fetus is not yet hypoxic and is adapting to the reduced blood flow. ✓
- 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

Management of ^{transient} Variable Decelerations

- Changing maternal position to improve uterine blood flow
- IV **hydration** to increase maternal blood volume, presumably leading to increased uterine blood flow
- Administering **oxygen** to the mother to try to get some additional oxygen through to the fetus. (The least useful).
- Decreasing or discontinuing oxytocin infusion to slow down or stop contractions that are provoking the decelerations. ^{stop}
- We may consider Amnioinfusion to improve oligohydramnios ^{NS inject through vagina → ↓ cord compression} ^{could cause cord compression}
- We may consider **Tocolytic drugs to slow down or stop contractions that are provoking the decelerations.**
- **Digital elevation of the fetal head out of the maternal pelvis to ease pressure on the umbilical cord**

left lateral position ← maternal position

Management of Variable Decelerations

- Occasional mild or moderate variable decelerations are common and **not considered threatening**.
- Severe variable decelerations **dip below 60 BPM for at least 60 seconds** ("60 x 60").
- If **persistent** and not correctable by simple means, they can be threatening to fetal well-being.
no engagement → C-section
" → use vacuum
- Like persistent, non-remediable late decelerations, fetuses demonstrating persistent, non-remediable severe variable decelerations should be delivered promptly.

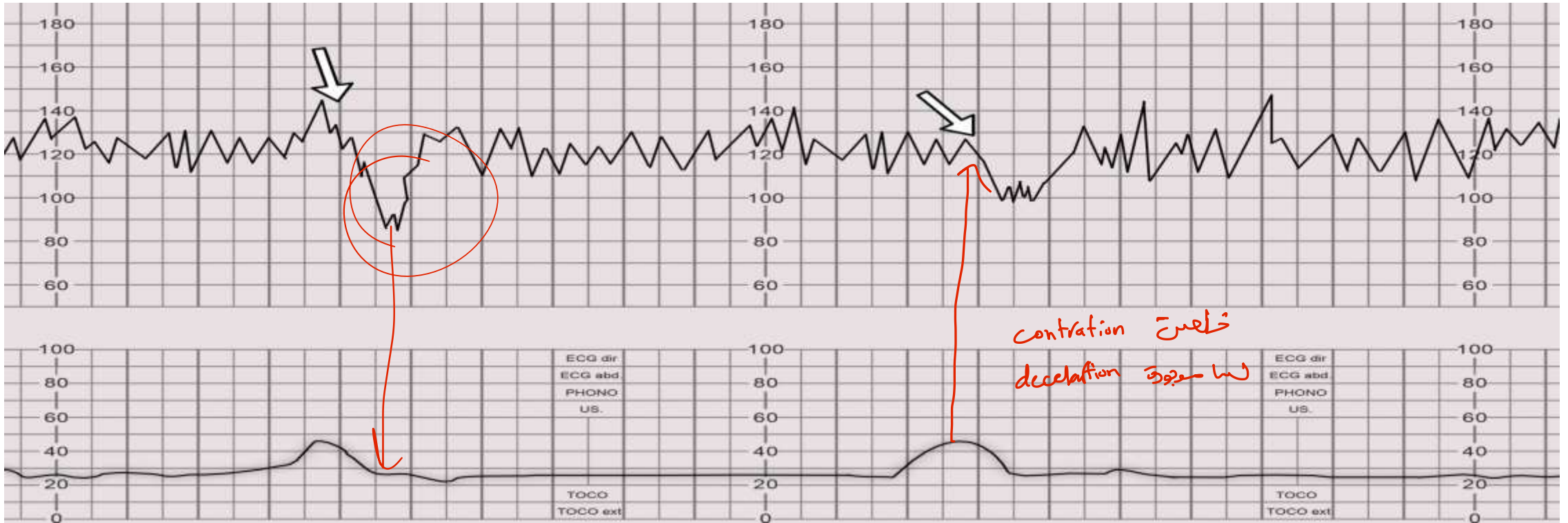
Late decelerations

Uteroplacental insufficiency is a failure of the placenta to deliver enough oxygen and nutrients to the fetus.

most dangerous

- Cause: **Uteroplacental Insufficiency**
- Insufficiency is caused by uterine tachysystole (uterine hyperstimulation), **maternal hypotension**, **epidural or spinal anesthesia**, **IUGR**, **hypertension** & preclampsia, intraamniotic infection, or placental abruption.
iatrogenic by PGE, oxytocin
- Late decelerations begin at the peak of the uterine contraction and recover **after** the contraction ends
intra uterine growth retardation
it ended
deceleration في وقت contraction زلت
- Severe, repetitive late decelerations usually indicate fetal metabolic acidosis.
can't compensate

Late Deceleration



Management of Late decelerations

↓ pressure of ISC → ↑ sensors return → ↑ O₂ to mom and baby

- ✓ Maternal left lateral position to improve uterine blood flow
- ✓ Correct maternal hypotension with IV fluids
- ✓ Administer O₂ by mask
- ✓ Stop oxytocin infusion
- ✓ Consider tocolytic drugs to slow down or stop contractions that are provoking the decelerations
- ✓ Vaginal examination (To evaluate cervical condition & descent)
 - If persistent perform fetal scalp PH
 - If persistent consider immediate delivery

— meconium or clear
— bleeding or not

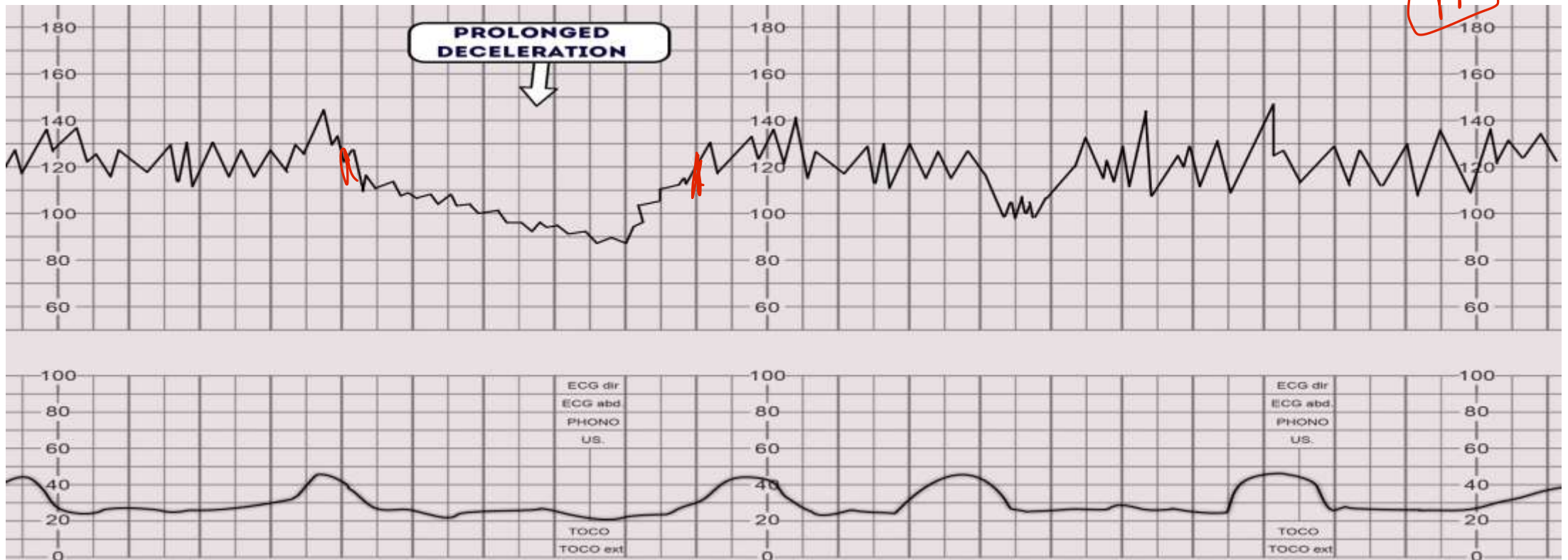
depend on her condition

dilation
vaginal (vacuum) C-section

• Prolonged deceleration:

If it lasts ²⁻³ between 2-3 minutes it is classed as **non-reassuring**.

If it lasts **longer than 3 minutes** it is immediately classed as **abnormal**. ^{>3}



Causes of prolonged decelerations

- Severe bradycardia: FHR less than 80 beats per minute, lasting longer than 3 minutes is an ominous finding and may be associated with fetal acidosis.

- Could be transient due to:

1. Supine hypotension → uterus compress IVC
2. Paracervical block
3. Epidural and spinal anesthesia

- Other important possible causes:

- Prolonged cord compression ✓ pulsating
- Cord prolapse ✓ → طالة برا → نبود ریه section
- Tetanic uterine contractions (Hyper stimulation of the uterus with oxytocin or prostaglandin)

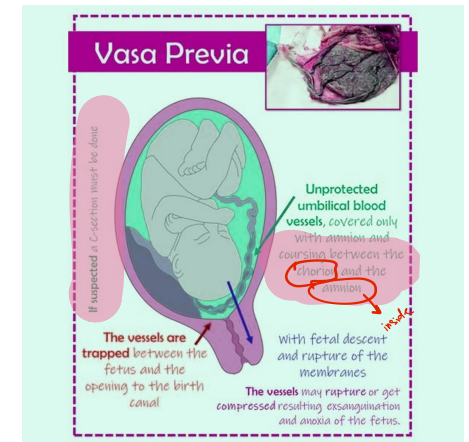
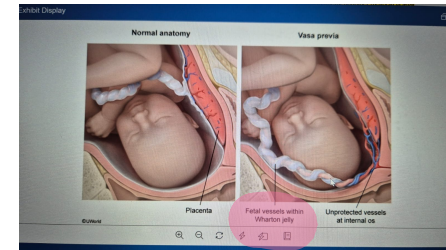
- Maternal seizures ✗

- Rapid fetal descent may cause strong vagal response ✗

- Vigorous vaginal examination may cause strong vagal response ✗ (1)

- If associated with vaginal bleeding we have to think of: Major abruptio placenta, rupture uterus and vasa previa. (2)

(3) → immediately cessation



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

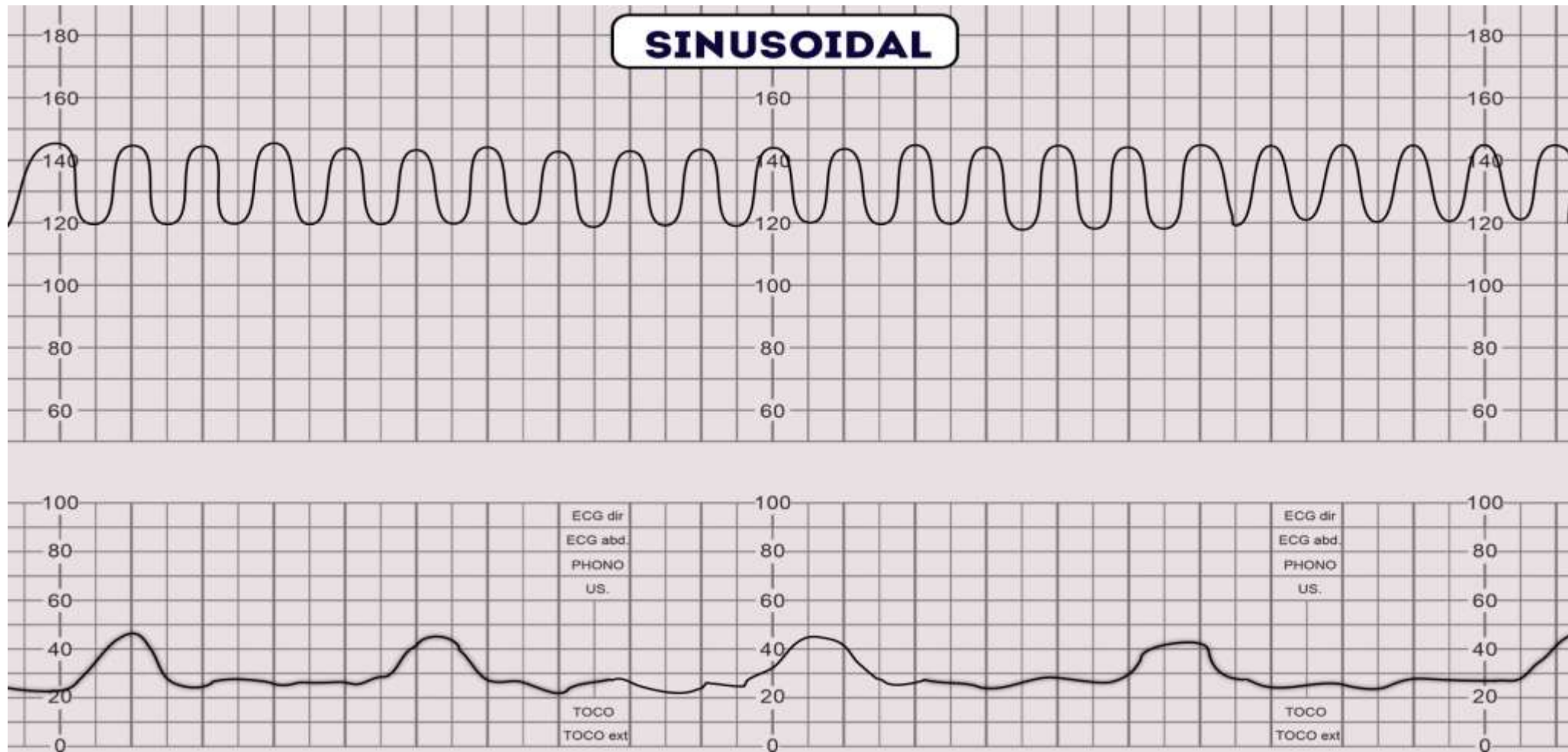
Severe fetal **hypoxia**

Severe **fetal anaemia** (Rh disease)

Fetal/maternal haemorrhage

baby has 250ml
blood

Term	Definition	Stage of Labor	Description
Prolonged labor	General term for labor that's longer than normal	1st or 2nd stage	Includes all slow-progress disorders
Protraction disorder	Slow cervical dilation or descent	1st or 2nd stage	Progress is happening, but slower than expected
Arrest disorder	No progress in dilation or descent for a defined time	1st or 2nd stage	Labor stops completely despite adequate contractions



Causes of Sinusoidal Pattern

- Sinusoidal pattern is very **concerning** as it is associated with high rates of **fetal morbidity** and **mortality**.
- **It occurs in association with:**
 - Severe fetal hypoxia
 - Severe fetal anemia
 - **Fetal-maternal hemorrhage**
 - **Ruptured vasa previa**

Remember

- Uterine hyper-contraction is the most frequent cause of a pathological CTG
- **Baseline and variability** are the most important features on a CTG – they are **indicative of hypoxia**.
- Remember a fetus will protect its heart muscle as a **priority.....the other organs and the brain will suffer the hypoxia first.**
- Interpret the CTG in the full clinical context and understanding of the fetal reserve.

**Category 1: Strongly predictive of normal fetal acid-base status at the time of observation.
Requires no specific management**

normal
CTG

Category I (Normal)

Category I FHR tracings include **all** of the following:

- Baseline rate: 110-160 beats/min
- Baseline FHR variability: moderate
- Late or variable decelerations: absent
- Early decelerations: present or absent
- Accelerations: present or absent

Category II FHR (Intermediate)

- The fetal heart rate tracing shows **ANY** of the following:
- Tachycardia, bradycardia without absent variability, minimal variability, absent variability without recurrent decelerations, marked variability, absence of accelerations after stimulation, recurrent variable decelerations with minimal or moderate variability, prolonged deceleration ≥ 2 minute but less than 10 minutes, recurrent late decelerations with moderate variability, variable decelerations with other characteristics such as slow return to baseline, and "overshoot".
- Not predictive of abnormal fetal acid-base status, but requires continued surveillance and reevaluation.

Category II FHR (Intermediate)

x

- Not predictive of abnormal fetal acid-base status, so management depends on clinical circumstances.
- Search for the underlying cause (ex: maternal hypotension) and correct it.
- Some interventions:
 - Change the mother's position to the left lateral recumbent.
 - Reduce the infusion rate of oxytocin
 - Increase intravenous fluids.

Category 3: Predictive of abnormal fetal acid-base status.

In addition to measures in category II treatment, may consider:

Fetal scalp blood sampling

Ultrasound doppler velocimetry

Delivery

abnormal pathological

Category III (Abnormal)

Category III FHR tracings include either of the following:

- Absent baseline FHR variability and any of the following:
 - Recurrent late decelerations
 - Recurrent variable decelerations
 - Bradycardia
- Sinusoidal pattern

Secondary Tests of Fetal Wellbeing

- Fetal Scalp Sampling *we don't do it*
- Scalp stimulation
- Acoustic stimulation the use of sound or auditory stimuli to elicit specific responses or effects in individuals
- Fetal pulse oximetry
- Fetal Electrocardiogram Analysis

Fetal Blood Sampling (Fetal Scalp PH)

- FBS may be used in cases of abnormal CTG.
- A vaginal examination needs to be performed prior to the procedure to assess the nature and position of the presenting part.
- Contraindications : maternal infection, women seropositive to hepatitis B, C, or to HIV, suspected fetal blood disorders, uncertainty about the presenting part, preterm fetus.
- CTG + FBS results in a reduction in cesarean deliveries when compared with CTG alone

Fetal Scalp PH

after persistent
abnormal CTG

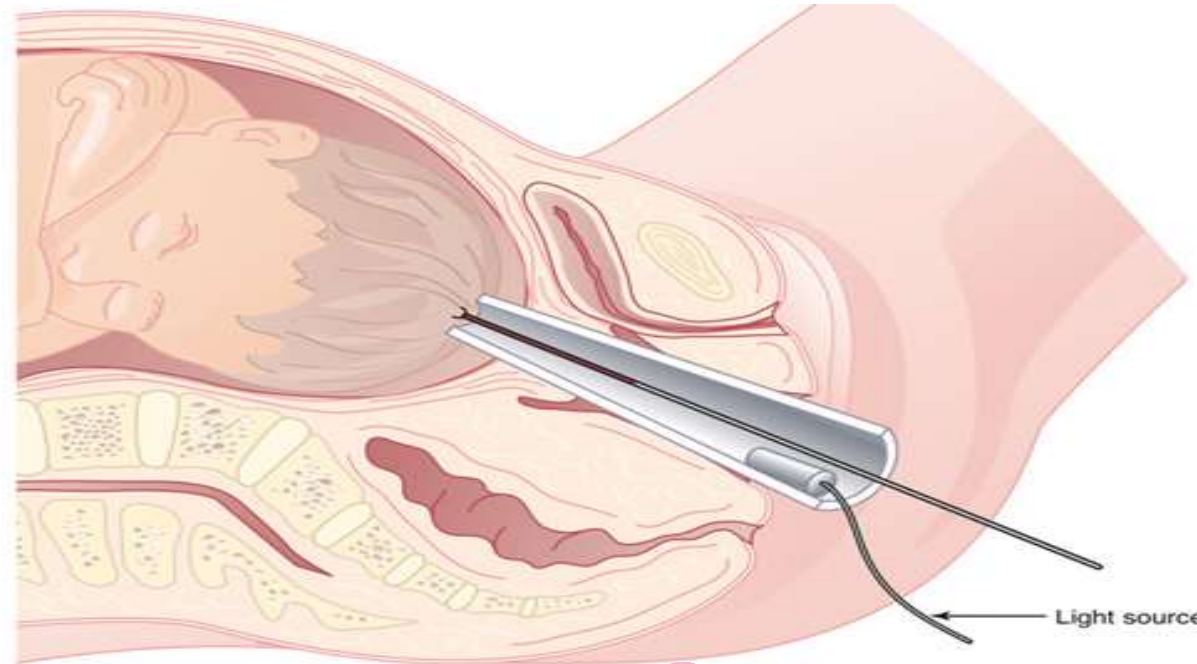


FIGURE 9-6 This technique of fetal scalp blood sampling via an amnioscope is still used in many centers. After making a small stab incision in the fetal scalp, the blood is drawn off through a long, heparinized capillary tube.

Fetal Blood Sampling (Fetal Scalp PH)

Interpretation	pH	Lactate (mmol/L)
Normal	≥ 7.25	< 4.2
Repeat in 30 mins	7.21 – 7.24	4.2 – 4.8
Birth expedited	≤ 7.20	> 4.8
Urgent delivery	< 7.15	> 5.0

abnormal $\leftarrow$

Dr Amal Barakat

Thank you

**The End of Intrapartum
Fetal Monitoring**