Advanced Principles in EFM
Speaking The Language of the Fetus

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Disclosures

• In addition to education and consulting services I have a professional relationship with
  • Elsevier: Co-author
  • Clinical Computer Systems: Education
  • AWHONN: 2019 President Elect
    • Opinions are my own and do not necessarily reflect those of AWHONN
• I may discuss off label medications or products
EFM: Screening Test

Expected Outcomes
↓ incidence of cerebral palsy
↓ incidence of intrapartum stillbirth

What Really Happened
No change in cerebral palsy rates
No change in intrapartum stillbirth
↑ interventions (cesarean birth)
Neonatal seizures decreased with EFM
Objective of fetal heart monitoring is to prevent fetal injury that might result from interruption of adequate oxygenation during labor.
NICHD Terminology

- NICHD: 1997
- ACOG: 2005
- AWHONN: 2005
- ACNM: 2006
- NICHD Reaffirmed: 2008
Variability

Minimal variability
- “More of a flat strip, where you don't see as big of accelerations in the heartbeat, or you'll see -- you won't see as many jiggles in the line
- Marked variability
  - ” You’re going to see big, tall accelerations and decelerations within a short period of time

The 2008 National Institute of Child Health and Human Development Workshop Report on Electronic Fetal Monitoring: Update on Definitions, Interpretation, and Research Guidelines

George A. Macones, MD, Gary D. V. Hankins, MD, Catherine Y. Spong, MD, John Hauth, MD and Thomas Moore, MD
FHR Tracing Evaluation

- Qualitative & quantitative description of:
  - Baseline rate
  - Baseline variability
  - Presence of accelerations
  - Periodic or episodic decelerations
  - Changes or trends over time
  - Uterine contraction evaluation
Placenta As An Endocrine Organ

- Feto-placental circulation: 3 weeks
  - Vessels join placenta=embryo
- Maternal-fetal fetus origin
  - Fetal contribution: Chorion
  - Maternal: Decidua (endometrium)

Placental Development and Function

- Growth more rapid than fetal growth
  - ↓ ~ 18-20 weeks
- Thickness after 20 weeks
- Secretes peptide and steroid hormones
  - Maintains pregnancy
  - Parturition and lactation preparation

![Placental hormone levels through pregnancy](image)
Placental Function

• **Respiration**
  - O₂ in maternal blood crosses placental barrier (membrane)
  - Enters fetal blood supply (diffusion)
  - CO₂ returns to maternal circulation across placental barrier

• **Nutrition**
  - Water, inorganic salts, carbohydrates, fats, proteins, and vitamins
  - Enzymatic carriers: maternal circulation via placental barrier
  - Metabolizes glucose; stores glycogen until fetal liver functions
Placental Function

• **Storage**
  • Carbohydrate, proteins, calcium, iron

• **Excretion**
  • Waste crosses placental barrier to enter maternal circulation
  • Minimal fetal waste due to dominant anabolic metabolism
Placental Function

• **Protection**
  - Prevents transfer of harmful maternal substances
  - Transfer of maternal immunity

• **Hormonal production**
  - Secretes hormones for pregnancy maintenance and fetal development
  - Hormones: steroid, estrogen, progesterone, protein, HCG, HPL, thyrotropin
Peptide Hormonal Action

- **Human chorionic gonadotrophin (hCG)**
  - Prolongs corpus luteum growth = maintains progesterone secretion
    - Prevents endometrial shedding
  - 6-8 weeks: placenta takes over progesterone production

- **Human placental lactogen (hPL)**
  - Promotes breast tissue growth for lactation
  - Metabolic effect by antagonizing maternal glucose use
Steroidal Hormonal Action

- **Estrogen**
  - Increases blood flow to uterus
  - Stimulates uterine muscle growth
  - Factor in labor onset and lactation

- **Progesterone**
  - Maintains endometrium
  - Reduces myometrial activity
  - Suppresses maternal immunological response to fetal antigens
Oxygenated blood enters IVS

Maternal BP sends blood to chorionic villi

Bathes” villi allowing substance exchange

Oxygenated maternal blood enters via chorionic villi

Deoxygenated blood back to umbilical arteries that divide to chorionic villi branches

Deoxygenated blood back to maternal system thru endometrial veins
Placental Intervillous Space

- Uterine perfusion
  - 700-800 mL/min at term
  - 10-15% of maternal CO
- Fetal tissue protrusions
  - Exposed to maternal blood
  - Bathes chorionic villi
- Factors impacting volume
  - Contractions, abruption

Maternal-Fetal Placental Circulation
Term Placenta

- Round and flat
  - ~ Diameter: 15-20 cm
  - Thickness: 1-2 cm
- Weight: 400-500 grams
  - Minus cord/membranes
Term Placenta

- Maternal surface (Duncan)
  - Red / blue in appearance
  - Arises from decidua basilis
    - Region between blastocyst and myometrium
    - Multiple lobules (cotyledons)
- Fetal surface (Schultz)
  - Smooth, white and shiny
  - Develops from chorionic villi
  - Contains umbilical vein/artery branches
15-20 Cotyledons or Lobules Act as a maternal-fetal circulatory subunit
Umbilical Cord

- Large vein and 2 small arteries
- Wharton’s jelly
  - Gelatin-like substance
  - Prevents compression
- Centrally located
Umbilical Cord Coiling

Umbilical Cord Coiling

- One coil/5 cm (0.2 ± 0.1 coils completed per cm)
- < 10th percentile (0.1 cm) (Strong)
  - ↑ karyotypic abnormalities, meconium, operative intervention
- <10\textsuperscript{th} or >90\textsuperscript{th} percentile (≥ 0.3 cm)
  - ↑ Variable decelerations
- Hypocoiling (≤0.26 coils cm)
  - PTL, oligohydramnios, FHR changes, operative vaginal delivery, LBW
- Hypercoiling (≥0.46 coils/cm)
  - FGR, FHR changes, LBW


Chorion and Amnion

- **Chorion**
  - Outer layer
    - Covers fetal surface
    - Contains umbilical vessels
- **Amnion**
  - Inner layer
    - Covers inside of chorion
    - Forms umbilical cord covering
# Importance of Intact Membranes

<table>
<thead>
<tr>
<th><strong>Membranes</strong></th>
<th><strong>Shock Absorber</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Barrier to infection</td>
<td>✓ Distributes pressure</td>
</tr>
<tr>
<td>✓ Maintain amniotic fluid</td>
<td>✓ Uterine activity</td>
</tr>
<tr>
<td>✓ Phosphoglycerolipid storage site</td>
<td>✓ Maternal movement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Amniotic Fluid</strong></th>
<th><strong>2nd and 3rd Trimester</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Protective barrier</td>
<td>✓ Fetal movement and growth</td>
</tr>
<tr>
<td>✓ Temperature control</td>
<td>✓ Develop muscle tone</td>
</tr>
<tr>
<td>✓ Cord floats freely</td>
<td>✓ 02, nutrients and waste flow</td>
</tr>
</tbody>
</table>
Amniotic Fluid Volume Changes

- Normal volume: 800-1200 mL
- Linear distribution
  - 1st trimester: 30 weeks
  - Slows from 30-36/38 weeks
  - ➔ 36/38 weeks until delivery
  - >40 weeks: ➔ 8-33%

Amniotic Fluid Influences

- Amniotic fluid osmolality
- Intramembranous/Transmembranous
- Fetal Urination and Fetal Swallowing
- Fetal Lung Fluid

Fetal Urination and Swallowing

- Primary source of fluid
  - Abnormal production
    - Structural: Renal agenesis
    - Oxygenation disruption
    - Diabetes / hydrops
- Swallowing
  - Major fluid removal mechanism
  - 500-1,000 mL/day
Physiology: Extrinsic and Intrinsic Factors

**Extrinsic**

"Outside" Influence
- Maternal / uteroplacental characteristics affect blood flow
  - Maternal impact
  - Uteroplacental impact
  - Umbilical circulation
  - Amniotic fluid features

**Intrinsic**

"Inside" influence
- Assists with maintaining fetal homeostasis when stressed
  - Fetal circulation
  - Autonomic nervous system
  - Baroreceptors
  - Chemoreceptors
  - Hormonal responses
Physiologic Extrinsic Influence

- Maternal influences
  - Positioning: compressed inferior vena cava \(\rightarrow\) ↓ venous return
    - ↓ Maternal blood flow to uterus
  - Contractions: ↓ uterine blood flow
  - Compensatory hypotension (i.e. epidural)

- Placental influences
  - Amount of surface area for maternal-fetal O2 exchange
  - Damaged cotyledons, smoking, vessel constriction from medications
Physiologic Extrinsic Influence

• Umbilical Cord
  • Structural defects (knots, 2 vessel cord)
  • Mechanical function (partial or complete compression)

• Amniotic Fluid
  • ↓ Placental function ⇒ ↓ Fetal kidney perfusion
    • Shunts blood away from kidneys
    • Causing oligohydramnios
Physiologic Intrinsic Influence

• Designed to interact / ensure adequate oxygenation to vital organs
• Autonomic Nervous System: Parasympathetic and Sympathetic
  • Responds to fetal oxygenation status and fetal BP
  • Parasympathetic Nervous System: “Pokey”
    • Influences FHR variability
    • ↑ tone and ↓ FHR baseline with advancing gestational age
  • Sympathetic Nervous System: “Speedy”
    • Stimulation ↑ FHR and may be promoted by hypoxemia
    • FHR baseline ↓ when blocked
Physiologic Intrinsic Influence

- Central Nervous System
  - Controlled by cerebral cortex and medulla oblongata
    - Intact well oxygenated brainstem
  - Normal range FHR baseline, moderate variability and + / - accelerations
Physiologic Intrinsic Influence

- **Chemoreceptors**
  - Respond to changes in fetal O2, CO2 and pH levels
  - ↑ CO2 or ↓ O2 ⇒ Fetal BP/FHR changes
    - Severe enough ⇒ Bradycardia

- **Baroreceptors**
  - Stretch receptors respond to changes in fetal BP
    - Located in aortic arch and carotid arteries
  - ↑ BP will ↓ FHR resulting in BP decrease
  - ↓ BP stimulates an increase in FHR
Physiologic Intrinsic Influence

• Hormones (epinephrine, norepinephrine, vasopressin)
  • Response to stressors ⇒ FHR changes
    • Stress caused by lower PO2
      • Epinephrine and norepinephrine released
      • ↑ FHR: blood shunted to brain/heart
    • Stress caused by hypoxemia/hypovolemic: vasopressin is released
      • Impacts fetal kidneys ↑ intravascular volume and peripheral resistance
        • ↑ Fetal BP
## Fetal Activity

<table>
<thead>
<tr>
<th>Biophysical Characteristic</th>
<th>Central Nervous System Control</th>
<th>Gestational Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone</td>
<td>Cortex: Subcortical</td>
<td>7.5 to 8.5 weeks</td>
</tr>
<tr>
<td>Movement</td>
<td>Cortex: Nuclei</td>
<td>9 weeks</td>
</tr>
<tr>
<td>Breathing</td>
<td>Ventral Surface, 4&lt;sup&gt;th&lt;/sup&gt; ventricle</td>
<td>20-21 weeks</td>
</tr>
<tr>
<td>Fetal Heart Rate</td>
<td>Posterior Hypothalamus Medulla</td>
<td>28-32 weeks</td>
</tr>
</tbody>
</table>

Origins of Fetal Hypoxia

• **Pre-placental:** 📞 02 content in maternal blood
  • Hypoxic placenta and fetus
  • High altitudes, cyanotic cardiac disease

• **Utero-placental:** Normal 02 content
  • Restricted flow into uteroplacental tissue
    • **Contractions,** preeclampsia, occlusions

• **Post-placental:** Normal 02 content
  • Villi fail to transfer oxygen to fetus
  • Abnormal placentation

Hypoxia: Fetal Defense Mechanisms

- Sustain metabolic requirements
- Redistribution of blood to vital organs
- Decreased oxygen consumption
  - Myocardium uses less $O_2$
  - FHR changes
- If no improvement in oxygenation
  - Convert to anaerobic metabolism
Aerobic Metabolism → Hypoxemia → Tissue Hypoxia → Anaerobic Metabolism → Lactic Acid Production → ↓ pH → Metabolic Acidosis → Injury or Death
# Measurement of Fetal Acid Base Status

## Indirect Methods
- Fetal Scalp Stimulation
- Vibroacoustic Stimulation

## Direct Methods
- Fetal Scalp Sampling
- Umbilical Cord Blood Sampling
Fetal Scalp Stimulation

• Noninvasive procedure for acid-base status
• Used for Category II FHR (indeterminate)
  • i.e. no spontaneous acceleration, minimal variability
• Perfomred during segments of baseline
  • Not during decelerations or bradycardia
• **NOT** a method of intrauterine resuscitation
Collection
Double Clamped Segment

- Stable at room temperature 1 hour
- Delayed cord clamping
  - At/below placenta: 30-60 seconds
- Clinical neonatal benefits
- Timely resuscitation
- Adjunct to Apgar scores
  - Immediate neonatal condition
  - Plan management
Umbilical Cord Gas Sampling

- Arterial and venous samples
  - Comparison and more accurate

**Artery:** Deoxygenated blood from fetus
- Presence /severity of fetal acidosis at/near birth
- Smaller lumens, thick vessel walls, less blood
- Arteries cross over veins

**Vein:** Oxygenated blood to fetus
- Placental tissue acid-base status at/near birth
- Distended vessel helps to support artery
### Single Digit Values (Term Gestation)

<table>
<thead>
<tr>
<th>Components</th>
<th>Normal Value</th>
<th>Metabolic Acidemia</th>
<th>Respiratory Acidemia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>≥ 7.20</td>
<td>&lt;7.20</td>
<td>&lt; 7.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significant is &lt;7.0</td>
<td></td>
</tr>
<tr>
<td><strong>PO2 (mmHg)</strong></td>
<td>≥ 20</td>
<td>&lt;20</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>PCO2 (mmHg)</strong></td>
<td>&lt;60</td>
<td>&lt;60</td>
<td>&gt;60 (elevated)</td>
</tr>
<tr>
<td><strong>HCO3 (mEq/L) Buffer</strong></td>
<td>≥ 22</td>
<td>&lt;22</td>
<td>≥ 22</td>
</tr>
<tr>
<td><strong>Base Deficit (mEq/L)</strong></td>
<td>≤ 12</td>
<td>&gt;12</td>
<td>&lt;12</td>
</tr>
<tr>
<td><strong>Base Excess (mEq/L)</strong></td>
<td>≥ -12</td>
<td>&lt; -12</td>
<td>&gt; -12</td>
</tr>
<tr>
<td>Amt of H+ ions to return pH to normal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Is pH less than 7.20?

- No
  - Normal gas

- Yes
  - Is Base Deficit 12 or higher?
    - No
      - Respiratory Acidemia
    - Yes
      - Is pCO2 >60?
        - No
          - Metabolic Acidemia
        - Yes
          - Mixed Acidemia
Case Study Application

- pH / PO2 / pCO2 / BE
- Venous Result
- Arterial Result

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<td>&lt; 7.20</td>
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<tr>
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<td>&lt; 20</td>
<td>Variable</td>
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<tr>
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<tr>
<td>Base Excess</td>
<td>≥ -12</td>
<td>&lt; -12</td>
<td>&gt; -12</td>
</tr>
</tbody>
</table>
Case Study #1

- 29 year old G3 P2
- 39 1/7 weeks: AROM clear fluid in active labor
  - 6/80/-1
- EFM
  - Cat I FHR during labor evolving to Cat II FHR in 2\textsuperscript{nd} stage
    - FHR tachycardia, minimal variability and late decelerations
- 2\textsuperscript{nd} stage
- Pushing x30 minutes
- Vacuum delivery for Category III FHR tracing with Apgars 2, 3, and 5
## Case Study #1: Umbilical Cord Gas Result

<table>
<thead>
<tr>
<th>Normal</th>
<th>Metabolic Acidemia</th>
<th>Respiratory Acidemia</th>
</tr>
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<tbody>
<tr>
<td>≥ 7.20</td>
<td>&lt;7.20</td>
<td>&lt; 7.20</td>
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<tr>
<td>≥ 20</td>
<td>&lt;20</td>
<td>Variable</td>
</tr>
<tr>
<td>&lt;60</td>
<td>&lt;60</td>
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</tr>
<tr>
<td>≥22</td>
<td>&lt;22</td>
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</tr>
<tr>
<td>≤ 12</td>
<td>&gt;12</td>
<td>&lt;12</td>
</tr>
<tr>
<td>≥ -12</td>
<td>&lt; -12</td>
<td>&gt; -12</td>
</tr>
</tbody>
</table>

- **pH**
  - V = 6.94  A = 6.86
- **PO2**
  - V = 17  A = 6
- **PCO2**
  - V = 45  A = 55
- **BE**
  - V: 20  A: 21.1
Case Study #2

• 39 year old G8 P7
• 41 5/7 weeks: IOL with oxytocin with SROM clear fluid at 4 cm
• EFM
  • Category II throughout labor mostly related to variable decelerations
• 2nd stage
• Pushed x 10 minutes
• Apgars 7 and 9
This arterial cord gas is

- pH 7.17
- pO₂ 10
- pCO₂ 70
- HCO₃ 21
- BD 11

A. Respiratory acidemia
B. Mixed acidemia
C. Metabolic acidemia
Base Excess During Normal Labor

- Assuming “normal” stresses of active phase labor and “commonly” occurring variable decelerations in 2nd stage
  - Average fetus enters labor
    - -2 mmol/L
  - Active labor
    - Decreases by 1 mmol/L per 3-6 hours
  - Second stage
    - Decreases 1 mmol/L per hour

Category II and III Fetal Heart Rate Tracings

- "Recurrent typical severe variable decelerations that may or may not prompt physician intervention"
  - ↓ Buffer by ~ 1 mmol/L per 30 minutes
- "Subacute fetal compromise"
  - ↓ Buffer by 1 mmol/L per 6 - 15 minutes
- "Acute, severe compromise (terminal bradycardia)"
  - ↓ Buffer as much as 1 mmol/L per 2-3 minutes

Fetal Bradycardia and Cord Arterial pH

• Deteriorates rapidly starting from bradycardia onset
• Irreversible group
  • 0.011mmol/L per minute
• Potentially reversible/unknown
  • No significant relationship between pH and delivery interval
  • 4-5% chance of <7.0 vs 26.8% in the irreversible group

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irreversible conditions</td>
<td></td>
</tr>
<tr>
<td>Placental abruption</td>
<td>39 (16.6)</td>
</tr>
<tr>
<td>Cord prolapse</td>
<td>9 (3.8)</td>
</tr>
<tr>
<td>Uterine rupture</td>
<td>21 (8.9)</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Failed instrumental delivery</td>
<td>3 (1.3)</td>
</tr>
<tr>
<td>Potentially reversible conditions</td>
<td>22 (9.4)</td>
</tr>
<tr>
<td>Iatrogenic uterine hyperstimulation</td>
<td>13 (5.6)</td>
</tr>
<tr>
<td>Hypotension after epidural anesthesia</td>
<td>5 (2.1)</td>
</tr>
<tr>
<td>After external cephalic version</td>
<td>4 (1.7)</td>
</tr>
<tr>
<td>(without abruption)</td>
<td></td>
</tr>
<tr>
<td>Aortocaval compression</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Unknown cause for fetal bradycardia</td>
<td>174 (74.0)</td>
</tr>
</tbody>
</table>

“30 minute rule” Example

- Base excess **decrease**
  - Q 3 minutes
  - 1 mmol/L
- pH **decline**
  - Q 1 minute
  - 0.011 mmol/L

**BE = -4 to -14**
- Base excess: $\frac{30}{3} + 10$
- $-4 + -10 = -14$

**pH = 7.2 to 6.87**
- $0.011 \times 30 = 0.330$
- pH: $7.2 - 0.333 = 6.867$
Acidemia & Fetal Injury

• It can take time for hypoxemia to progress to metabolic acidemia, although this varies widely
• Even when metabolic acidemia is present, neurologic injury is very uncommon
• Isolated fetal RESPIRATORY acidemia (elevated PCO2) is NOT associated with neurologic injury
• When obtaining an cord blood gases, ALWAYS obtain both arterial and venous specimens and record all values!
Lactate

- Metabolite of anaerobic metabolism
- Sensitive marker for tissue hypoxia
  - Sepsis, trauma, necrotizing fasciitis
- Adults: Venous 0.5 - 2.2 mM (dependent on lab)
  - 2.3 - 3.9 mM: mild physiologic dysfunction
  - ≥ 4.0 mM: severe physiologic dysfunction
Umbilical Lactate

• Typically measured by scalp sampling
  • Associated with low 5-minute Apgar scores, NICU admission, HIE
• Measurement of **umbilical** artery lactate appears be better than pH or base excess in predicting adverse outcomes
  • Direct product of anaerobic metabolism
  • Source of umbilical artery lactate is fetal, not maternal or placental
• Direct measure of fetal hypoxia
  • Fetal brain is sensitive to hypoxic injury
Umbilical Lactate

- May be a more precise assessment tool
- Easy rapid measurement using test strip that requires a smaller amount of fetal blood
- Normal levels not precisely defined
  - 3.5 - 7 mM upper limit of normal range
Three Elements of EFM Standardization

- Terminology: What do we call it?
- Interpretation: What does it mean?
- Management: What to do about it?
Baseline Fetal Heart Rate

- Approximate mean FHR rounded to nearest 5 bpm (e.g., 140 or 145)
- Assess over 10 minutes
  - Requires minimum 2 minutes but not contiguous
- Excludes
  - Accels, decels, marked variability, and any segments differing by > 25 bpm
- Bradycardia: < 110 bpm
- Tachycardia: > 160 bpm
# Differentials for Bradycardia

<table>
<thead>
<tr>
<th>Maternal</th>
<th>Fetal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sympatholytics</td>
<td>Cardiac conduction abnormalities</td>
</tr>
<tr>
<td><em>Beta-blockers (propanolol), clonidine</em></td>
<td><em>Heart block</em></td>
</tr>
<tr>
<td>Viral infection (CMV)</td>
<td>Fetal oxygenation pathway interruption</td>
</tr>
<tr>
<td>Autoimmune and connective tissue disease</td>
<td>Structural cardiac defects</td>
</tr>
<tr>
<td><em>Sjogren’s Syndrome, SLE, APAS</em></td>
<td><em>Heterotaxy syndrome</em></td>
</tr>
<tr>
<td><em>(Anti-Ro/SS-A or Anti-La/SS-B antibodies)</em></td>
<td></td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>Fetal heart failure</td>
</tr>
<tr>
<td>Hypothermia</td>
<td></td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td></td>
</tr>
</tbody>
</table>
# Differentials for Tachycardia

<table>
<thead>
<tr>
<th>Maternal</th>
<th>Fetal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beta-sympathomimetic drugs</strong></td>
<td><strong>Acute blood loss</strong></td>
</tr>
<tr>
<td>Terbutaline, epinephrine</td>
<td></td>
</tr>
<tr>
<td><strong>Cocaine</strong></td>
<td><strong>Fetal Anemia</strong></td>
</tr>
<tr>
<td><strong>Dehydration</strong></td>
<td><strong>Heart Failure</strong></td>
</tr>
<tr>
<td><strong>Fever</strong></td>
<td><strong>Hyperthyroidism</strong></td>
</tr>
<tr>
<td><strong>Hyperthyroidism</strong></td>
<td><strong>Hypoxia / Hypoxemia</strong></td>
</tr>
<tr>
<td><strong>Infection (chorioamnionitis, pyelonephritis)</strong></td>
<td><strong>Increased metabolic rate</strong></td>
</tr>
<tr>
<td><strong>Parasympatholytic drugs</strong></td>
<td><strong>Tachyarrhythmias</strong></td>
</tr>
<tr>
<td>Atropine, scopolamine, dicyclomine</td>
<td>WPW, SVT(paroxysmal or continuous)</td>
</tr>
<tr>
<td></td>
<td>Infection and Fetal Sepsis</td>
</tr>
</tbody>
</table>
## Baseline Variability

<table>
<thead>
<tr>
<th>Description</th>
<th>Graphs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undetectable from baseline</td>
<td><img src="image1.png" alt="Graph" /></td>
</tr>
<tr>
<td>Absent</td>
<td><img src="image2.png" alt="Graph" /></td>
</tr>
<tr>
<td>Visually detectable from FHR BL, but ≤ 5 bpm</td>
<td><img src="image3.png" alt="Graph" /></td>
</tr>
<tr>
<td>Minimal</td>
<td><img src="image4.png" alt="Graph" /></td>
</tr>
<tr>
<td>6 – 25 bpm</td>
<td><img src="image5.png" alt="Graph" /></td>
</tr>
<tr>
<td>Moderate</td>
<td><img src="image6.png" alt="Graph" /></td>
</tr>
<tr>
<td>&gt;25 bpm</td>
<td><img src="image7.png" alt="Graph" /></td>
</tr>
<tr>
<td>Marked</td>
<td><img src="image8.png" alt="Graph" /></td>
</tr>
</tbody>
</table>
Minimal and Absent Variability

- Fetal sleep cycle
- Fetal tachycardia
- General anesthesia
- Prematurity
- Congenital anomalies
- Preexisting neurologic injury

- Medications
  - Narcotics, barbiturates, atropine, phenothiazines, tranquilizers
  - Fetal anemia
  - Fetal cardiac arrhythmia
  - Infection
  - Fetal metabolic acidosis
Moderate Variability

- Reliably predicts absence of fetal metabolic acidemia at time of observation
- Active and alert fetus
- Reflection of neuromodulation of an active CNS
  - Normal cardiac responsiveness
- Reflection of R-R interval changes
Marked Variability

- Etiology unclear
- Presumed to be result of increase alpha-adrenergic activity
  - Fetal activity or fetal stimulation
- In the absence of abnormal FHR changes
  - Not associated with acidemia based on fetal blood pH or Apgar scores
- Interpret in context of other FHR changes
Sinusoidal

- Excluded from definition of variability
- Smooth, sine wave-like pattern with regular frequency and amplitude
- 3-5 cycles per minute, must be present for 20 minutes for diagnosis
- Severe fetal anemia, amnionitis, fetal sepsis, and narcotic analgesics
Accelerations

• Visually apparent abrupt increase from baseline
• Term fetus
  • Onset to peak < 30 seconds; peak (acme) ≥ 15 bpm
  • Duration > 15 seconds; < 2 minutes from onset to return to baseline
• Preterm fetus
  • Onset to peak < 30 seconds; peak (acme) ≥ 10 bpm
  • Duration > 10 seconds
• Prolonged acceleration ≥ 2 minutes, < 10 minutes
Decelerations

• Nadir
  • Abrupt
    • Onset to nadir < 30 seconds
  • Gradual
    • Onset to nadir ≥ 30 seconds

http://perinatology.com/Fetal%20Monitoring/Intrapartum%20Monitoring.htm
Early Deceleration

- **Gradual** decrease and return to baseline associated with a contraction
- Onset, nadir, and offset always occur coincidently with the contraction, with the nadir at contraction peak
- Because of the importance in timing related to uterine contractions, be careful regarding the use of a toco versus palpation or IUPC
Early Decelerations

• Vagal response from head compression
  • Benign finding
• Associated with
  • Labor between 4-7 cm
  • Primigravida
  • Persistent occiput posterior
  • Cephalopelvic disproportion
Early Decelerations

**Transient head compression**

**Altered intracranial pressure and/or cerebral blood flow**

**Reflex parasympathetic outflow**

**Gradual FHR slowing**

**Early deceleration**

**Contraction relaxes and autonomic reflexes subside**
Late Deceleration

- **Gradual** decrease and return to baseline associated with a contraction
- Delayed onset, with nadir *always* occurring after contraction peak
- Because of the importance in timing related to uterine contractions, be careful regarding the use of a toco versus palpation or IUPC
Late Deceleration

- Transient alterations in O2 transport
- Associated with
  - Decreased uteroplacental circulation
  - Postdates placenta, pre-eclampsia
Recurrent or sustained disruption of oxygenation

Tissue hypoxia

Anaerobic metabolism

Lactic acidosis

Metabolic acidemia

Direct myocardial depression
Variable Decelerations

- Abrupt decrease in FHR below the baseline of $> 15$ bpm lasting $> 15$ seconds but $< 2$ minutes
- When associated with contractions,
  - May vary in onset, depth, and duration from contraction to contraction
Variable Deceleration

- Cord compression: Most common deceleration in labor
- Associated with
  - Nuchal cord or short cord or body entanglement
  - Umbilical cord prolapse
  - Rapid fetal descent
  - Oligohydramnios
  - Cord abnormalities (knot, decreased Wharton’s jelly)
Prolonged Decelerations

- Decrease of $> 15$ bpm from baseline
  - Duration of $> 2$ minutes but $< 10$ minutes
  - Change of baseline: duration of $\geq 10$ minutes
- Gradual or abrupt onset
Prolonged Deceleration

- Associated with
  - Rapid fetal descent
  - Prolonged cord compression
  - Vagal stimulation after vaginal exam or FSE placement
  - Oligohydramnios
  - Decreased Wharton’s Jelly
  - Maternal event: hypotension, seizure
Significant Decelerations

➢ “Significant metabolic acidemia cannot be excluded. Further, these deceleration patterns signify the presence of physiologic stresses that increase the risk of developing such acidemia. “

➢ Variable decelerations lasting >60 seconds reaching a nadir of > 60 bpm below the baseline

➢ Variable decelerations lasting >60 seconds reaching a nadir <60 bpm regardless of baseline

➢ Any late decelerations of any depth

➢ Any prolonged deceleration

REASSURING AND NONREASSURING
NOT DEFINED BY NICHD!

• **Dictionary: Reassuring**
  • Say or do something: Remove doubts and fears of someone
  • To restore to assurance or confidence
  • To assure anew

• **Dictionary: Non-reassuring**
  • Not reassuring
  • Giving cause for concern
  • Chaldean and Pythagorean Numerology: value 3
<table>
<thead>
<tr>
<th>FHR Characteristic</th>
<th>NE</th>
<th>No NE</th>
<th>aOR b (95% CI)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachycardia</td>
<td>18 (16.2)</td>
<td>31 (11.7)</td>
<td>1.40 (0.68-2.89)</td>
<td>0.36</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>8 (7.2)</td>
<td>2 (0.8)</td>
<td>3.45 (0.52-22.65)</td>
<td>0.20</td>
</tr>
<tr>
<td>Minimal/absent variability</td>
<td>54 (48.7)</td>
<td>38 (14.3)</td>
<td>5.11 (2.74-9.54)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Recurrent variable decel.</td>
<td>56 (50.5)</td>
<td>133 (50.2)</td>
<td>0.77 (0.45-1.30)</td>
<td>0.32</td>
</tr>
<tr>
<td>Severe variable decel.</td>
<td>35 (31.5)</td>
<td>49 (18.5)</td>
<td>1.82 (1.00-3.13)</td>
<td>0.05</td>
</tr>
<tr>
<td>Any late decel.</td>
<td>59 (95.2)</td>
<td>88 (80.0)</td>
<td>2.66 (1.56-4.54)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Recurrent late decel.</td>
<td>29 (26.1)</td>
<td>31 (11.7)</td>
<td>1.86 (0.93-3.69)</td>
<td>0.08</td>
</tr>
<tr>
<td>Prolonged decel.</td>
<td>45 (40.5)</td>
<td>57 (21.5)</td>
<td>2.14 (1.22-3.75)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

aData presented as n (%)
bModeled in separate regressions and adjusted for maternal age, weight, insurance status, and FHR category
I. Baseline: 110-160
   Moderate Variability
   Accelerations and/or Early Decelerations May Be Present
   Absent Variable, Late, and Prolonged Deceleration

II. Everything else

III. Absent variability with either recurrent late or variable decelerations
    Absent variability with bradycardia
    Sinsoidal pattern

Uterine Activity Terminology

- Frequency: Beginning of contraction to beginning of next one
- Duration: Length of contraction from beginning to end
  - Measured in seconds
- Strength / Intensity: Assessed via palpation or mmHg
  - Montevideo units
- Resting Tone: Intrauterine pressure when uterus is not contracting
  - Assessed via palpation or mmHg
- Relaxation time: Time from end of contraction to beginning of next one
Assessment of Uterine Activity

• Quantified as the number of contractions present in 10 minutes
  • Averaged over 30 minutes
• Frequency alone is a partial assessment
  • Duration, intensity, relaxation time, resting tone
• Terminology
  • Normal: 5 contractions or less in 10 minutes
  • Tachysystole (not hyperstimulation or hypercontractility)
    • > 5 contractions in 10 minutes
Resting Tone and Relaxation Time

- Resting tone
  - Normal: Maintains adequate fetal oxygenation
  - Normal: < 20-25 mg
  - Hypertonus

- Relaxation time to ensure adequate $O_2$ and $CO_2$ exchange
  - First stage: 60 seconds
  - Second stage: ~45 seconds
Tachysystole >5 contractions in 10 minutes
Averaged over 30 minutes

Constriction of spiral arterioles and ↓ blood flow in intervillous space

Risk for fetal hypoxemia

Metabolic acidemia
Tachysystole

• Known complication of induction/augmentation
• Spontaneous tachysystole
  • Intrauterine infection (bacterial “irritation” of myometrium)
  • Placental abruption (prostaglandins activated)
  • Cocaine
  • Norepinephrine/catecholamines related to maternal anxiety
  • Uterine leiomyoma
EFM Standardization

• What do I call it?
  • Standardized NICHD terminology & categories

• What does it mean?
  • Standardized principles of interpretation

• What do I do about it?
  • Standardized management using a simple questions designed to ↓ risk of error
  • Based on EFM’s strength: NPV related to metabolic acidemia
Why Can’t We Provide Care Right All The Time Every Time?

- Distractions
  - Personal or Unit
- Stress
- Fatigue
- Memory lapses
- Brain “freeze”
- Inadequate training
- Inadequate experience

Fetal oxygenation involves the transfer of oxygen from the environment to the fetus...

And the subsequent fetal physiologic response if oxygen transfer is interrupted...
<table>
<thead>
<tr>
<th>PATHWAY</th>
<th>ETIOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lungs</td>
<td>Airway and breathing</td>
</tr>
<tr>
<td></td>
<td>Respiratory depression, asthma, cystic fibrosis</td>
</tr>
<tr>
<td>Heart</td>
<td>Heart rate and rhythm</td>
</tr>
<tr>
<td></td>
<td>SVT, bradycardia after seizure</td>
</tr>
<tr>
<td>Vasculature</td>
<td>Blood pressure and volume status</td>
</tr>
<tr>
<td></td>
<td>Severe pre-e, hypovolemia, dehydration</td>
</tr>
<tr>
<td>Uterus</td>
<td>Contraction strength, frequency, intensity resting tone</td>
</tr>
<tr>
<td></td>
<td>Tachysystole</td>
</tr>
<tr>
<td>Placenta</td>
<td>Placental separation</td>
</tr>
<tr>
<td></td>
<td>Abruption, vasa previa</td>
</tr>
<tr>
<td>Umbilical Cord</td>
<td>Cord compression</td>
</tr>
<tr>
<td></td>
<td>Cord prolapse, cord entanglement</td>
</tr>
</tbody>
</table>

What information does the FHR tracing provide regarding oxygen transfer?

- Head Compression
- Cord Compression
- Uteroplacental insufficiency
All clinically significant FHR decelerations **HAVE EXACTLY THE SAME TRIGGER**...

Interruption of oxygen transfer from the environment to the fetus at one or more points along the oxygen pathway

So, when we see a late, variable, or prolonged deceleration, we can agree that the oxygen pathway has been interrupted at one or more points...
Principle #1
Variable, late or prolonged decelerations signal interruption of the oxygen pathway at one or more points.

Principle #2
Moderate variability or accelerations exclude ongoing hypoxic injury.
“In a fetus exhibiting either moderate variability or accelerations of the FHR, damaging degrees of hypoxia-induced metabolic acidemia can reliably be excluded”

EXCEPT: The converse is not true:

Minimal-absent variability **DOES NOT** reliably predict the presence of hypoxic injury

Absence of accelerations **DOES NOT** reliably predict the presence of hypoxic injury
One end of the FHR spectrum

1. Definitions
2. Interpretation
3. Management

What do I call it?
Baseline rate...130 bpm
Variability...moderate
Accelerations...present
Decelerations...absent
Uterine Activity
Changes or trends over time...none
Category 1
What does it mean?

"Happy baby"?
"Baby’s fine"?
"Nothing to worry about"?
"Reassuring"?
What does it mean?

Two Principles of Fetal Heart Rate interpretation

**Environment**
- Lungs
- Heart
- Vasculature
- Uterus
- Placenta
- Cord
- **Fetus**

1. Decelerations (late, variable or prolonged) signal interruption of the oxygen pathway at one or more points

2. Moderate variability or accelerations exclude hypoxic neurologic injury

**Potential Injury**
- Hypoxemia
- Hypoxia
- Metabolic acidosis
- Metabolic acidemia
What do I call it?
- Baseline rate...150 bpm
- Variability...moderate
- Accelerations...absent
- Decelerations...present
- Uterine Activity
- Changes or trends...yes

Category 2

The middle of the FHR spectrum
What does it mean?

“Ominous”?
“Concerning”?
“Problematic”?
“Pathologic”?
“Reassuring”?
“Non-reassuring”
Two Principles of Fetal Heart Rate interpretation

**Environment**
- Lungs
- Heart
- Vasculature
- Uterus
- Placenta
- Cord

1. Decelerations (late, variable or prolonged) signal interruption of the oxygen pathway at one or more points

**Fetus**
- Hypoxemia
- Hypoxia
- Metabolic acidosis
- Metabolic acidemia

2. Moderate variability or accelerations exclude hypoxic neurologic injury

**Potential Injury**
The far end of the FHR spectrum

1. Definitions
2. Interpretation
3. Management

What do I call it?
Baseline rate...190
Variability...absent
Accelerations...absent
Deceleration...present, recurrent
Uterine activity: where’s the toco?
Changes or trends...?

Category 3
What does it mean?

“Ominous”?  
“It’s time to get a real doctor in here”

“Problematic”?  
“The lights of the nursery are in your future”

“Non-reassuring”
A Standardized Intrapartum FHR Management Model

Four Central Concepts: “ABCD”

A - Assess the oxygen pathway and review differentials
B - Begin conservative corrective measures
C - Clear for delivery
D - Decision to delivery time

Intrapartum Fetal Heart Rate Management Decision Model

Is the patient low-risk?

Yes

Routine Surveillance
- Every 30 min in the 1st stage of labor
- Every 15 min in the 2nd stage of labor

No

Heightened Surveillance
- Every 15 min in the 1st stage of labor
- Every 5 min in the 2nd stage of labor

FHR Category?

I

Is there FHR and uterine activity?

Yes

FHR Category?

II or III

“B” – Begin corrective measures

“C” – Clear obstacles to rapid delivery

“D” – Determine decision to delivery time

ABCD

Presence of moderate variability or accelerations and Absence of clinically significant decelerations

No/unsure

Is vaginal delivery likely before the onset of metabolic acidemia and potential injury?

Yes

Expedite Delivery

No/unsure

Miller, Miller & Cypher, 2017
Confirm Fetal Heart Rate and Uterine Activity
“B”  Begin Corrective Measures

✓ Maternal repositioning
✓ IV fluid bolus
✓ Oxygen administration
✓ Correct hypotension
✓ Decrease uterine activity
✓ Amnioinfusion
✓ Tocolytic administration
✓ Alteration in 2nd stage pushing technique
AWHONN Physiologic Goals

- Support maternal coping and labor progress
- Maximize uterine blood flow
- Maximize umbilical circulation
- Maximize oxygenation
- Maintain appropriate uterine activity
“Now what do you do with all this information?”

• “Standardized management”: minimize the opportunities for preventable error
• Even the best scenarios for practice cannot prevent all poor outcomes
  • Obstetric TEAM must be able to articulate action’s rationale in order to defend clinical practice
If a tracing remains in Category II after conservative corrective measures, how do you decide whether it is safe to continue labor?

Why not exclude metabolic acidemia?
(moderate variability and/or accelerations)

And exclude significant interruption of oxygenation?
(no significant decelerations)
If you have any question...the safest approach is to proceed to the next step...

In an alphabetical management plan, the next immediate step after “B” is
Clear Obstacles to Rapid Delivery

If conservative measures do not correct FHR tracing, it’s prudent to plan ahead for a possible need for rapid delivery

This does **NOT** commit the patient to delivery

It simply identifies common sources of unnecessary delay in a systematic way so they can be addressed in timely fashion

By doing this, it demonstrates reasonableness and prudence...two elements that define the standard of care
Facility
Staff
Mother
Fetus
Labor
“D”- Determine decision to delivery time

Is vaginal delivery likely before the onset of metabolic acidemia and potential injury?
USE INDIVIDUAL CLINICAL JUDGMENT TO ESTIMATE
Time until the onset of metabolic acidemia

What is too long?
Algorithm for management of category II fetal heart rate tracings

Moderate variability or accelerations

Yes

Significant decelerations with ≥50% of contractions for 1 hour

Yes

Cesarean

No

Observe

Significant decelerations with ≥50% of contractions for 30 minutes

Yes

Observe for 1 hour

No

Cesarean or OVD

Persistent pattern

Observe

Cesarean or OVD

Manage per algorithm

Note: If not resolved with appropriate conservative corrective measures, which may include supplemental oxygen, maternal position changes, intravenous fluid administration, correction of hypotension, reduction or discontinuation of uterine stimulation, administration of uterine relaxant, amniotomy, and/or changes in second stage breathing and pushing techniques.

Significant Decelerations

<table>
<thead>
<tr>
<th></th>
<th>Trial Hospital (6)</th>
<th></th>
<th>Post</th>
<th></th>
<th>Non-Trial Hospital (23)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre Oct 2015-</td>
<td>Post April 2016-</td>
<td></td>
<td>Post April 2016-Feb 2017</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>March 2016</td>
<td>Feb 2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Births</td>
<td>5,208</td>
<td>9,974</td>
<td></td>
<td></td>
<td>Total Births</td>
<td>19,363</td>
<td>46,839</td>
</tr>
<tr>
<td>Repeat CD</td>
<td>737</td>
<td>1,459</td>
<td></td>
<td></td>
<td>Repeat CD</td>
<td>2,885</td>
<td>6,933</td>
</tr>
<tr>
<td>Eligible</td>
<td>4,471</td>
<td>8,515</td>
<td></td>
<td></td>
<td>Eligible</td>
<td>16,478</td>
<td>39,906</td>
</tr>
<tr>
<td>Primary CD</td>
<td>384/4,471</td>
<td>1,562/8,515</td>
<td></td>
<td>18.3%</td>
<td>Primary CD</td>
<td>3,136/16,478</td>
<td>7,259/39,906</td>
</tr>
<tr>
<td>-1.5%</td>
<td>19.8%</td>
<td>5</td>
<td></td>
<td></td>
<td>-0.8%</td>
<td>19%</td>
<td>18.2%</td>
</tr>
<tr>
<td>p &lt; 0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P = 0.02</td>
<td></td>
</tr>
<tr>
<td>VD</td>
<td>3,334/4,471</td>
<td>6,451/8,515</td>
<td></td>
<td></td>
<td>VD</td>
<td>12,296/16,478</td>
<td>30,305/39,906</td>
</tr>
<tr>
<td>1.2%</td>
<td>74.6%</td>
<td>75.8%</td>
<td></td>
<td></td>
<td>1.3%</td>
<td>8</td>
<td>74.6%</td>
</tr>
<tr>
<td>P = 0.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P = 0.02</td>
<td></td>
</tr>
<tr>
<td>Operative VD</td>
<td>253/4,471</td>
<td>502/8,515</td>
<td></td>
<td></td>
<td>Operative VD</td>
<td>1,045/16,478</td>
<td>2,342/39,906</td>
</tr>
<tr>
<td>0.2%</td>
<td>5.7%</td>
<td>5.9%</td>
<td></td>
<td></td>
<td>-0.4%</td>
<td>6.3%</td>
<td>5.9%</td>
</tr>
<tr>
<td>P = 0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P = 0.02</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Non-Trial (23)</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5-min Apgar &lt;7</strong></td>
<td>102/4,471</td>
<td>146/8,515</td>
<td>2,554/16,47</td>
<td>8</td>
<td>6,545/39.906</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.7%</td>
<td>8</td>
<td>1.55%</td>
<td>1.6%</td>
</tr>
<tr>
<td><strong>5-min Apgar &lt;5</strong></td>
<td>474/4,471</td>
<td>66/8,515</td>
<td>1,236/16,47</td>
<td>8</td>
<td>227/39,906</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.78%</td>
<td>8</td>
<td>0.53%</td>
<td>0.57%</td>
</tr>
<tr>
<td><strong>5-min Apgar &lt;3</strong></td>
<td>25/4,471</td>
<td>49/8,515</td>
<td>87/16,478</td>
<td></td>
<td>227/39,906</td>
</tr>
<tr>
<td></td>
<td>0.57%</td>
<td>0.57%</td>
<td>0.53%</td>
<td></td>
<td>0.57%</td>
</tr>
</tbody>
</table>

| **Severe UNC**       | 71/4,471  | 98/8,515  | 247/16,478      |     | 559/39,906 |
|                      | 1.6%      | 1.2%      | 1.5%           |     | 1.4%      |

UNC: Unexplained Newborn Complications (severe respiratory complications, sepsis, birth trauma, neonatal shock, neuro injury)

Even with algorithms and expert consensus, delivery decisions can may be challenging for the entire OB team. No matter what the decision, nothing will guarantee a good outcome. But having a less than perfect outcome despite a well-thought-out plan is not necessarily unreasonable. It is much more difficult to convince someone that our actions were reasonable if we neglect to make a plan, meaning if we fail to make a decision at a critical point.
<table>
<thead>
<tr>
<th><strong>Lungs</strong></th>
<th><strong>Heart</strong></th>
<th><strong>Vasculature</strong></th>
<th><strong>Uterus</strong></th>
<th><strong>Placenta</strong></th>
<th><strong>Cord</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway and breathing</td>
<td>Heart rate and rhythm</td>
<td>Blood pressure</td>
<td>Contraction strength</td>
<td>Placental separation</td>
<td>Vaginal exam</td>
</tr>
<tr>
<td>Supplemental oxygen</td>
<td>Position changes</td>
<td>Fluid bolus</td>
<td>Stop or reduce stimulant</td>
<td>Consider uterine relaxant</td>
<td>Consider amnioinfusion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Facility</strong></th>
<th><strong>Staff</strong></th>
<th><strong>Mother</strong></th>
<th><strong>Fetus</strong></th>
<th><strong>Labor</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>OR availability Equipment</td>
<td>Notify Obstetrician Surgical assistant Anesthesiologist Neonatologist Pediatrician Nursing staff</td>
<td>Informed consent Anesthesia options Laboratory tests Blood products Intravenous access Urinary catheter Abdominal prep Transfer to OR</td>
<td>Confirm Estimated fetal weight Gestational age Presentation Position</td>
<td>Consider factors such as: Estimated fetal weight Gestational age Presentation Position</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Determine Decision to Delivery Time</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consider factors such as: Arrest disorder Protracted labor Remote from delivery Poor expulsive efforts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Clear Obstacles to Rapid Delivery</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical considerations (prior abdominal or uterine surgery) Medical considerations (obesity, hypertension, diabetes, SLE) Obstetric considerations (parity, pelvimetry, placental location)</td>
</tr>
</tbody>
</table>
Lateral Positioning

- Right or left lateral
  - Changes relationship of umbilical cord, fetus and uterine wall
  - Supine associated with more changes in FHR characteristics
- Improves maternal cardiac return and cardiac output
  - Uterus positioned off vena cava or aorta
    - ↓ Risk of maternal hypotension
  - Maximizes blood flow to uterus
    - Improves fetal oxygenation
    - Improves cardiac return and output
Lateral Positioning

**Fetal Pulse Oximetry**

- Critical threshold: 30%
- Hypoxia likely to cause metabolic acidosis

- Improves fetal oxygenation
  - Mean FSpO2:
    - LL = 53.2%, RL = 50.5%, Supine = 46.7%

---

IV Fluids

• What do we give
• How much do we give
• Does it make a difference
Intravenous Fluids

• Maximizes intravascular volume which may improve uteroplacental perfusion
  • Hypotension or hypovolemia
• 500 -1000 cc bolus LR increases FSpO²
• Greatest ↑ with 1000 cc bolus
  • Change continues for more than 30 minutes
Caution with high risk patients = Pulmonary edema
Maternal pulse pressure at admission is a risk factor for fetal heart rate changes after initial dosing of a labor epidural: a retrospective cohort study

Nathaniel R. Miller, MD; Rebecca L. Cypher, MSN; Peter E. Nielsen, MD; Lisa M. Foglia, MD

OBJECTIVE: To examine low maternal admission pulse pressure (PP) as a risk factor for new onset postepidural fetal heart rate (FHR) abnormalities.

STUDY DESIGN: Retrospective cohort study of nulliparous, singleton, vertex-presenting women admitted to labor and delivery after 37 0/7 weeks that received an epidural during labor. Women with a low admission PP were compared with those with a normal admission PP. The primary outcome was new onset FHR abnormalities defined as recurrent late or prolonged FHR decelerations in the first hour after initial dosing of a labor epidural.

RESULTS: New onset FHR abnormalities, defined as recurrent late decelerations and/or prolonged decelerations, occurred in 6% of subjects in the normal PP cohort compared with 27% in the low PP cohort (odds ratio, 5.6; 95% confidence interval, 2.1–14.3; P < .001). A multivariate logistic regression analysis generated an adjusted odds ratio of 28.9 (95% confidence interval, 3.7–221.4; P < .001).

CONCLUSION: New onset FHR abnormalities after initial labor epidural dosing occur more frequently in women with a low admission PP than those with a normal admission pulse. Admission PP appears to be a novel predictor of new onset postepidural FHR abnormalities.

Keywords: intrapartum fetal heart monitoring, obstetric anesthesia, pregnancy hemodynamics

Pulse Pressure Study Objective

• Hemodynamic parameter estimating intravascular volume
• Calculated by subtracting DBP from SBP
  • BP = 134/72: Pulse pressure = 62 mmHg
• Examine ↓ maternal pulse pressure (PP) as a risk factor for new onset post-epidural FHR abnormalities
  • ↓ PP = <45 mmHg
  • FHR abnormalities in first 60 minutes after dosing
    • Recurrent late decelerations and/or prolonged decelerations
New onset FHR abnormalities after initial labor epidural dosing occur more frequently in women with low admission PP compared to those with normal admission PP.
The “So What” Factor

• Why is there a low pulse pressure?
  • Evaluate for intravascular volume reduction
    • Bleeding or dehydration
• Increase IV fluid maintenance rate
  • 125 cc/hr designed to replace loss in resting patient
  • Labor = active metabolically and physiologically
    • Consider 200-250 cc/hr in healthy patient
• Pretreat with vasoconstricting agent
Hypovolemic (<45 mmHg)
Euvolemic (≥50 mmHg)
Contraction Associated Decelerations

• Hypovolemic vs euvolemic = 41.1% vs 13.6%
• CAHRD
  • ↑ Post-epidural FHR abnormalities (43.5% vs 31.1%)
  • ↑ Diastolic hypotension (63.7% vs 50.0%)
  • ↑ Need for resuscitative interventions (33.9% vs 23.1%)

• Your goal: Intrapartum maternal heart rate assessment
  Intrapartum fluid management
Sports medicine literature indicates that adequate hydration is useful for peak athletic performance

125 cc/hr versus 250 cc/hr in nullips with spontaneous labor between 2 - 5 cm

"... novel finding that increasing fluid administration...is associated with a lower frequency of prolonged labor and possibly less need for oxytocin. Thus inadequate hydration in labor may be a factor contributing to dysfunctional labor and possibly cesarean delivery"
Effect Of Increased Intravenous Hydration On The Course Of Labor In Nulliparous Women

• Objective: Determine whether increased IVF affect labor progress
• RCT: 195 women in labor
  • 125 or 250 mL/hr LR or isotonic sodium chloride
  • Uncomplicated nulliparous women with singleton term gestations
    • Spontaneous active labor with dilatation between 2 and 5 cm
• Mean volume
  • 250 ml group = 2487 ml       125 ml group=2008 mL
<table>
<thead>
<tr>
<th></th>
<th>125 cc/hr = 94</th>
<th>250 cc/hr = 101</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean duration: 1&lt;sup&gt;st&lt;/sup&gt; stage</td>
<td>483 minutes</td>
<td>413 minutes</td>
<td>.060</td>
</tr>
<tr>
<td>Mean duration: 2&lt;sup&gt;nd&lt;/sup&gt; stage</td>
<td>69 minutes</td>
<td>71 minutes</td>
<td>NS</td>
</tr>
<tr>
<td>Mean total labor duration</td>
<td>552 minutes</td>
<td>484 minutes</td>
<td>.060</td>
</tr>
<tr>
<td>Frequency of labor &gt; 12 hours</td>
<td>20/78 = 26%</td>
<td>12/91 = 13%</td>
<td>.047</td>
</tr>
<tr>
<td>Oxytocin Augmentation</td>
<td>61 (65%)</td>
<td>51 (49%)</td>
<td>.062</td>
</tr>
<tr>
<td>Cesarean Section</td>
<td>16 FTP = 15</td>
<td>10 FTP = 10</td>
<td>.22</td>
</tr>
</tbody>
</table>
Normal Saline With OR Without Dextrose

- Objective: compare intravenous NS with and without dextrose on the course of labor in nulliparas
- Double blind RCT: 289 women in active labor; 125 cc/hr
  - NS
  - NS with 5% dextrose (D5NS)
  - NS with 10% dextrose (D10NS)
<table>
<thead>
<tr>
<th></th>
<th>NS = 84</th>
<th>D5NS = 76</th>
<th>D10NS = 72</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time from IVF start to 10 cm</td>
<td>360 minutes (95-1203)</td>
<td>299 minutes (82-1091)</td>
<td>328 minutes (61-672)</td>
<td>.10</td>
</tr>
<tr>
<td>2nd stage</td>
<td>106 minutes (24-266)</td>
<td>69 minutes (17-227)</td>
<td>62 minutes (14-191)</td>
<td>.01</td>
</tr>
<tr>
<td>Time from IVF start to delivery</td>
<td>464 minutes (185-1336)</td>
<td>392 minutes (100-1157)</td>
<td>393 minutes (97-827)</td>
<td>.02</td>
</tr>
<tr>
<td>Labor &gt;12hrs</td>
<td>18 (22%)</td>
<td>7 (9.3%)</td>
<td>5 (5.8%)</td>
<td>.01</td>
</tr>
</tbody>
</table>
Study goal: Provide evidence whether IV glucose supplementation during induction in nullips can reduce duration of active labor.

Random: 250 mL/hour IV D5NS or 250 mL/hour NS for whole L&D duration

1\textsuperscript{st} and 2\textsuperscript{nd} stage: D5NS vs NS: (441 versus 505 minutes)

Delivery by 200 minutes: 19% versus 8%

Delivered by 450 minutes: 75% versus 61%

No difference in the rate of cesarean section and APGAR score.
• Study goal: Provide evidence whether IV glucose supplementation during induction in nullips can reduce duration of active labor.
• Random: 250 mL/hour IV D5NS or 250 mL/hour NS for whole L&D duration
• 1st and 2nd stage: D5NS vs NS: (441 versus 505 minutes)
• Delivery by 200 minutes: 19% versus 8%
• Delivered by 450 minutes: 75% versus 61%
• No difference in the rate of cesarean section and APGAR score
Let’s Talk About Oxygen

Although the classic triad of intrauterine resuscitation has been position changes, IV fluids, and oxygen, there is little evidence on potential adverse effects (both hypoxia and hyperoxia can cause free radical production & oxidative stress)

More research is needed on the risks of oxygen, both short- & long-term, on the duration of use, the types of FHR tracings where it is indicated, and algorithms for intrauterine resuscitation

Oxygen for intrauterine resuscitation: of unproven benefit and potentially harmful

Maureen S. Hamel, MD; Brenna L. Anderson, MD, MSc; Dwight J. Rouse, MD, MSPH

Maternal oxygen is often given to laboring women to improve fetal metabolic status or in an attempt to alleviate nonreassuring fetal heart rate patterns. However, the only 2 randomized trials investigating the use of maternal oxygen supplementation in laboring women do not support that such supplementation is likely to be of benefit to the fetus. And by increasing free radical activity, maternal oxygen supplementation may even be harmful. Based on a review of the available literature, we conclude that until it is studied properly in a randomized clinical trial, maternal oxygen supplementation in labor should be reserved for maternal hypoxia, and should not be considered an indicated intervention for nonreassuring fetal status.

Key words: fetal resuscitation, labor, maternal oxygen

to hemoglobin) in maternal arterial blood is around 100 mm Hg, while the umbilical venous Po2 in the near term fetus is estimated to be approximately 28 mm Hg. Despite lower partial pressures within the umbilical vein, the fetus is able to adequately oxygenate its tissues. Oxygen saturation is the percentage of oxygen-binding sites on hemoglobin that are bound by oxygen. Normal oxygen saturation in healthy women is 99-100% while in the near term fetus it is usually 60-70%.
<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>N</th>
<th>Groups</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawes et al, 1988 RCT</td>
<td>Elective CD</td>
<td>35</td>
<td>$O_2$ 50% vs 33%</td>
<td>ND: Cord gases Apgars</td>
</tr>
<tr>
<td>Perreault et al, 1992 RCT</td>
<td>Elective CD</td>
<td>20</td>
<td>$O_2$ 50% vs 100%</td>
<td>ND: Cord gases 5 minute Apgars</td>
</tr>
<tr>
<td>Thorp et al, 1995 RCT</td>
<td>2nd stage labor</td>
<td>86</td>
<td>$O_2$ 10L face mask vs no $O_2$</td>
<td>↑ abnormal cord gases prolonged $O_2$</td>
</tr>
<tr>
<td>Sirimai et al, 1997 RCT</td>
<td>2nd stage labor</td>
<td>80</td>
<td>$O_2$ vs no $O_2$</td>
<td>ND: Cord gases</td>
</tr>
<tr>
<td>Jozwik et al, 2000 RCT</td>
<td>Elective CD</td>
<td>41</td>
<td>$O_2$ 60% at 15L x15 min vs $O_2$ face mask</td>
<td>ND: Fetal acid base status</td>
</tr>
<tr>
<td>Qian et al, 2017 RCT</td>
<td>2nd stage labor No EFM changes</td>
<td>443</td>
<td>$O_2$ 2L/min nasal cannula vs placebo</td>
<td>ND: Cord gases FHR changes</td>
</tr>
<tr>
<td>Raghuraman et al, 2018 RCT</td>
<td>1st and 2nd stage</td>
<td>7,789</td>
<td>$O_2$ vs no $O_2$</td>
<td>$O_2$: ↑ neo morbidity in acidemic neonates</td>
</tr>
</tbody>
</table>

Oxygen for Category II Intrauterine Fetal Resuscitation
A Randomized, Noninferiority Trial
Society of Maternal-Fetal Medicine
Pregnancy Meeting: 2018

http://www.smfmstreamingvideos.com/Player/08/08.html
Among patients with category II fetal heart tracings, intrauterine resuscitation with room air is noninferior to oxygen in improving umbilical artery lactate. The results of this trial challenge the efficacy of a ubiquitous obstetric practice and suggest that room air may be an acceptable alternative.

Take Home Points on Oxygen

- Try other corrective measures initially
- Do you really need oxygen for moderate variability
- **DISCUSS** simultaneous oxytocin - oxygen use
  - What’s causing Category II changes?
- Discontinue as soon as fetal response warrants
Correct Hypotension

- Systolic BP < 100 mmHg or 20% decrease in BP
  - From pre-anesthesia levels
- Neuraxial anesthesia
  - Risk for ↓ uteroplacental blood flow R/T sympathetic blockade
- Position change and IV fluid bolus
- Ephedrine
  - Increases vascular tone to improve BP
- Phenylephrine
Ephedrine: Dosage 5-10mg IV push

Maternal effects

- Alpha and beta receptor stimulation ➔ vasoconstriction
  - ↑ heart rate
  - ↑ cardiac output
  - ↑ blood pressure

Fetal effects

- ↑ FHR
- Tachycardia
- ↑ FHR variability
Reduction of Uterine Activity

12 HOURS OF LABOR?

I AM GOING TO HEAR ABOUT THIS FOR THE REST OF MY LIFE.

Limited to no exchange of O2 and CO2

Reduced exchange

Free exchange of O2 and CO2
Reduction of Uterine Activity

**Endogenous Oxytocin**
- First stage of Labor:
- Maternal circulating concentrations ~2-4 μu/min
- Fetal contribution ~ 3 μu/min
- Combined: 5-7 μu/min

**Exogenous Oxytocin**
- Half life is 10-12 minutes
  - 3-4 ½ lifes to reach steady state
- Uterine response within 30-60 min
- Full effect of oxytocin dose
- Physiologic dosing
  - Initial dose: 1-2 μu/min
  - Increase 1-2 μu/min q 30-60
Reduce Uterine Activity

• Corrective Measures
  • \( \downarrow \) or discontinue oxytocin or cervical ripening agent
  • Lateral positioning
  • IV fluid bolus

• Simultaneous interventions
  • Oxytocin dc’d = resolution 14.2 minutes
  • Oxytocin dc’dand IVF bolus 500 cc = resolution 9.8 minutes
  • Oxytocin dc’d, IVF bolus 500 cc, lateral position = resolution 6.1 minutes

30-40 minutes:
FHR "resolution", normal uc pattern, restart oxytocin by half

Reduction of Uterine Activity

• 56 nullips elective induction
• 30 minutes of oxytocin induced “hyperstimulation”
  – Associated with a ↓ in FspO2
  – ≥ 5 contractions /10 minutes
    – ↓ 20% FSpO2
  – ≥ 6 contractions/10 minutes
    – ↓ 29% FSpO2

>30 mmHg decreases flow to intervillous space
>50 mmHg blood flow ceases
Amnioinfusion

- Transcervical placement of IV fluid
- Corrects umbilical cord compression
- Impacts variable decelerations
  - Not LATE decelerations or minimal/absent variability
- Suggested procedure
  - Bolus 250-500 cc over 30 minutes via infusion pump
  - Consider continuous infusion 2-3 cc/min (120-180 cc/min)
- What goes in must come out
Amnioinfusion for potential or suspected umbilical cord compression in labour (Review)

Hofmeyr GJ, Lawrie TA
Main results

We have included 19 studies, with all but two studies having fewer than 200 participants. Transcervical amnioinfusion for potential or suspected umbilical cord compression was associated with the following reductions: caesarean section overall (13 trials, 1493 participants; average risk ratio (RR) 0.62, 95% confidence interval (CI) 0.46 to 0.83); fetal heart rate (FHR) decelerations (seven trials, 1006 participants; average RR 0.53, 95% CI 0.38 to 0.74); Apgar score less than seven at five minutes (12 trials, 1804 participants; average RR 0.47, 95% CI 0.30 to 0.72); meconium below the vocal cords (three trials, 674 participants, RR 0.53, 95% CI 0.31 to 0.92); postpartum endometritis (six trials, 767 participants; RR 0.45, 95% CI 0.25 to 0.81) and maternal hospital stay greater than three days (four trials, 1051 participants; average RR 0.45, 95% CI 0.25 to 0.78). Transabdominal amnioinfusion showed similar trends, though numbers studied were small.
Tocolytic Administration For Uterine Contractions
Beta -2 Sympathomimetic (Terbutaline): 0.25 mg

Alterations in 2nd Stage Pushing Efforts

- Involuntary
  - Spontaneous pushing against a closed glottis
  - In response to descent of presenting part on perineum
- Valsalva
  - Directed strenuous bearing down effort against a closed glottis for at least 10 seconds
  - “Take a deep breath and hold it for as long as you can” (usually 10 seconds) using the entire contraction 2-3 pushes of 10 seconds each

Directed and Non-directed Pushing

• Directed
  • Similar to closed glottis
  • Also includes instructions on positioning
  • Often supine or Semi-Fowlers

• Non-directed
  • Clinicians encourage women to choose methods she feels is effective
  • Choosing her position
  • Deciding whether to hold her breath during pushing efforts
  • Determining duration of each push
Open Glottis

- Spontaneous involuntary bearing down accompanying uterine contractions
- Expiratory grunting or vocalization
- 3-4 pushes of 6-8 seconds with each contraction
Closed Glottis

- Potential ↑ risk for pelvic floor and perineal injuries
  - Structural and neurogenic injury to pelvic floor and perineum
    - Vaginal wall, bladder, and support structures are forced in front of fetal head
      - Obstructs fetal descent
      - Increased risk of urinary incontinence
Alteration in Second Stage Pushing Technique

Alterations in 2nd Stage Pushing Efforts

Discourage prolonged breath-holding ("purple pushing")
  • Consider open glottis pushing, allow patient to choose
  • Discourage >3 pushing efforts with each contraction
  • Discourage > 6-8 seconds of each pushing effort
  • Don’t forget about FHR
    • Pushing efforts may need to be modified based on pattern
      • Push every other or 3rd contraction to avoid recurrent decels
  • Reposition as necessary for FHR decelerations/fetal descent
  • Consider delayed pushing
Approaches to Limit Intervention During Labor and Birth

When not coached to breathe in a specific way, women push with an open glottis. In consideration of the limited data regarding outcomes of spontaneous versus Valsalva pushing, each woman should be encouraged to use the technique that she prefers and is most effective for her.
Cochrane Review

• Seven RCT’s comparing spontaneous to Valsalva
  • No differences in duration of 2nd stage, rates of operative vaginal delivery, cesarean episiotomy, perineal lacerations, 5 minute Apgar <7, NICU admissions
  • Valsalva technique: shorter duration of pushing
    • Mean difference: 5.2 minutes vs 7.78 minutes

Effect of spontaneous pushing versus Valsalva pushing in the second stage of labour on mother and fetus: a systematic review of randomised trials

M Prins, J Boxem, C Lucas, E Hutton

Department of Midwifery Science, AVAG and the EMGO Institute for Health and Care Research, VU University Medical Centre, Amsterdam
Department of Clinical Epidemiology, Biostatistics and Bioinformatics, Academic Medical Centre, University of Amsterdam, Amsterdam, the Netherlands
Department of Obstetrics and Gynaecology, McMaster University, Hamilton, ON, Canada

Correspondence: M. Prins, Midwifery Academy of Amsterdam and Groningen (AVAG), Louwesweg 6, 1066 BC Amsterdam, the Netherlands. Email marianne.prins@nholland.nl

- Meta-analysis (3 RCT’s): low risk nullips ≥36 weeks without epidural
  - No difference in operative vaginal delivery, cesarean, episiotomy or perineal lacerations
  - Shorter 2nd stage with Valsalva (18.59 minutes) except confidence intervals were wide:
    - Sample size was too SMALL
Purpose of Documentation

• Facilitate communication among & between caregivers

• Promote improved quality of care by encouraging assessment and reevaluation of progress and clinical plans

• Meet professional and legal standards
"In spite of the apparent importance of charting, it is probably one of the greatest 'hates' of nurses. Many nurses complain that the time spent in charting might be more profitably used in actual patient care."

A very wise nurse
Intrapartum FHR Monitoring Challenges

- Failure to recognize Category II / III FHR and underlying physiology
- Lack of current FHM education and competency training
- Maternal-FHR Signal Ambiguity
- Failure to follow protocols
- Poor documentation
- Inadequate EFM tracing
- Communication failure at all care levels
- Lack of clinical context for current obstetric situation
- Lack of situational awareness
- Failure to address physician/nursing concerns
- Chain of command problems

Adapted from: Esplin, M. S., & Eller, A. G. 10 tips for overcoming common challenges of intrapartum fetal monitoring. Use these expert tips to anticipate and address the common challenges of intrapartum FHR monitoring to improve care of the mother and baby and reduce potential liability. Four clinical case scenarios presented. OBG Manag. 2016; 28 (S): 34–46
Assessment of EFM tracings infers that there is **BEDSIDE** visual review of a paper tracing or labor room computer screen.
On occasion

- Tracing analysis from a remote location necessary

Staffing ratios do not allow for a bedside evaluation

Remote tracing review from an operating room during critical situation (i.e. emergent cesarean)
The Obstetric Record

• Critical Thinking
  Assessment: Encompasses everything
  Communication: What I tell others
  Documentation: What is recorded
  ▪ Must accurately reflect occurrence and sequence of events
  ▪ Will be subject to keen scrutiny by experts
The Three “D”s

• Disclosure
  A family’s story will be affected by disclosure conversations following an unexpected outcome,
  Do not underestimate the impact

• Documentation
  Records will become a sword for the plaintiffs or a shield for the defense

• Deposition
  Closely related to documentation, what is testified to at deposition will be the basis of trial testimony and may impact settlement
Documentation must be “CLEAR”

- Contemporaneous
- Logical
- Explicit
- Accurate
- Readable
Contemporaneous

- Written around or near time of occurrence or intervention
- No legal standard
- Use common sense
- Records must be transparent
- No harm in a proper “late” entry
Gradual FHR baseline increase from 120 to 155 bpm over an hour. Irregular contractions with Montevideo units <130 mm Hg. Normal vital signs. Dr Navarre notified of baseline change/vital signs; will review tracing remotely from clinic.
Logical

- Plain and unambiguous
- Show a clear plan related to patient assessment/status
- SOAP concept provides a logical format
  
  **S:** Feeling more pelvic pressure  
  **O:** FHR 130 bpm, mod var, (-) accel, (-) decel, 3 cm, 90%/-0  
  **A:** 1. 38 y/o G4 P3 at 40 2/7 wks  
    2. Latent labor  
  **P:** Continue expectant management, anticipate NSVD
Explicit

• Avoid vague or ambiguous terms
• FHR and uterine activity,
  • Use components rather than categories
• 10 years from now
  • If you know components you can apply the summary terms, but the reverse is not!
My point: Hospitals have mandated categories be documented at the same intervals as FHR / UA components. This is redundant and consumes nursing time not to mention people are wrong in category interpretation at times.
| Table 1. Principles of effective obstetric documentation and communication

<table>
<thead>
<tr>
<th>Documentation quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Permanently accessible, retrievable, and available for audits</td>
</tr>
<tr>
<td>• Thorough, accurate, relevant, and consistent</td>
</tr>
<tr>
<td>• Clear, concise, timely, and complete</td>
</tr>
<tr>
<td>• Legible regardless if paper or electronic format</td>
</tr>
<tr>
<td>• Entered contemporaneously and sequentially</td>
</tr>
<tr>
<td>• Reflective of nursing process and critical thinking</td>
</tr>
<tr>
<td>• Apply standardized EFM nomenclature to entries</td>
</tr>
<tr>
<td>• Avoid nonspecific terms such as “reassuring, good”</td>
</tr>
<tr>
<td>• Provide evidence of patient handoffs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Staff education and training</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Comprehensive documentation education and training plan for new employees</td>
</tr>
<tr>
<td>• Incorporating technical elements of charting with organization or unit documentation policies</td>
</tr>
<tr>
<td>• Ongoing follow-up education for all employees to reinforce information and documentation trend updates</td>
</tr>
<tr>
<td>• Conduct team training</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Documentation and communication policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Familiarization with organization and work location documentation and communication policies that include chain of command, consultation and on-call policies, transfer policies, and conflict resolution</td>
</tr>
<tr>
<td>• Consider annual review of key policy by bedside clinicians and leadership</td>
</tr>
<tr>
<td>• Integrated into documentation systems that abide by recommended industry standards, governmental mandates, accrediting agencies, and organizational policies</td>
</tr>
<tr>
<td>• To include:</td>
</tr>
<tr>
<td>• Data security</td>
</tr>
<tr>
<td>• Protection of patient identification</td>
</tr>
<tr>
<td>• Confidentiality of patient information, clinical professionals’ information, and organizational information</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medical record security system</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Medical record entries must be:</td>
</tr>
<tr>
<td>• Accurate, valid, and complete</td>
</tr>
<tr>
<td>• Authenticated demonstrating entries are truthful, the clinician is readily identified, and information has not been added or inserted</td>
</tr>
<tr>
<td>• Dated and time-stamped by the clinician</td>
</tr>
<tr>
<td>• Legible/Readable</td>
</tr>
<tr>
<td>• Completed using standardized terminology and abbreviations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standardized terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Standardized terminologies and The Joint Commission-approved abbreviations that are used to describe plan, deliver, and evaluate nursing care based on professional organizational guidelines and position statements</td>
</tr>
</tbody>
</table>
Accurate

- Timing of notes, interventions, occurrences
- Use correct terminology
- Notes must provide a truthful representation of what happened
- Avoid allegations of spoliation
<table>
<thead>
<tr>
<th>Display Time</th>
<th>User</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cervical consistency: medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervical position: midposition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contraction frequency: 7 / 10 min in last 15 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average contraction duration: 71 seconds in last 15 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contraction intensity: 37 in last 15 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FHR 1: Baseline: 128 bpm in last 15 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maternal heart rate (SpO2): 80 BPM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maternal SpO2: 97%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maternal heart rate (SpO2): 87 BPM</td>
</tr>
</tbody>
</table>
Give Arizona state TV
something.

[Handwritten notes on paper]
Late Entry

“When there is a delay in entering chart information, write the phrase late entry at beginning of the note. ...Use the current date and time. Explain the delay in recording the information...”

Late entry due to urgency of patient care situation. At 22:10 patient had increasing pelvic pressure and bloody show. Fetal heart rate baseline 145 bpm, moderate variability, intermittent variable decelerations. Firm contractions every 2-4 minutes lasting 70-90 seconds. Vaginal examination by CNM Zemmer: 6/100%/-1. Approximately 10 minutes later, involuntary pushing noted, followed by a 5-minute prolonged deceleration to 90 beats per minute. Patient turned to right side. Repeat examination by this nurse 10/100%/+4. CNM Zemmer called to room for delivery. Head out at 22:32, followed by shoulder dystocia. Time of birth 22:38.
Which Of These Notes Is Better?

Nurse at bedside; fetal heart rate appears sketchy; toco not picking up contractions; patient requests pain medication; midwife Duncan called for orders.

Nurse at bedside; unable to interpret fetal heart rate data due to noncontiguous tracing related to maternal body habitus; firm contractions palpable every 2-3 minutes; monitors readjusted patient requests pain medication; pain scale 7 of 10; midwife Duncan called for pain medication orders and fetal spiral electrode/intrauterine pressure catheter placement.

Of questionable authenticity or trustworthiness: *a sketchy accent; a sketchy character.*

Of dubious safety; potentially harmful or dangerous: *a sketchy neighborhood.*
Frequency of Assessments and Documentation

• No published peer-reviewed data related to perinatal outcomes

• Concept of simultaneous assessment and documentation with EFM is not supported in the literature

• We mistakenly use IA assessment and documentation guidelines for EFM
<table>
<thead>
<tr>
<th>Phase</th>
<th>Latent phase (&lt;4 cm)</th>
<th>Latent phase (4-5 cm)</th>
<th>Active phase (≥ 6 cm)</th>
<th>Second stage (passive fetal descent)</th>
<th>Second stage (active pushing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-risk without oxytocin</td>
<td>Insufficient evidence to make a recommendation. Frequency at the discretion of the midwife or physician.</td>
<td>Every 30 minutes</td>
<td>Every 30 minutes</td>
<td>Every 30 minutes</td>
<td>Every 15 minutes</td>
</tr>
<tr>
<td>With oxytocin or risk factors</td>
<td>Every 15 minutes with oxytocin; every 30 minutes without</td>
<td>Every 15 minutes</td>
<td>Every 15 minutes</td>
<td>Every 15 minutes</td>
<td>Every 5 minutes</td>
</tr>
</tbody>
</table>

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Frequency of assessment should always be determined based on the status of the mother and fetus and at times will need to occur more often based on their clinical needs, e.g., in response to a temporary or ongoing change.

Summary documentation is acceptable, and individual hospital policy should be followed.

Documentation does not necessarily need to occur at the same intervals as assessment when using continuous EFM because FHM data are recorded in the tracing. For example, while evaluation of the FHR may occur every 15 minutes with EFM, a summary of findings of fetal status may be documented in the medical record less frequently. However, it is important that the documentation reflect the frequency of assessment and the interpretation of FHM findings.
Consider Performing Audits

• Based on unit’s needs
  • Frequency of late entries
• Heightened awareness of documentation
  • Full systematic assessment
• Ensure policies are consistent with standard of care
  • MD, CNM, RN
• Ensure policies are up to date
  • Reflective of what unit is REALLY doing
Literature

- Scientific, peer reviewed journals
- “Authoritative” textbooks
- “You can prove anything you really want to prove”
Systematic Review
Meta-Analysis

Randomized Controlled Trials

Cohort Studies and Cross Sectional

Case Controlled Studies: Case Series, Case Reports

Ideas, Expert Opinions, Background Information, Editorials, Anecdotes

Quality of Evidence