

OVERVIEW OF INTERPRETING FETAL HEART RATE TRACINGS

FLAME LECTURE: 53

FITZMAURICE 12.30.23

LEARNING OBJECTIVES

- ▶ Describe approaches to assessing fetal well being
- ▶ Interpret electronic fetal monitoring
- ▶ Prerequisites
 - ▶ NONE
- ▶ See also – for applications of this lecture’s concepts in various clinical settings
 - ▶ FLAME LECTURE 54: Outpatient antenatal testing
 - ▶ FLAME LECTURE 54B: The NST & CST
 - ▶ FLAME LECTURE 55: Inpatient and intrapartum fetal heart rate monitoring
 - ▶ FLAME LECTURE 70: Intermittent fetal monitoring in labor

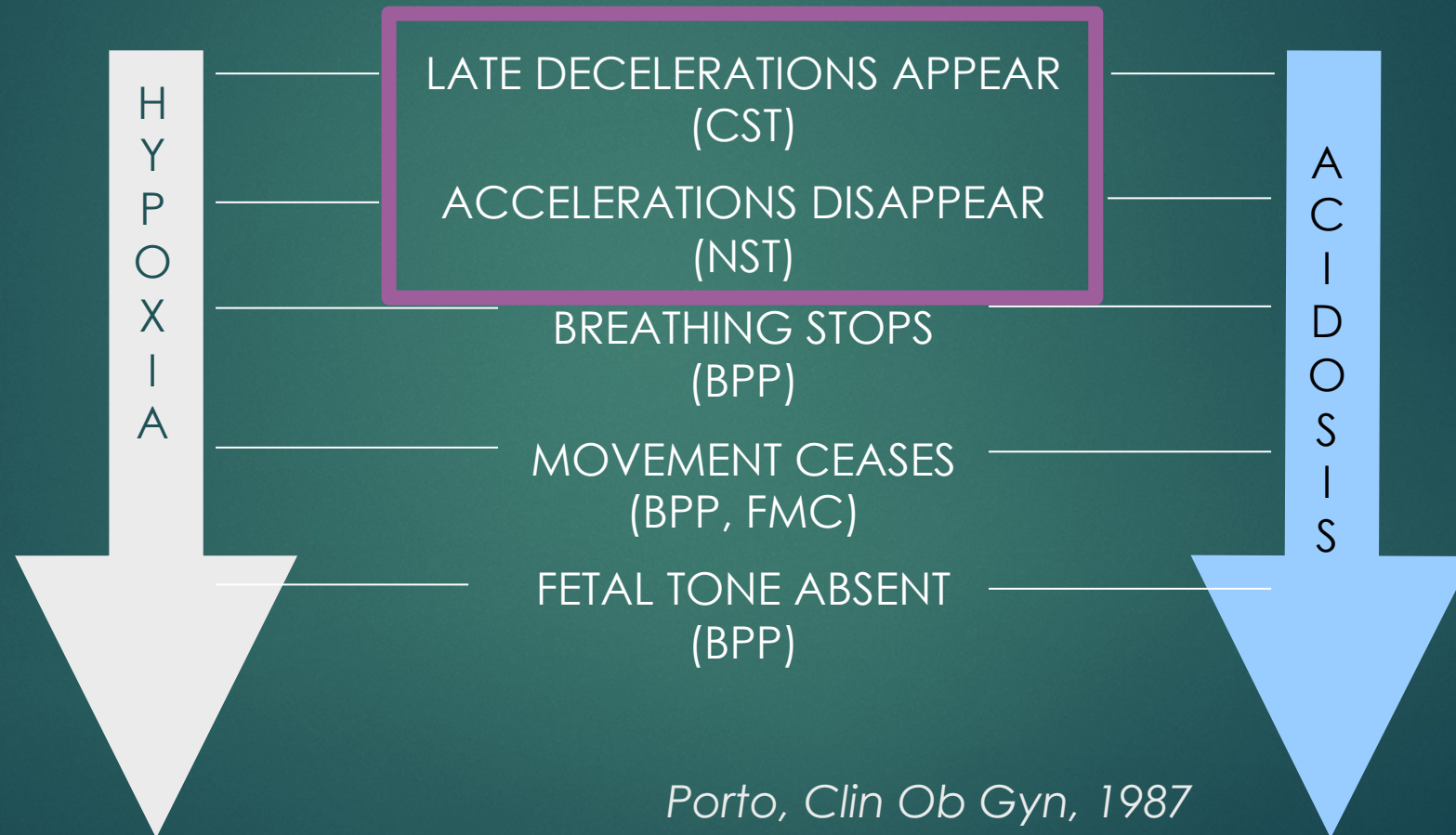
FHR MONITORING: PHYSIOLOGIC RATIONALE

- ▶ The fetal brain is incredibly sensitive to changes in **blood oxygenation** and **pH**
 - ▶ Interplay of sympathetic and parasympathetic stimulation/tone
 - ▶ Level of fetal activity
- ▶ Identification of fetal hypoxia allows for the opportunity to intervene with delivery
 - ▶ Decreased risk of fetal metabolic acidosis leading to fetal neurologic injury or death



ANTEPARTUM FETAL DISTRESS CASCADE

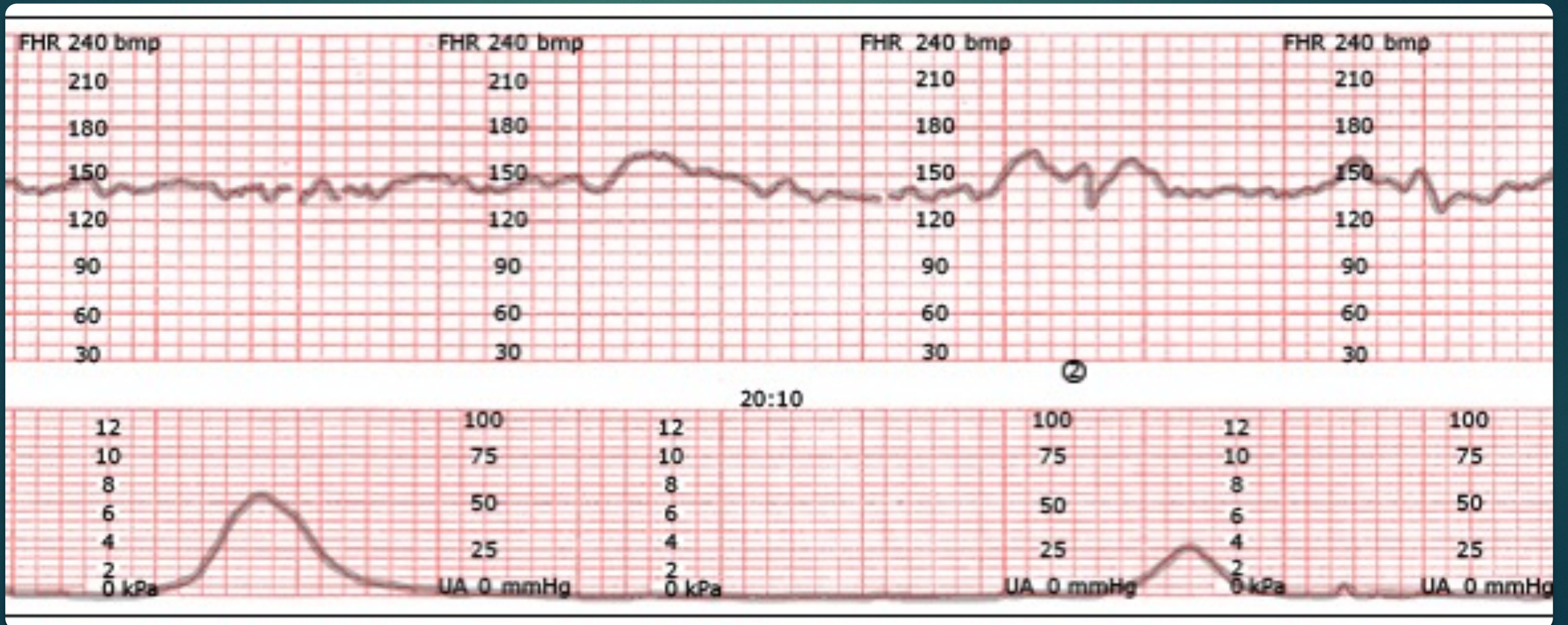
Fetal heart rate changes appear early



Porto, Clin Ob Gyn, 1987

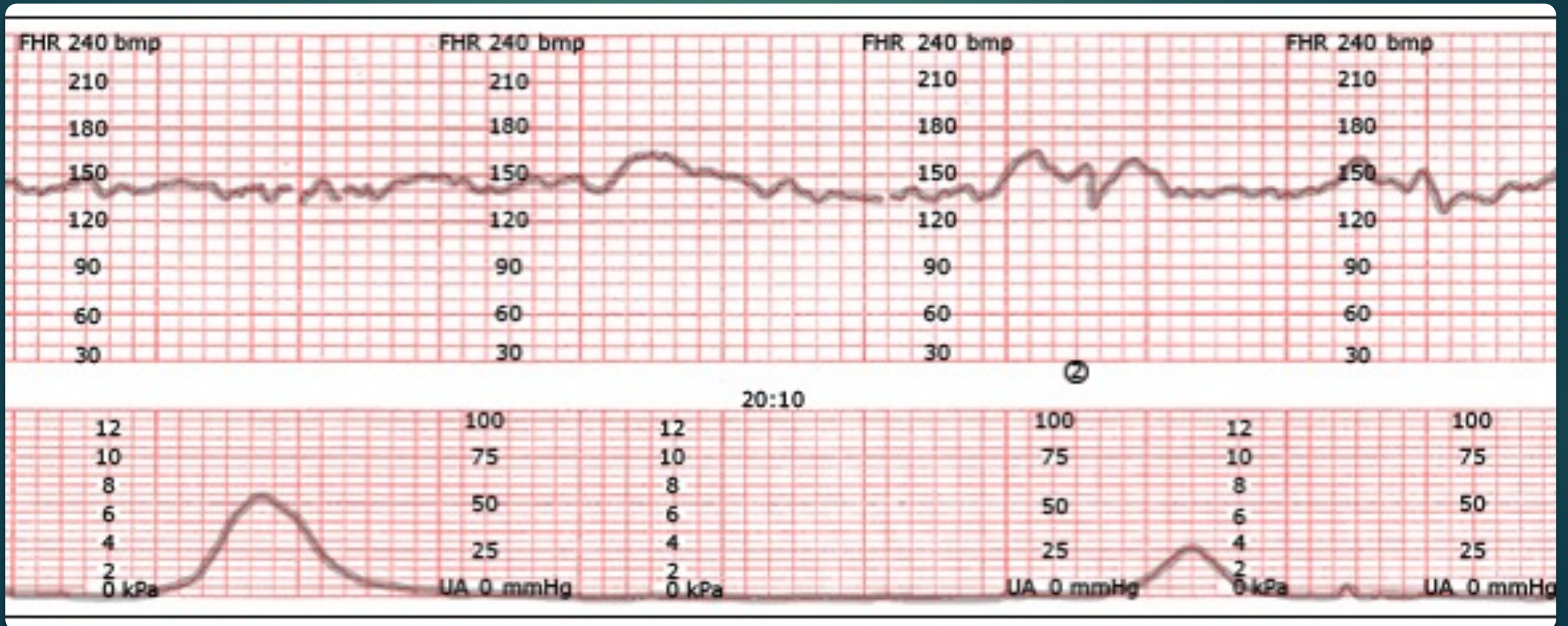
NORMAL FETAL HEART RATE TRACING – THE BASICS

- Upper graph is fetal heart rate in beats per minute
 - Each vertical box = 10 BPM. Normal FHR is between 110-160
 - Each small horizontal box = 10 seconds; each large box (not well seen in this pic) is one minute



NORMAL FETAL HEART RATE TRACING – THE BASICS

- Lower graph represents uterine activity. We call this monitor the tocometer
 - You can see one (maybe two) contractions occurring with slow symmetrical onset and offset
 - Significance of vertical boxes (as a measure of strength) depends on internal vs. external monitoring



INTERNAL VS. EXTERNAL MONITORING

▶ Fetal heart rate

- ▶ External monitor: uses Doppler ultrasound
- ▶ Internal monitor: fetal scalp electrode (FSE)
 - ▶ FSE avoids loss of signal or risks of misinterpreting signal (i.e., maternal HR)
 - ▶ However, placement requires amniotomy to place and carries small risk of scalp bleeding, hematoma, and infection

▶ Uterine activity

- ▶ External monitor: mechanical pressure transducer
- ▶ Internal monitor: intrauterine pressure catheter (IUPC)
 - ▶ IUPC allows for measurement of strength and precise measurement of duration of contractions, as well as baseline uterine tone
 - ▶ However, placement also requires amniotomy, and small risk of placental abruption

BASELINE: DEFINITION AND SIGNIFICANCE

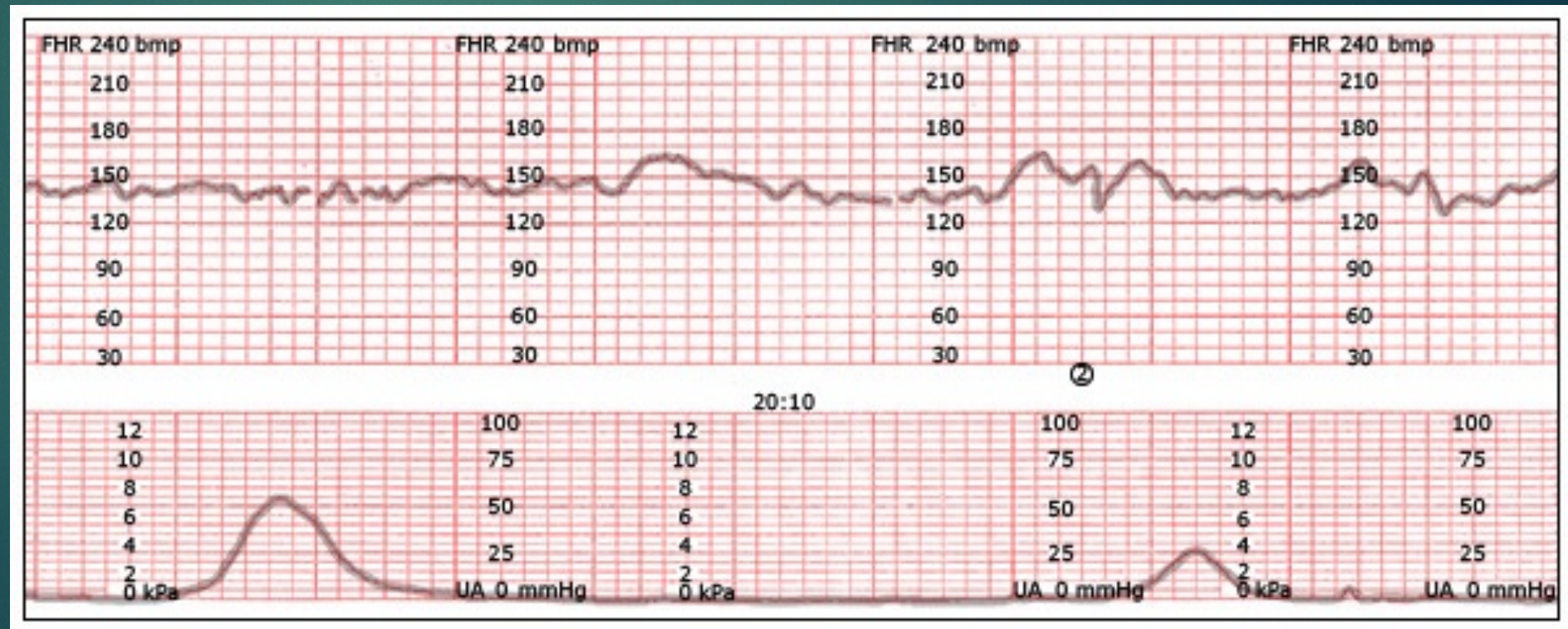
- ▶ Baseline FHR is always rounded to closest increment of 5 BPM
- ▶ Baseline FHR requires remaining stable for a 10-minute segment:
 - ▶ Intermittent accelerations or decelerations during that 10-minute period is fine
 - ▶ However, the baseline can't be changing or displaying marked variability during that segment
- ▶ Normal FHR baseline: FHR 110-160 beats per minute¹
 - ▶ Parasympathetic tone becomes more dominant as neurologic maturity progresses, so usually baseline will decrease with gestational age
 - ▶ A baseline slower than 110-120 requires immediate assessment of whether terminal fetal bradycardia is occurring
 - ▶ A baseline faster than 160 invites suspicion for maternal/fetal infection

¹Quoted from ACOG Practice Bulletin No. 106, Table 1

INTERPRETING BASELINE VARIABILITY

- ▶ Fluctuations in the baseline FHR that are irregular in amplitude and frequency
- ▶ Variability is visually quantitated as the amplitude of peak-to-trough in beats per minute.
 - ▶ Moderate variability: amplitude range 6-25 beats per minute (NORMAL VARIABILITY)

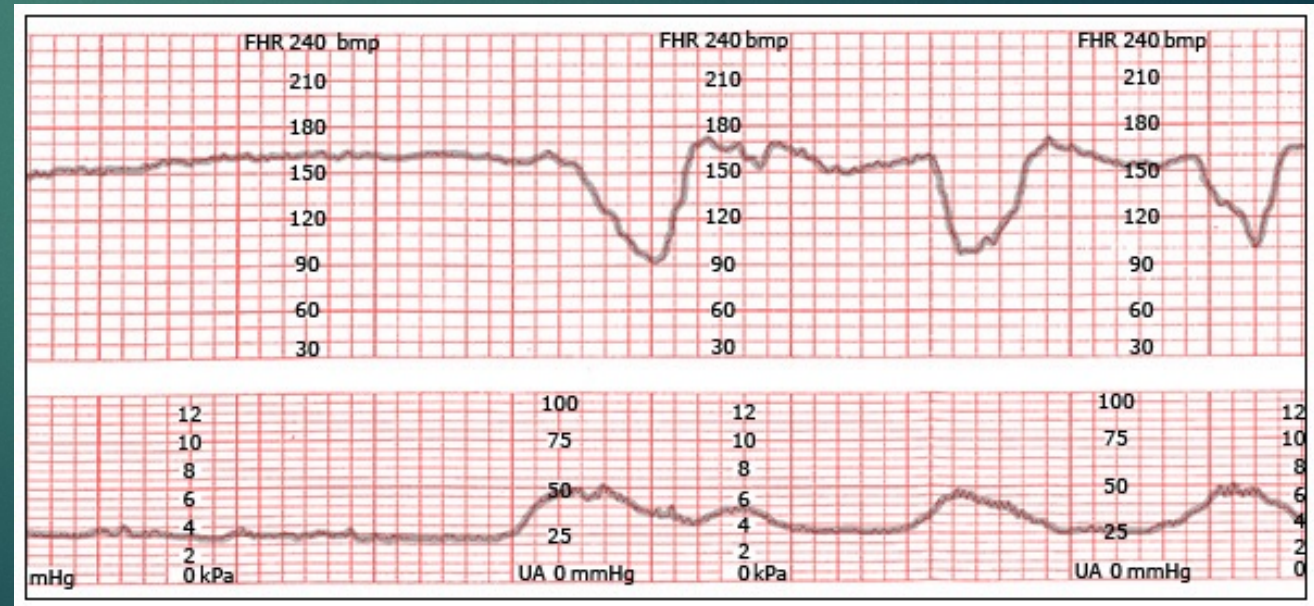
MODERATE



INTERPRETING BASELINE VARIABILITY

- ▶ Fluctuations in the baseline FHR that are irregular in amplitude and frequency
- ▶ Variability is visually quantitated as the amplitude of peak-to-trough in beats per minute.
 - ▶ *Minimal*: amplitude range <5 BPM (abnormal)
 - ▶ *Absent*: amplitude range undetectable (very abnormal)
 - ▶ *Marked*: amplitude range >25 BPM (very abnormal)

MINIMAL



BASELINE VARIABILITY: SIGNIFICANCE

- ▶ Differential for decreased baseline FHR variability:
 - ▶ fetal sleep cycles
 - ▶ medication response (CNS depressants, opiates, alcohol, magnesium sulfate)
 - ▶ fetal CNS anomalies (hydrocephaly/anencephaly)
 - ▶ cardiac anomalies
 - ▶ persistent fetal tachycardia
 - ▶ excessive vagal stimulation
 - ▶ fetal hypoxia and/or acidemia
- ▶ Marked variability may also be associated with hypoxia/acidemia, and is not considered reassuring

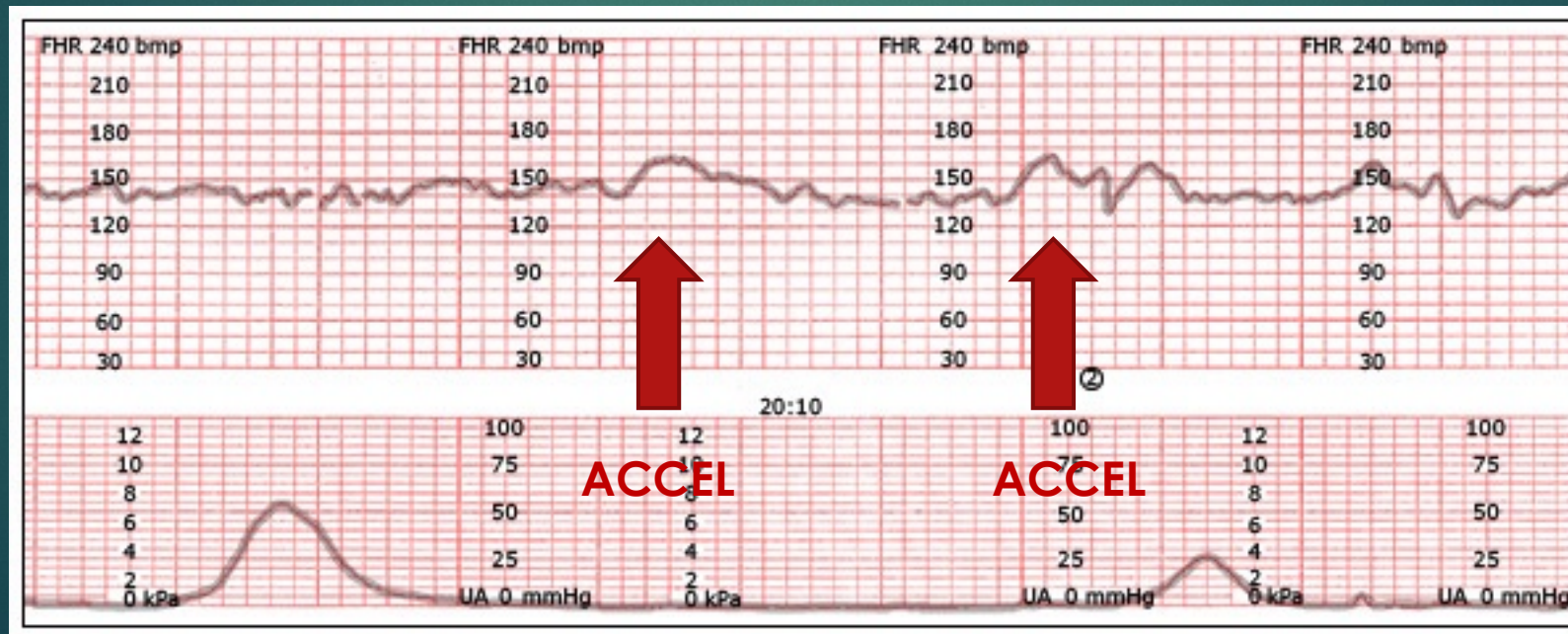
ACCELERATIONS

- ▶ A visually apparent increase in FHR (onset-to-peak less than 30 seconds)
 - ▶ ≥ 32 weeks: an acceleration has a peak of ≥ 15 BPM above the baseline, with a duration of 15 seconds or more, but less than 2 minutes from onset-to-return (15x15s)
 - ▶ < 32 weeks: an acceleration has a peak of ≥ 10 BPM or more above the baseline, with a duration of 10 seconds or more, but less than 2 minutes from onset-to-return (10x10s)
- ▶ Prolonged acceleration lasts 2 minutes or more but less than 10 minutes in duration
- ▶ If an acceleration lasts 10 minutes or longer, it is a baseline change¹

¹Quoted from ACOG Practice Bulletin No. 106, Table 1

ACCELERATION: SIGNIFICANCE

- ▶ If accels are present, the fetus is extremely unlikely to be academic (this is “REASSURING” that there is not fetal academia present)
- ▶ If accels are absent, the baby may be sleeping, and a vibroacoustic or fetal scalp stimulation may be performed. If an acceleration is elicited, the fetus is very unlikely to be acidemic.



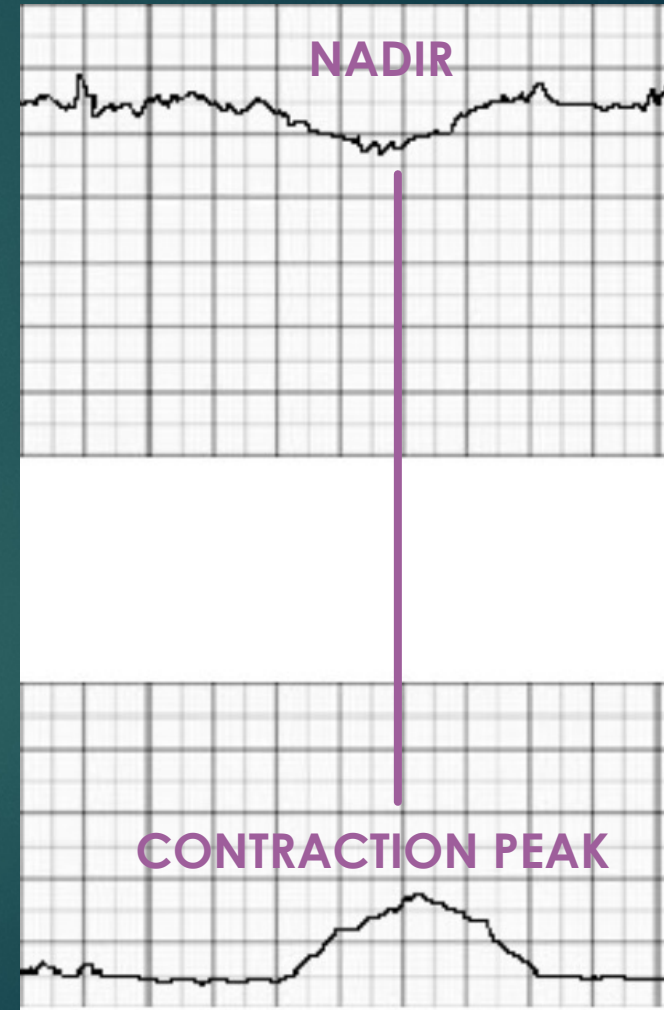
BASELINE: 140 BPM
VARIABILITY: MOD
ACCELS: present
(peaking ~165 BPM)

DECELERATIONS

- ▶ The next few slides will discuss the three TYPES of decelerations:
 - ▶ Early Decelerations
 - ▶ Variable Decelerations
 - ▶ Late Decelerations
- ▶ If a deceleration is longer than 2 minutes, irrespective of the type, it is referred to a prolonged deceleration
- ▶ We also discuss the frequency of decelerations, irrespective of the type, as they relate to contractions:
 - ▶ Intermittent decelerations occur with less than 50% of contractions
 - ▶ Recurrent decelerations occur with greater than 50% of contractions

EARLY DECELERATIONS

- ▶ Visually apparent usually symmetrical gradual decrease and return of the FHR associated with a uterine contraction
- ▶ A gradual FHR decrease is defined as from the onset to the FHR nadir of ≥ 30 seconds
- ▶ The NADIR of the deceleration occurs AT THE SAME TIME as the PEAK of the contraction
- ▶ In most cases the onset, nadir, and recovery of the deceleration are coincident with the beginning, peak, and ending of the contraction, respectively (“mirror image”)
- ▶ Etiology **benign**; believed to be 2/2 vagal stimulation by fetal head compression
 - ▶ Typically, only seen in labor. Most often occurs at ~4-6 cm cervical dilation and 10cm (‘complete’)



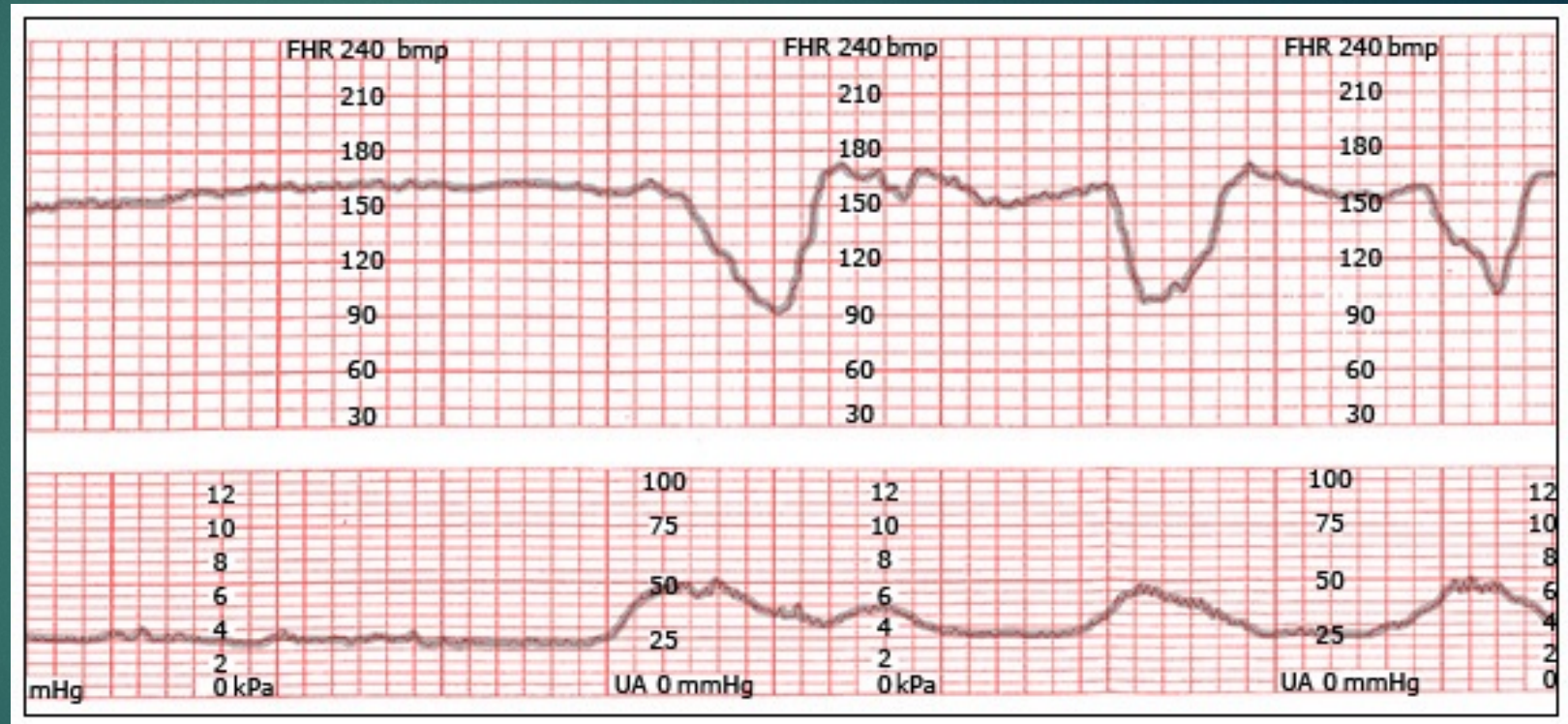
VARIABLE DECELERATIONS

- ▶ Visually apparent abrupt decrease in FHR
- ▶ An abrupt FHR decrease is defined as from the onset of the deceleration to the beginning of the FHR nadir of < 30 seconds
- ▶ The decrease in FHR is ≥ 15 BPM & lasting ≥ 15 seconds but < 2 minutes in duration
- ▶ When variable decelerations are associated with uterine contractions, their onset, depth, and duration commonly vary with successive uterine contractions (their appearance is *variable*)
- ▶ Before and/or after a variable deceleration, we might see what appear to be accelerations (“Shoulders”)
 - ▶ Physiology: increasing strength of uterine contraction leads 1st to occlusion of the thin-walled umbilical vein → decreased venous return to heart → reflex fetal tachycardia → compression of the two thick-walled umbilical arteries → increase in fetal BP and SVR → fetal baroreceptor-mediated bradycardia → cessation of compression of the umbilical arteries followed by the umbilical vein

VARIABLE DECELERATIONS

▶ Etiology of variable decelerations with contractions

- ▶ low amniotic fluid volume
- ▶ short umbilical cord
- ▶ nuchal cord
- ▶ cord entanglement
- ▶ prolapsed cord
- ▶ knot in the cord
- ▶ decreased Wharton's jelly
- ▶ rapid descent of the fetus

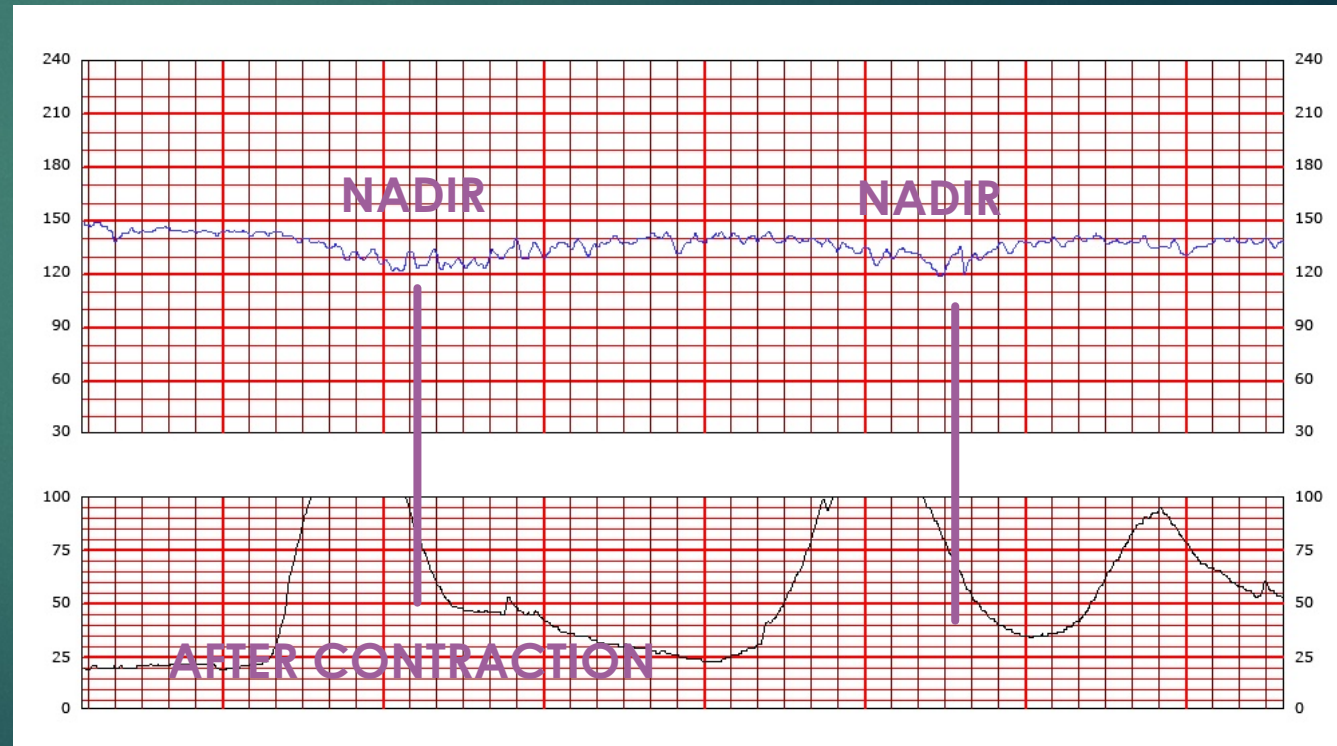


▶ We can see the variables and lates during ANTEPARTUM testing and in LABOR

- ▶ Interpreting these is critical for triaging the timing and route of delivery as we will review in future FLAMES

LATE DECELERATIONS

- ▶ Visually apparent usually symmetric gradual decrease and return of the FHR associated with a uterine contraction (much more subtle appearing)
- ▶ A gradual FHR decrease is defined as from the onset to the FHR nadir of 30 seconds or more
- ▶ The deceleration is DELAYED in timing, with the nadir of the decel occurring AFTER the peak of the contraction
- ▶ In most cases, the onset, nadir, and recovery of the deceleration occur AFTER the beginning, peak, and ending of the contraction, respectively

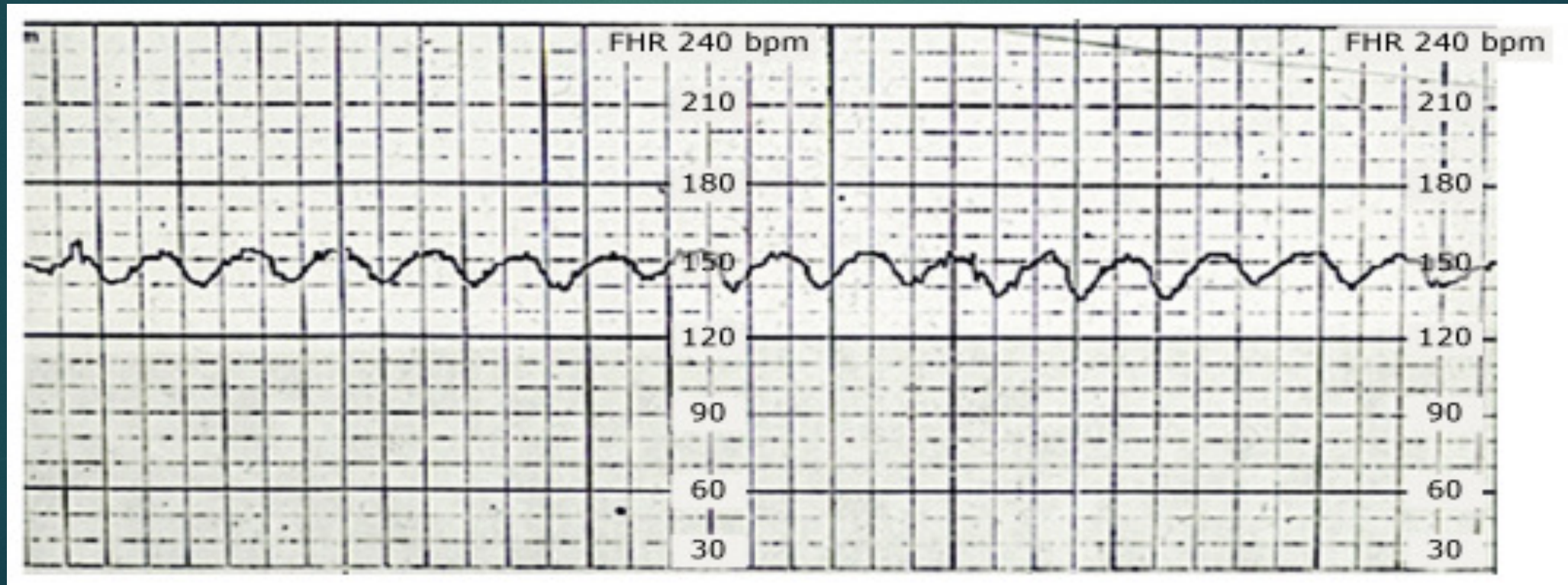


LATE DECELERATIONS

- ▶ Occur 2/2 uteroplacental insufficiency
 - ▶ Myometrial contraction → decreased blood flow to placenta → respiratory acidosis --> metabolic acidosis
 - ▶ Fetal chemoreceptor response to acidemia → decreased heart rate
- ▶ Differential diagnosis:
 - ▶ Placental post-maturity
 - ▶ Abruptio placentae, placental malformation
 - ▶ Chronic placental damage 2/2 maternal disease (i.e., maternal cHTN, DM, APAS)
 - ▶ Pre-eclampsia
 - ▶ Cocaine/amphetamines
 - ▶ Maternal hypotension (supine position, epidural, trauma, hemorrhage)
 - ▶ Inadequate uterine relaxation

SINUSOIDAL PATTERN

- ▶ Visually apparent, smooth, sin wave-like undulating pattern in FHR baseline with a cycle frequency of 3-5 per minute which persists for 20 minutes or more
- ▶ Strongly correlated with severe fetal hypoxia/acidemia



UTERINE ACTIVITY: DEFINITIONS

- ▶ Evaluating contractions is both important for assessing labor progress or ruling in/out labor, but also assists in interpretation of decelerations as described previously
- ▶ Normal: expect contractions every 2-4 minutes in active labor
- ▶ **Tachysystole**: more than five contractions in 10 minutes (<math>< q2m</math>), averaged over a 30-minute window
 - ▶ Can cause variable and late decelerations
- ▶ In the preterm patient:
 - ▶ There is no evidence-based threshold for contraction frequency distinguishing false from early labor, but common practice considers <math>< 4</math> uterine contractions per hour reassuring

IMPORTANT LINKS/REFERENCES

- ▶ [ACOG PRACTICE BULLETIN 106 – Intrapartum Fetal Heart Rate Monitoring: Nomenclature, Interpretation, and General Management Principles](#)
- ▶ [UpToDate.com, Young BK - Intrapartum Fetal Heart Rate Assessment](#)
- ▶ Please also refer to FLAME LECTURE 55 – Intrapartum fetal heart rate monitoring