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ANTENATAL FETAL SURVEILLANCE: HOW MUCH IS TOO MUCH?

Linda M. Szymanski, MD PhD
Associate Professor
Maternal Section Head
Maternal Fetal Medicine



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DISCLOSURE OF RELEVANT FINANCIAL RELATIONSHIP(S) WITH INELIGIBLE COMPANIES

- There will be discussion of off-label uses of medications during this presentation

REFERENCES TO OFF-LABEL USAGE(S) OF PHARMACEUTICALS OR INSTRUMENTS

- Nothing to disclose



All relevant financial relationships have been mitigated.

LEARNING OBJECTIVES

- To discuss the available guidance regarding:
 - *indications* for
 - *timing* of, and
 - *frequency* of antenatal fetal surveillance
- To review the existing evidence for determining the type of antenatal testing to perform.

2 IMPORTANT QUESTIONS

How much is too much?



How much is not enough?



ANTEPARTUM FETAL SURVEILLANCE

BACKGROUND

A Brief Review



ANTEPARTUM FETAL SURVEILLANCE

BACKGROUND

- Antenatal fetal testing is widely used despite limited evidence on how to best utilize the various tests.
- There is also a lack of data supporting the effectiveness of surveillance at improving perinatal outcomes. This is in part because the outcome we are trying to prevent – stillbirth – is rare.
- Unfortunately, no large well-designed randomized trials have not been performed to determine the effectiveness of testing or which method is the most effective or superior. Tens of thousands of pregnant patients would be required for an adequate study!
- **THUS... guidelines are largely based on expert consensus and relevant observational studies!**

ANTEPARTUM FETAL SURVEILLANCE

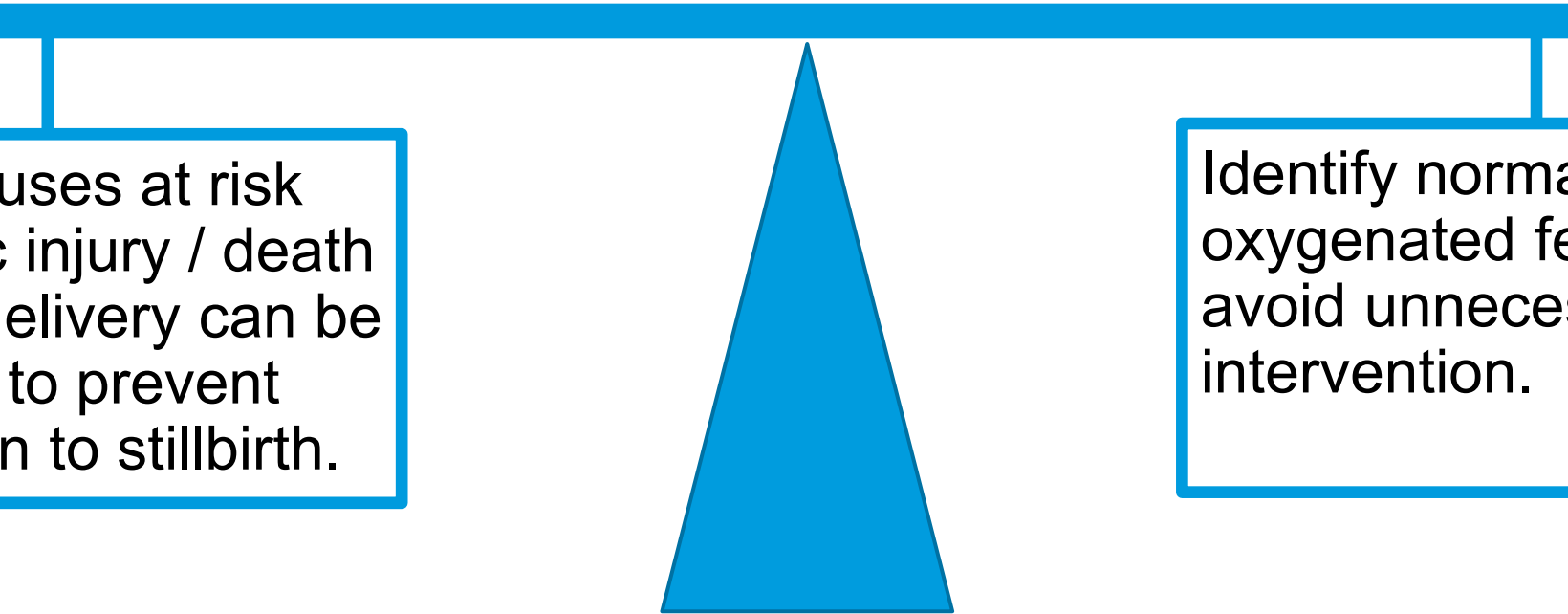
BACKGROUND: GOALS OF TESTING

“The goal of evidence-based antepartum fetal evaluation is to decrease perinatal mortality and permanent neurologic injury through judicious use of reliable and valid methods of fetal assessment without acting prematurely to modify an otherwise healthy pregnancy or providing a false sense of well-being in cases of impending morbidity.”

ANTEPARTUM FETAL SURVEILLANCE

BACKGROUND: GOALS OF TESTING

A balancing act!



Identify fetuses at risk for hypoxic injury / death so timely delivery can be performed to prevent progression to stillbirth.

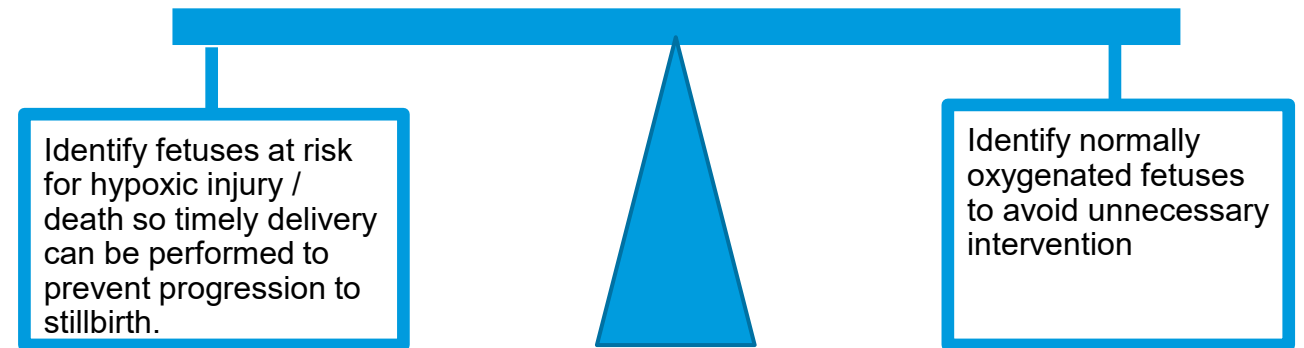
Identify normally oxygenated fetuses to avoid unnecessary intervention.

ANTEPARTUM FETAL SURVEILLANCE

BACKGROUND: GOALS OF TESTING

Keep in Mind:

- Trade-off for reducing stillbirth risk may be long-term neurologic disability
- Acting to potentially reduce risk of stillbirth may result in iatrogenic prematurity → also a risk factor for perinatal mortality



ANTEPARTUM FETAL SURVEILLANCE

BACKGROUND

Rationale / Theory:

- Fetal Hypoxia
- Acidosis



- Reduce amniotic fluid
- Affect fetal movement
- Fetal heart rate changes



Fetal Death

**AVAILABLE
TESTING OPTIONS
FOR ASSESSING
FETAL WELL-
BEING**

NST – non stress test

BPP – biophysical profile

Modified BPP – modified BPP

CST – contraction stress test

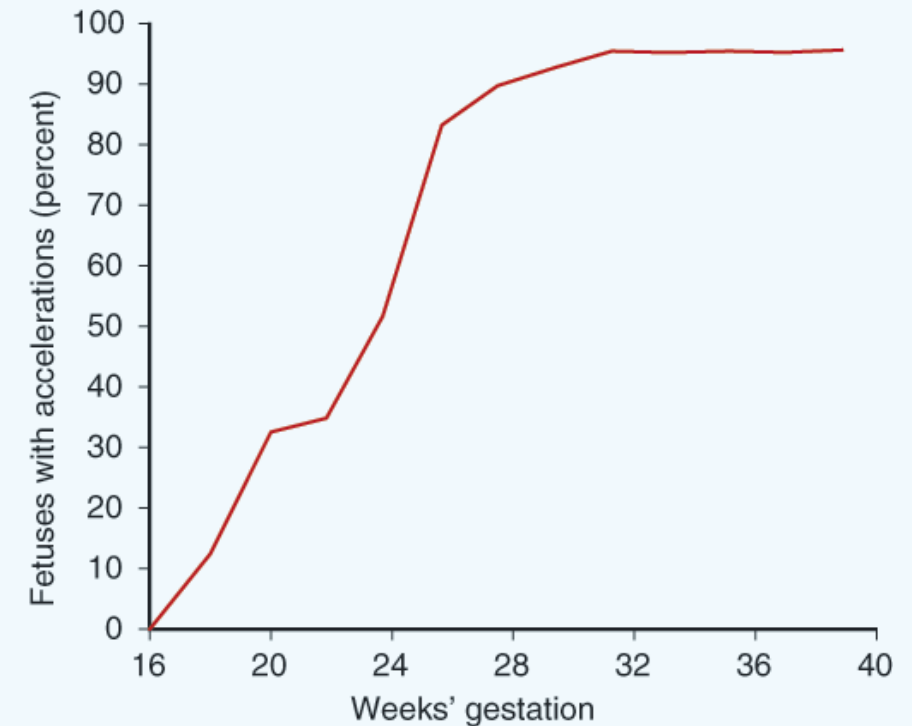
Dopplers

ANTEPARTUM FETAL SURVEILLANCE

NST

- By the end of the 1970s, NST was the primary antenatal testing modality.
- NST is currently the most widely used primary testing method.
- **Basis of the test:** Accelerations of the fetal heart rate reflect fetal well-being and normal fetal autonomic function; absence of acidosis.
 - The most widely applied definition of a reactive test:
 - At least 2 accelerations - amplitude of 15 beats/min lasting 15 seconds in 20 minutes of monitoring
 - Before 32 weeks, amplitude of 10 beats/min lasting 10 seconds

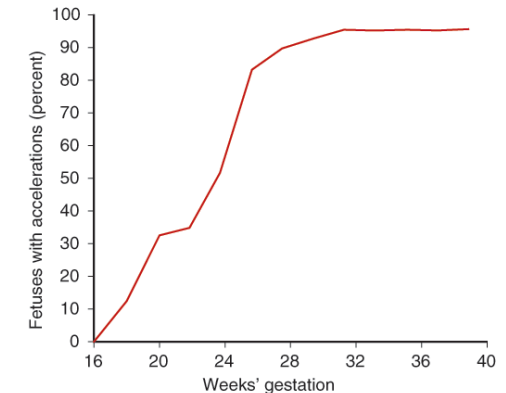
Percentage of fetuses with at least one 15 bpm acceleration for 15 seconds with fetal movement



ANTEPARTUM FETAL SURVEILLANCE

NST

- **Reactive NSTs:**
 - 24-28 weeks: 50% may be nonreactive
 - 28-32 weeks: 15% are not reactive
- **Vibroacoustic Stimulation (VAS):**
 - If NST is nonreactive after 20 minutes, VAS can be performed:
 - 3 seconds of less applied near fetal head
 - Can repeat at 1-minute intervals up to 3x
 - If no response → further evaluation (BPP or CST)
- If the fetal heart rate is nonreactive after the NST has been extended for 40 minutes, a BPP or CST should be performed.
- **Most fetuses with a nonreactive NST are not compromised.**



ANTEPARTUM FETAL SURVEILLANCE

BPP

	Score of 2	Score of 0
NST *	Reactive	Nonreactive
Fetal Breathing	≥ 1 episode for ≥ 30 sec in 30 minutes	Absent of no episode ≥ 30 sec in 30 minutes
Gross body movements (Fetal movement)	≥ 3 discrete body or limb movements in 30 minutes	< 3 discrete movements
Fetal tone	≥ 1 episode of extremity extension with return to flexion or opening & closing of hand	No extension / flexion movements
Amniotic Fluid Volume	Single deepest vertical pocket > 2 cm	Single deepest vertical pocket ≤ 2 cm
30 minutes of observation		
* NST may be omitted without compromising validity if other components are normal		

ANTEPARTUM FETAL SURVEILLANCE

BPP

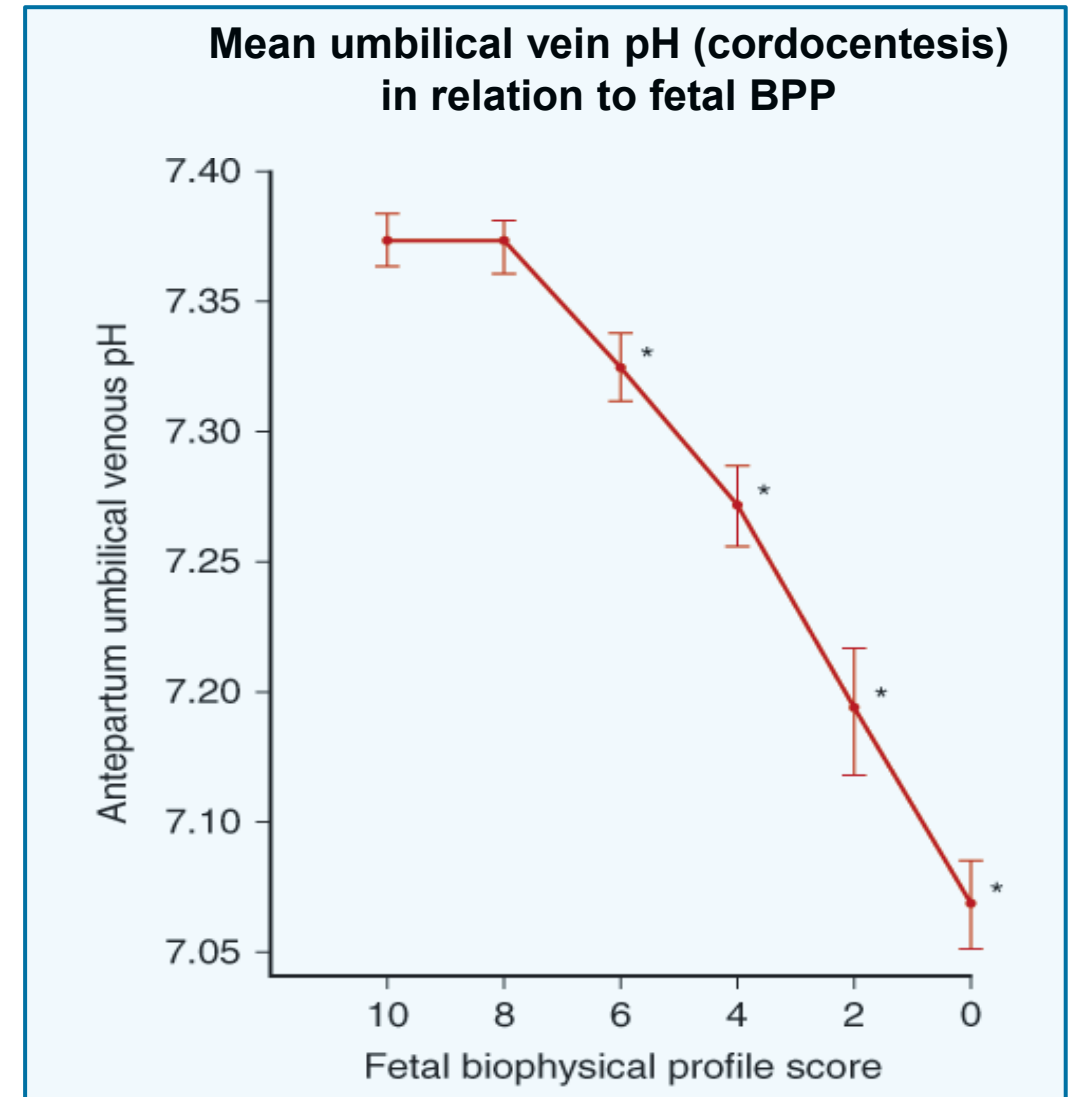
Score	Interpretation	Recommendation
10/10	Normal	-
8/10	Normal	-
6/10	Equivocal	< 37 0/7 weeks: repeat in 24 hours * ≥ 37 0/7 weeks: further evaluation and consider delivery
4/10	Abnormal	Consider delivery; If < 32 weeks: Individualize, extended monitoring may be appropriate
2/10	Abnormal	Deliver

* Individualize (for example, can consider delivery if 36 weeks or greater)

ANTEPARTUM FETAL SURVEILLANCE

BPP

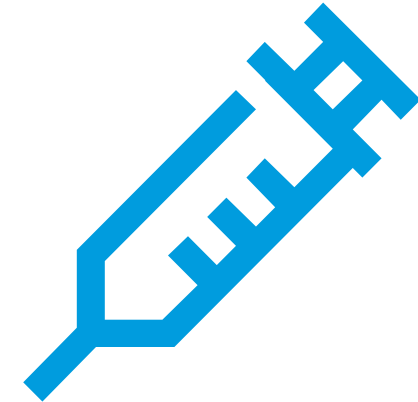
- Can be done as early as 26-28 weeks (or earlier)
- The BPP correlates well with fetal acid-base status.
- Acute fetal response to hypoxemia is a predictable, physiologically based cascade:
 - loss of fetal breathing movements & FHR accelerations, then
 - decreased fetal movement, and finally
 - loss of fetal tone



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BPP

- Antenatal corticosteroid administration may transiently affect the BPP (lowers score but does not affect neonatal outcome).
 - Primarily affects NST and fetal breathing
 - Seen within 48 hours of administration
 - Repeat BPPs within 24-48 hours typically normal (some have reported return to normal by 48-96 hours)



ANTEPARTUM FETAL SURVEILLANCE

MODIFIED BPP

NST

(short-term assessment)



Amniotic Fluid
Assessment

(long-term – placental function)

- Developed to simplify and reduce testing time. Takes the components of the BPP that are most predictive of perinatal outcome.
- **Normal:** Reactive NST **and** deepest vertical pocket > 2 cm
- **Results of the modified BPP are similar to the complete BPP, namely a false-negative rate of 0.8 per 1000.**

ANTEPARTUM FETAL SURVEILLANCE

CONTRACTION STRESS TEST (CST)



- **CST (sometimes called the *oxytocin challenge test*), was the first biophysical technique widely applied for antepartum fetal surveillance.**
- **THEORY:**
 - Uterine contractions reduce blood flow to the intervillous space
 - A fetus with inadequate placental reserve will demonstrate recurrent late decelerations with contractions
- **Process:**
 - Patient is placed in the semi-Fowler position
 - Continuous external fetal heart rate and uterine contraction monitoring is recorded, and a baseline is obtained before stimulating uterine activity.
 - IV oxytocin is increased until there are 3 contractions in 10 minutes of moderate intensity that last 40-60 seconds (this simulates the stress experienced in the first stage of labor).
- **Contraindications:**
 - High risk for preterm labor
 - Prior classical cesarean delivery
 - Placenta previa

ANTEPARTUM FETAL SURVEILLANCE

CONTRACTION STRESS TEST (CST)

Interpretation of CST:

Finding	Description	Incidence (%)
Negative	No late decelerations appear anywhere on the tracing with adequate uterine contractions (three in 10 min).	80
Positive	Late decelerations that are consistent and persistent present with the majority (>50%) of contractions without excessive uterine activity; if persistent late decelerations are seen before the frequency of contractions is adequate, the test is interpreted as positive.	3–5
Suspicious	Decelerations are late and inconsistent. Variable decelerations	5
Hyperstimulation	Uterine contractions closer than every 2 min or lasting more than 90 s or five uterine contractions in 10 min; if no late decelerations are seen, the test is interpreted as negative.	5
Unsatisfactory	The quality of the tracing is inadequate for interpretation or adequate uterine activity cannot be achieved.	5

A negative CST has been consistently associated with good fetal outcome. The incidence of perinatal death within 1 week of a negative CST (false-negative rate) to be < 1:1,000

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HOW DO THEY COMPARE?

	Stillbirth Rate/1000 within 1 week of normal test * (False-Negatives)	False-Positive Rate (%)
NST	1.9	55-90
BPP	0.8	40-50
Modified BPP	0.8	60
CST	0.3	35-65

- * Hard to make definitive conclusions; disparate populations, approaches, intervals.
- * Is the lower risk of stillbirth because of more contact with health professionals or the test?

ANTEPARTUM FETAL SURVEILLANCE

TESTING MODALITIES

(+)'s and (-)'s

ANTEPARTUM FETAL SURVEILLANCE

NST – ADVANTAGES & DISADVANTAGES

Advantages	Disadvantages
Simple to perform	Higher frequency of abnormal results
Noninvasive	Abnormal score may reflect sleep cycle
Outpatient setting	May be difficult if patient is obese, has multiple gestation, or polyhydramnios
Requires less skilled personnel	Higher false positive rate
Less expensive	Lower positive predictive value
Low false-negative rate	False-negative rate not as low as CSTs or BPPs

ANTEPARTUM FETAL SURVEILLANCE

BPP – ADVANTAGES & DISADVANTAGES

Advantages	Disadvantages
Noninvasive	Abnormal score may reflect sleep cycle
Low false-negative rate	Can be time-consuming (average time is 18 mins)
May detect anomalies	Requires more skill and equipment
Assesses acute and chronic markers of hypoxia	More expensive than NST
False-negative rate similar to CSTs	Cannot be reviewed unless video recorded
Provides information on fetal number, presentation, placental position	

ANTEPARTUM FETAL SURVEILLANCE

CST – ADVANTAGES & DISADVANTAGES

Advantages	Disadvantages
Reliable	High cost
High predictive value	Cumbersome to implement
Low false negative rate	High false positive rate
Can assess fetus' ability to tolerate labor	Inconvenient for patients
	Time consuming
	Hospital setting
	May cause preterm labor; fetal nonreassuring status
	Does not take into account polyhydramnios
	Inducing contractions is contraindicated in certain situations (placenta previa)

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Practical Application

ANTEPARTUM FETAL SURVEILLANCE

QUESTIONS!

No consensus on:

- Who to test?
- Which test to perform?
 - Misconceptions regarding which is "better"
- When to start testing?
- How frequently to test?

ANTEPARTUM FETAL SURVEILLANCE

WHO SHOULD BE TESTED?

- ***Surveillance is suggested for conditions with:***

- Stillbirth risk > 0.8 / 1,000 births
- Relative Risk for stillbirth of 2.0 or greater



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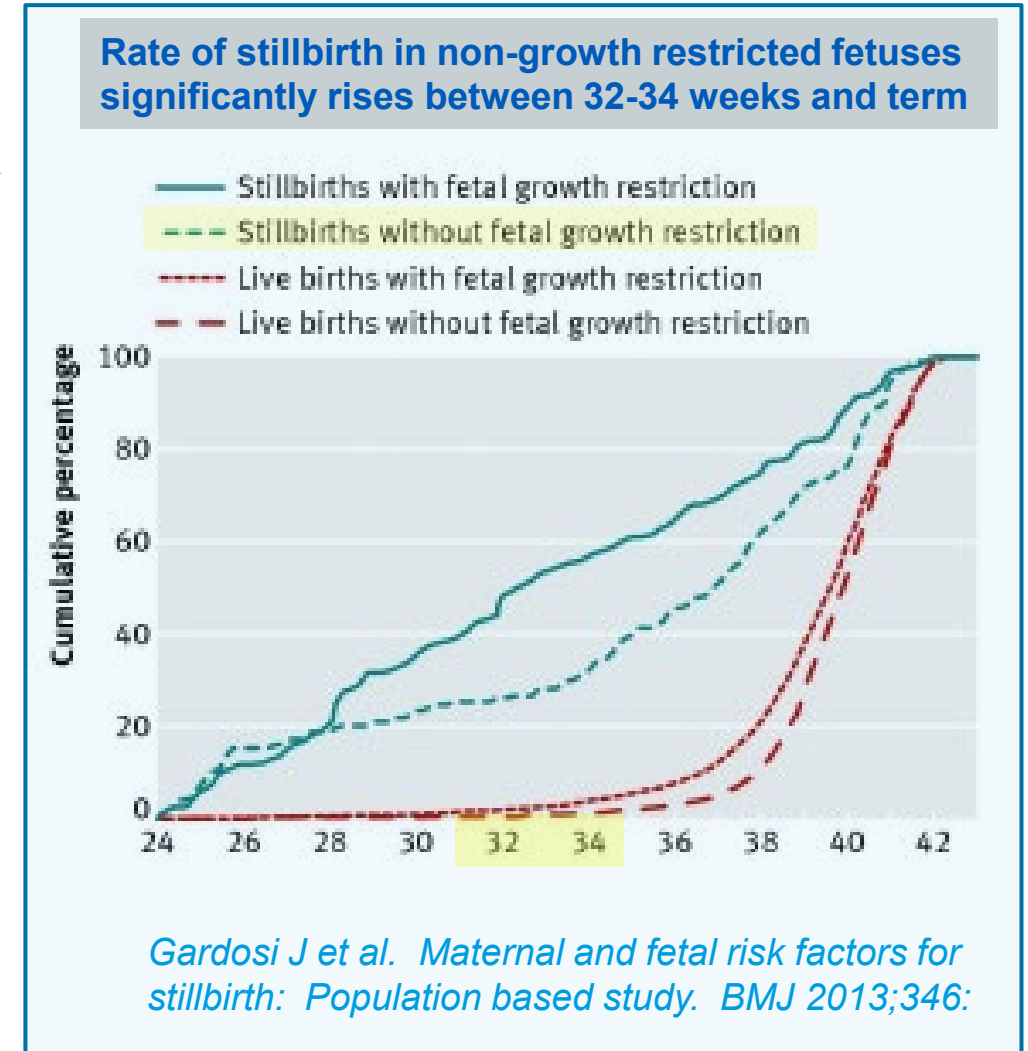
WHO SHOULD BE TESTED?

Fetal	Maternal	Obstetric
Fetal Growth Restriction	Hypertensive Disorders	Previous Stillbirth
Multiple Gestation	Diabetes	History of Adverse Outcome
Decreased Fetal Movement	Systemic Lupus Erythematosus	Intrahepatic Cholestasis of Pregnancy
Aneuploidy ?	Antiphospholipid Syndrome	Late Term
	Sickle Cell Disease	Velamentous Cord Insertion
	Renal Disease	Single Umbilical Artery
	Thyroid Disorders – Poorly controlled	Oligohydramnios
	Substance use	Polyhydramnios (moderate to severe)
	Obesity	
	Advanced Maternal Age ?	
	IVF ?	
	COVID ?	

ANTEPARTUM FETAL SURVEILLANCE

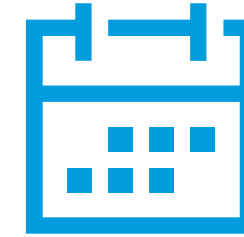
WHEN TO START?

- Starting at 32 0/7 weeks of gestation or later is appropriate for most
- In certain circumstances, earlier testing may be warranted:
 - Typically in patients with multiple comorbidities
 - At a gestational age when delivery for perinatal benefit would be considered
- Guidelines generally suggest:
 - At or by 32 0/7
 - At or by 36 0/7
 - At or by 39 0/7



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FREQUENCY OF TESTING



- No evidence to guide recommendations
- Originally arbitrarily set at once weekly (so this is the minimum)
- Some investigators perform twice-weekly tests, with additional testing completed for maternal or fetal deterioration regardless of the time elapsed since the last test.
- Others perform nonstress tests daily or even more frequently, such as with severe preeclampsia remote from term.
- With results of the ARRIVE Trial, delivery at 39 weeks may be considered instead of testing beyond this gestational age

ANTEPARTUM FETAL SURVEILLANCE

WHICH TESTING MODALITY?

- *Depends on:*

- Gestational age
- Medical comorbidities
- Need for other evaluations (ie, growth)
- Resources

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WHICH TESTING MODALITY?

- **Who Needs a Fluid Check??**
- Patients at risk for oligohydramnios

At Risk For Oligohydramnios
Hypertensive Disorders of Pregnancy • Chronic Hypertension • Gestational Hypertension • Preeclampsia
Post-Term Pregnancy
Renal Disease
Pre-existing diabetes WITH vascular disease or other co-morbidities

ANTEPARTUM FETAL SURVEILLANCE

WHICH TESTING MODALITY?

- BPP or modified BPP?
 - Depending upon resources, etc, it may make more sense to do a BPP
 - Modified BPPs are best utilized in centers that offer fluid checks in their Antenatal Testing Center
 - Which is more convenient for patient?
- How often should fluid be checked?
 - NO standard guideline of how often
 - Depends on clinical picture

EXAMPLE:

- Patient with cHTN with normal BPs and no medications does not require weekly fluid checks. Can alternate BPP or modified BPP and NST.
- Patient with cHTN and difficult to control BPs on multiple medications should have weekly fluid checks.

ANTEPARTUM FETAL SURVEILLANCE

NST VS BPP – A GUIDELINE

NST	BPP or modified BPP * (at risk for oligohydramnios)	Alternate BPP/NST (weekly testing)
Diabetes: Pre-existing – well-controlled GDM-A2	Chronic Hypertension Poorly controlled or Other co-morbidities	Chronic Hypertension Well-controlled
Obesity	Gestational Hypertension	Mono-Di Twins
Cholestasis	Preeclampsia	Previous Stillborn
Di-Di Twins	Post-term Pregnancy	
Advanced Maternal Age	Renal Disease	
In Vitro Fertilization	Diabetes Pre-existing with vascular disease or Other co-morbidities	
Lupus – uncomplicated	Lupus - complicated	

- * If in twice weekly testing, alternate BPP and NST
- * If scheduled for growth ultrasound, do BPP

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WHICH TESTING MODALITY?

- If the patient is NOT at risk for developing oligohydramnios, then NST alone is appropriate.

Not at Risk for Oligohydramnios
Well-controlled pregestational diabetes / GDM-A2
Obesity
Intrahepatic Cholestasis of Pregnancy
Multiple Gestations (dichorionic-diamniotic)
Advanced Maternal Age
IVF Pregnancies
Previous Stillbirth

ANTEPARTUM FETAL SURVEILLANCE

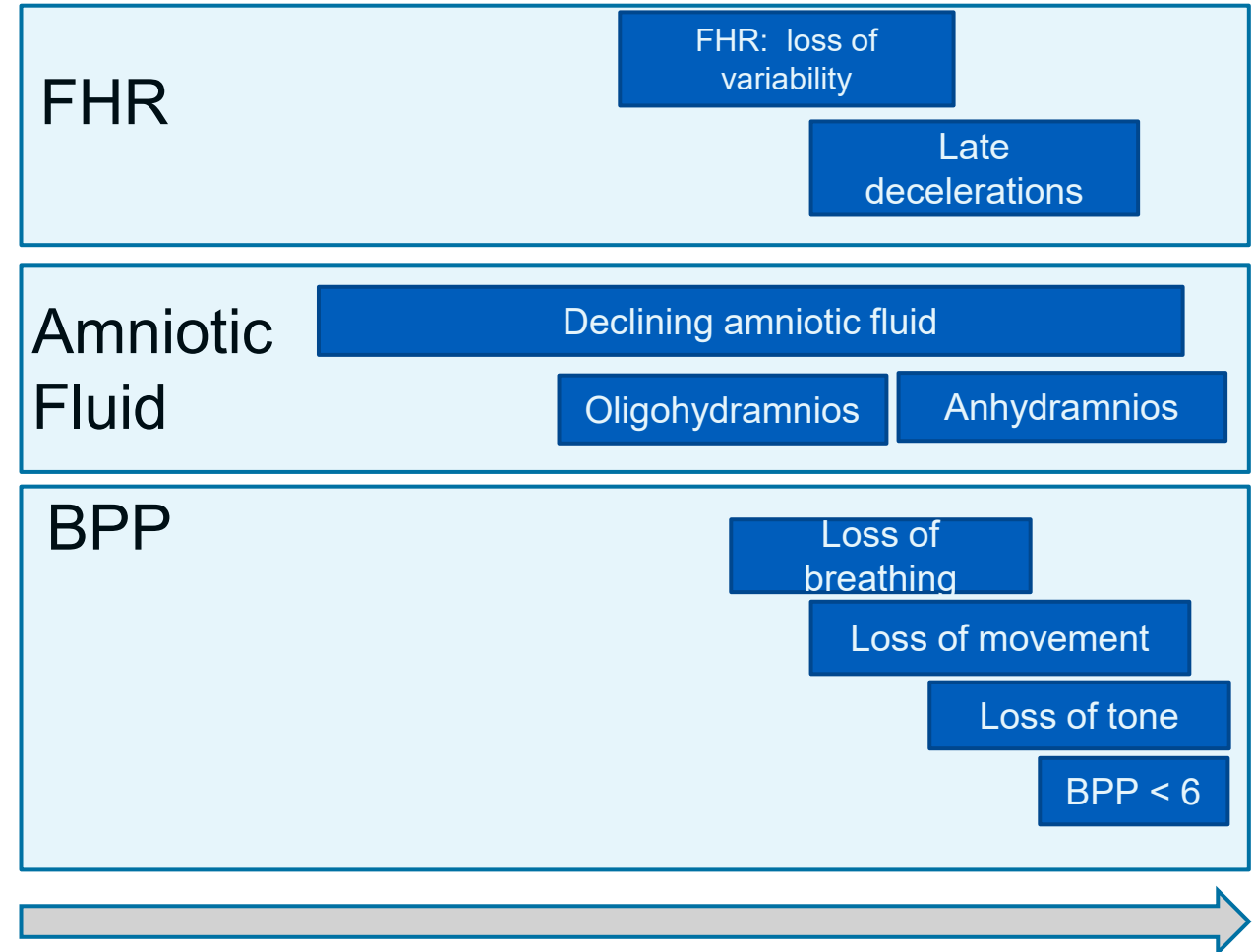
SCHEMATIC OF TYPICAL FETAL DETERIORATION

CLINICAL PROGRESSION WITH PLACENTAL INSUFFICIENCY (EXAMPLE IN FGR)

- Best predictors of deterioration:

Amniotic fluid and Doppler parameters
(venous)

- Doppler abnormalities & amniotic fluid declines
- BPP variables – linked to acid-base status
- Decreased short-term variability
- Spontaneous late decelerations
- Abnormal BPP



ANTEPARTUM FETAL SURVEILLANCE

INTERESTING...

Obstetrics: *Current Commentary*

Antepartum Testing for the Prevention of Stillbirth

Where Do We Go From Here?

Grace J. Johnson, MD, Steven L. Clark, MD, and Mark A. Turrentine, MD

Where do we go from here? For both ethical and practical considerations, randomized controlled trials are virtually impossible. Given a stillbirth rate of 1.2 per 1,000 deliveries beyond 39 weeks of gestation for women 35 years of age or older or with body mass indexes (BMIs, calculated as weight (kg)/[height (m)]²) of 40 or greater,^{3,5} a standard power calculation suggests the need to randomize more than 196,000 women to detect a reduction in stillbirth rate to 0.8 per 1,000, the rate seen with current indications for antepartum testing.¹ Because, respectively, only 3% and 17% of pregnant women exceed these BMI and age thresholds, a study population involving 5% of the annual delivery volume in the United States would be necessary to appropriately study this issue, even with 100% enrollment of eligible patients.^{5,18} A stepped wedge cluster design typically requires an even greater study population. Such a study is simply not feasible.

being are unlikely. Thus, beyond 39 weeks of gestation, if the demonstrated risk for stillbirth is deemed unacceptable to a woman with advanced maternal age or morbid obesity, delivery, with its complete elimination of subsequent stillbirth risk, seems preferable to the initiation of an antenatal testing protocol with no evidence of efficacy. Routine testing of these high-risk women rather than delivery seems especially untenable in light of recent data regarding induction of labor reported in the ARRIVE trial.¹⁹

(Obstet Gynecol 2018;132:1407–11)

ACOG'S GUIDANCE



ACOG COMMITTEE OPINION

Number 828

Committee on Obstetric Practice
Society for Maternal-Fetal Medicine

This Committee Opinion was developed by the Committee on Obstetric Practice in collaboration with committee members Rita Wesley Driggers, MD and Allison S. Bryant, MD, MPH and the Society for Maternal-Fetal Medicine in collaboration with Alessandro Ghidini, MD.

Indications for Outpatient Antenatal Fetal Surveillance

ABSTRACT: The purpose of this Committee Opinion is to offer guidance about indications for and timing and frequency of antenatal fetal surveillance in the outpatient setting. Antenatal fetal surveillance is performed to reduce the risk of stillbirth. However, because the pathway that results in increased risk of stillbirth for a given condition may not be known and antenatal fetal surveillance has not been shown to improve perinatal outcomes for all conditions associated with stillbirth, it is challenging to create a prescriptive list of all indications for which antenatal fetal surveillance should be considered. This Committee Opinion provides guidance on and suggests surveillance for conditions for which stillbirth is reported to occur more frequently than 0.8 per 1,000 (the false-negative rate of a biophysical profile) and which are associated with a relative risk or odds ratio for stillbirth of more than 2.0 compared with pregnancies without the condition. Table 1 presents suggestions for the timing and frequency of testing for specific conditions. As with all testing and interventions, shared decision making between the pregnant individual and the clinician is critically important when considering or offering antenatal fetal surveillance for individuals with pregnancies at high risk for stillbirth or with multiple comorbidities that increase the risk of stillbirth. It is important to emphasize that the guidance offered in this Committee Opinion should be construed only as suggestions; this guidance should not be construed as mandates or as all encompassing. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised.

Recommendations and Conclusions

The American College of Obstetricians and Gynecologists makes the following recommendations and conclusions regarding indications for antenatal fetal surveillance:

- This Committee Opinion provides guidance on and suggests surveillance for conditions for which stillbirth is reported to occur more frequently than 0.8 per 1,000 (the false-negative rate of a biophysical profile or modified biophysical profile) and which are associated with a relative risk (RR) or odds ratio for stillbirth of more than 2.0 compared with pregnancies without the condition.
- When data on gestational age-adjusted risk of occurrence of stillbirth were not available, the Committee's suggestions regarding when to begin antenatal fetal surveillance are based on the reported risk of stillbirth, generally falling into three major categories of when to begin: (1) at or by 32 0/7 weeks, (2) at or by 36 0/7

weeks, or (3) at or beyond 39 0/7 weeks of gestation (if undelivered). However, individualization about if and when to begin antenatal fetal surveillance is advised.

- Initiating antenatal fetal surveillance at 32 0/7 weeks of gestation or later is appropriate for most at-risk patients. However, for pregnant individuals with multiple or particularly worrisome high-risk conditions (eg, chronic hypertension with suspected fetal growth restriction), antenatal fetal surveillance might begin at a gestational age when delivery would be considered for perinatal benefit.
- As with all testing and interventions, shared decision making between the pregnant individual and the clinician is critically important when considering or offering antenatal fetal surveillance for individuals with pregnancies at high risk for stillbirth or with multiple comorbidities that increase the risk of stillbirth. This can be particularly important in situations

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INTERIM UPDATE

ACOG PRACTICE BULLETIN

Clinical Management Guidelines for Obstetrician–Gynecologists

NUMBER 229

(Replaces Practice Bulletin Number 145, July 2014)

Committee on Practice Bulletins—Obstetrics. This Practice Bulletin was developed by the Committee on Practice Bulletins—Obstetrics with the assistance of Dwight J. Rouse, MD.

INTERIM UPDATE: The content in this Practice Bulletin has been updated as highlighted (or removed as necessary) to reflect a limited, focused change to align with American College of Obstetricians and Gynecologists (ACOG) Committee Opinion No. 828, *Indications for Outpatient Antenatal Fetal Surveillance*, and provide updated information regarding fetal kick counts.

Antepartum Fetal Surveillance

The goal of antepartum fetal surveillance is to **reduce the risk of stillbirth**. Antepartum fetal surveillance techniques based on assessment of fetal heart rate (FHR) patterns have been in clinical use for almost four decades and are used along with real-time ultrasonography and umbilical artery Doppler velocimetry to evaluate fetal well-being. Antepartum fetal surveillance techniques are routinely used to assess the risk of fetal death in pregnancies complicated by preexisting maternal conditions (eg, diabetes mellitus) as well as those in which complications have developed (eg, fetal growth restriction). The purpose of this document is to provide a review of the current indications for and techniques of antepartum fetal surveillance and outline management guidelines for antepartum fetal surveillance that are consistent with the best scientific evidence.

Background

Physiology of Fetal Heart Response and Fetal Behavioral State Alteration

In animals and humans, FHR pattern, level of activity, and degree of muscular tone are sensitive to hypoxemia and acidemia (1–4). Redistribution of fetal blood flow in response to hypoxemia may result in diminished renal perfusion and oligohydramnios (5). Surveillance techniques such as cardiotocography, real-time ultrasonography, and maternal perception of fetal movement can identify the fetus that may be undergoing some degree of uteroplacental compromise. Identification of suspected fetal compromise provides the opportunity to intervene before progressive metabolic acidosis results in fetal death. However, acute, catastrophic changes in fetal status, such as those that can occur with placental abruption or an umbilical cord accident, are generally not predicted by tests of fetal well-being. Therefore, fetal deaths from such events are less amenable to prevention.

In humans, the range of normal umbilical blood gas parameters has been established by cordocentesis per-

formed in pregnancies in which the fetus ultimately proved to be healthy, and ranges vary by gestational age (6). Although the degree of hypoxemia and acidemia at which various indices of fetal well-being become abnormal is not known with precision, it can be estimated based on data from published studies. In one investigation, the fetal surveillance was performed immediately before cordocentesis. Fetuses with an abnormal test result were found to have a mean ($\pm$ standard deviation) umbilical vein blood pH of 7.28 ($\pm$ 0.11). Cessation of fetal movement appears to occur at lower pH levels; fetuses with abnormal movement were found to have a mean umbilical vein blood pH of 7.16 ($\pm$ 0.08) (7). Thus, a reasonable correlation between certain measurable aspects of FHR and behavior and evidence of fetal metabolic compromise can be inferred.

Although abnormal fetal surveillance results may be associated with acidemia or hypoxemia, they reflect neither the severity nor duration of acid-base disturbance. The degree and duration of acidemia is weakly correlated with adverse short-term and long-term

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OBSTETRICS & GYNECOLOGY

“... shared decision making between the pregnant individual and the clinician is critically important when considering or offering antenatal fetal surveillance for individuals with pregnancies at high risk for stillbirth or with multiple comorbidities that increase the risk of stillbirth.”

ANTEPARTUM FETAL SURVEILLANCE

SUMMARY

- INDIVIDUALIZE!!! Especially when multiple indications for antenatal fetal surveillance are present.
- Balance risk of stillbirth with risks of early delivery.
- No ideal single test or testing strategy exists for all high-risk pregnancies.
- Clinician judgment and logic, as well as evidence from observational studies, should guide testing strategies for each patient.
- If an abnormal result is seen, perform a second test, consider betamethasone if preterm, observe carefully before deciding to delivery.
- Any decision to proceed with delivery should be based on the complete clinical picture – test results, overall maternal/fetal condition, gestational age!!
- Shared decision making with patient:
 - Threshold of viability
 - Costs (of testing, time off work, transportation, etc)

ANTEPARTUM FETAL SURVEILLANCE

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QUESTIONS & DISCUSSION

