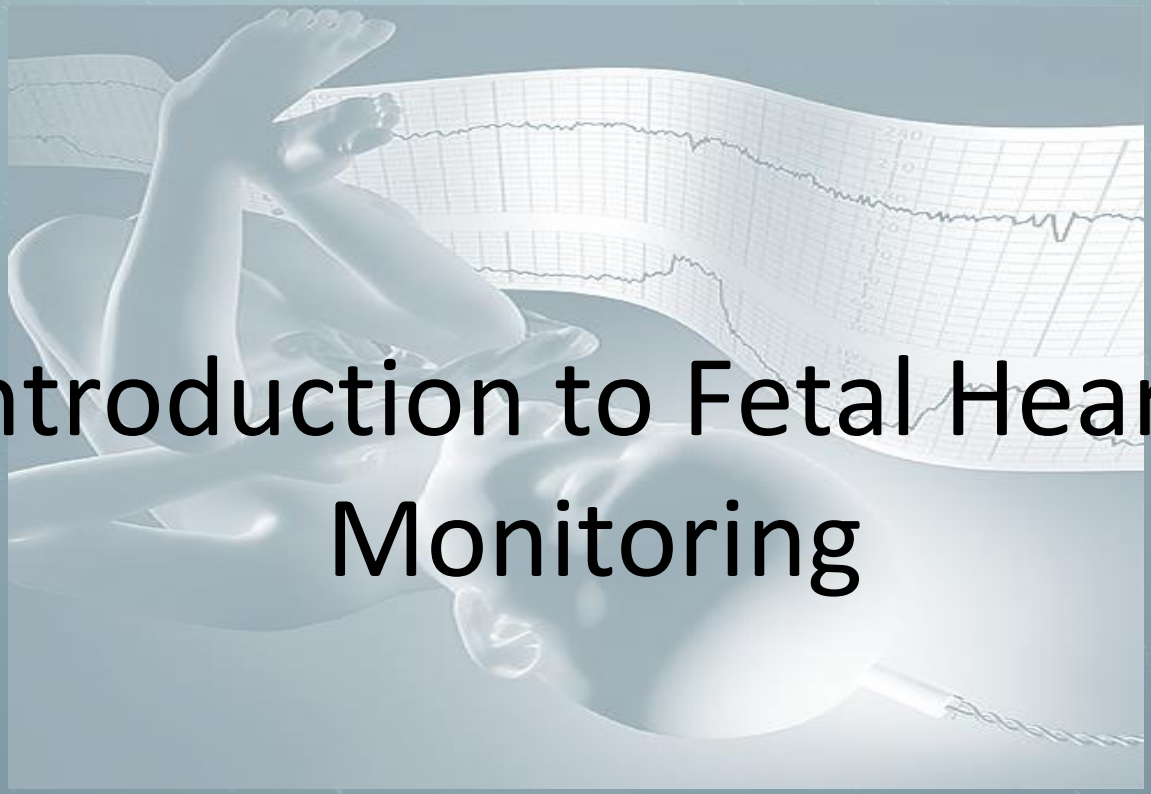


Introduction to Fetal Heart Monitoring

Megan Leach, BSN, RNC-OB, C-EFM

Objectives

- Identify benefits/limitations of each method of monitoring
- Identify components of uterine activity and fetal heart rate pattern
- Differentiate between FHR categories I, II and III.
- Select appropriate interventions for specific fetal heart rate and uterine activity patterns

References

- AWHONN Fetal Heart Monitoring Principles and Practices 6th Edition, 2009
- 2008 NICHD Report on Electronic Fetal Monitoring
- AWHONN Perinatal Nursing 4th Edition, 2014
- ACOG PB #106 Intrapartum FHR Monitoring, 2017
- UpToDate: June 2018
  - Assessment &Management of Intrapartum Fetal Heart Tracings

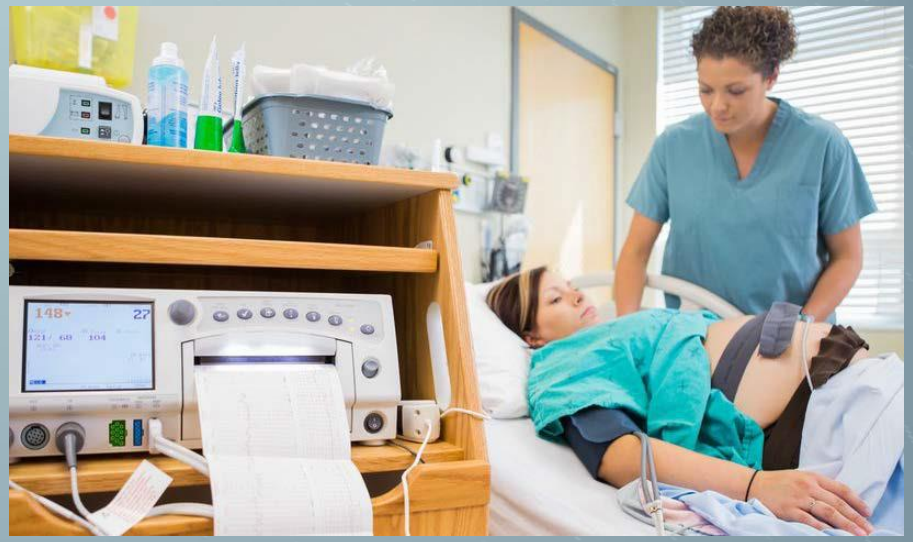
History of FHM

1800s

1917

Dr Hon 1958

Commerciall y available 1968



Fundamentals of FHM Equipment

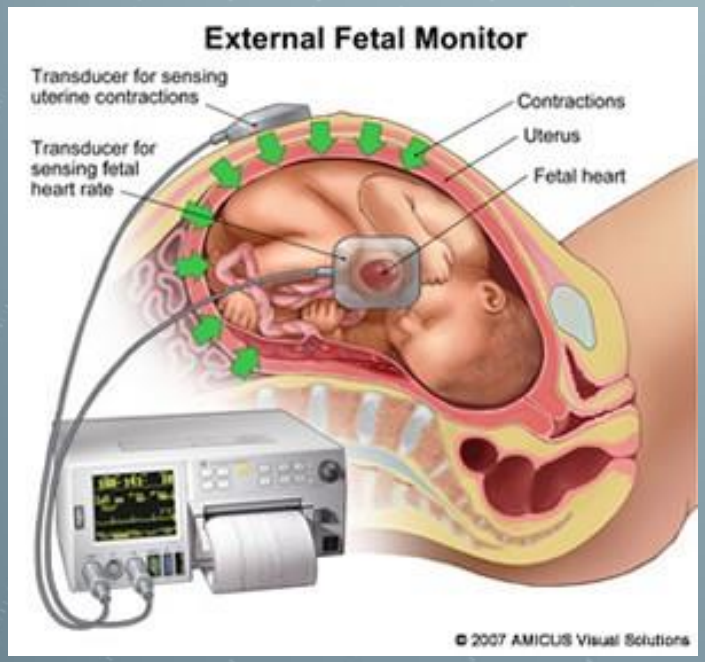
How can we capture the necessary fetal signal?

Fundamentals

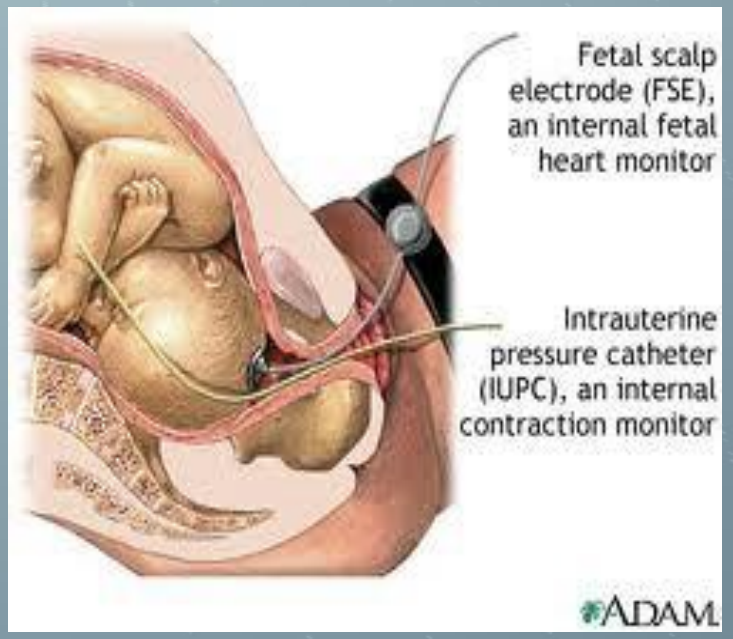
- The Equipment
  - Monitor make and model
  - Types of transducers & techniques of monitoring
    - FHR: External & Internal
    - Uterine activity: External & Internal
    - FHM Strip: Paper or Electronic

Fundamentals: Transducers

External



Internal



Uterine Activity

- Methods of Assessing UA
  - Palpation
  - Tocodynamometer (TOCO)
  - Intrauterine Pressure Catheter

Palpation

Can obtain a general indication of frequency, duration, intensity and resting tone.

IMPORTANT: Use with all other methods of monitoring uterine activity to verify accuracy of information

Palpation

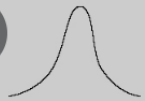
- Benefits
  - Noninvasive
  - Hands on; human touch
  - Mobility of mother
  - No equipment necessary
- Limitations
  - Maternal size can limit ability to palpate contractions
  - Subjective
  - No hard copy generated

Tocodynamometer (TOCO)

- Pressure sensitive button on TOCO detects external changes in the contour of the abdomen that occur with uterine contractions
- Can assess relative frequency and duration
- Palpate to obtain a general indication of intensity and resting tone

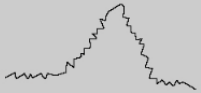
TOCO

- Benefits
  - Minimally invasive
  - Does not require ROM
  - Tracing generated
- Limitations
  - Does not objectively measure intensity and resting tone
  - Maternal size can interfere with ability of TOCO to sense changes in abdomen
  - Location sensitive; placement can lead to false information
  - Limits maternal mobility



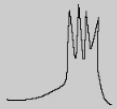
Normal

1. Uterine contraction wave form



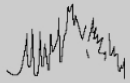
Respirations

2. Respiration may produce an undulating overla.



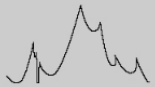
Pushing

3. Valsalva maeuver with pushing effects during the second stage of labor may produce blunted spikes



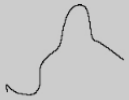
Vomiting seizures

4. Extreme maternal activity such as vomiting or a seizure may produce a series of sharp spikes



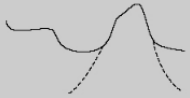
Fetal activity

5. Fetal movement may produce sharp isolated spikes



Sudden baselines shift

6. Sudden baseline shifts may be produced by maternal position change



Obscured

7. Low baseline setting may obscure all but tip of contractions

Inverted

8. Certain placements of tocodynamometer may produce reversed waveform when uterus contracts away from the tocodynamometer

TOCO

- Troubleshooting
  - Palpate fundus to find point of maximum intensity
  - Apply TOCO firmly to abdomen
  - UA Reference (last step)
  - Document all interventions performed

Intrauterine Pressure Catheter (IUPC)

- Can assess frequency, duration, intensity and resting tone

- Indications:

  IF YOU NEED MORE INFORMATION

  - Dystocia (abnormal labor)
  - TOL/VBAC
  - Inability to obtain accurate assessment of UA with administration of oxytocin
  - Amnioinfusion
  - Withdrawal of amniotic fluid for testing

IUPC

- Contraindications:

  ROM not desired

  - Maternal infection with risk of vertical transmission
  - Vaginal bleeding
  - Placenta previa or low-lying placenta

  IS THE RISK OF IUPC PLACEMENT WORTH THE BENEFIT OF THE INFORMATION GENERATED?

IUPC

- Benefits
  - Objective measurement of frequency, duration, intensity and resting tone in mmHg or MVUs
  - Tracing generated
  - Amnioinfusion
- Limitations
  - Requires ROM and cervical dilatation
  - Invasive procedure
  - Increased risk of uterine infection, perforation or placental separation
  - Limits maternal mobility

IUPC

- Troubleshooting
  - Have patient cough to verify placement
  - Palpate to confirm presence of contractions
  - Check for possible displacement of catheter
  - Rotate catheter 180 degrees
  - Re-zero transducer per manufacturer's instructions
  - Document all interventions performed

Fetal Heart Rate

- Methods of Assessing Fetal Heart Rate
  - Fetoscope or Hand Held Doppler
  - Ultrasound Transducer
  - Spiral Electrode

Fetoscope

- *True* method of auscultation
- Detects **sounds** of fetus' heart beats
- Can assess fetal heart rate, rhythm, increases or decreases

Fetoscope

- Benefits
  - Widespread application
  - Noninvasive
  - Patient comfort and mobility
  - Increased hands-on care with 1:1 nurse/patient ratio
- Limitations
  - Difficult to count , cannot assess variability
  - May miss an event when not listening
  - Difficult to assess FHR with movement, obese mother or during contraction
  - No tracing generated
  - 1:1 nurse/patient ratio difficult
  - Requires practice and

Ultrasound Transducer

- Sound waves detect fetal heart **movement**

- Assess fetal heart baseline rate, rhythm, variability, accelerations and decelerations

Ultrasound Transducer

- Benefits
  - Noninvasive
  - Does not require ROM
  - Provides a permanent record
- Limitations
  - Restricts maternal movement
  - Difficult transmissions with maternal and/or fetal movement, maternal obesity, fetal position
  - Monitor may half/double count with tachycardia or bradycardia

Ultrasound Transducer

- Troubleshooting
  - Apply gel
  - Reposition
  - Apply snuggly to abdomen
  - Palpate maternal pulse or compare to pulse ox

Spiral Electrode

- Detects **electrical activity** of fetus' heart
- Assess baseline rate, rhythm, variability, accelerations and decelerations
- Indicated when information obtained with other methods is not adequate
- Contraindicated with some maternal infections or fetal coagulopathies

IS THE RISK OF ESE PLACEMENT WORTH THE BENEFIT OF THE INFOR

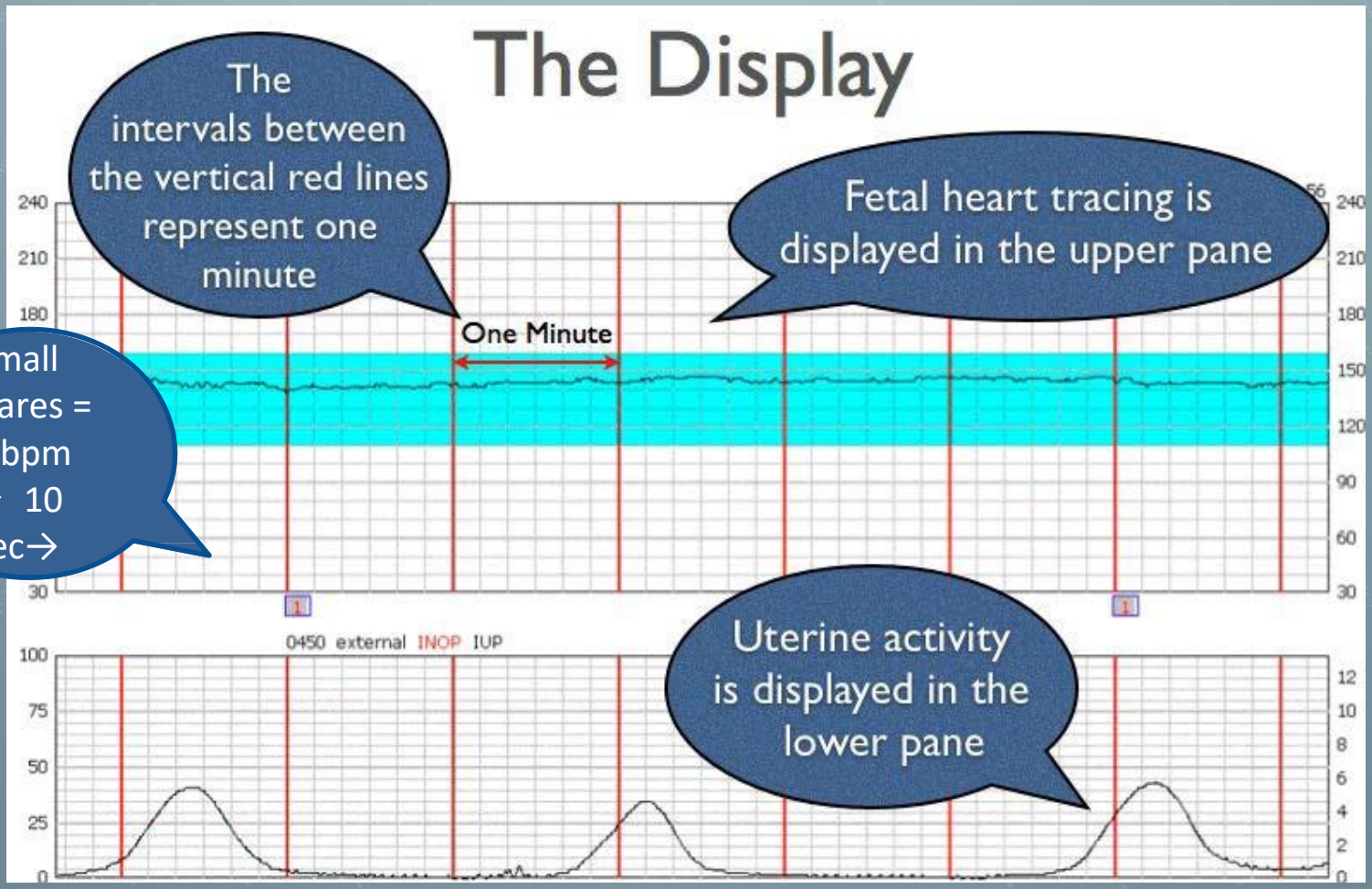
Spiral Electrode

- Benefits
  - Continuous detection of FHR
  - Allows for more freedom of movement for patient than does U/S
- Limitations
  - Requires ROM, adequate cervical dilatation, appropriate fetal presenting part
  - Potential for transmission of maternal infection
  - Potential for fetal injury
  - May record maternal HR with fetal demise
  - Potential for electronic interference and artifact

Spiral Electrode

- Troubleshooting
  - Check all connections
  - Replace SE and/or monitor part
  - Confirm fetal HR with ultrasound transducer or doppler
  - Assess maternal pulse while validating FHR

FHM Paper



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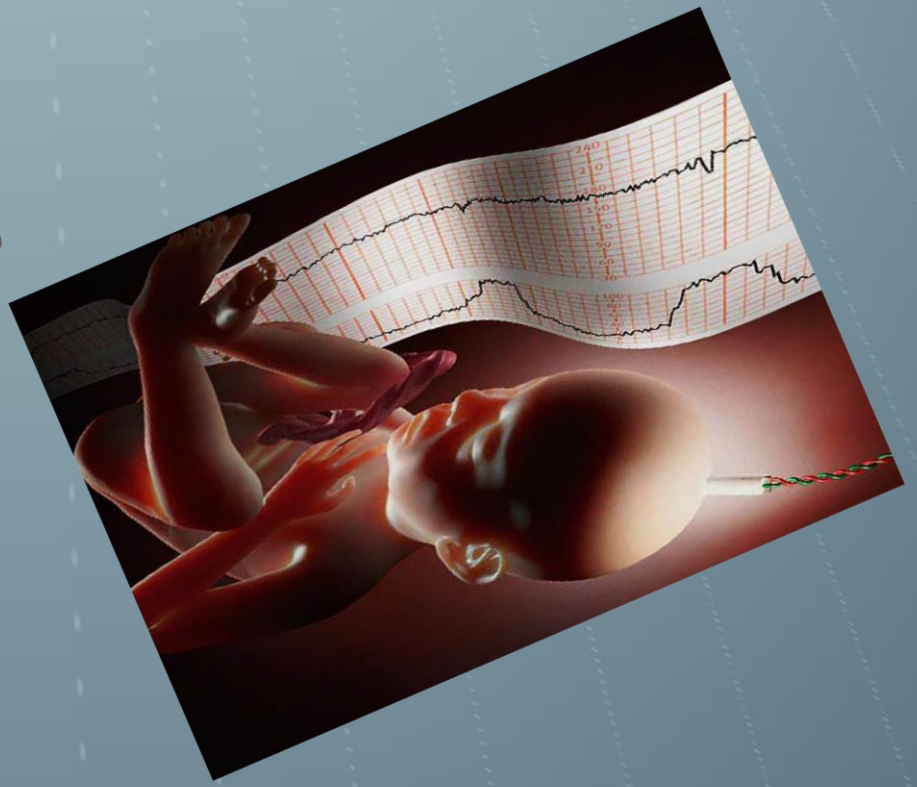
Physiologic Factors Affecting Fetal Heart Rate Patterns

Why the fetus reacts the way it does?



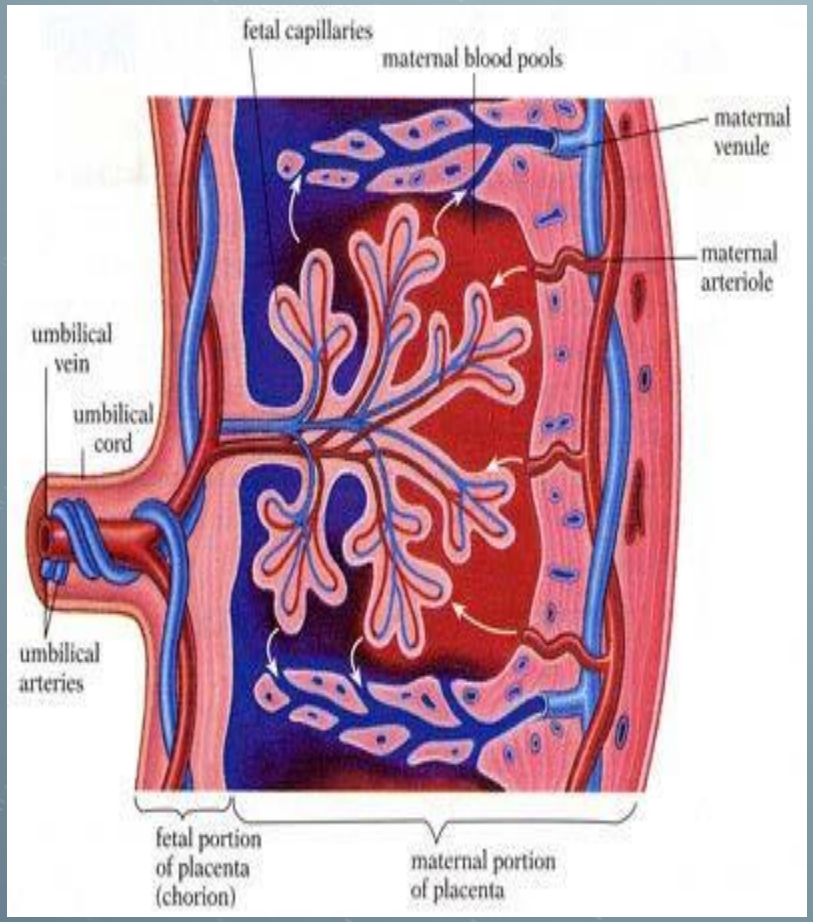
Purpose of FHM

A normal FHR pattern reflects an intact, oxygenated brainstem, autonomic nervous system, and heart.

Physiologic Factors Affecting Fetal Heart Rate Patterns

- Maternal fetal circulation
- Disruption of fetal oxygenation
- Neural control of fetal cardiac activity

Maternal Fetal Circulation



Fetal oxygen transfer depends on functional:

1. Maternal systems
2. Placental integrity
3. Umbilical cord patency

Maternal Fetal Circulation

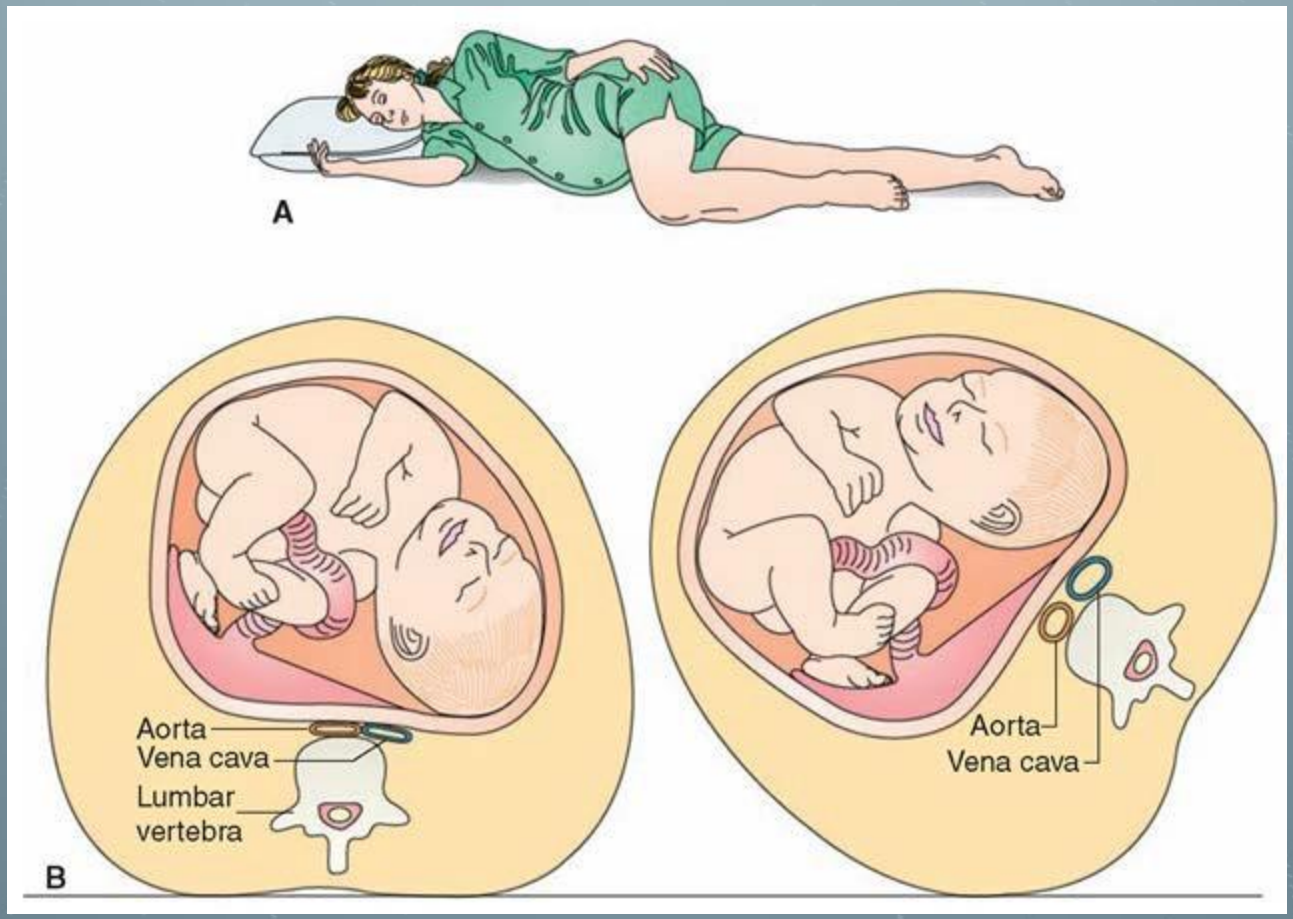
Maternal Influences:

- Maternal oxygenation
  - Changes in O2 carrying capacity
- Maternal blood pressure
  - Blood flow to the uterus

Maternal assessment identifies risk factors that may affect FHR patterns

Maternal Fetal Circulation

Supine Hypotension

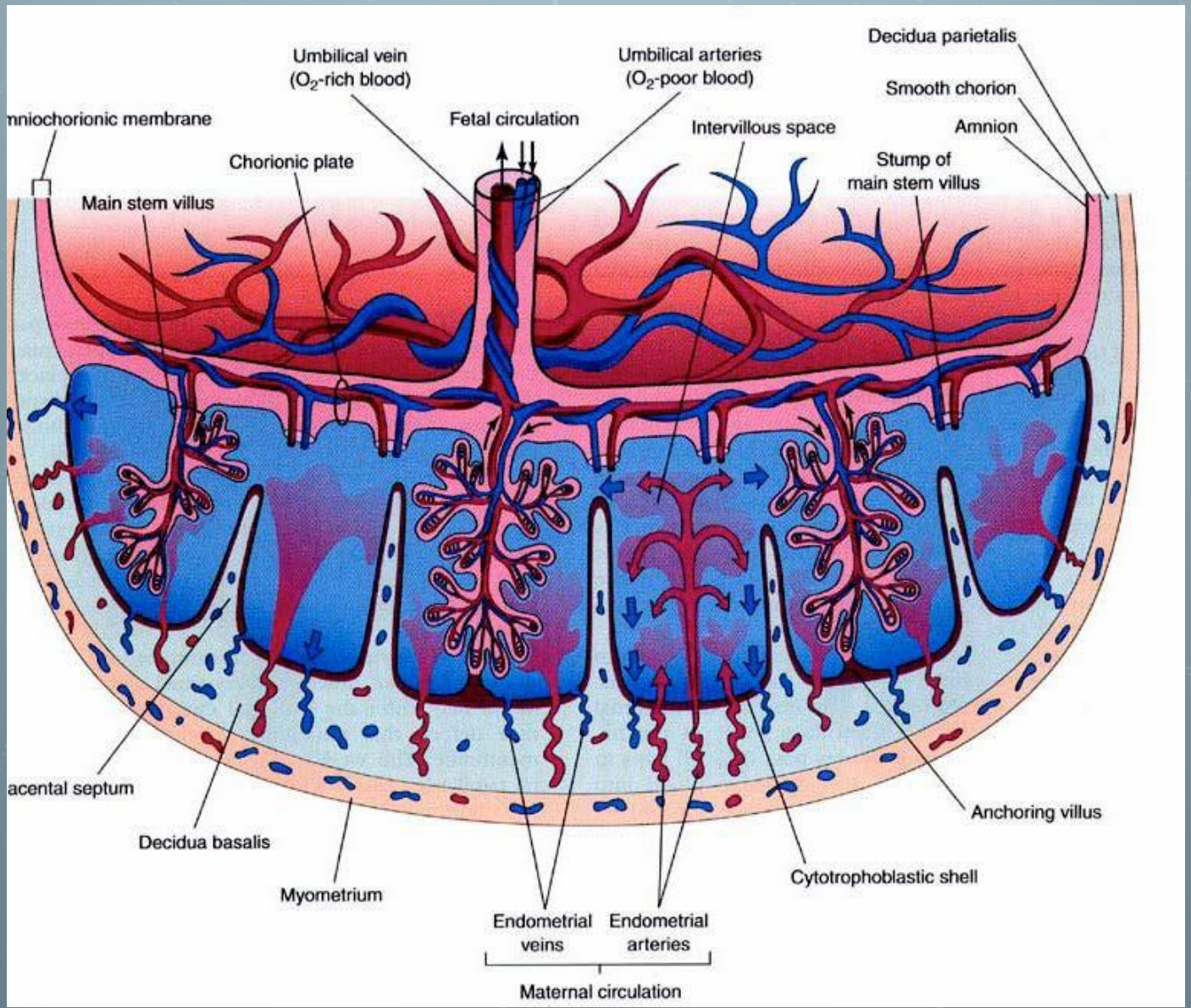


Maternal Fetal Circulation

Placental Integrity

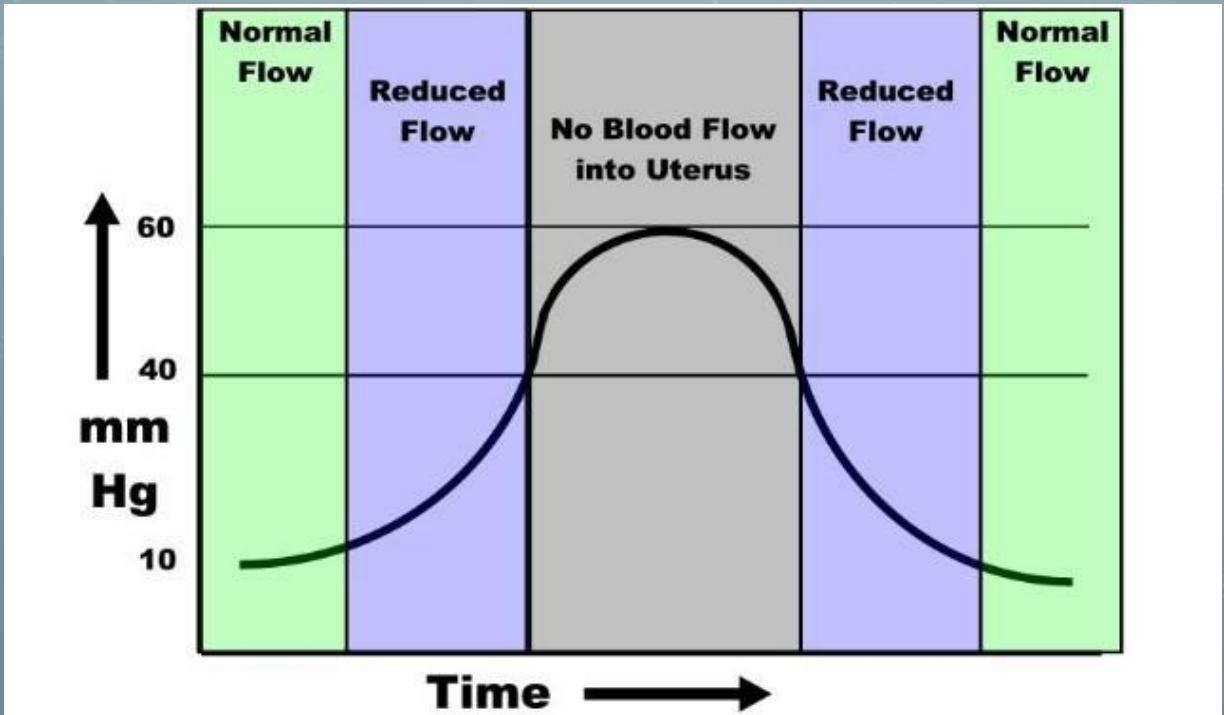
- Functional placental surface area
- Placental blood flow – intervillous space perfusion

Maternal Fetal Circulation



Maternal Fetal Circulation

- Labor influences on fetal oxygenation



Change in Uterine Blood Flow with Contractions

Maternal Fetal Circulation

Umbilical Cord Patency

- Cord cushioning
  - Amniotic fluid
  - Warton's jelly
  - Cord dimension
- Cord compression
  - Knot, prolapse, wrapped around body part
- Vascular abnormalities

Neural Control of Fetal Cardiac Activity

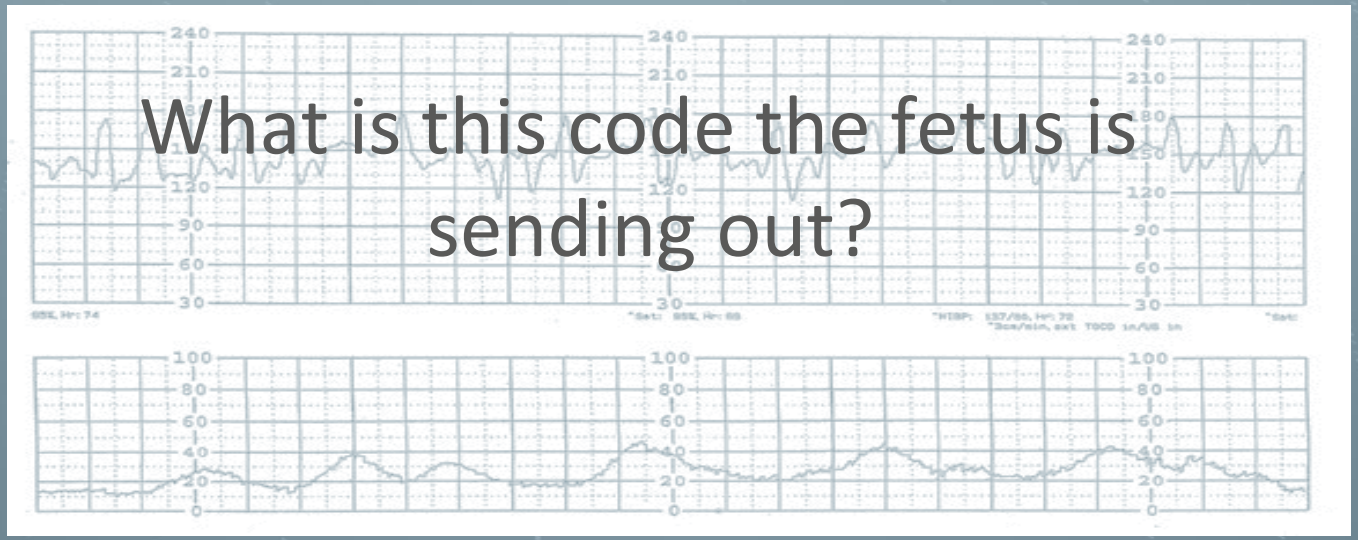
Fetal Reserve

- O2 available – O2 consumed = fetal reserve
  - Healthy fetus has 2X what is needed

Fetal oxygenation affects the function of the brain → affects the function of the cardiovascular system

- Multiple influences on the FHR
  - Autonomic nervous system
    - Sympathetic & Parasympathetic Branches
  - Baroreceptors & Chemoreceptors
  - Fetal hormones
  - Sleep-wake cycles
  - External stimuli

Fetal Heart Monitoring Interpretation



Fetal Heart Monitoring Interpretation

- Fetal assessment relies on the premise that the FHR reflects fetal oxygenation
  - It is a good predictor of normal outcomes
  - It is **not** a good predictor of poor outcomes

Fundamentals:
Assessment of FHR & UA Characteristics

Fetal Heart Rate:

The 4 Elements

- Baseline
- BL variability
- Accelerations
- Decelerations

Uterine Activity:

The 4 Elements

- Frequency
- Duration
- Intensity
- Resting tone

Consistency of Process: The Same way EVERY time

Basic Pattern Interpretation

- Systematic interpretation to evaluate every tracing:
  - FHR baseline
  - FHR baseline variability
  - Periodic or episodic changes
  - Uterine activity
  - Category
  - Pattern evolution
  - Accompanying clinical characteristics
  - Probable cause of the changes present
  - Normal vs. Urgent Evaluation Necessary

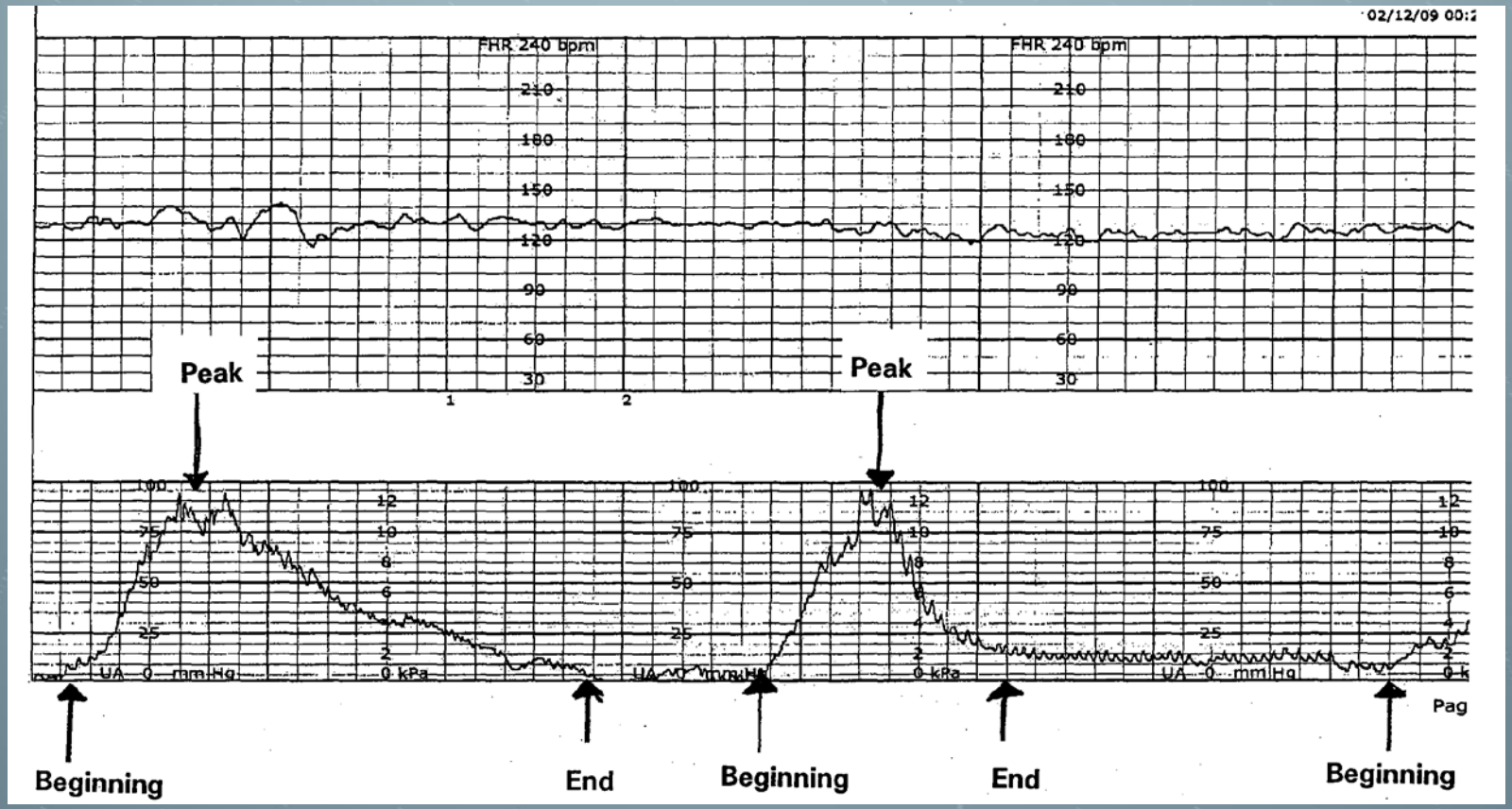
Uterine Activity

- Frequency:
  - How often are the contractions occurring?
  - Usually assessed in ½ minute or whole minute intervals - count from the beginning of one contraction to the beginning of the next.
  - Document range
  - Avoid “occasional” or “irregular”

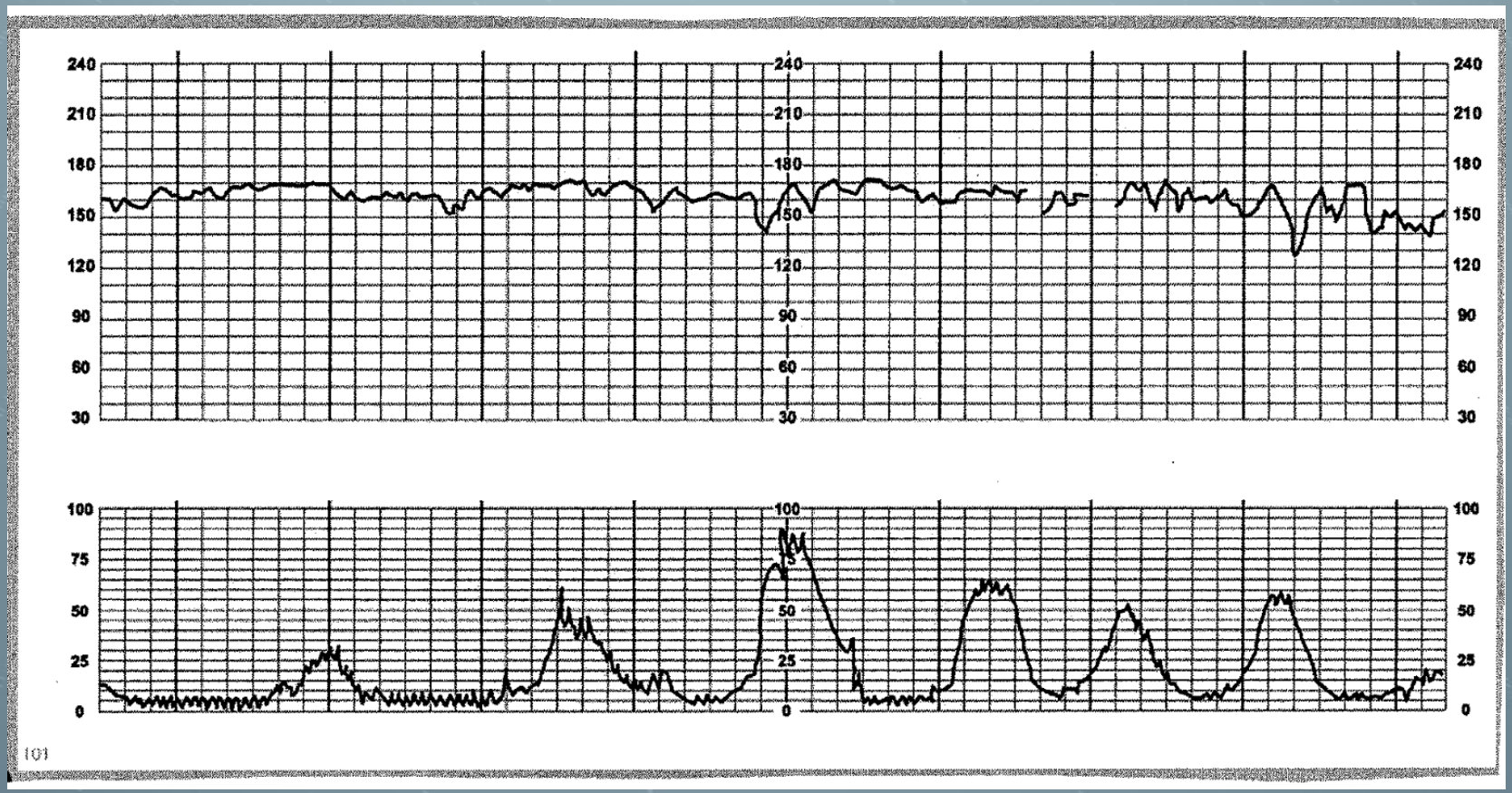
Uterine Activity

- Frequency
  - Normal: ≤ 5 contractions in 10 minutes, averaged over 30 minutes
  - Tachysystole: > 5 contractions in 10 minutes, averaged over 30 minutes
  - Coupling & tripling contractions

Uterine Activity



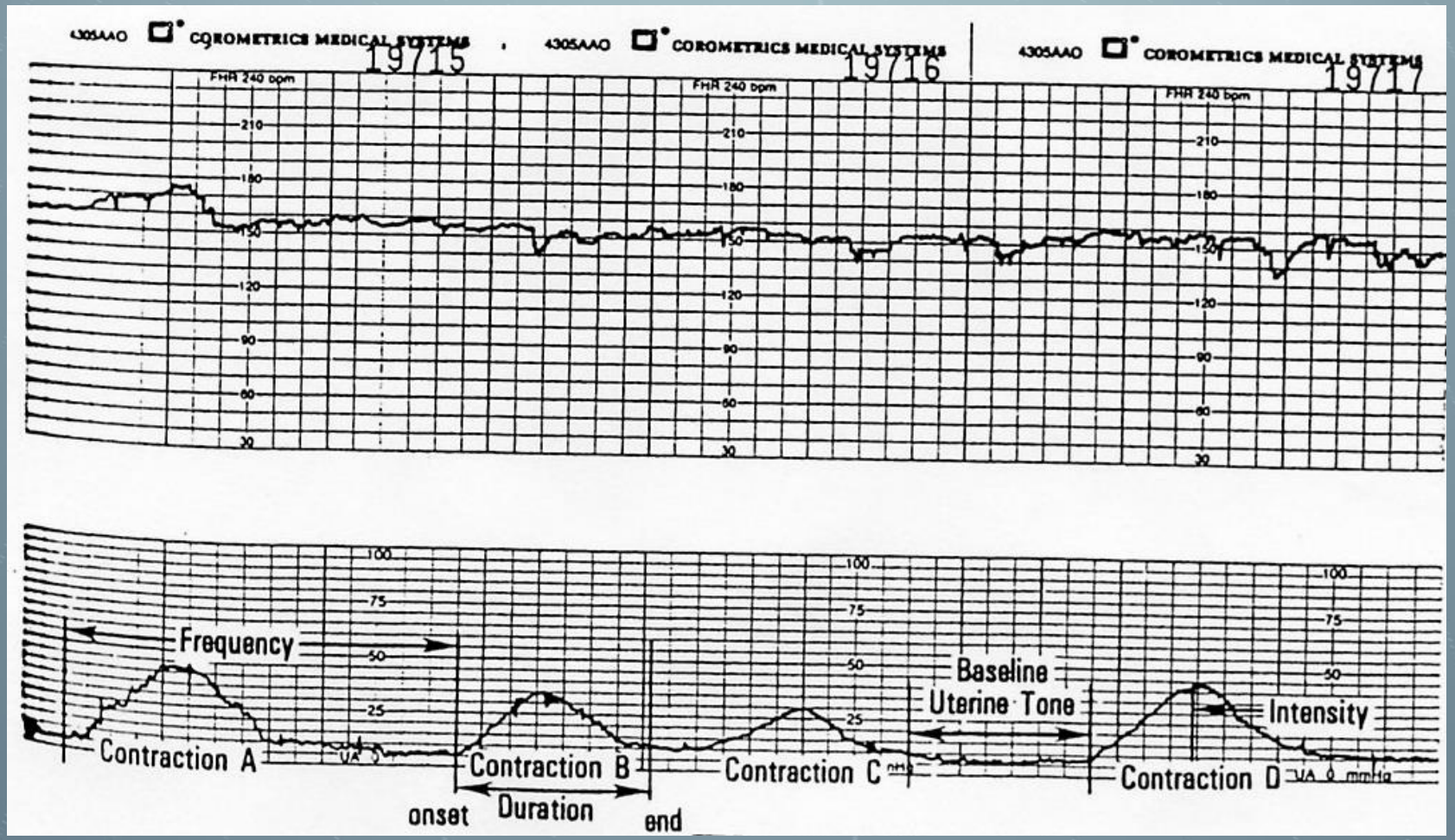
Uterine Activity



Uterine Activity

- Duration
  - Usually assessed in ten second intervals—count from when contraction starts to when it ends
  - Document range
  - How long is too long?

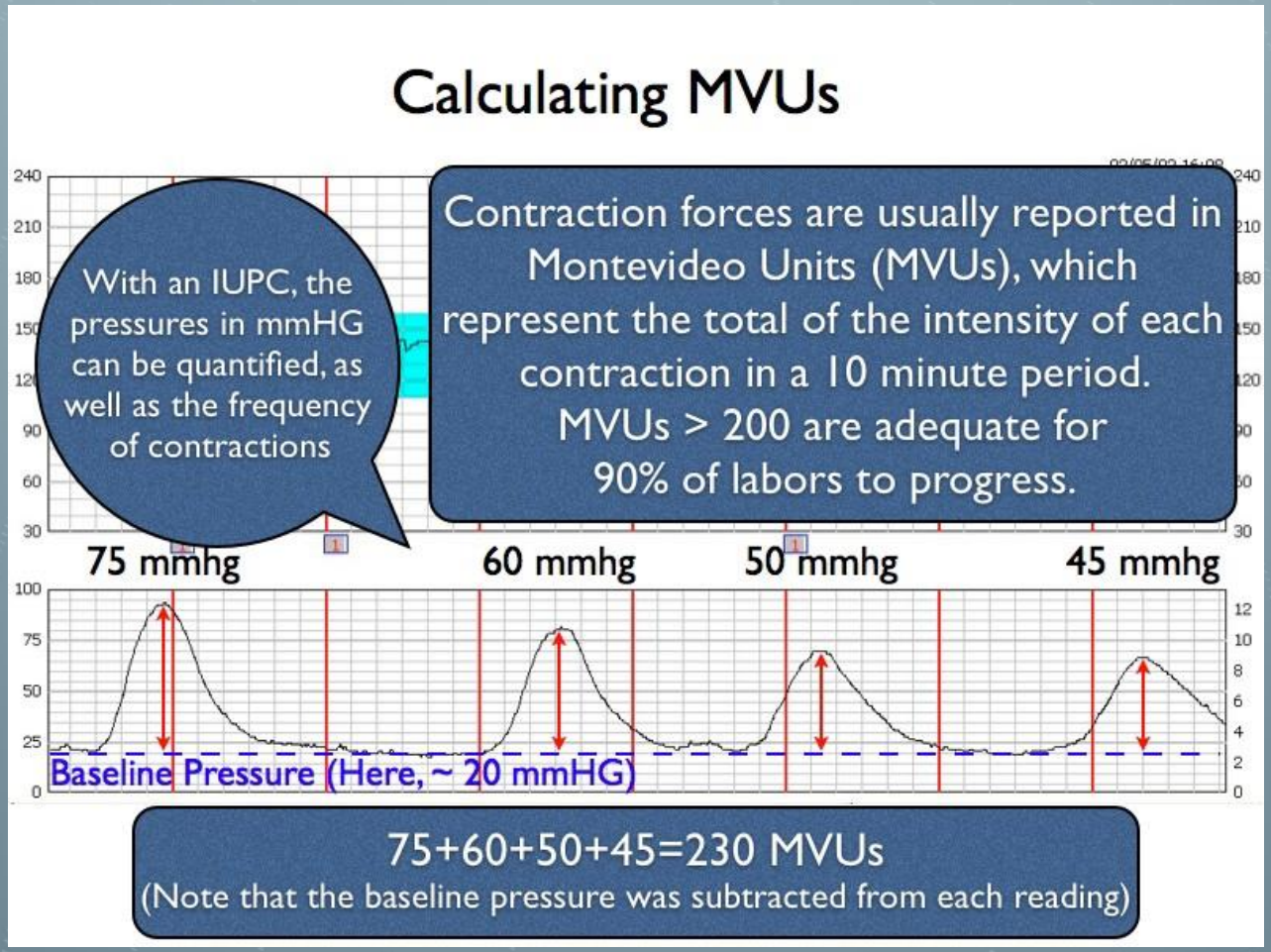
Uterine Activity



Uterine Activity

- Intensity
  - How strong are they?
  - Assessed by palpation or IUPC
  - With palpation, document as mild, moderate, or strong
  - With IUPC, document in mmHg or MVU's (Montevideo Units)

Uterine Activity



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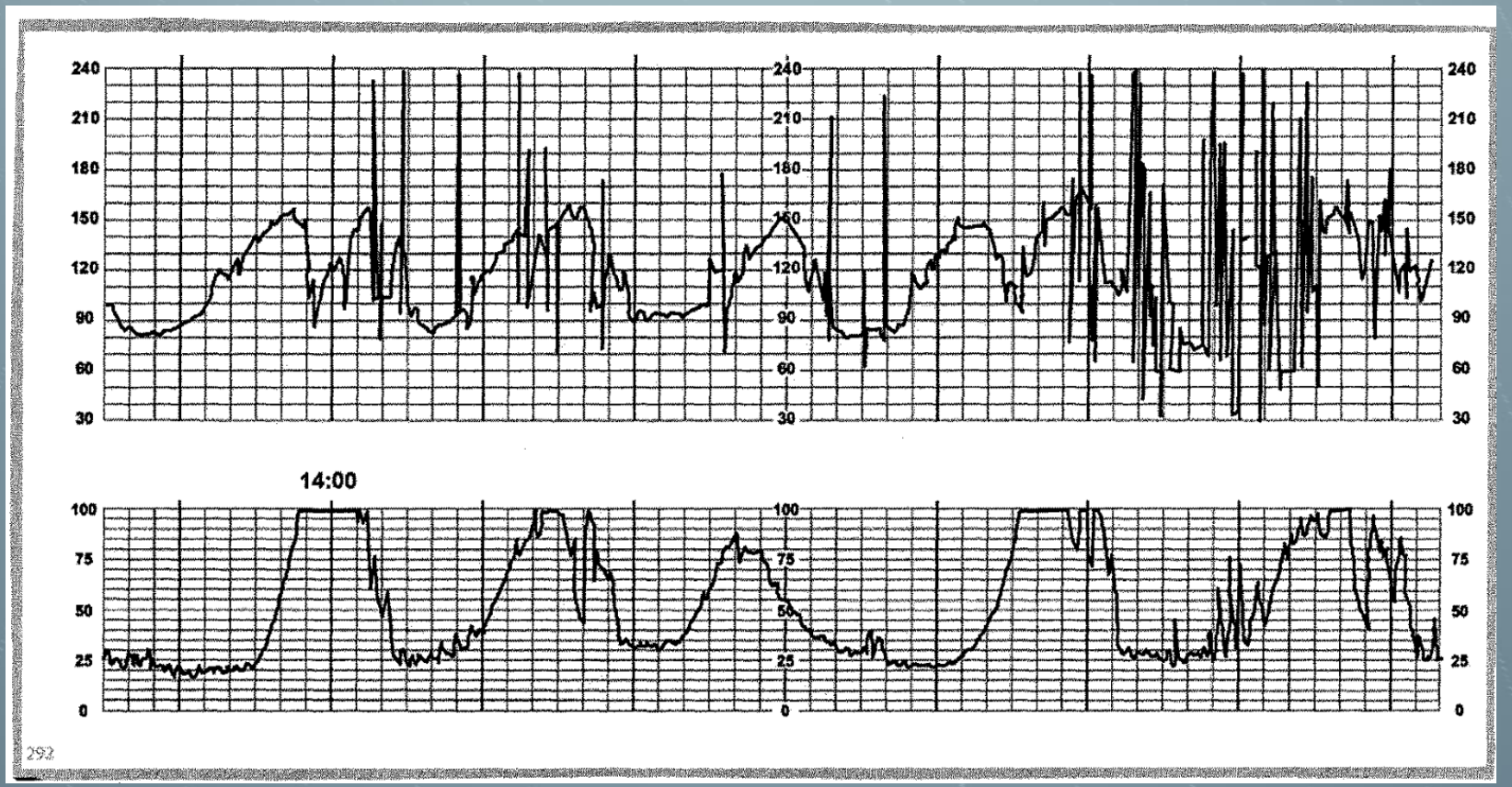
Uterine Activity

Resting Tone

- Uterine tone between contractions
- Palpation (with TOCO): soft or firm
- IUPC: mmHg
  - Usual $\leq$ 20mmHg

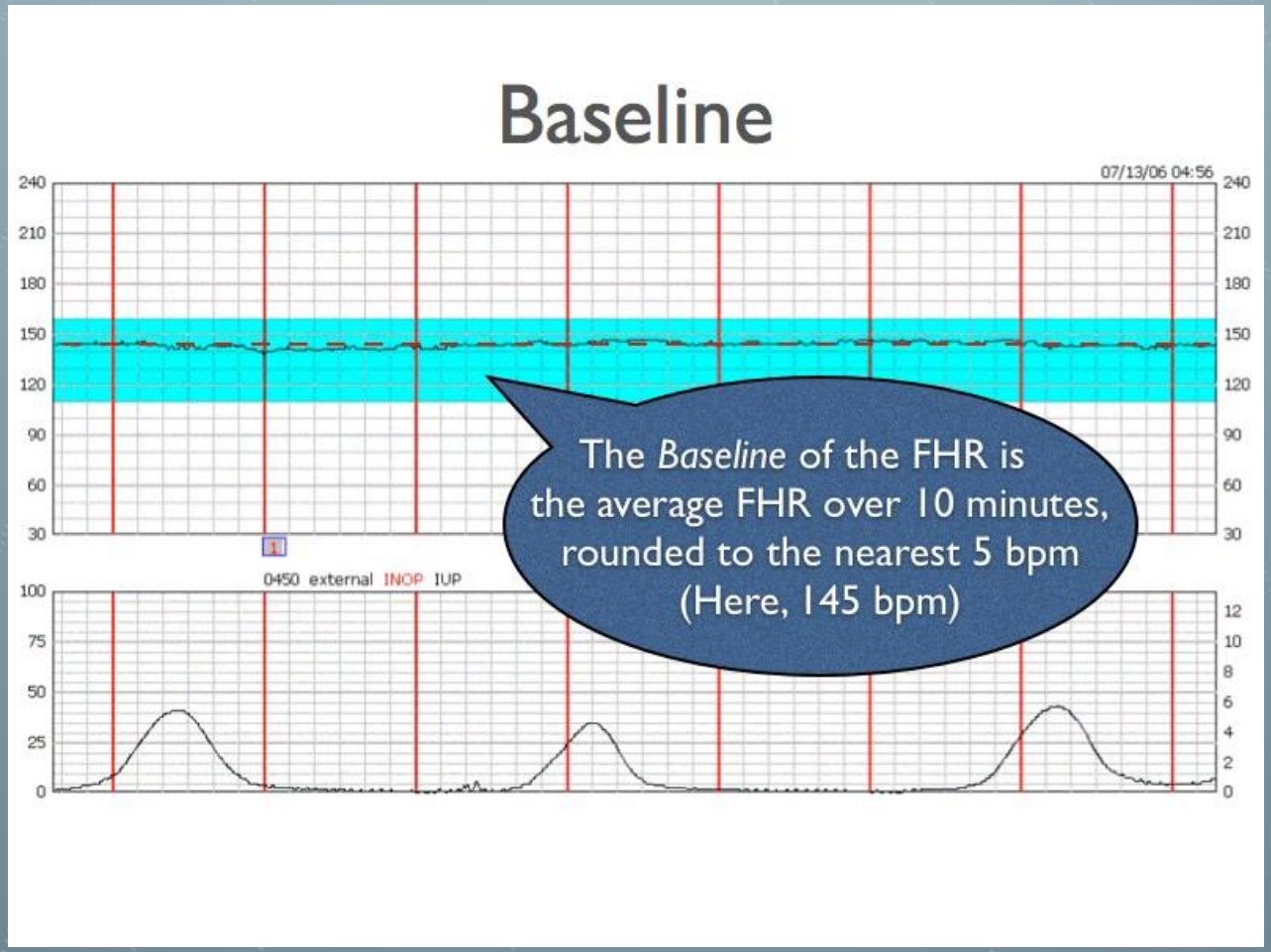
Uterine Activity



Fetal Heart Rate

- Baseline Fetal Heart Rate
  - Normal range is 110-160 bpm
  - Mean FHR over a 10 minute period rounded to increments of 5 bpm, excluding accelerations and decelerations and periods of marked FHR variability
  - In any 10-minute window, the baseline must last for at least a 2 minute period (not necessarily contiguous), otherwise the baseline is indeterminate. You may need to refer to the previous 10-minute window to determine the baseline.

Fetal Heart Rate



Fetal Heart Rate

- Tachycardia
  - Sustained baseline FHR greater than 160 bpm for more than 10 minutes
  - Causes can be either maternal or fetal
- Bradycardia
  - Sustained baseline FHR less than 110 bpm for more than 10 minutes
  - Causes can be either maternal or fetal

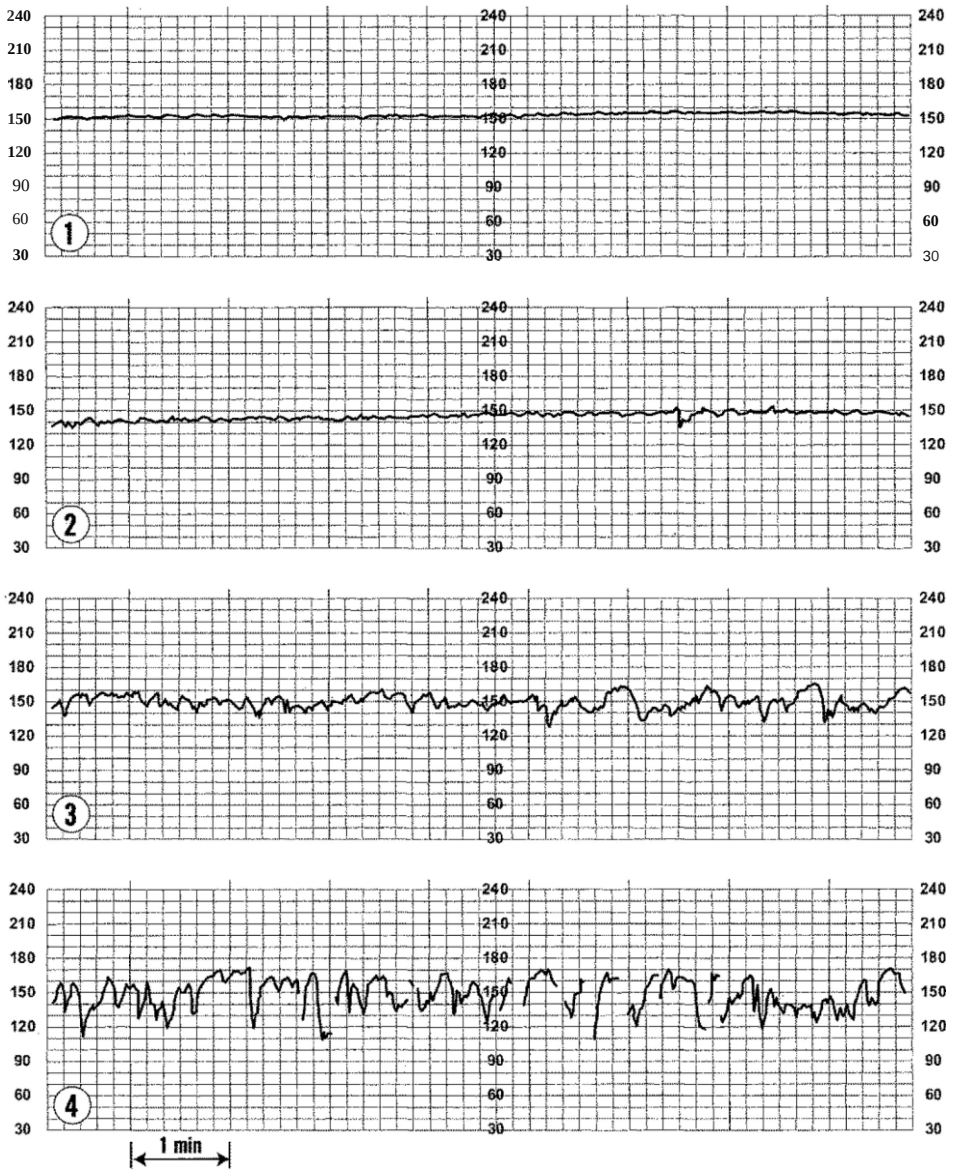
Fetal Heart Rate

- Baseline FHR variability
  - Fluctuations in the baseline FHR that are irregular in amplitude and frequency
  - Amplitude range is **visually** quantified as follows:
    - **Absent** FHR variability = Undetectable amplitude range
    - **Minimal** FHR variability = >undetectable ≤ 5 bpm
    - **Moderate** FHR variability = 6-25 bpm amplitude range
    - **Marked** FHR variability = >25 bpm amplitude range

Fetal Heart Rate

- Baseline FHR Variability: a reflection of current fetal oxygen reserve
  - Moderate variability: (Ideal)
    - If present, can exclude fetal acidemia at current time
  - Minimal variability
    - Sleep, sedation, hypoxic stress
  - Absent variability

VISUAL ASSESSMENT OF VARIABILITY SCALE



Adaptedfrom Electronic fetal heart monitoring: Research guidelines for interpretation, National Institutes of Child Health and Human Develop ment Research Planning Worksnop, 1997, *Journal of Obstetric, Gynecologic and Neonata l Nursing,* 26(6), 635--640. Copyright © AWHONN.

Fetal Heart Rate

- Periodic Changes
  - Associated ***with*** contractions
  - Recurrent if occur with ≥ 50% of contractions in a 20-minute window.
  - Intermittent if < 50% of contractions in 20 min
- Episodic Changes
  - Not associated with contractions

Fetal Heart Rate

- Periodic Changes
  - Late decelerations
  - Early decelerations
  - Variable decelerations
  - Accelerations
- Episodic Changes
  - Accelerations
  - Variable decelerations

Fetal Heart Rate

Accelerations

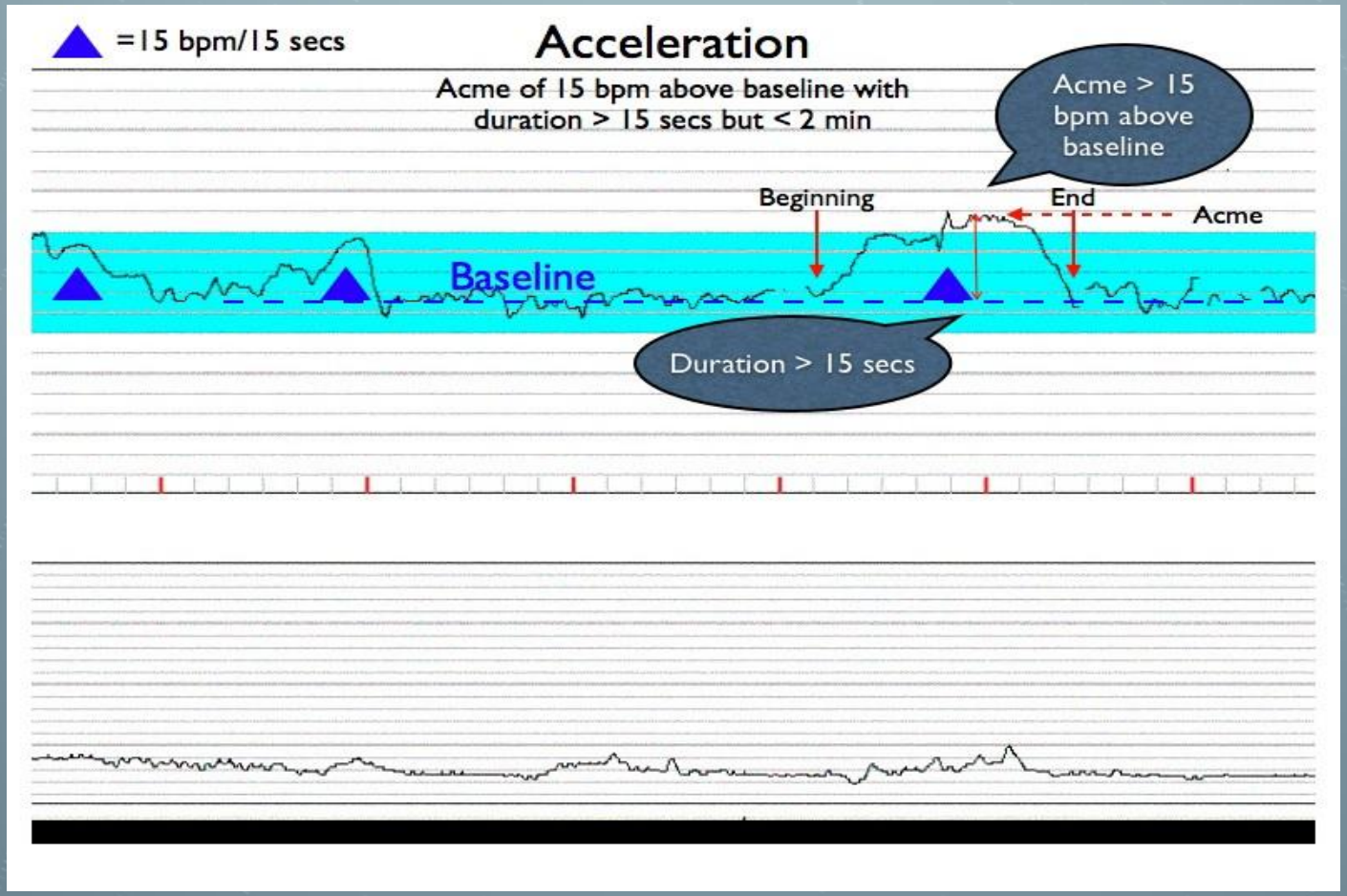
- Abrupt (onset to peak in < 30 sec) increases in FHR above the baseline
- Can be periodic or episodic
- In fetus ≥ 32 weeks should be at least 15 beats above the baseline and last for at least 15 seconds (15X15 rule)
- In fetus < 32 weeks, can be acceptable if 10X10

Fetal Heart Rate

Accelerations

- Indicate a well-oxygenated fetus with an intact CNS
- If present, can exclude fetal acidemia at that time

Fetal Heart Rate



Fetal Heart Rate

Decelerations

- Decrease from the baseline FHR
- Gradual or abrupt decline
- Periodic or episodic
- May be recurrent

Fetal Heart Rate

- Four types

  - Early

  - Late
  - Variable

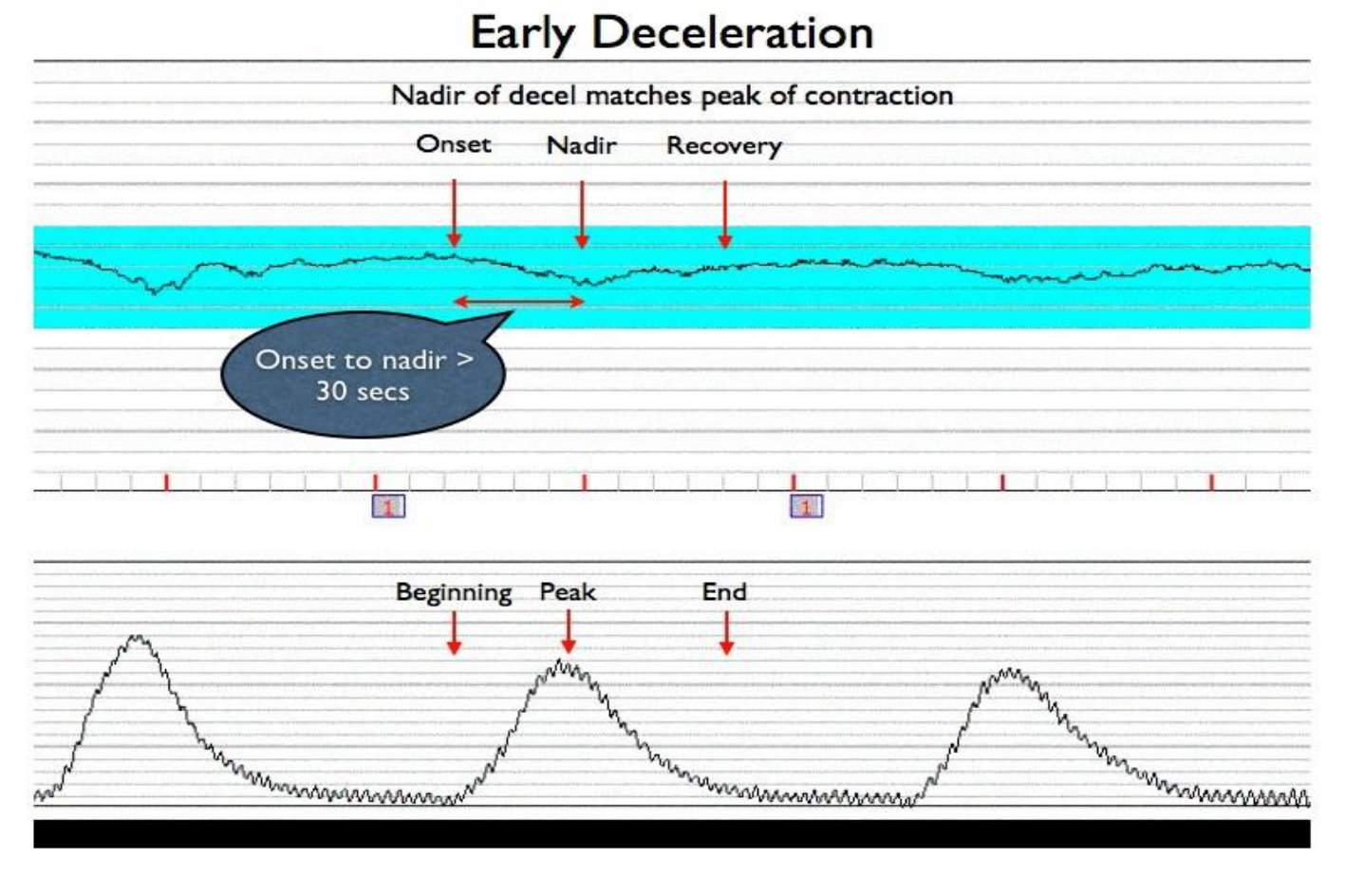
  - Prolonged

Fetal Heart Rate

Early Decelerations

- Gradual decrease (onset to nadir in ≥ 30 seconds) in the FHR from the baseline
- Usually symmetrical
- The lowest point (nadir) occurs with the peak of the contraction
- Associated with **head compression**
- Thought to be a benign response to head compression, but decide if they are occurring in the usual circumstance

Fetal Heart Rate



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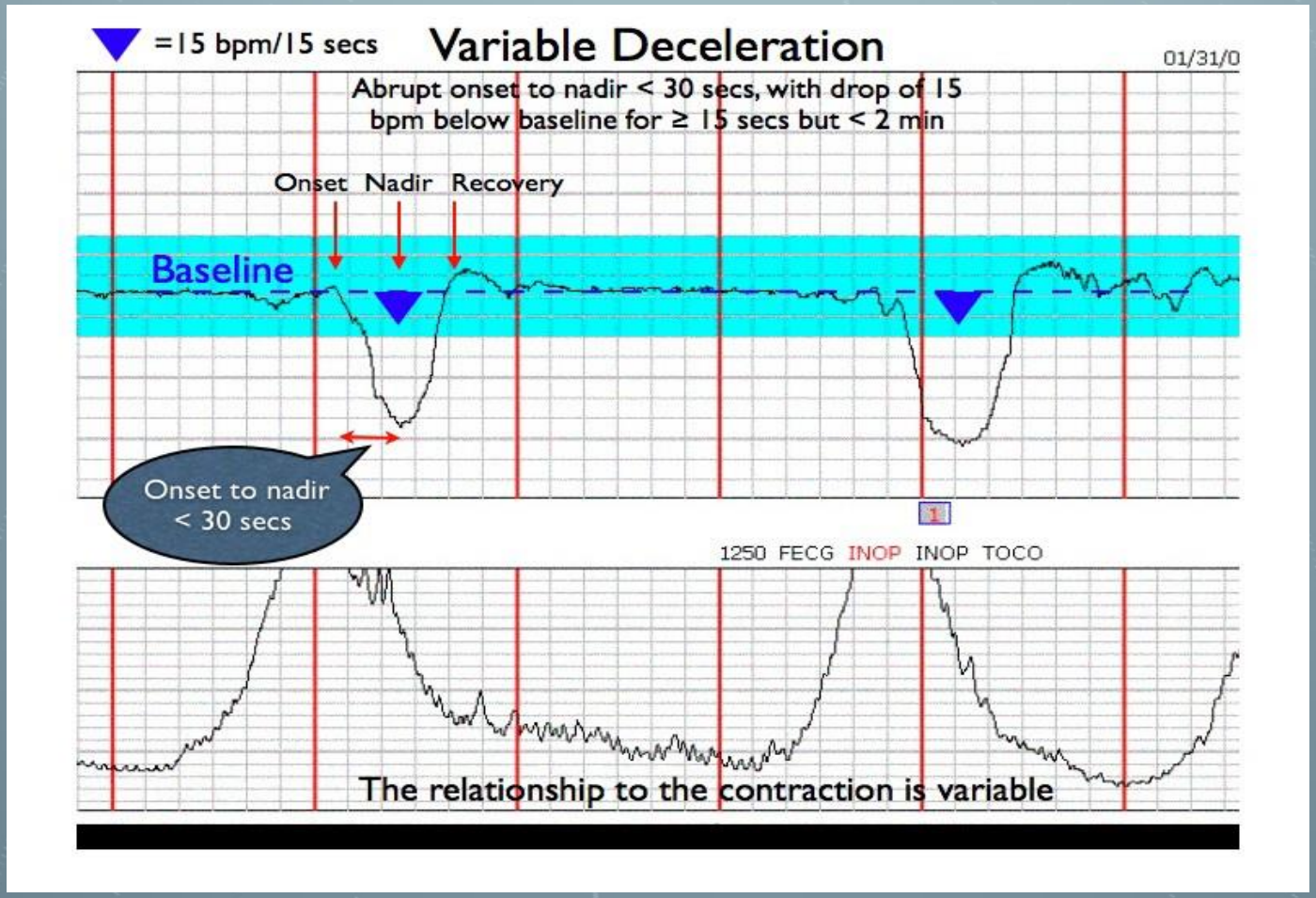
Fetal Heart Rate

Variable Decelerations

- Abrupt decline (onset to beginning of nadir in ≤ 30 seconds) from baseline FHR with usual abrupt return also
- Decrease is ≥ 15 bpm, lasting ≥ 15 seconds, and < 2 min
- Can be periodic or episodic
- Associated with **cord compression**
- Significance depends on duration and persistence and other parameters of the clinical picture, such as baseline FHR, variability, presence/absence of accelerations. Look at entire clinical picture to determine fetal tolerance

Fetal Heart Rate



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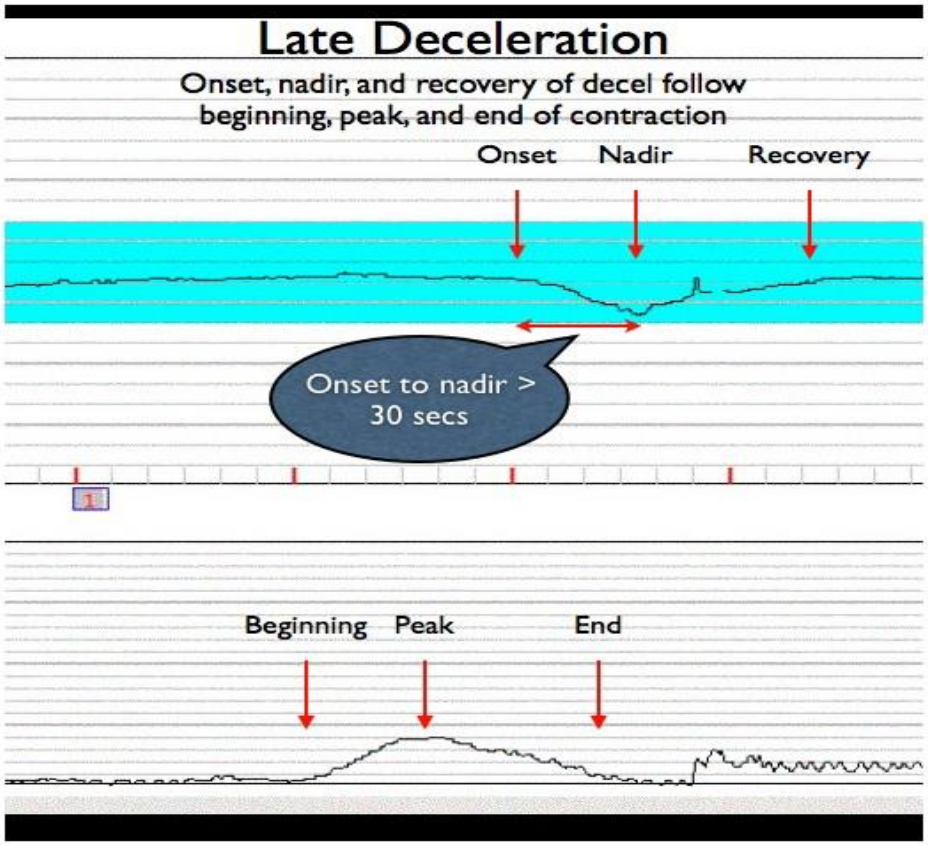
Fetal Heart Rate

Late Decelerations

- Gradual decrease (onset to nadir in ≥ 30 seconds) and return to baseline with nadir occurring after the peak of the contraction
- Usually symmetrical
- At end of contraction, FHR will not have returned to baseline (delayed in timing)
- Associated with **utero-placental insufficiency (UPI)**
- Determine significance by assessing if you can "fix" the cause—and by their recurrence
- Fetal tolerance determined by accompanying FHR baseline, **variability** and presence or absence of other periodic or episodic changes

Fetal Heart Rate



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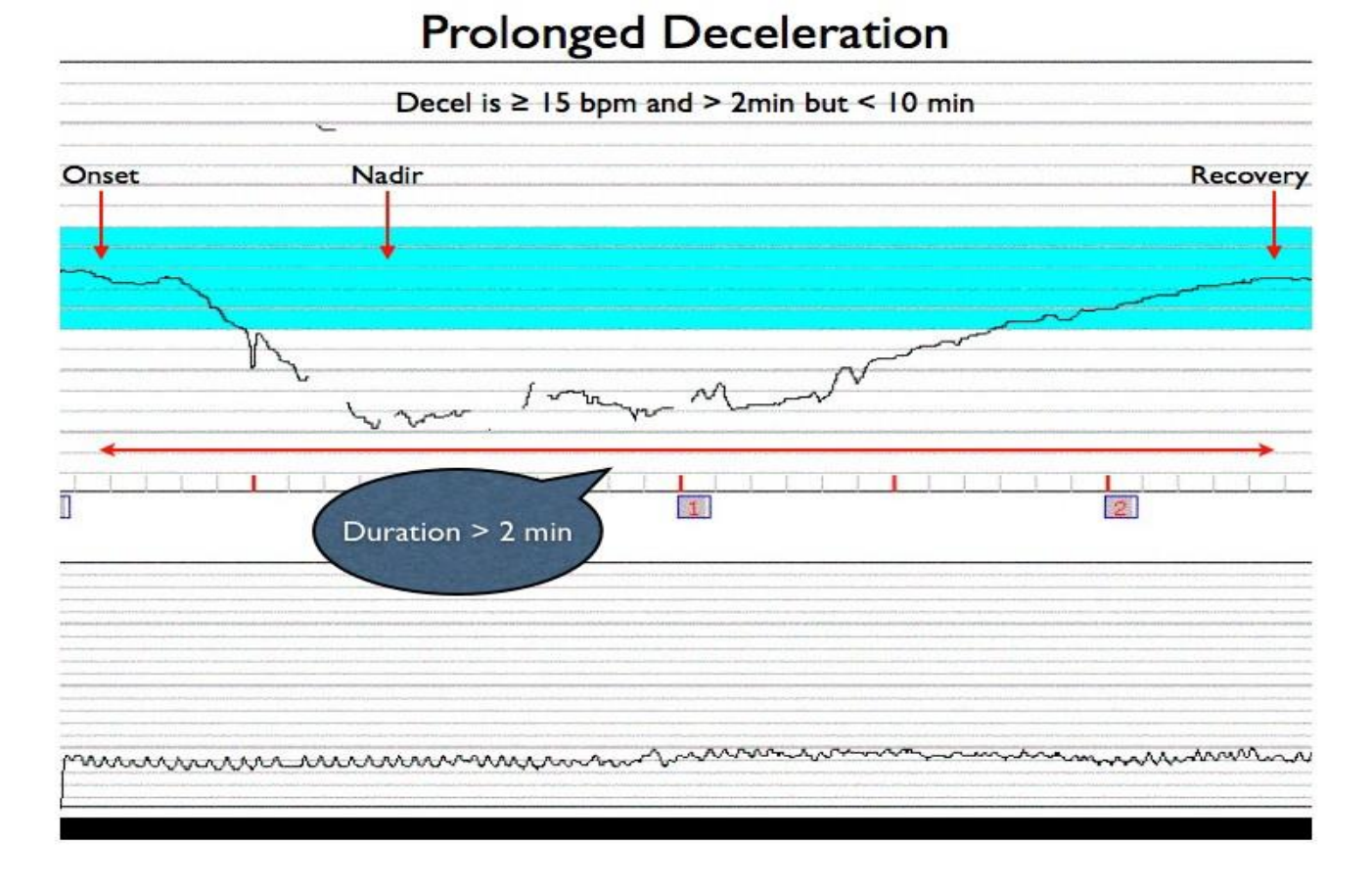
Fetal Heart Rate

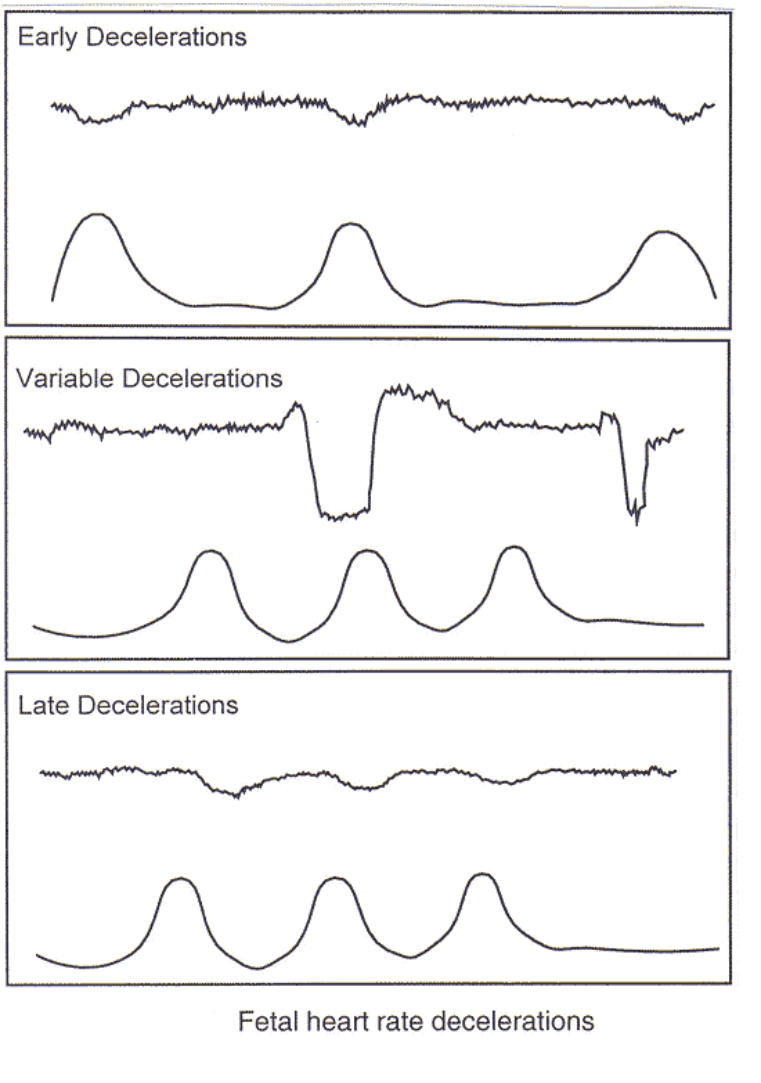
Prolonged Deceleration

- Deceleration lasting ≥ 2 minutes and < 10 minutes
- What just happened?
- **Fix the cause!**
- Usually will return to pre-deceleration state if interventions relieve the cause

Fetal Heart Rate



Fetal Heart Rate



Fetal heart rate decelerations

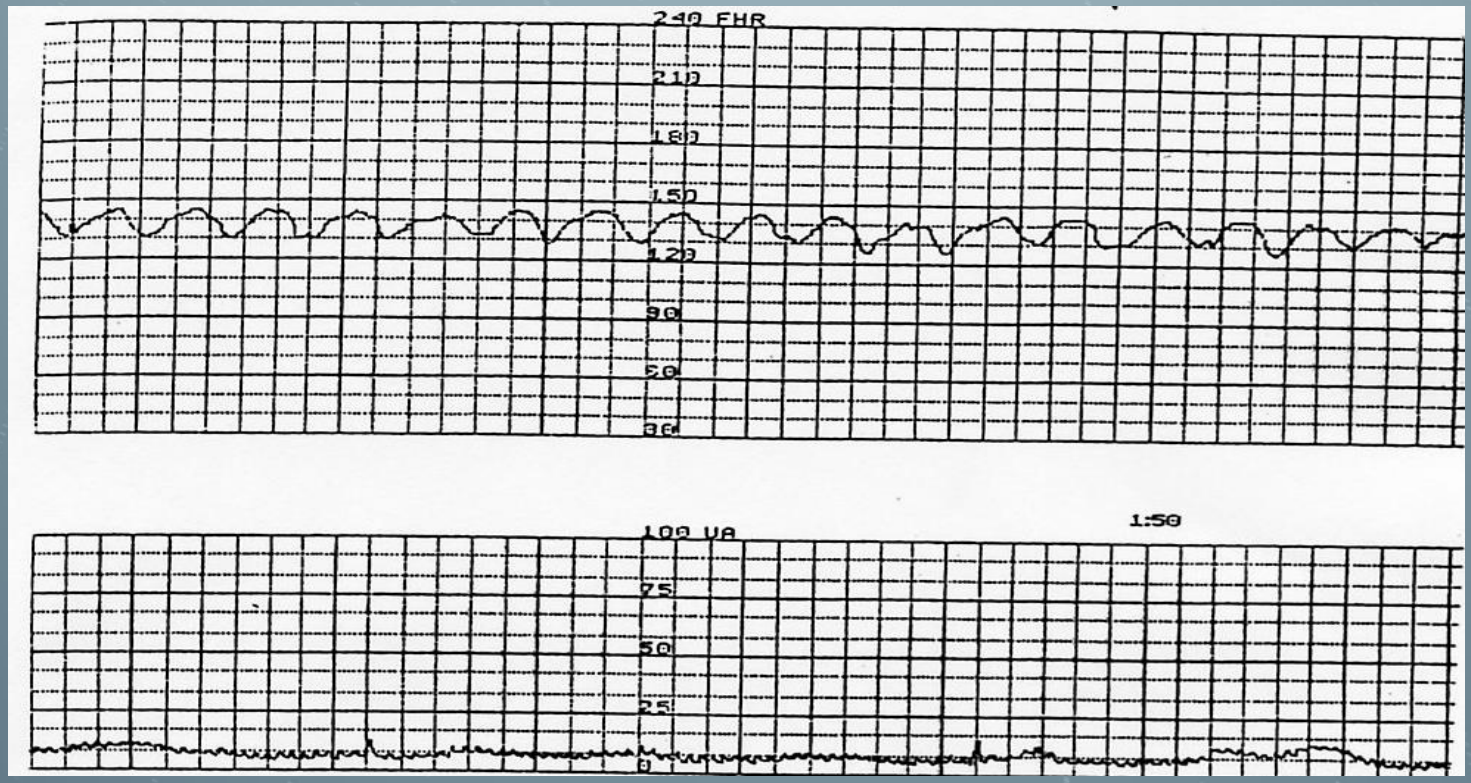
V ariable ?
E arly ?
A ccl. ?
L ate ?

C ord
H ead
O k
P lacenta

Fetal Heart Rate

Sinusoidal FHR Pattern

- Smooth, sine wave-like undulations with a cycle frequency of 3-5/ minute lasting ≥ 20 minutes



Basic Pattern Interpretation

- The 2008 NICHD Report of Fetal Heart Rate Monitoring:
  - Defined standard fetal heart rate nomenclature
  - Identified three categories for fetal heart rate interpretation
  - Proposed future research
    - Endorsed by ACOG, AWHONN, ACNM, AAFP

Interpretation

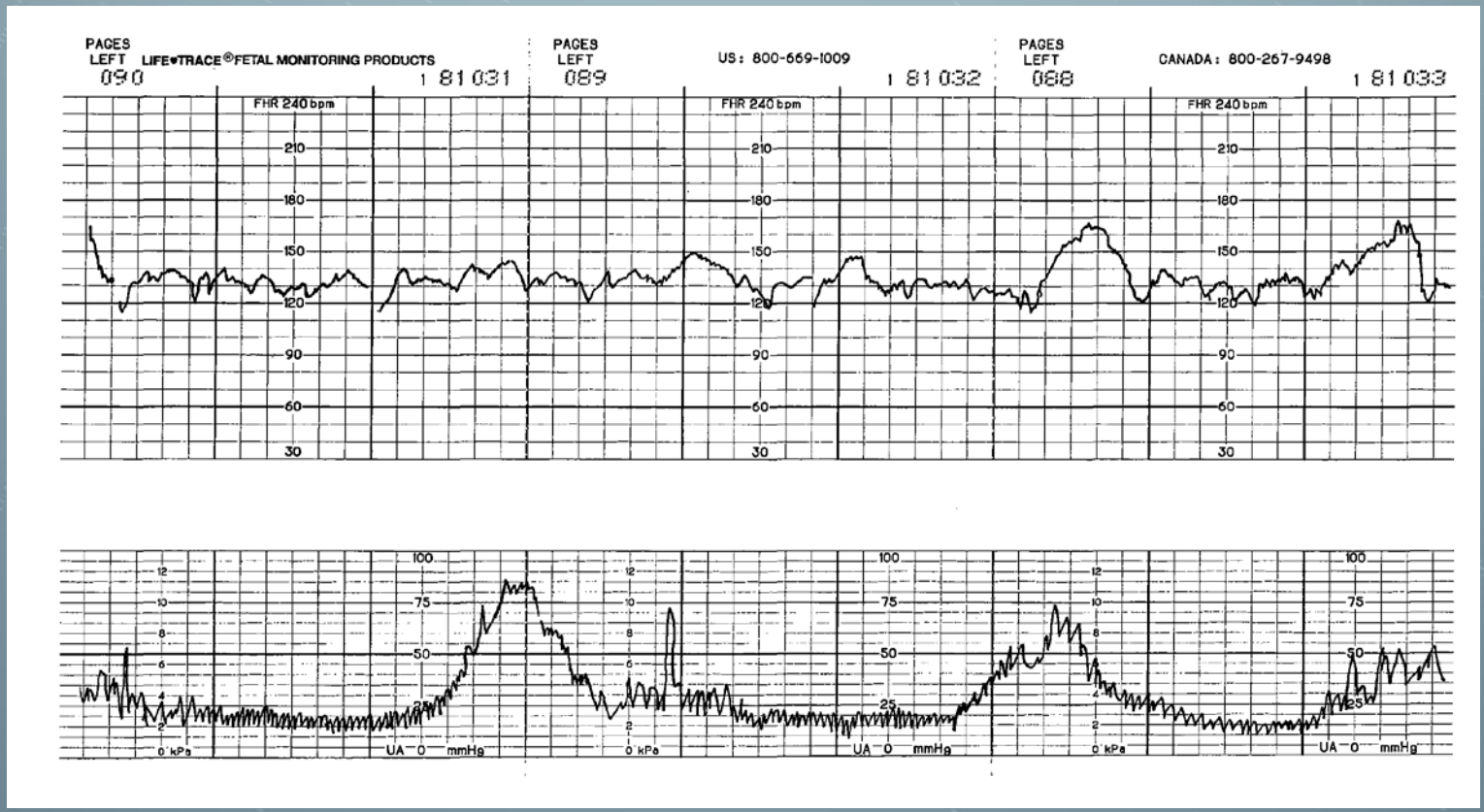
- **NICHD Three Tier FHR System**
  - **Category I**
  - **Category II**
  - **Category III**

- **Refers to the Acid Base Status of fetus**

Interpretation

- Category I – Normal fetal acid-base status
  - Includes ALL of the following:
    - Baseline FHR: 110-160 bpm
    - Baseline variability: moderate
    - Late or variable decelerations: absent
    - Early decelerations: present or absent
    - Accelerations: present or absent

Category I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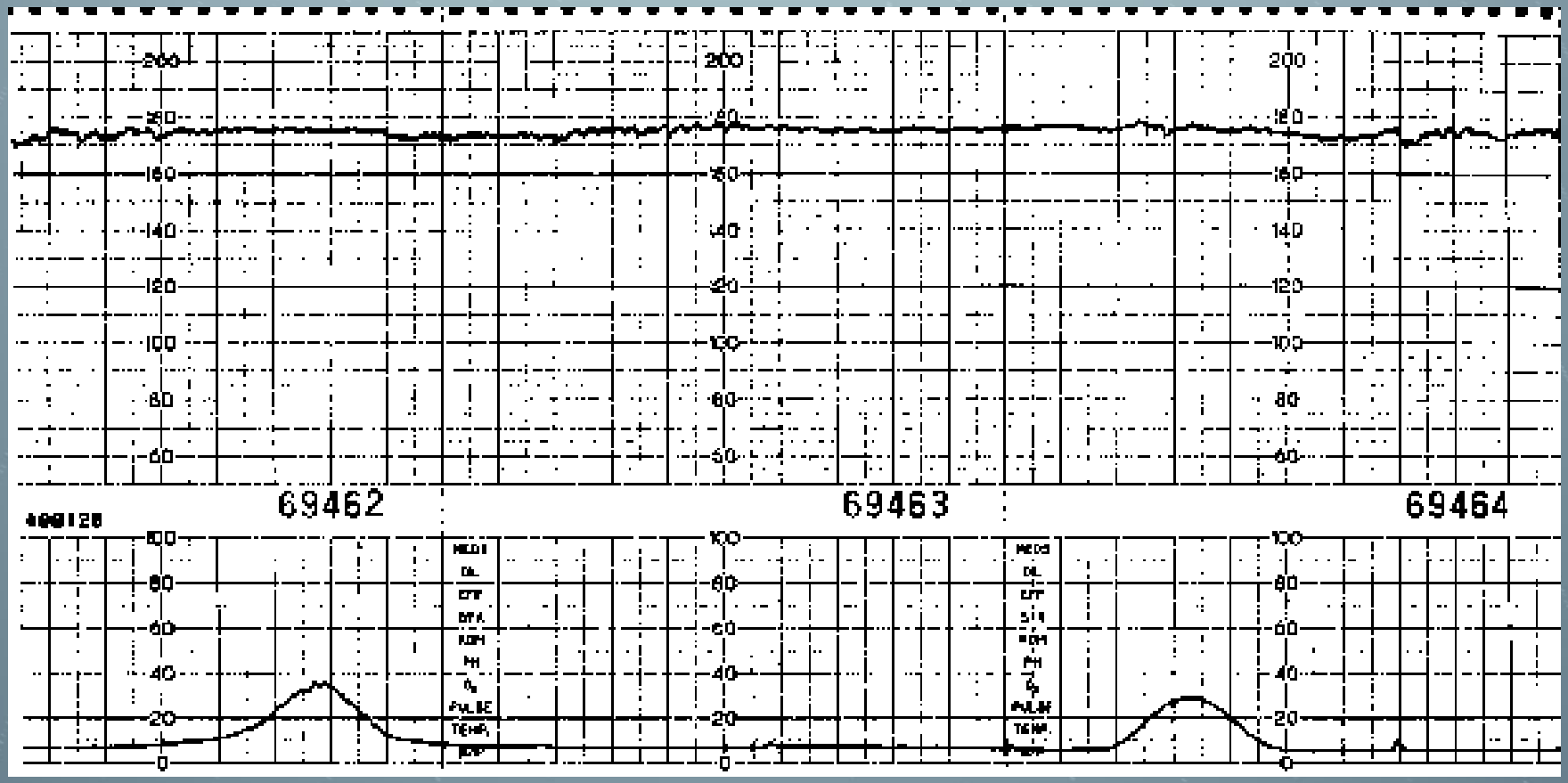
FHR 240 bpm
210
180
150
120
90
60
30
UA 0 mmHg
0 kPa

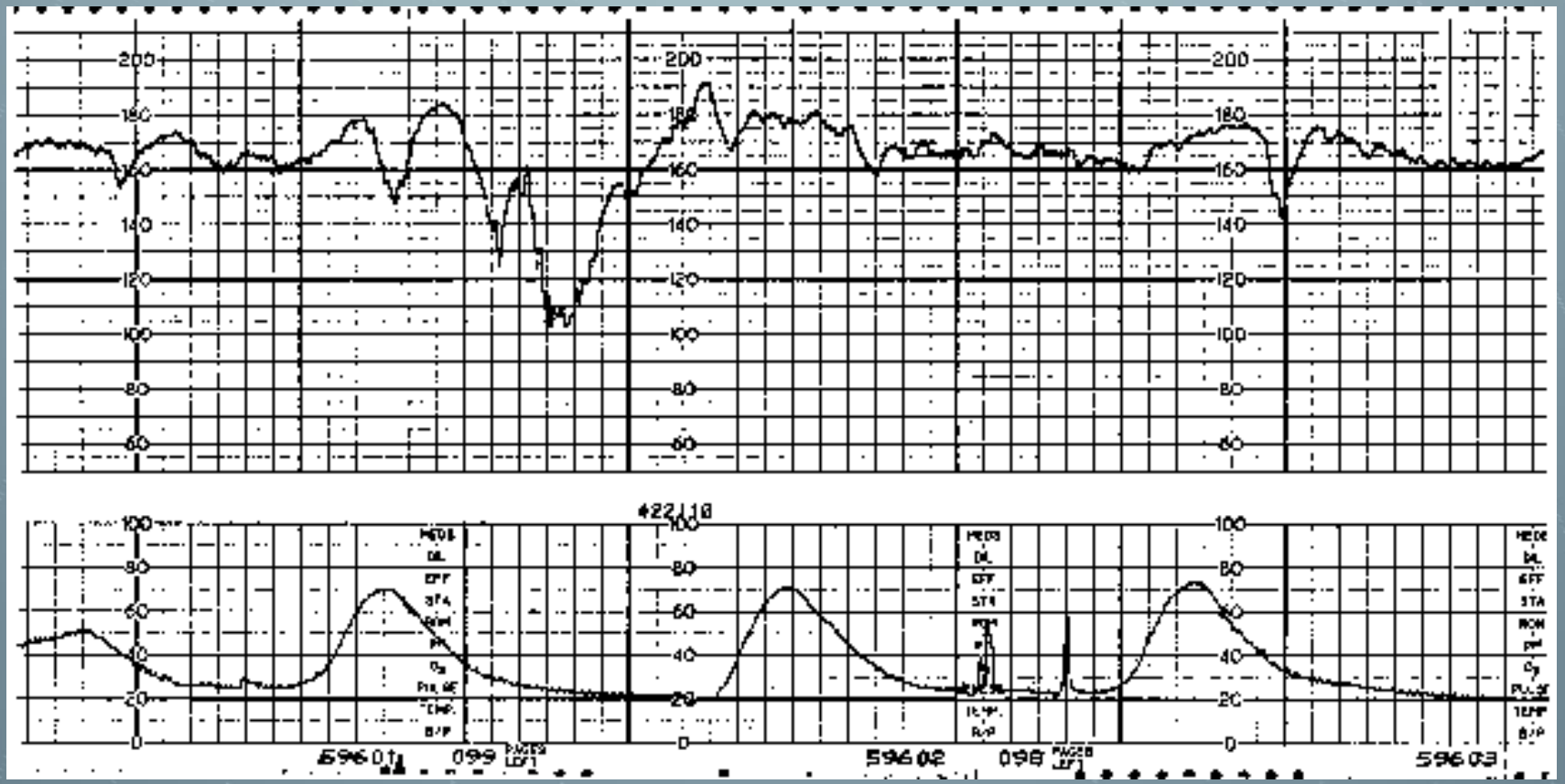
Interpretation

- Category II - Indeterminate fetal acid-base status
- Examples:
  - Bradycardia not accompanied by absent variability
  - Tachycardia
  - Minimal variability
  - Absence of induced accelerations after fetal stimulation
  - Prolonged decelerations
  - Recurrent late decelerations with moderate variability

Category II



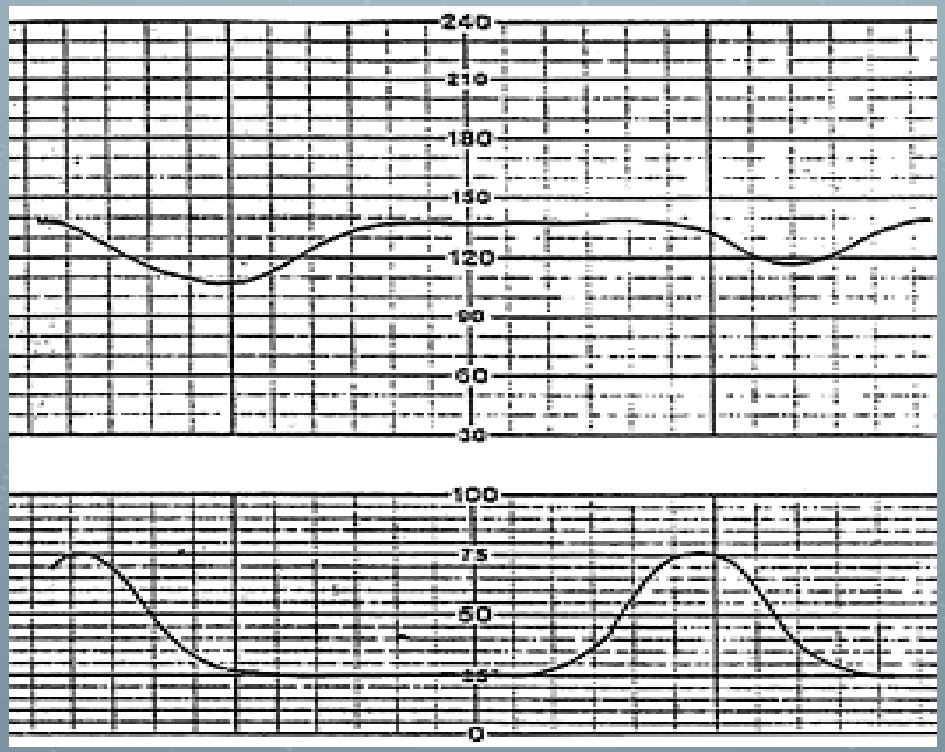
Category II



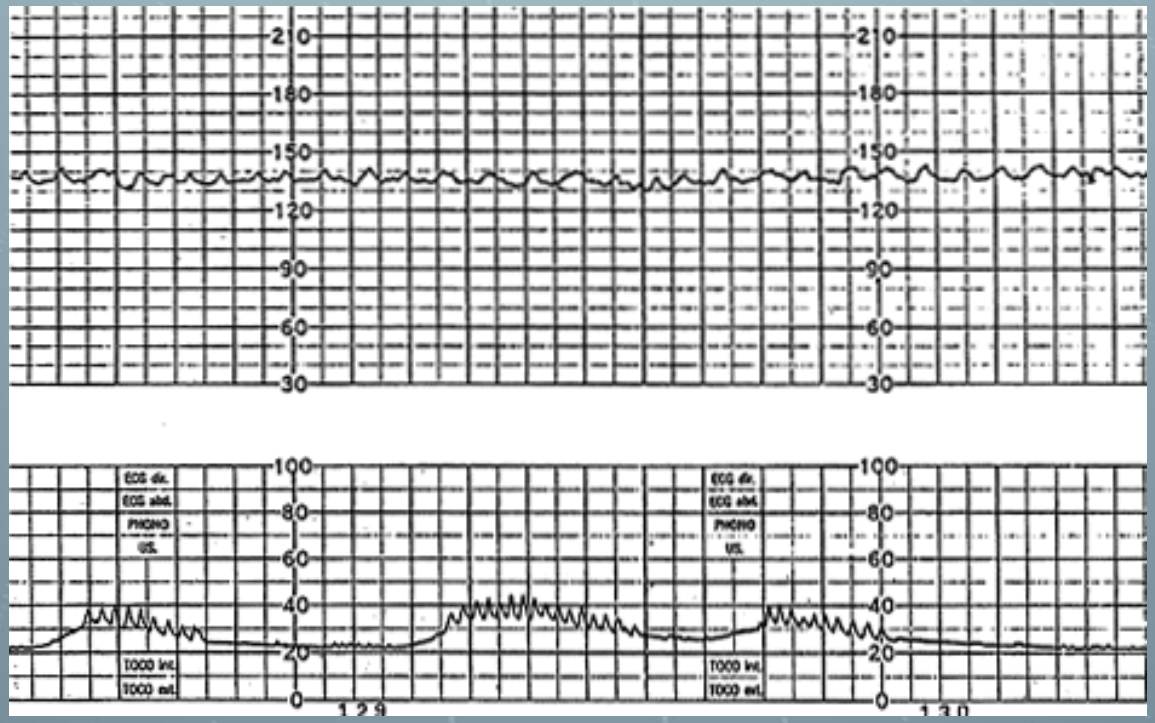
Interpretation

- Category III – Predictive of abnormal fetal acid-base status
- Includes:
  - Absent FHR variability AND
  - Bradycardia OR recurrent lates OR recurrent variable decelerations
- *OR*
  - Sinusoidal pattern

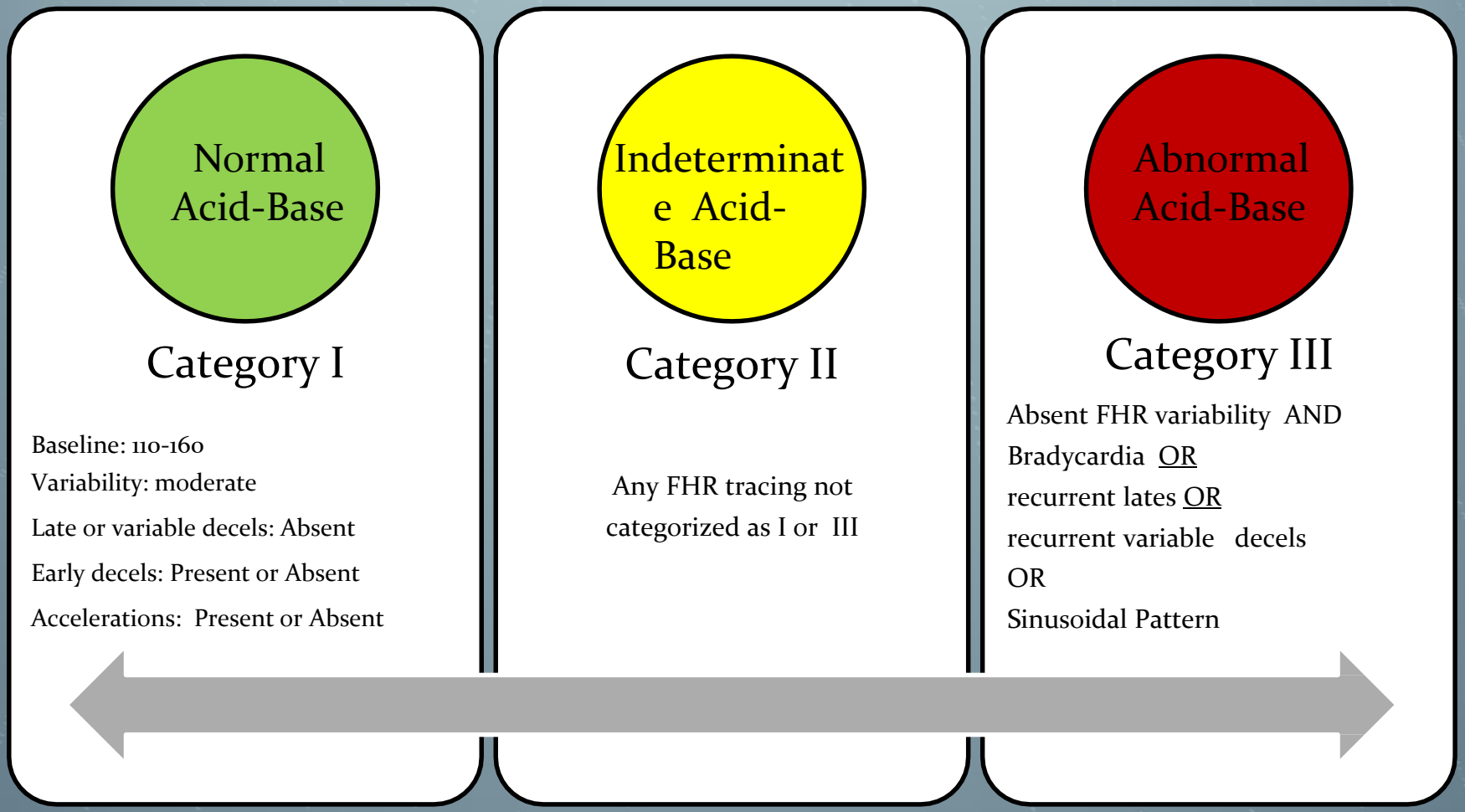
Category III



Category III



FHR Occurs Across a Continuum



General Management Principles

- Category I: predictive of *normal acid-base status*; follow in routine manner; no action required

- Category II: *indeterminate of fetal acid-base status*
  - Require heightened surveillance
  - Clinical interventions vary to circumstances
  - Consider birth options in context of labor progress & evolution of pattern

- Category III: predictive of *abnormal fetal acid-base status*
  - Clinical interventions vary to circumstances
  - If not quickly resolved, expedite delivery

FHM Case

Gina is a **G3, P2002** at **39 6/7** weeks' gestation

She came to L&D with c/o decreased FM for 24 hr.

Prenatal course without complication and all labs WNL

NST was non-reactive and **BP:156/98, P:88, R: 18, T:98.8 15 min.**

repeat BP 150/96

SVE – 2/80%/-1

Provider notified, ordered oxytocin induction

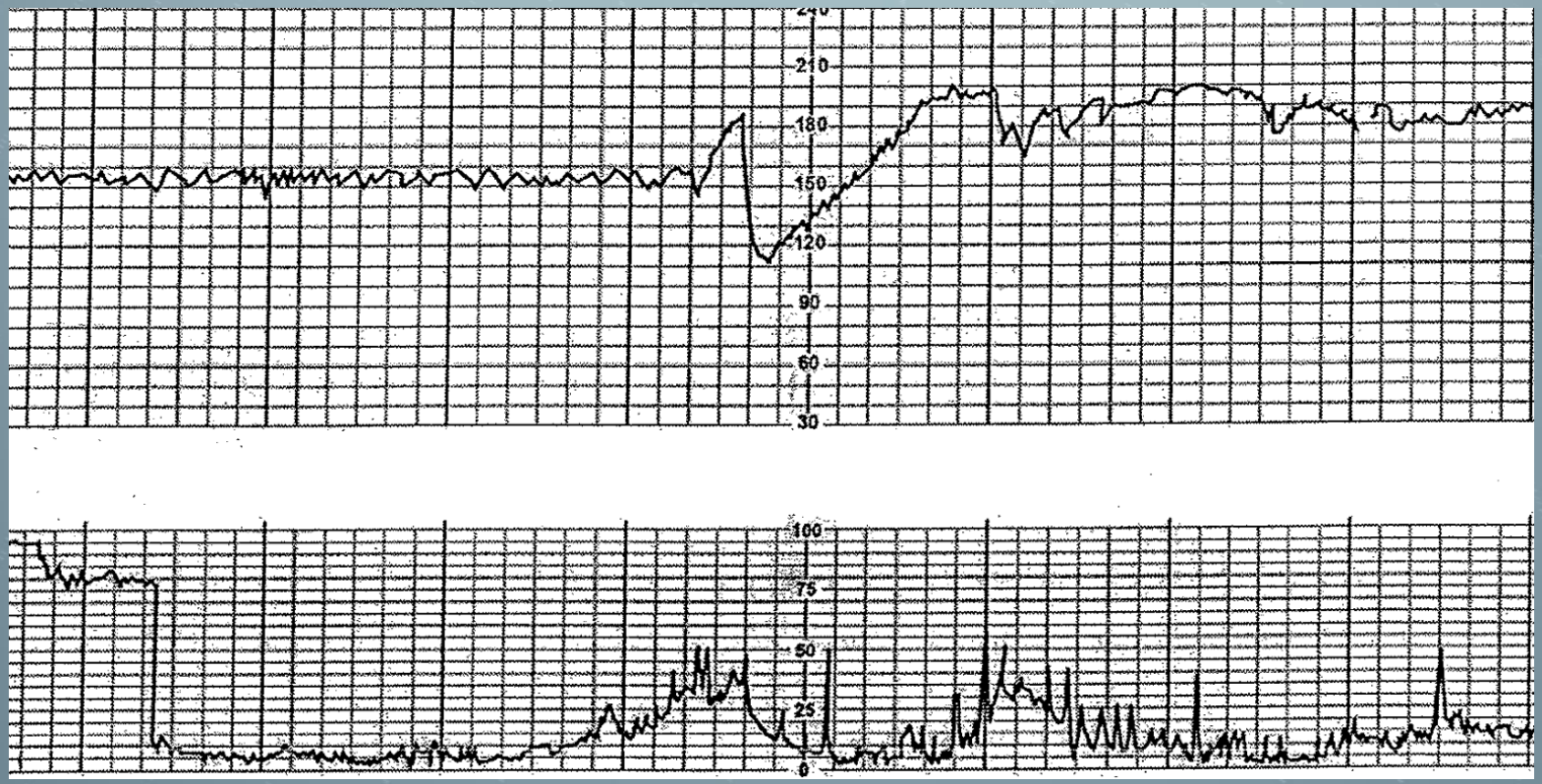
What are her risk factors?

↓FM- NR NST

↑BP

US/ TOCO

2 hr. later. Oxytocin at 8mu/min. SVE 3/80%/-1, BP 154/96



BL, variability, decels, category?

155, mod, variable, II

What FHR characteristic indicates the presence or absence of fetal oxygen reserve?

a. Depth of deceleration pattern
b. Duration of deceleration of pattern
c. Presence of variability

Interventions?

- Reposition
- Fluid bolus

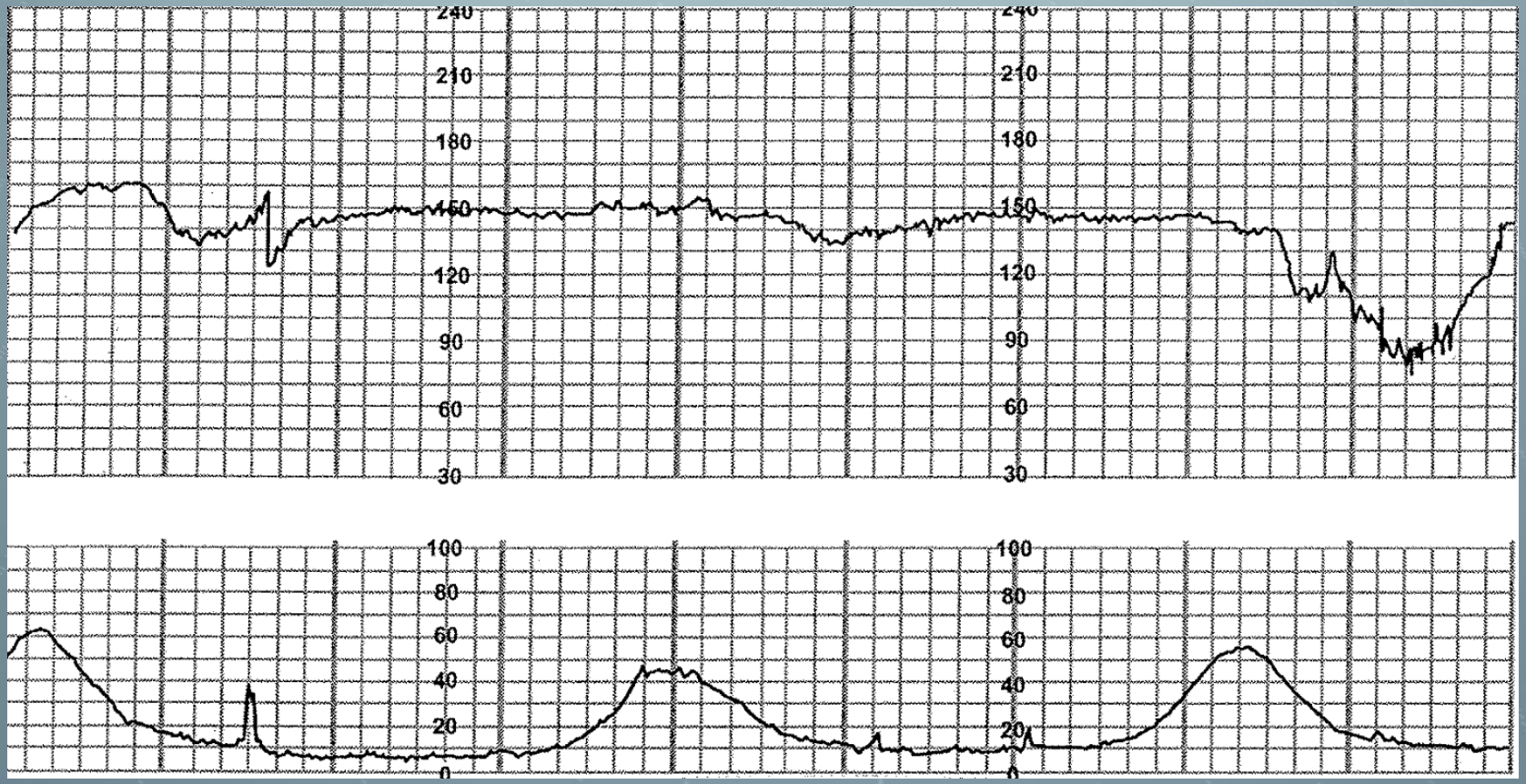
Maybe DC Oxytocin (protocol ?)

Moderate variability/single variable deceleration O2 not indicated

FSE/IUPC

40 min. later. SROM, clear fluid. BP 162/98, c/o HA

Magnesium Sulfate Infusion Initiated. Labetalol 20 mg IV SVE 4/90%/-1



BL, variability, decels, category? 150,

minimal, variable and late, II Contractions?

q 3 min, 90-100 sec, 45-60 peak, 8-10 Resting tone

What is a possible physiologic extrinsic influence (outside the baby) causing Gina's tracing?

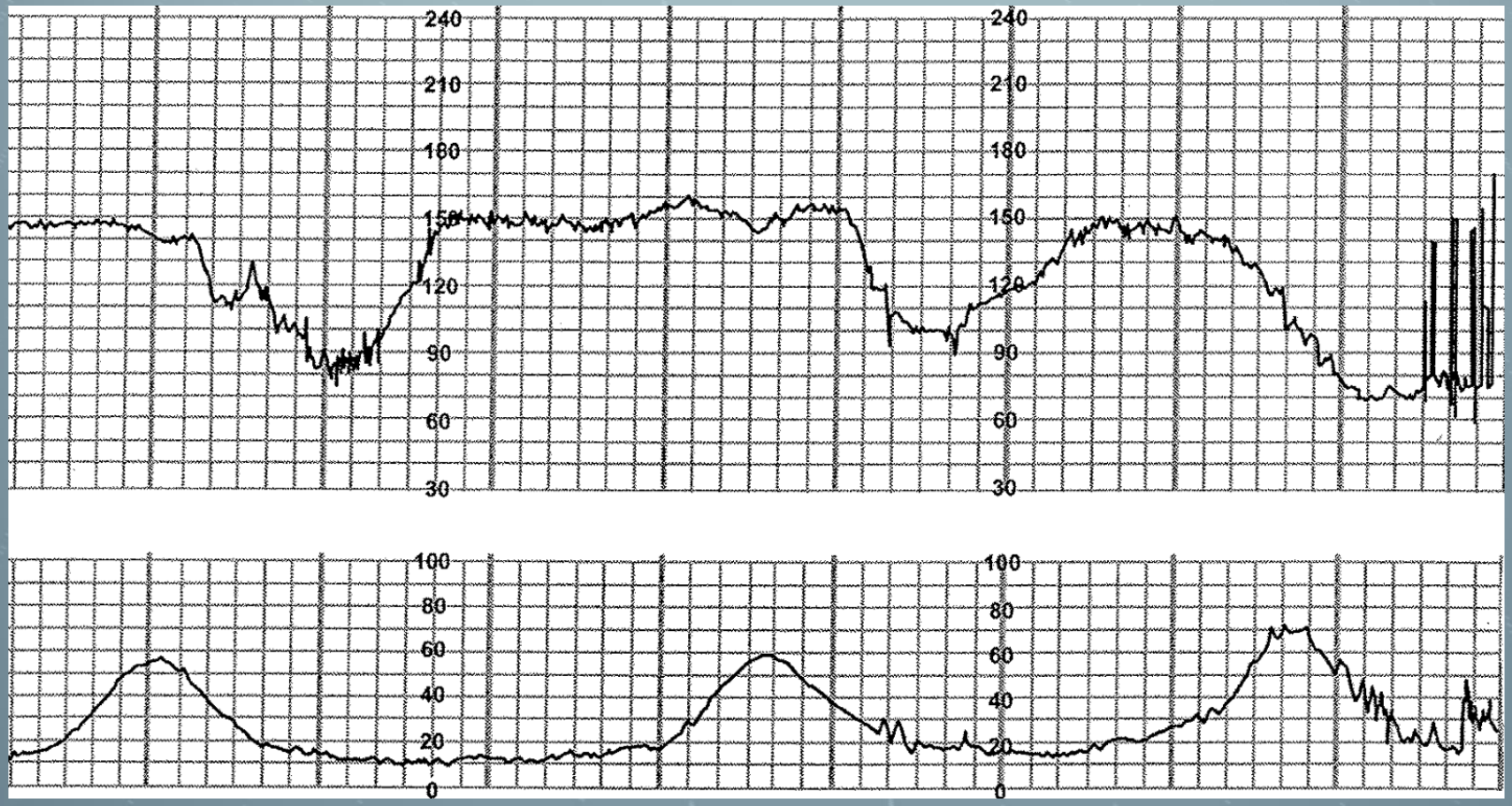
a. Increased uterine tone
b. Decreased placental blood flow
c. Fetal growth restriction

- Oxytocin was discontinued

FSE/IUPC

1 hr. later. Epidural in place. BP 155/96

Magnesium Sulfate at 2 gm/hr. SVE 9/100%/+1



BL, variability, decels, category?

150,min-mod, late, variable, prolonged, II

Contractions?

q 2-3 min, 90-130 sec, 55-70 peak, 10-15 RT (MVU- ?)

What is a possible physiologic rationale for the FHR pattern?

a. Compromised placental and umbilical perfusion
b. Head compression and Magnesium Sulfate
c. Late decelerations and fetal acidosis

- Gina gave birth 40 min. later- pushed for 20 min. on her side with every other contraction, O2 per mask.

- SCN was at delivery.
- Baby girl did not require resuscitation. APGARs of 7/9 (1 off color, tone, reflex irrit.), wgt. 6# 14.

- Pt continued on Mag for 24 hr.

- Discharge BP 144/90, home on Labetalol p.o., f/u in 3 days

Interventions

How do I fix this problem?

Interventions

- **Physiologically based**

- Follow the nursing process
  - Assess – Interpret - Diagnose – Intervene – Evaluate

- What is the underlying cause?
- Can I fix it?

- If not, interventions should promote oxygenation of mother and fetus

Interventions

Five physiologic interventions:

- Maximize uterine-placental blood flow
- Maximize umbilical circulation
- Maximize available oxygen
- Maintain appropriate uterine activity
- Support maternal coping and labor progress

Interventions

- How do we meet these goals?
  - **Position laterally**
    - Relieve pressure on umbilical cord
    - Increases blood flow through the uterus and placenta
    - Relieve supine hypotension
  - **Intravenous hydration**
    - Increases blood volume to increase blood flow to placenta and uterus
  - **Medication**
    - Turn off, decrease or remove oxytocin or other agents
    - Administer tocolytics
    - Administer oxygen to treat maternal hypoxia
  - **Reduce pain/anxiety**

Interventions

Questions to think about:

- Are there FHR Baseline changes?
  - Tachycardia, Bradycardia, decreased variability
- What is the cause?
  - Do I need further information?
- How can I correct the problem?
- Did my interventions fix it?

Deceleration	Cause	Physiologic Intervention
Variable	Cord Compression	• Maximize umbilical blood flow (lateral position, IV fluids)
Late	Maternal perfusion, decreased placental function, tachysystole	• Maximize utero-placenta blood flow (lateral position, IV fluids) • Maximize available oxygen (help with maternal coping, O2 if necessary) • Maintain appropriate uterine activity (decrease, turn off or remove oxytocin or other agents)
Prolonged	Tachysystole, hypotension, cord prolapse, cord compression, rapid fetal descent	• Maximize utero-placenta blood flow (lateral position, IV fluids) • Maximize available oxygen (help with maternal coping, O2 if necessary) • Maintain appropriate uterine activity (decrease, turn off or remove oxytocin or other agents)
Early	Head Compression	• Support maternal coping

Review of FHR Strips

Group Practice

- Reading FM strips takes time and lots of practice
- Class is only an introduction to concepts that it is based on
- Reviewing strips in the context of labor with an expert mentor is the best way to learn
- It is a process of constant practice and updating

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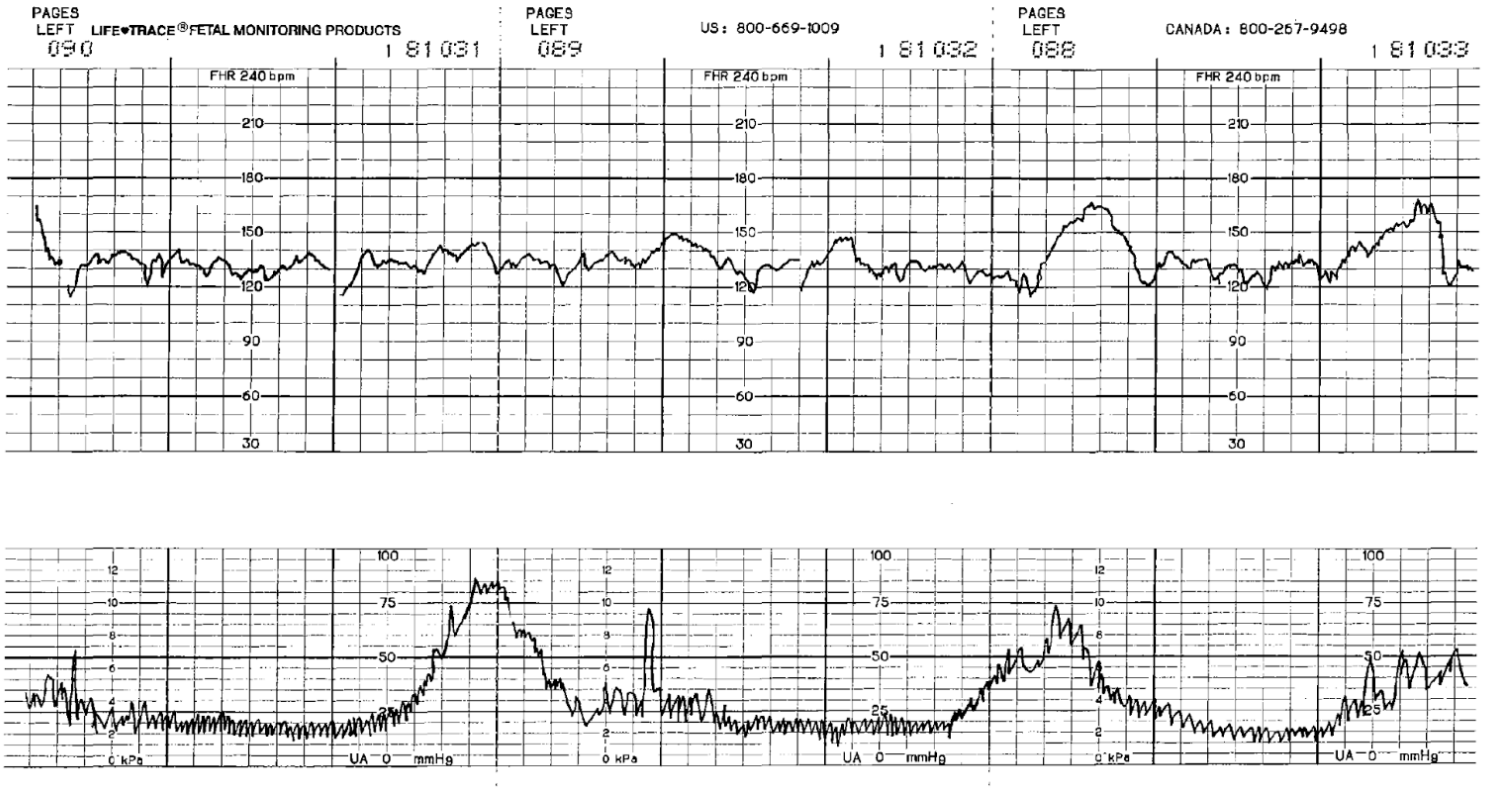
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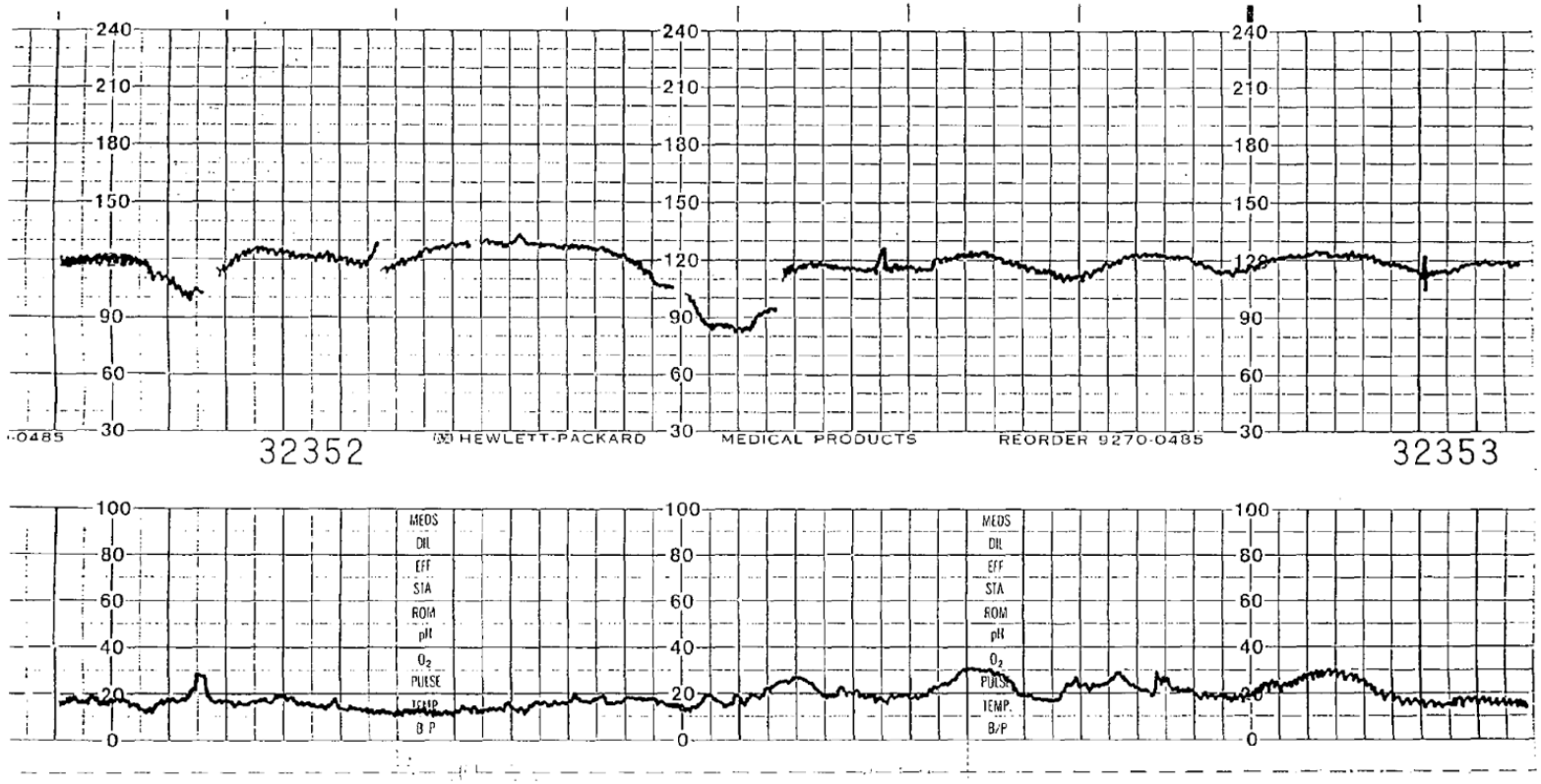
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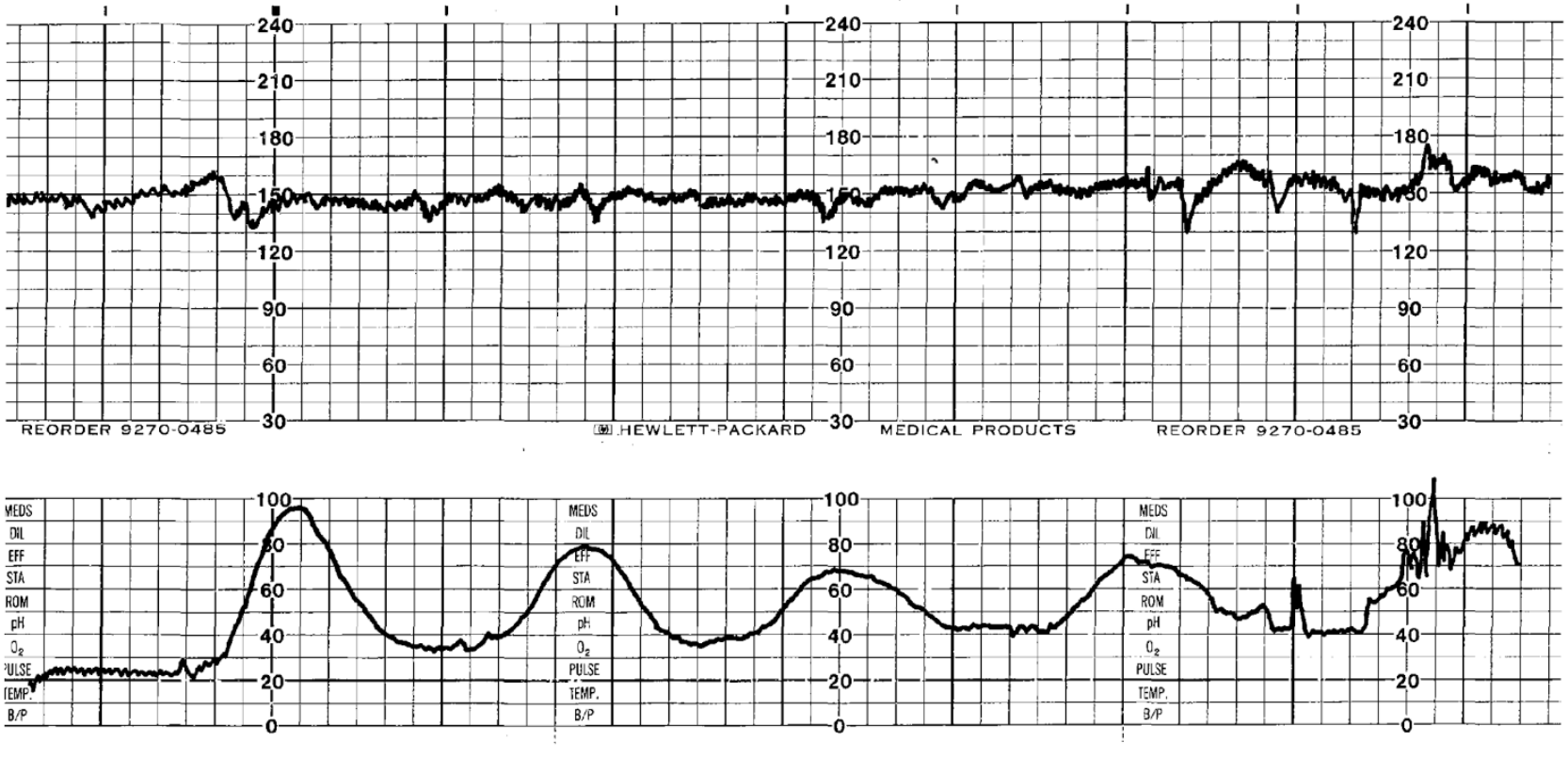
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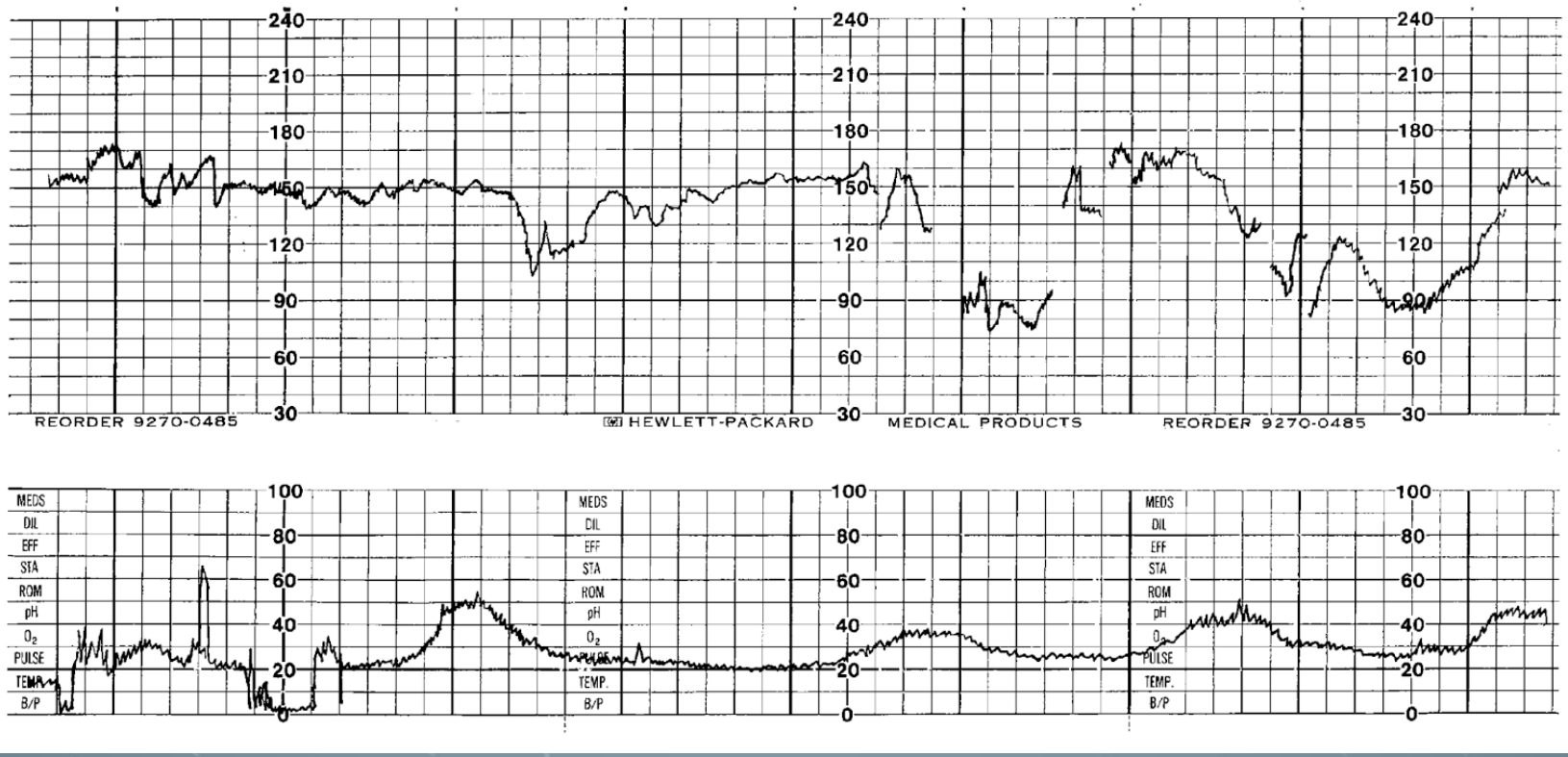
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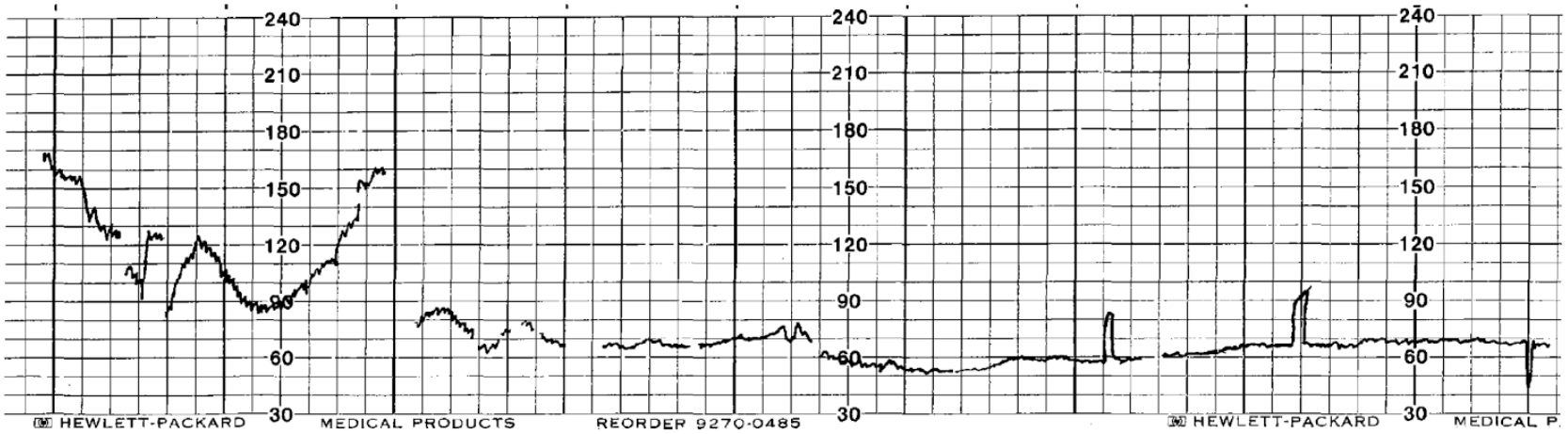
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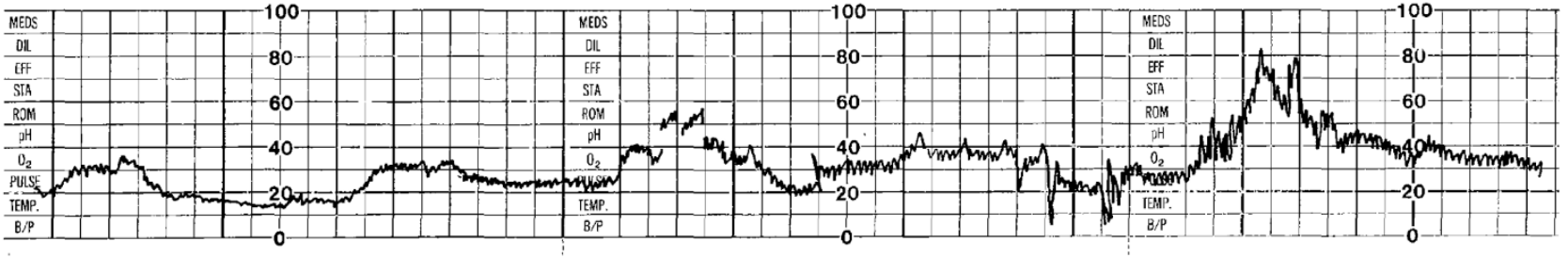
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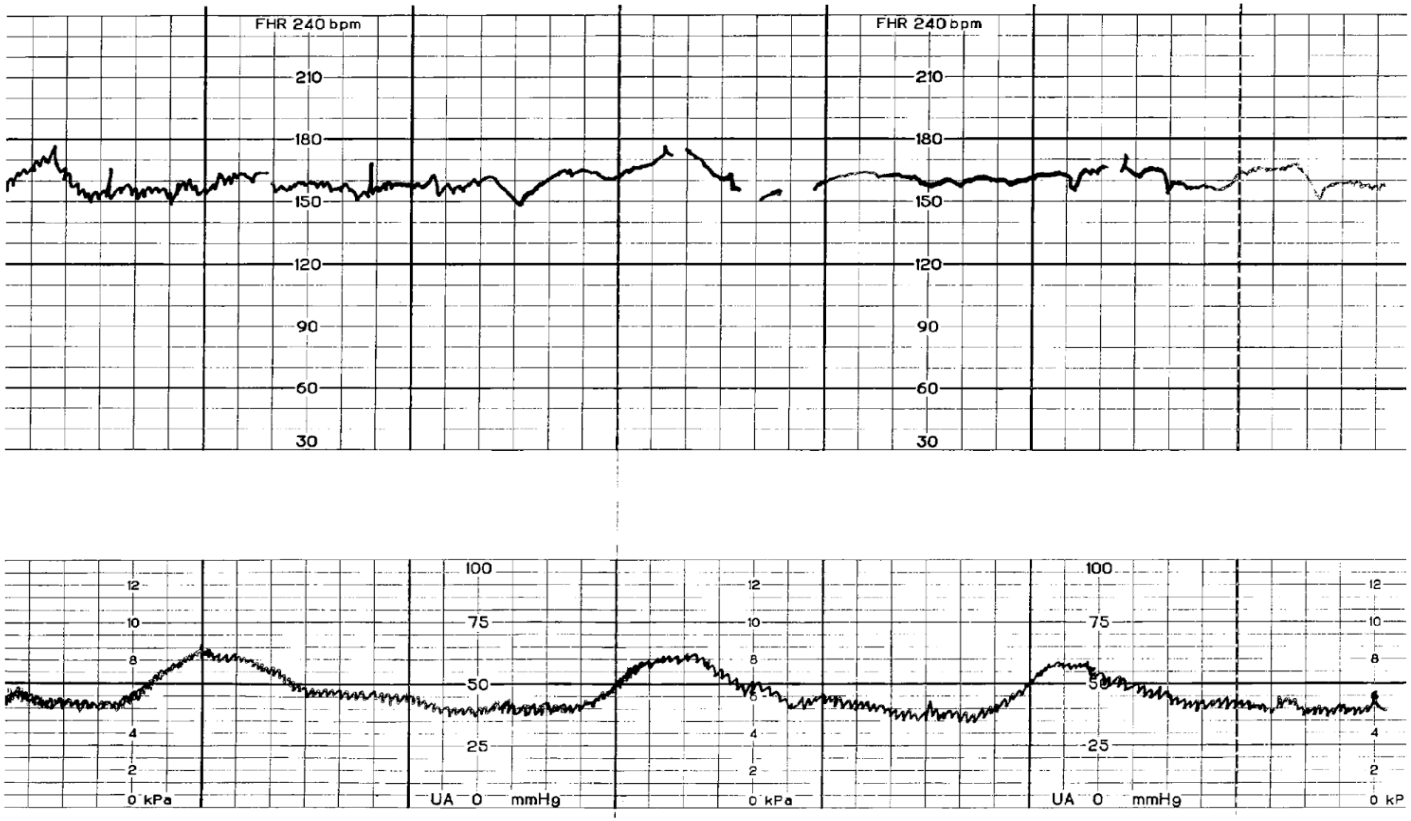
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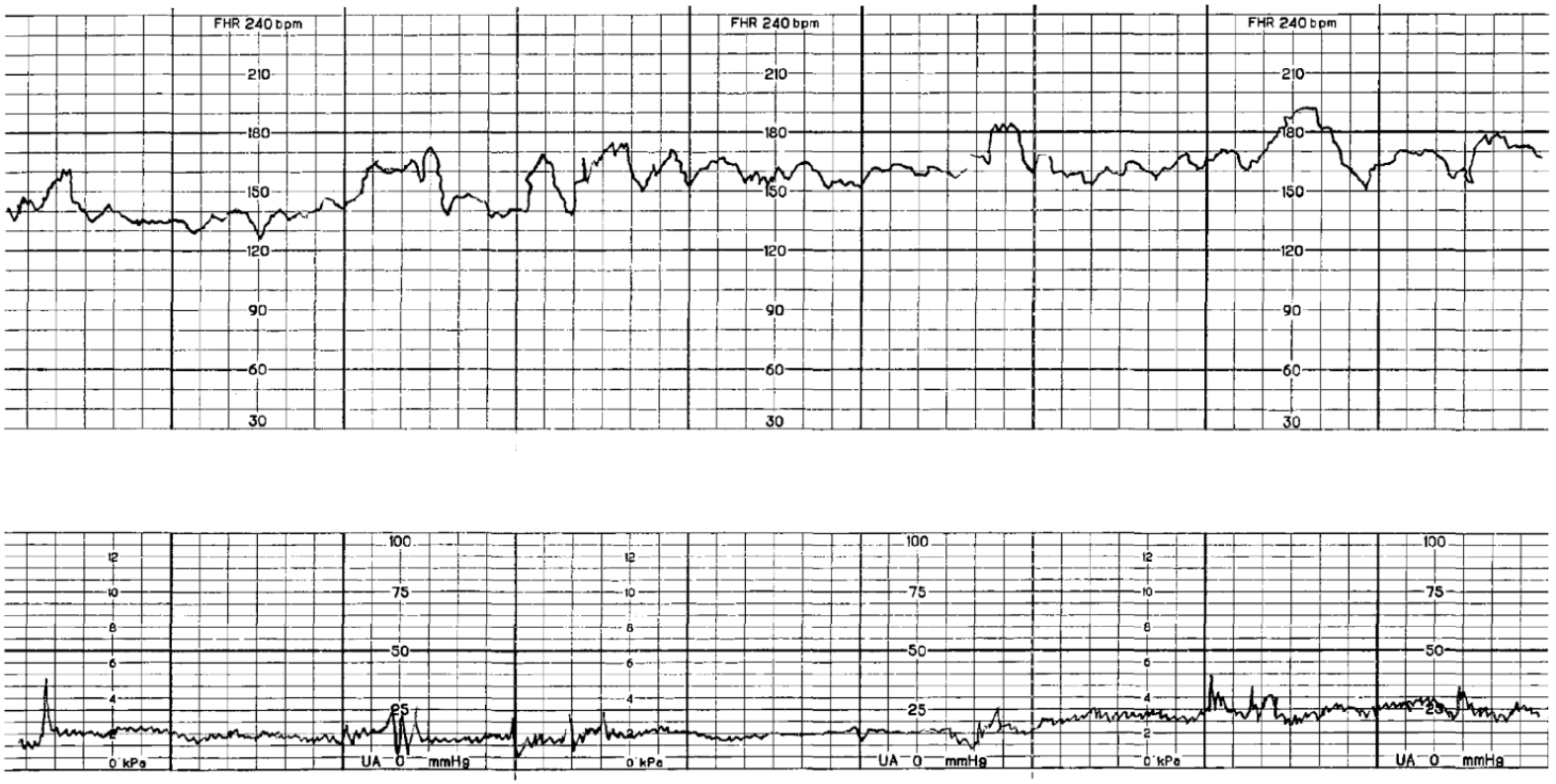
Case 14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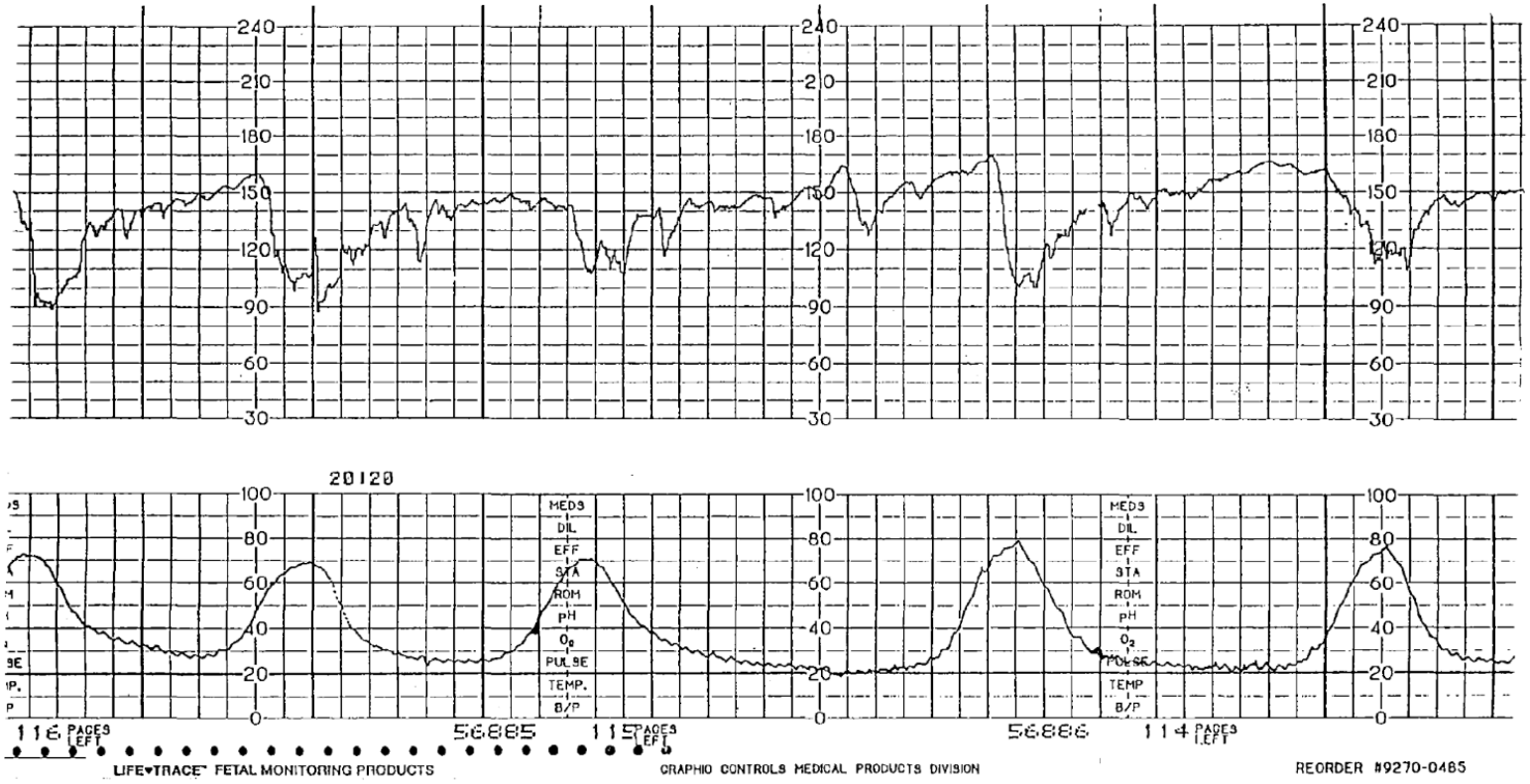
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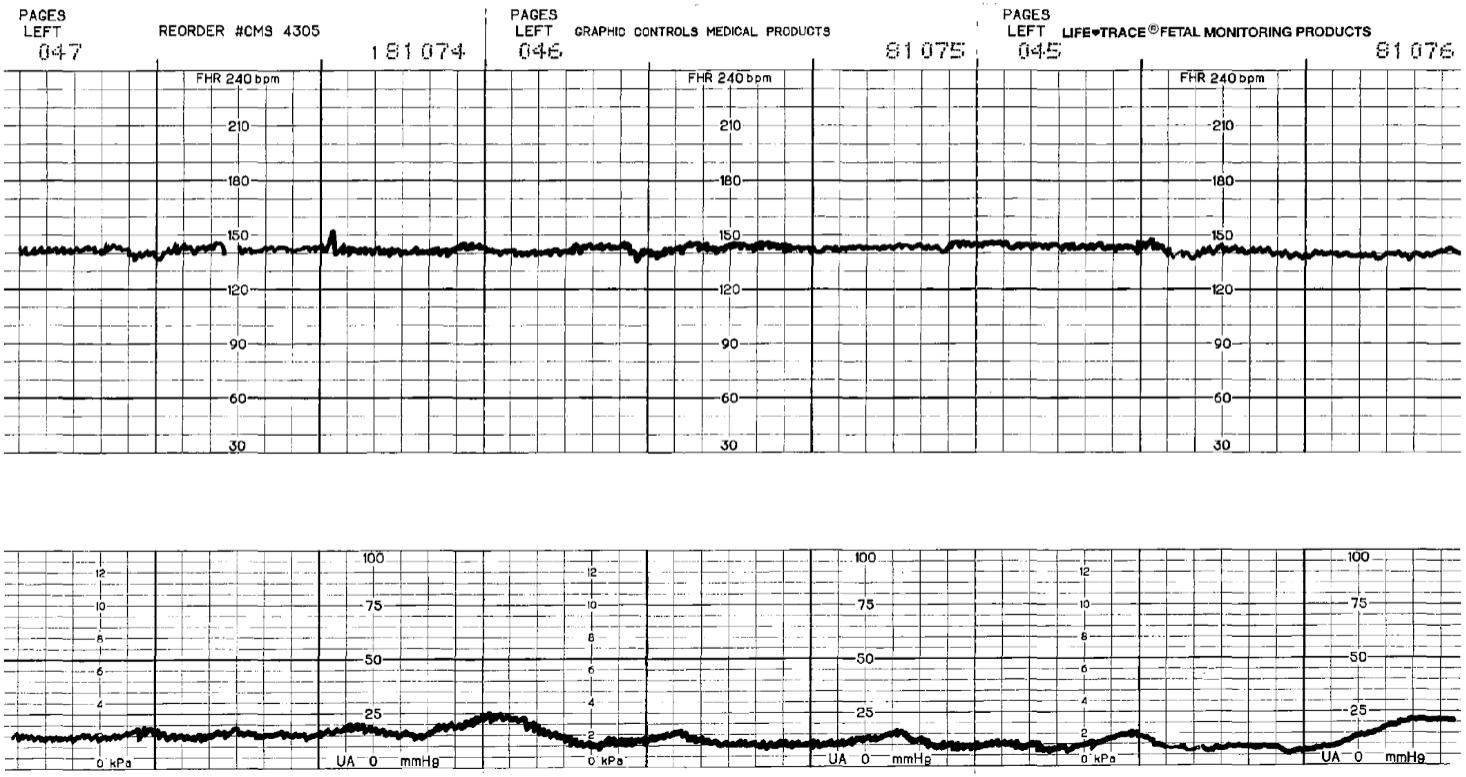
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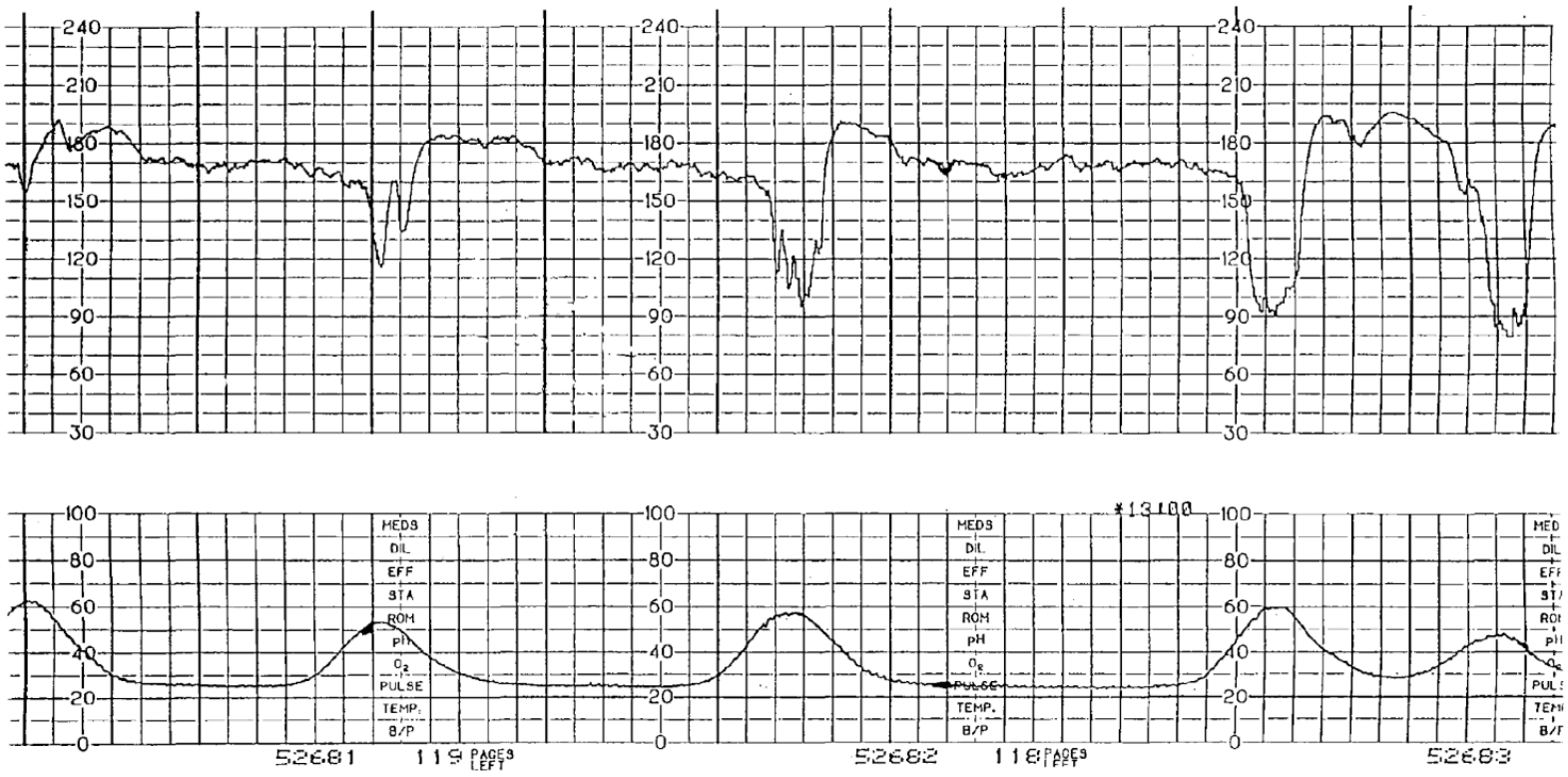
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Communication
&
Responsibility

Team Work

Communication

- In 2015 ineffective communication was the second most common reasons for perinatal sentinel events for mothers or infants.

The Joint Commission, Sentinel Event Data 2004-2015

Communication

- Foundations of Effective Communication
  - Complete
  - Brief
  - Clear/ Specific
  - Timely

Responsibility

- Act within scope of practice
- Seek support and guidance
- Work within organizational standards
- Duty of care to the woman and employer
- Maintain knowledge and skills
- Be prepared to explain ones practices

Responsibility

- Standards set by:
  - Nurse Practice Act: Established to protect the public by regulating nursing practice.
  - Regulating bodies:TJC, State Health Dept., Centers for Medicare/Medicaid Services, CDC, OSHA, FDA,
  - Professional organizations: AWHONN, AORN,
  - Policies & Procedures: Your institution's guidelines

Know who to go to if you are not sure about a specific nursing practice.