FHR Interpretation in 20 (or so) Slides
Intermountain Healthcare
University of Utah
M. Sean Esplin MD
Maternal Fetal Medicine
Pathophysiology

• Fetal heart rate monitoring = Fetal brain monitoring

• Brain monitors and responds to
  – Extrinsic influences
  – Intrinsic influences
  – Homeostatic interactions between the fetus and the environment

• Goal = maintain optimal blood flow (oxygenation) of the brain without compromising other organs
Questions to Ask Yourself

• Where did we start from?
  – Is there a clinical risk factor that suggests a predisposition to acidemia

• What is the pH now? And when was I last reassured?

• Is there evidence of impaired oxygen transfer?
  – If yes:
    • Can I improve oxygen transfer (interventions)?
    • Can I reasonably exclude metabolic acidosis?

• If I cannot exclude metabolic acidosis how long do I have before injury might occur?
Strip Review

• Essential characteristics for tracing interpretation
  – Clinical setting – provides the background risk
  – Baseline – Important to determine all other features
  – Variability – A marker of normal pH
  – Decelerations – A marker of ongoing O2 deprivation
  – Contractions – potential cause of O2 deprivation
  – Accelerations – A marker of normal pH
  – Change over time – evidence of an evolving process and marker of time course
... the subsequent fetal response if oxygen transfer is disrupted

FETUS

Hypoxemia
Hypoxia
Metabolic acidosis
Metabolic acidemia
Hypotension

POTENTIAL INJURY
Three Key Concepts

1. **Significant FHR decelerations (variable, late, prolonged) represent interruptions in fetal oxygen transfer**

2. **Disrupted oxygen transfer does not cause injury unless there is progression to metabolic acidemia**

3. **The presence of FHR variability and/or accelerations predict the ABSENCE of metabolic acidosis**

* The converse is *not* always true...
Three Tier System

• Category 1
  – Baseline: 110-160 bpm
  – Variability: moderate (6-25 bpm)
  – Accelerations: present or absent
  – Decelerations: No late/variable/prolonged

This should be your “go to” definition of normal.
Three Tier System

• Category III
  – Absent variability **with** any one of the following
    • Recurrent late decelerations
    • Recurrent variable decelerations
    • Bradycardia
  – Sinusoidal pattern
    • Cycle frequency 3-5/min lasting at least 20’

If this persists, it is pretty good evidence that you are in deep doo doo.
Category II

• Baseline
  – Bradycardia (<110 bpm) with preserved variability
  – Tachycardia (>160 bpm)

• Variability
  – Minimal (≤ 5 bpm but detectable)
  – Absent (undetectable)
    • but NOT accompanied by recurrent decelerations
  – Marked (>25 bpm)

• Accelerations
  – Absence of acceleration with scalp stimulation

• Decelerations
  – Late
  – Variable
  – Recurrent
  – prolonged
The Basics

• Category I: “Strongly predictive of normal fetal acid-base status”

• Category III: “Predictive of abnormal fetal acid-base status”

• Category II: “Indeterminate....[they] require evaluation and continued surveillance and reevaluation, taking into account the entire associated clinical circumstances”

Gee, thanks...
FHR Tracings and Acidemia

• Moderate variability predicts pH > 7.15
  – Negative predictive value 98%
• Minimal/absent variability AND decels associated with pH< 7.15
  – Though predictive value still poor (23%)
• Likelihood of acidemia increases with depth of recurrent decelerations
  – Especially late and with min/absent variability

Evolving Fetal Compromise

- Recurrent variable/late decelerations
- Progressively deeper decelerations
- Reflexive fetal tachycardia (+/-)
- Progressive reduction in variability moderate to minimal to absent
- Terminal bradycardia

Repetitive Cord Occlusion

• Near term fetal sheep – exposed to cord occlusion
  – Mild – 1 minute occlusion every 5 minutes
  – Moderate – 1 minute occlusion every 3 minutes
  – Severe – 1 minute of occlusion every 2 minutes

• Continuous measurement of base deficit (BD) as a marker of metabolic acidosis

Frasch, MG, et al. AJOG 2009;200:200
Deceleration

• Fetal sheep cord occlusion studies
• 1:5 occlusion series – 1 minutes occlusion every 5 minutes
  – Onset of each occlusion was accompanied by a variable FHR deceleration, with rapid return to baseline levels
  – Small fall in pH and a rise in BD and lactate occurred in the first 30 minutes of occlusions
    – (pH, 7.34 ± 0.07; BD, 1.3 ± 3.9 mmol/L; lactate, 4.5 ± 1.3 mmol/L)
  – Values remained stable, despite a further 3.5 hours of occlusions
Deceleration

• 1:2.5 occlusion series – 1 minutes occlusion every 2.5 minutes
  – Rapid occlusion frequency provided only a brief period of recovery between occlusions
  – After 1 hour
    • All animals had a severe metabolic acidosis, with pH 6.92 ± 0.03; BD, 19.2 ± 1.5 mmol/L, and lactate 14.6 ± 0.8 mmol/L by the end of the occlusions
Timecourse to Acidemia

- With minimal/absent variability and recurrent decelerations, acidemia evolves over ~60' – In the setting of a previously normal tracing
- Can occur more quickly with acute events – Abruptio placentae, uterine rupture, cord prolapse – Sudden and profound fetal bradycardia

Evidence is limited but general expert consensus is “about one hour”

Low JA Obstet Gynecol 1999;93:85-91
Williams KP Am J Obstet Gynecol 2003;188:820-3
Eilimian A Obstet Gynecol 1997;89:373-6
Clark S Am J Obstet Gynecol 1982
ACOG Algorithm

Intrapartum Fetal Heart Rate Management Decision Model

Confirm FHR and uterine activity

FHR Category?

I

II or III

FHR Category?

I

II

III

“ABCD”

“A” – Assess oxygen pathway
“B” – Begin corrective measures

Moderate variability and/or accelerations
and
No clinically significant decelerations

“C” – Clear obstacles to rapid delivery
“D” – Determine decision to delivery time

Is the patient low-risk?

Yes

No

Routine Surveillance

• Every 30 min in the 1st stage of labor
• Every 15 min in the 2nd stage of labor

Heightened Surveillance

• Every 15 min in the 1st stage of labor
• Every 5 min in the 2nd stage of labor

Expedite Delivery

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

Yes

No

http://mail.ny.acog.org/website/EFMPoster.pdf
ACOG Algorithm

Category I

Surveillance

“Low risk”
1st stage q 30 min
2nd stage q 15 min

“High risk”
1st stage q 15 min
2nd stage q 5 min

Category II

Conservative Measures “A & B”

Assess Oxygen Pathway
Lungs
Heart
Vasculature
Uterus
Placenta
Cord

Category II AND
Metabolic acidemia CAN be excluded
(Moderate variability or accelerations)

Category II - III
AND
Metabolic acidemia CANNOT be excluded
(Minimal-absent variability and no accelerations)

Category III

Prepare for Delivery “C & D”

Clear obstacles to delivery
Facility
Staff
Mother
Fetus
Labor

Is immediate delivery indicated?
No

Decision-delivery
Facility
Staff
Mother
Fetus
Labor

Evolution of metabolic acidemia ~ 60 min
Subtract 50% safety margin ~ 30 min
Subtract “decision-delivery estimate” ~ X min
Allow the remaining time for vaginal delivery or correction of the FHR tracing

If vaginal delivery does not occur in this time frame and the FHR abnormalities have not been corrected, it is reasonable to offer operative delivery

Five Tier System

- Stepwise evaluation of FHR tracing

1. Variability

2. Baseline rate

3. Presence of recurrent decelerations

- With ≥50% of contractions over 20'

- Decelerations classified mild/mod/severe

<table>
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<tr>
<th>Category</th>
<th>Definition</th>
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<tr>
<td><strong>Green</strong></td>
<td>No acidemia</td>
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<tr>
<td><strong>Blue</strong></td>
<td>No central fetal acidemia</td>
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<tr>
<td><strong>Yellow</strong></td>
<td>No central fetal acidemia, but FHR patterns suggests intermittent reductions in O2 which may result in fetal O2 debt</td>
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<tr>
<td><strong>Orange</strong></td>
<td>Fetus potentially on the verge of decompensation</td>
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<tr>
<td><strong>Red</strong></td>
<td>Evidence of actual or impending damaging fetal asphyxia</td>
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# Five Tier System

## Moderate (Normal) Variability

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<tr>
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<th>Early</th>
<th>Mild VD</th>
<th>Mod VD</th>
<th>Sev VD</th>
<th>Mild LD</th>
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<th>Mild PD</th>
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## Absent Variability

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**Sinusoidal**

Marked Variability

- **R**
- **Y**

**VD,** Variable decelerations; **LD** Late decelerations; **PD,** Prolonged decelerations; **Brd,** Bradycardia; **Tachy,** Tachycardia;

**G,** Green; **B,** Blue; **Y,** Yellow; **O,** Orange; **R,** Red

FIGURE 1
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

Latent Phase

Normal labor progress

No

Yes

Cesarean

Active Phase

No

Observe

Second Stage

Normal progress

No

Yes

Cesarean or OVD

Observe

Cesarean or OVD

Observe

Manage per algorithm

Significant decelerations with ≥50% of contractions for 30 minutes

Yes

Observe for 1 hour

No

Persistent pattern

OVD, operative vaginal delivery.

*They have 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, amnioinfusion, and/or changes in second stage breathing and pushing techniques.

Conclusion

• Proposed algorithm is the result of Expert opinion
  – Not tested in prospective fashion (or retrospective fashion for that matter)
• “We do not believe it is possible to simultaneously eliminate preventable fetal neurologic injury and significantly reduce the cesarean delivery rate for abnormal FHR patterns”
  – This approach will increase the cesarean section rate in order to prevent HIE
Summary General Approach

• Recognize potential for fetal compromise
• Attempt to improve oxygen delivery
  – Begin corrective measures
• Anticipate time to delivery
  – “Do you think she can do it???”
    • Parity, labor progress, fetal size/station/position, etc
• Account for potential complicating factors
  – time to mobilize care teams (operative delivery)
  – maternal factors (BMI, prior surgery, willingness)
Crystal Clear, Right?

• It’s as simple as I, II, III
• Or maybe green, blue, yellow, orange, red?

• Questions???
Case 1

• 25 year old G2 P1001 at 37 weeks 6 days gestation
  – Presents with spontaneous labor
  – Has history of previous cesarean section for uncertain indication
  – GBS positive
  – BP 109/69, p=85, pain score 7/10
  – Cvx: 1/70/-2

• What are the risks?
04:56 am
1cm/70%/-2
07:36 am
3cm/80%/-1
Epidural placed
08:40 am
3cm/80%/-1
Outcome

• NSVD of Female infant
  – Weight 6 pounds 3 ounces
  – Apgars - 1, 0, 0
  – Blood gas sent but lost – No value available
Learning Points

• Natural progression of variable decelerations
  – Mild variables to moderate moderate variables to tachycardia to decreased variability to terminal bradycardia

• Make sure you can adequately assess the baseline and variability
  – Rest through a contraction or two

• Loss of situational awareness
  – “The doctor is watching too”
  – “The next push”

• Don’t underestimate the importance of the cord gas
Case 2
ADMIT INFORMATION

Birth Date: 12/19/1987  Age: 21
Ped: Ref:  Blood Type: B+

MED/SURG HISTORY
Med Hist: denies Surg: Hx of scraping of cervix

PSYCHOSOCIAL
Support Person: mother, sister, friend Single and Keeping
Will you have the help you need after discharge? Yes

TOKACCO/ALCOHOL/SUBST USE
Tobacco Use Never Smokers in the Home - No Alcohol Use Not Since Pregnant Substance Use Never

PATIENT REQUESTS
Newborn Care Provider REFER Epidural

INFORMATION SOURCE
Patient Pretantal Record

PAIN ASSESSMENT/ MANAGEMENT
Pain Management Goal Set epidural

DOMESTIC VIOLENCE
Reports No Abuse

ADVANCED DIRECTIVES
Patient has Living Will - No Organ Donor - No Power of Attorney - No Written Medical Treatment Plan - No Pt Declines Additional Advanced Directives Info

PE-CARDIOVASCULAR (03/17/2009 23:21)
Skin Warm and Moist Cardiac exam: RRR HEART SOUNDS S1, S2 No Peripheral Edema

PE-NEURO (03/17/2009 23:21)
Patient Alert, Oriented X3 Patient Obey Commands Upon Request Appropriate Behavior Calm Behavior Cooperative Behavior Effectively Coping Sensation intact, All Extremities Moves All Extremities Purposefully Bed In Low Position Call Light within Reach

PE: GI SYSTEM (03/17/2009 23:21)
No tenderness on palpation Normal/Preg Abdomen Exam

PE-PULMONARY (03/17/2009 23:21)
Respiratory Pattern Even, no Effort Normal Chest Expansion Breath Sounds Clear Bilaterally

PE-EXTREMITIES (03/17/2009 23:21)
Normal Extrem. Exam

ROOM: GA04  Parity: 0/0/10
LMP: 08/11/2008  Gravida: 2
EDC: 03/18/2009  Unit Ref #: 540751443
Admit GA: 39.6  Med Rec #: 07-27-57
Deliv GA: 40.0  Encounter #: 24087289

PE-BRADEN SCALE (03/17/2009 23:21)
Total Braden score 21

PE: GU SYSTEM (03/17/2009 23:21)
Voiding without disconfort Patient Express Compliance Patient Verbalizes Knowledge Significant Other Verbalizes Knowledge Patient Asked No Questions

PE-LEARNING ASSESSMENT (03/17/2009 23:21)
RN reviewed/Continued Plan of Care Taught about FHR Tracing Patient Orientated to Room/Calf Light Taught about Monitor/Equipment Taught about Plan of Care Taught about Pain Management/Scale (0-10)

PE- FALLS RISK ASSESSMENT
Total Falls Risk Assessment Score = 3 Total Safe Handling Score = 0 - Performs Independently

ASSESSMENT/PLAN
Assess: 39.6 wk primip, labor eval
Plan: monitor, assess, notify md, eval

ADMIT HISTORY COMPLETE
Admit History Completed 03/17/2009 23:26

1ST VAGINAL EXAM (03/17/2009 23:03)
Cervix soft Cervix posterior 2+ cm. Dilatation Vag Examin 90% Effaced -1 Station RN Vaginal Exam Bishop Score 8

1ST STRIP REVIEW BY NURSE (03/17/2009 23:24)
Acceleration(s) Noted Moderate Variability (5-25 BPM) Baseline Rate 130 UT Palpated Moderate Uterus Palpates Soft Between UC

1ST VITAL SIGNS (03/17/2009 23:00)
Blood Pressure 119/70 Heart Rate 89 Respiratory Rate 18 Temperature 36.5 Tympanic Pain Score 6
Interpretation? Interventions?
Interpretation?  Interventions?
Venous Blood Gas
pH=7.21, pCO2=48
pO2=16.5, BE=-9.7