Antenatal Fetal Assessment

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Goals
- Prevent fetal death
- Identify suspected fetal compromise
- Avoid fetal hypoxic insult

Primary questions to answer
- Is this fetus better off delivered or undelivered?
- Is intervention warranted or not?

Evidence of Efficacy

- No RCT’s demonstrate decreased risk of fetal death
  - Incorporated into routine practice without benefit of rigorous RCT’s
  - Unlikely such a study will ever be conducted
    - Too widely ingrained into current practice

- Multiple retrospective trials suggest decreased risk fetal death in tested patients
  - Versus untested (low-risk) patients and
  - Untested historical (at-risk) patients
Antenatal Fetal Assessment
Performance

- Normal test highly reassuring
  - Very low false negative rate
- Stillbirth rate
  - NST: 1.9/1000 (581 patients)
  - CST: 0.3/1000 (12,668 patients)
  - BPP: 0.8/1000 (54,617 patients)
- Negative predictive value
  - 99.8%
  - But, not predictive of acute changes in fetal status
    - Abruption, umbilical cord prolapse

- Positive predictive value is substantial
- Much better at “ruling out” compromise that “ruling in”
- Difficult to quantify precisely
  - Tests introduced into clinical practice before RCT’s were conducted to evaluate specificity/sensitivity
  - Abnormal tests are acted upon obscuring true relationship between abnormal test and IUFD
- Must rely on surrogate markers
  - 90% of NR NST’s followed by negative CST’s
  - Modified BPP’s vs full BPP’s: false (+) 60%
  - Abnormal CST’s associated with false (+) 65-75%

Antenatal Fetal Assessment
Physiologic Basis

- Generation of reactive FHR patterns
  - Intact electrical conduction pathways
  - Appropriate myocardial neurohormone receptors
  - Sympathetic/parasympathetic reflex arcs
  - Inherent myocardial contractility
- FHR patterns seen with hypoxemia/acidemia
  - Relatively fixed FHR baseline
  - Diminished variability and accelerations
  - Appearance of spontaneous late decelerations
Antenatal Fetal Assessment
Physiologic Basis

- FHR pattern affected by other factors
  - Fetal sleep state
    - Decreased variability 20’ to 2 hours
  - Gestational age
    - Maturation of FHR central regulatory centers incomplete
    - At 24-32 weeks, lower amplitude (10 bpm) accelerations
  - Maternal factors
    - Fasting versus fed: inconsistent effect
    - Antihypertensive medications
      - Effects on baseline and amplitude/frequency of accelerations
    - CNS depressants and stimulants
  - Maternal metabolic status (DKA, maternal hypoxemia)

Fetal Assessment
Physiologic Basis

- Maternal factors
  - Hypertensive diseases
  - Diabetes
  - Thrombophilias
  - Obesity
  - Connective tissue disease
  - Hemoglobinopathies
  - Cardiac/pulmonary/renal disease
  - Thyroid disease
  - Other-see below

- Pregnancy-Related
  - Decreased fetal motion
  - Abnormal AFV
  - Growth restriction
  - Postterm
  - Isomunization
  - Prior adverse outcome
  - Multiple gestation
  - Fetal anomaly (most)
  - Other-see below
Antenatal Fetal Assessment
Initiation of Testing

- Don’t start until prepared to intervene
- Balance multiple factors
  - Neonatal survival prognosis
  - Severity of underlying MF disease
  - Must account for entire clinical picture
    - Example: PPROM at 25 weeks
  - Iatrogenic prematurity
    - 1.5% of women tested preterm were delivered for false positive antenatal surveillance tests


Antenatal Fetal assessment
Initiation of Testing

- 32-34 weeks gestation appropriate point to start most at-risk patients in testing
- Consider testing earlier
  - Particularly severe pathophysiology
  - Multiple maternal/fetal issues
- Individualize management plan
  - Must be prepared to act on abnormal results

ACOG Practice Bulletin 2016 Reaffirmed

Antenatal Fetal Assessment
-Fetal Movement-

- Decreased movement sometimes, but not always, perceived prior to fetal death
  - Simplest technique for monitoring well being
  - No RCT’s demonstrating reduced risk IUFD
- Perception of a vigorous fetus reassuring
- Further fetal assessment indicated with maternal perception of diminished fetal activity
Antenatal Fetal Assessment
-Non-Stress Test-

- Based upon premise that fetal movement will produce FHR acceleration in fetus that is not acidemic or neurologically depressed
- Heart rate reactivity equated with normal fetal autonomic function
- Fetal sleep cycle most likely cause for loss of reactivity

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Antenatal Fetal Assessment
-Non-Stress Test-

- Categorized as reactive or non-reactive
  - Reactive: 2 accelerations of 15 bpm for 15 secs in 20’
  - Non-reactive: does not meet criteria in 40 min
- Influence of gestational age
  - 24-28 wks: 50% may not be “reactive”
  - 28-32 wks: 15% may not be “reactive”
- Vibroacoustic stimulation shortens test time
  - 1-2 second application; may repeat up to 3 times
  - 5 minutes shorter in Cochrane Review meta-analysis

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Antenatal Fetal Assessment
-Contraction Stress Test-

- Assess FHR response to contractions
  - Fetal oxygenation transiently decreased by uterine contractions
  - In compromised fetus, late decelerations
- CST requires 3 contractions of 40 seconds’ duration in ten minute window
  - Spontaneous
  - Oxytocin (OCT)
  - Nipple stimulation

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Antenatal Fetal Assessment
-Contraction Stress Test-

- Classified on basis of late decelerations
  - Negative
    - No late or significant variable decelerations
  - Positive
    - Late decelerations after 50% or more of contractions
    - Equivocal-suspicious
    - Late decelerations after < 50% of contractions
    - Equivocal-tachysystole
    - Decelerations associated with contractions more frequent than every 2 minutes or lasting more than 90 secs
  - Unsatisfactory
    - Fewer than 3 contractions in 10 minutes

- Under most circumstances, delivery indicated when CST is positive
  - Route of delivery not dictated

- Contraindications to CST
  - Preterm labor
  - PPROM
  - Placenta previa; vasa previa

Antenatal Fetal Assessment
-Biophysical Profile-

- Composed of five components
  - NST
  - Fetal breathing
    - One or more 30 second episodes
  - Fetal movement
    - Three or more discrete body/limb movements
  - Fetal tone
    - One or more extension/flexion of extremity
    - Opening or closing of hand
  - Amniotic fluid volume (chronic)
    - MVP at least 2 cm
    - AFI greater than 5
Antenatal Fetal Assessment
-Biophysical Profile-

- In general, components of BPP “lost” in predictable order
  - NST, breathing, movement, tone
- Score of 8-10 normal
- Score of 6 equivocal
  - False + rate of at least 75%
  - At term—often proceed with delivery
- Preterm—repeat BPP within 24 hours
- Score of 4 or less—delivery indicated
  - Exception may be for extreme prematurity
  - Must individualize fetal assessment and management
- Abnormal results don’t dictate route of delivery

ACOG Practice Bulletin #145, July 2014

Antenatal Fetal Assessment
-Modified Biophysical Profile-

- Amniotic fluid reflects fetal urine production
- Decreased AFV or oligohydramnios may result from placental dysfunction and relatively decreased fetal renal perfusion
  - Chronic marker of placental function
- Modified BPP combines NST with AFI
  - Reactive NST with AFI > 5 considered normal
  - Time-efficient method to assess acute and chronic markers of fetal well-being

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Antenatal Fetal Assessment
-Doppler Velocimetry-

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- 20
- 21
Antenatal Fetal Assessment
-Doppler Velocimetry-

- Interrogation of multiples vessels
  - Uterine artery
    - Potential screening tool for preeclampsia and IUGR
  - Umbilical artery
    - Surveillance for IUGR
  - Fetal middle cerebral artery
    - Surveillance for fetal anemia
  - Brain sparing with IUGR
  - Fetal ductus venosus
    - Surveillance for IUGR

- Commonly employed indices
  - Systolic to diastolic ratio (S/D)
  - Resistance index (S-D/S)
  - Pulsatility index (S-D/Mean Area)
Antenatal Fetal Assessment
Doppler Velocimetry: IUGR

- Middle cerebral artery doppler evaluation
- Brain sparing evidenced by increased end diastolic flow

A. Abnormal UA Doppler flow. The arrows point to the low diastole, indicating high placental resistance. B. Abnormal MCA Doppler flow at 27 weeks gestation. The vertical arrows point to the diastole, which is increased, indicating a "brain-sparing effect."


Antenatal Fetal Assessment
-Doppler Velocimetry-

- Work utilizing ductus venosus
- Ductus venosus shunts highly oxygenated blood from umbilical vein directly to fetal IVC, bypassing liver, and perfusing fetal brain

ACOG Practice Bulletin # 204 January 2019
Antenatal Fetal Assessment

Doppler Velocimetry: IUGR

- Unlike umbilical artery or MCA abnormalities which may be present for weeks, absence or reversal of ductus venosus a-wave occur late in progression of placenta-based IUGR

- Two situations where clinical efficacy most clearly demonstrated
  - Known or suspected IUGR
  - Potential fetal anemia
    - Monitor peak systolic velocities of MCA
      - Increased with fetal anemia
      - Isoimmunization
      - Parvovirus infection
      - Fetal-maternal hemorrhage
      - IUGR?
      - TAPS screening MoDi twins

ACOG Summary

- Level A: Good and consistent scientific evidence
  - Use of MVP < 2 cm, not AFI < 5 cm, to diagnose oligohydramnios associated with reduced unnecessary interventions
  - For IUGR fetuses, umbilical artery Doppler velocimetry with NST/ BPP's associated with improved outcomes

- Level B: Limited/inconsistent scientific evidence
  - Abnormal results from NST should be followed up with additional testing (BPP or CST)

- Level C: Consensus and expert opinion
  - Start testing at 32 weeks, but individualize
  - Once started, repeat testing 1-2 times/week
    - Acute changes in status require reassessment
Antenatal Fetal Assessment
ACOG Summary

- Level C: Consensus and expert opinion
  - Delivery of fetus with abnormal testing may be attempted by labor induction
    - Repetitive late decelerations usually dictate cs
  - With isolated persistent oligohydramnios, MVP < 2 cm, delivery at 36-37 weeks recommended
    - If < 36 weeks, individualize management

ACOG Practice Bulletin #145 Reaffirmed 2016
Intrapartum Fetal Assessment

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Goals
- Prevent fetal death
- Avoid fetal hypoxemic insult

Primary question to answer
- Can the labor process be allowed to continue or is expedited delivery indicated?

The Problem
- Very high false positive rate
  - > 99% FP rate for EFM predicting cerebral palsy

Patterns and Definitions
- Baseline: 110-160 bpm
- Baseline variability
  - Absent, minimal (<5), moderate (6-25), marked (>25)
- Early deceleration: mirror image of contraction
- Variable deceleration: abrupt decrease in FHR
- Late deceleration: nadir after peak of contraction
- Prolonged deceleration: > 2 and < 10 minutes
- Sinusoidal: smooth, sine wave-like; > 20 minutes

ACOG Practice Bulletin 2009; Reaffirmed 2015
Intrapartum Fetal Assessment
Three-Tiered FHR Interpretation

- **Category I**
  - Baseline 110-160 bpm
  - Variability: moderate
  - Late or variable decelerations: absent
  - Early decelerations: present or absent
  - Accelerations: present or absent

- **Category II**
  - All tracings not Category I or Category III
  - Typically, most common tracings encountered
  - Baseline FHR: 110-160 or
    - Bradycardia without absent variability
    - Tachycardia
  - Baseline FHR variability
    - Moderate/marked/minimal, or absent, if no recurrent decels
  - Accelerations: absent or induced with stimulation
  - Periodic or episodic decelerations
    - Recurrent variables with minimal/moderate variability
    - Prolonged deceleration > 2 and < 10 minutes
    - Recurrent late decelerations with moderate variability
    - Variable decelerations with slow return or 'shoulders'

- **Category III**
  - Absent FHR variability AND any of following:
    - Recurrent late decelerations
    - Recurrent variable decelerations
    - Bradycardia
    - Sinusoidal pattern

ACOG Practice Bulletin #106 July 2009; Reaffirmed 2015

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Intrapartum Fetal Assessment

- Efficacy of EFM v. intermittent auscultation
  - Increased rate CS
  - Increased rate vacuum and forceps
  - No reduction in perinatal mortality
  - Reduced risk of neonatal seizures
  - No reduction in risk of cerebral palsy
  - Only 4% of CP cases tied exclusively to intrapartum insult

- Intermittent auscultation
  - Logistically difficult to follow protocols
  - Not appropriate for high-risk pregnancies

ACOG Practice Bulletin #106 July 2009; Reaffirmed 2015
Intrapartum Fetal Assessment

- Response to Category II and III tracings
  - Discontinue oxytocin
  - Cervical exam: cord prolapse, rapid cervical change
  - Maternal repositioning
  - Correct maternal hypotension
  - Consider oxygen supplementation; tocolytics?
  - Assess for uterine tachysystole

- Ancillary tests
  - Digital scalp stimulation; vibroacoustic stimulation

ACOG Practice Bulletin #106 July 2009; Reaffirmed 2015

Intrapartum Fetal Assessment

ACOG Recommendations/Conclusions

- Good/Consistent evidence: Level A
  - 99% false positive rate for EFM to predict cerebral palsy
  - Risk of cerebral palsy not reduced
  - EFM associated with increased risk of CS, vacuum, and forceps
  - Amnioinfusion to resolve recurrent variable decels
  - Fetal pulse oximetry not useful diagnostic tool

- Limited/Inconsistent evidence: Level B
  - High inter/intra observer variability of readings
  - Reinterpretation of tracings, particularly if neonatal outcome known, is unreliable

- Expert Opinion: Level C
  - Three-tiered system of categorization recommended
  - High-risk patients should be monitored with EFM

ACOG Practice Bulletin #106 July 2009; Reaffirmed 2015