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An Approach to the Use of the BPP and its Component Tests in the Antenatal Assessment of Fetal Well Being [SA-38]

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3:40 PM – 4:30 PM



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An Approach to the Biophysical Profile and its Component Tests

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Goals of Antepartum Fetal Assessment

- Reduce perinatal morbidity and mortality
- Reduce interventions in uncompromised pregnancies

Indications for Antepartum Surveillance

- Post dates
- History of stillbirth
- Hypertensive disorders
- Growth restriction
- Diabetes mellitus
- Premature rupture of membranes
- Others

Methods of Antepartum Surveillance

- Fetal movement counting
- Non-Stress Test (NST)
- Contraction stress Test (CST)
- Biophysical Profile (BPP)
- Doppler flow studies

Methods of Antepartum Surveillance

- All of these are screening tests with high false positive rates and low false negative rates.
- They are useful in at risk pregnancies rather than as a routine in all pregnancies.

Antepartum Surveillance

- A favorable test is highly reassuring against current fetal compromise
- A non-reassuring test has a very high probability of being a false positive, but requires further – and likely ongoing, repetitive monitoring studies

Biophysical Profile

Manning 1990

26,780 High Risk Pregnancies

“The biophysical scoring is derived from the assessment of 5 variables... coded as normal or abnormal according to fixed criteria and are then assigned an arbitrary score of 2 when normal and zero if abnormal.”

Biophysical Profile

Component Tests

1. **NST - Non-Stress Test**
2. **FBM - Fetal Breathing Movements**
3. **FM - Gross Body Movements**
4. **FT - Fetal Tone**
5. **AFV - Amniotic Fluid Volume**

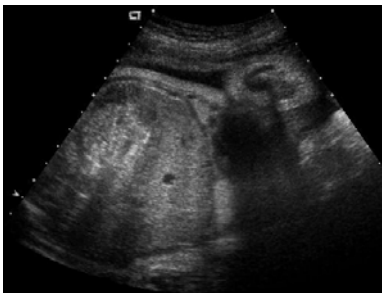
Non-Stress Test – NST

- **Fetal heart rate accelerations:**
- **≥ 2 episodes of 15 bpm for 15 sec in 20 min**
- **Generally occurs with fetal movements**

Fetal Breathing Movements – FBM

- **At least one episode of sustained breathing movements of at least 30 sec in 30 minutes**
- **Hiccoughs? – Yes per Manning**
- **Multiple shorter episodes?**

Fetal Breathing Movement



Gross Body Movements – FM

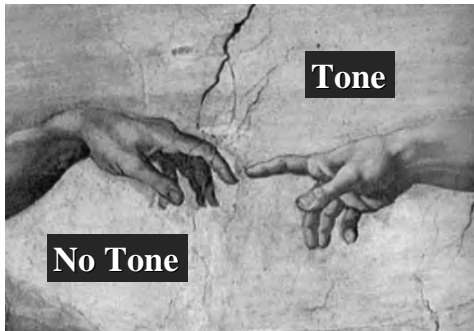
- **At least 3 discrete fetal movements in 30 min**
- **Limbs and/or torso**

Fetal Tone – FT

- At least one episode of limb or trunk extension with return to flexion in 30 min
- Gross body movements can rarely occur without tone (occasional slow indolent rolls)
- Hard to evaluate if crowding (as from low fluid)

Fetal Tone

- Hand/Finger Movements
- Hand Position



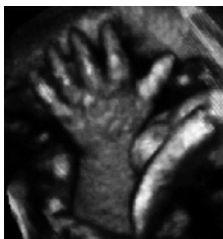
Tone



No Tone



Tone



Fetal Tone

- Mouth/Facial Movements
 - Yawning



Amniotic Fluid Volume – AFV

- **Initial criterion:** at least 1 cm in 2 perpendicular planes
- **Changed to** at least one fluid pocket of at least 2 cm vertical depth (Manning)
- **No advantage to the Amniotic Fluid Index – AFI (Magann 2004)**

Biophysical Profile Assumption

A sleeping fetus is indistinguishable from a compromised (hypoxic) fetus

Biophysical Profile

Why a 30 minute test?

- **Dynamic biophysical activity** is cyclical – 20 to 40 minutes
- **Presence of each response** is reassuring
- **Absence of any response** is questionable
- **30 min test** is within the range of normal periodicity.

Perinatal Mortality

Gross	7.37/1000	(0.70%)
Corrected	1.9/1000	(0.19%)
Normal BPP	0.73/1000	(0.07%)

Negative predictive accuracy of a live outcome within 1 week of a normal BPP is 99.93% - Manning 1987

Corrected Perinatal Mortality by Biophysical Profile Score

8 or 10	1.54/1000
6	9.76/1000
4	26.3/1000
2	94.0/1000
0	285.7/1000

Complete BPP needed to assess risk when individual components are non-reassuring

Manning 1990

Outcome After Non-Reassuring Biophysical Profile

- **98.8% of fetuses with a non-reassuring BPP have a live outcome**
- **Not natural history, but the result of active management of the pregnancies**

Vintzileos 1985

**“High Risk = Low Risk
And Low Risk = High Risk”**

O’Keeffe

BPP and Cerebral Palsy

- CP in 84,974 live births was 3.68/1000
- CP in 26,290 referred high-risk tested pts was 1.33/1000
- CP in 58,657 mixed low/high risk untested pts was 4.74/1000
- In tested pts, relationship of CP to last BPP was inverse, exponential, and highly significant

Manning 1998

Biophysical Profile

Parameter	Hypoxia
Cardiac (NST)	Acute
Respiratory (FBM)	Acute
Gross Motor (FM)	Acute
Tone (FT)	Acute
Amniotic Fluid (AFV)	Chronic

Gradual Hypoxia Concept

- Dynamic biophysical activities are controlled by neural activity from different sites in the brain
- Sites become functional at different stages of development
- Later centers require more oxygen
- Later developing centers are more sensitive to acute hypoxia

Gradual Hypoxia Concept

Tone	8 weeks
Movement	9 weeks
Breathing Activity	20 weeks
Heart Reactivity	26+ weeks

NST vs Umbilical Cord pH

- 124 consecutive patients within 6 hrs of c-section
- Reactive NST and/or normal FBM: 100% had normal blood pH
- First manifestation of acidosis (pH < 7.2): Non-reactive NST and absent FBM, ppv = 71%

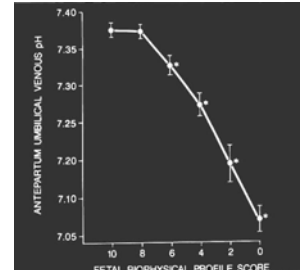
Vintzileos 1987

Compromised BPP Umbilical Artery Blood Gases

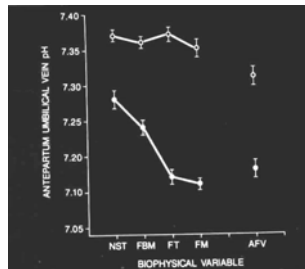
N-R/No	#/82 pts	pH	pO ₂	pCO ₂
NST	30	7.21	11.9	57.7
FBM	24	7.21	11.5	57.3
FM	9	7.08	8.3	69.3
FT	5	7.03	6.2	72.0

Vintzileos 1992

BPP vs Antepartum Umbilical Vein pH 493 BPP and PUBS in 212 Fetuses



BPP vs Antepartum Umbilical Vein pH 493 BPP and PUBS in 212 Fetuses



Amniotic Fluid Volume

- Decrease indicates chronic fetal compromise
- Hypoxia > cardiac compromise > decreased fetal organ perfusion > decreased urine production
- Risk of cord compression and death

Amniotic Fluid Volume and Corrected Perinatal Mortality

Normal	2.6/1000
Marginal	44/1000
Decreased	111/1000

Chamberlain, Manning 1984

97.5% of BPPs are Normal

Can any of the component tests of the BPP be left out when the other initial criteria are normal, without diminishing the positive predictive value for a normal outcome?

Ultrasound Portion of BPP

- **Fetal Breathing Movements – FBM**
- **Gross Movements – FM**
- **Fetal Tone – FT**
- **Amniotic Fluid Volume – AFV**

If 8/8, NST adds no additional predictive value. Manning 1987

NST vs BPP

- **Positive predictive value of abnormal BPP > abnormal NST
56.6% vs 13.1%**
- **Negative predictive value of normal BPP = normal NST
98.8% vs 98.0%**

Manning 1984, 1987

Modified Biophysical Profile NST and AFV

- **NST – Acute Parameter**
 - Reactivity implies fetal movement
 - Fetal movement rare without tone
- **AFV – Chronic Parameter**

Modified Biophysical Profile NST and AFV

- **Decreased AFV and heart rate decelerations despite a reactive NST are an indication for delivery**
- **Despite intervention, associated with**
 - Meconium staining
 - Decelerations in labor
 - C-sections for fetal distress
 - Small for gestational age

Eden 1988

Modified Biophysical Profile NST and AFV

- **Practical for routine assessment of fetal well being in high risk pregnancy**
- **Affords insights – spontaneous decelerations – unavailable with ultrasound surveillance alone**

Miller 1996

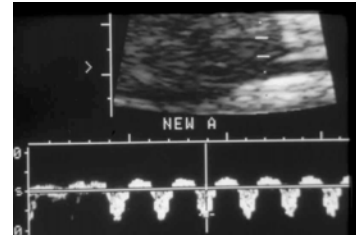
Fetal Monitoring

- **Full BPP is reserved for cases with non-reactive NST and normal AFV**
- **With non-reactive NST and/or decelerations and an abnormally low AFV, consider delivery**

The Role of Doppler Studies When BPP Intermediate

- **Umbilical Artery S/D**
 - Low diastolic like non-reassuring BPP
 - Absent/reversed: urgent concern
- **MCA decreased resistance, some use**
- **Ductus Venosus**
 - Abnormal wave form may become the deciding test for timing delivery

Reversed Diastolic Flow



Pitfalls in Using BPP

- Manage by BPP only, without checking for correctable pregnancy problems
- Manage by non-reassuring Modified BPP without using full BPP
- Inexperience/faulty BPP technique
- Procrastination or reluctance to act on worrisome BPP results

BPP Interval of Testing

- **Twice weekly BPP: a fetus should not become severely compromised or die within a half week if the mother's condition has not deteriorated**
- **PROM: Daily BPP and/or NST**

30 min qd Monitoring in PROM

- **Continuous FM and/or FBM for 30 sec: No infection in 100%**
- **No FBM, total time of FM < 50 sec: Infection present 100%**
- **FBM < 30 sec but FM > 50 sec: Infection in 84%**

Goldstein 1988

