INTRAPARTUM MONITORING AND ITS RELATIONSHIP TO EARLY NEONATAL MORTALITY AND MORBIDITY

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Croatia
CTG

Most common (> 85 %) obstetrical procedure in labor since 1968

CTG

- Continuous
- Intermittent
- Fetal stethoscope – Pinard
- Doppler device
CTG

- External – US Doppler device
- Internal – fetal ECG – R waves
CTG

- Admission test

- In labor
LABOR ADMISSION TEST

- It is still routine practice in most obstetric units but there is little evidence on its benefits - performed for 20 to 30 min

- review of RCT found that the LAT did not reliably predict fetal ability to tolerate labor over time in low risk pregnancies and did not reduce neonatal morbidity but increases CS rate by 20 %

CTG

1st goal

Identification of acidotic fetuses in whom timely intervention will prevent death

2nd goal

Prevention of fetal neurologic injury

CTG

- High FPR for predicting adverse outcomes and increases the rate of operative intervention
- High inter and intra observer variability

CTG

„The situation in CTG can be compared with vocalization of monkeys in the jungle; when danger is imminent they always scream. But monkeys scream much too often; especially when there is no real danger at all.”

META ANALYSIS

- N – 37000 (13 studies)
- Continuous CTG vs. intermittent auscultation
- Perinatal death (RR 0.86, 95% confidence interval (CI) 0.59 to 1.23, n = 33,513, 11 trials)
- Cerebral palsy (RR 1.75, 95% CI 0.84 to 3.63, n = 13,252, 2 trials)
- Neonatal seizures (RR 0.50, 95% CI 0.31 to 0.80, n = 32,386, 9 trials)

META ANALYSIS

- Acidosis (pH < 7.00) (RR 0.92, 95% CI 0.27-3.11)
- HIE (RR 0.46, 95% CI 0.04-5.03)
- Apgar score <4 at 5 min (RR 1.80, 95% CI 0.71-4.59)
- NICU (RR 1.01, 95% CI 0.86-1.18)
- Neurodevelopmental impairment at ≥12 months of age (RR 3.88, 95% CI 0.83-18.2)

META ANALYSIS

- **Cesarean Section**
  (RR 1.63, 95% CI 1.29 to 2.07, n = 18,861)

- **Instrumental vaginal birth**
  (RR 1.15, 95% CI 1.01 to 1.33, n = 18,615)

- **Spontaneous vaginal births**
  (RR 0.91, 95% CI 0.86-0.96)

Meta analysis

- Continuous CTG - an extra 12 CS and 25 operative vaginal deliveries per 1000 births
- Intermittent auscultation 1:1 - midwife:woman in labor

Either continuous CTG or intermittent auscultation is acceptable in uncomplicated patients.

High risk pregnancies (preeclampsia, suspected IUGR, diabetes mellitus) should be monitored continuously during labor.

ACOG, 2009

Uncomplicated pregnancies — every 30 min in the I stage and every 15 min in the II stage of labor

Complicated pregnancies — every 15 min in the I stage and every 5 min in the II stage

category II or III tracing is reviewed more frequently, as appropriate for the clinical scenario

THREE TIERED FHR INTERPRETATION SYSTEM

- I category – „Reassuring”
- II category - “Non-reassuring”
- III category - “Abnormal”

### NICHID definitions of FHR characteristics and patterns

**Variability**
- Fluctuations in baseline that are irregular in amplitude and frequency
  - Absent = amplitude undetectable
  - Minimal = amplitude 0 to 5 bpm
  - Moderate = amplitude 5 to 20 bpm
  - Marked = amplitude over 20 bpm
- Measured in a 10-minute window. The amplitude is measured peak to trough. There is no distinction between short-term and long-term variability.

**Baseline rate**
- Bradycardia = below 110 bpm
- Normal = 110 to 160 bpm
- Tachycardia = over 160 bpm
- The baseline rate is the mean bpm (rounded to 0 or 5) over a 10-minute interval, excluding periodic changes, periods of marked variability, and segments that differ by more than 25 bpm. The baseline must be identifiable for two minutes during the interval (but not necessarily a contiguous two minutes); otherwise, it is considered indeterminate.

**Acceleration**
- A gradual∗ increase in the FHR. Before 32 weeks of gestation, accelerations should last ≥10 sec and peak ≥10 bpm above baseline. As of 32 weeks gestation, accelerations should last ≥15 sec and peak ≥15 bpm above baseline.
- A prolonged acceleration is ≥22 minutes but less than 10 minutes. An acceleration of 10 minutes or more is considered a change in baseline.

**Late deceleration**
- A gradual∗ decrease and return to baseline of the FHR associated with a uterine contraction. The deceleration is delayed in timing, with the nadir of the deceleration occurring after the peak of the contraction. The onset, nadir, and recovery usually occur after the onset, peak, and termination of a contraction.

**Early deceleration**
- A gradual decrease and return to baseline of the FHR associated with a uterine contraction. The nadir of the FHR and the peak of the contraction occur at the same time. The deceleration’s onset, nadir, and termination are usually coincident with the onset, peak, and termination of the contraction.

**Variable deceleration**
- An abrupt decrease in FHR below the baseline. The decrease is ≥15 bpm, lasting ≥15 sec and ≤2 minutes from onset to return to baseline. The onset, depth, and duration of variable decelerations commonly vary with successive uterine contractions.

**Prolonged deceleration**
- A decrease in FHR below the baseline of 15 bpm or more, lasting at least 2 minutes but <10 minutes from onset to return to baseline. A prolonged deceleration of 10 minutes or more is considered a change in baseline.

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NICHID: National Institute of Child Health and Human Development; bpm: beats per minute; sec: seconds; FHR: fetal heart rate.

∗“Gradual” and “abrupt” changes are defined as taking ≥30 seconds or ≤30 seconds, respectively, from the onset of the deceleration/acceleration to the nadir/peak.

# NICHD criteria for category I, II, and III FHR tracings

## Category I

All of the following criteria must be present. Tracings meeting these criteria are predictive of normal fetal acid-base balance at the time of observation.

- Baseline rate: 110 to 160 bpm
- Moderate baseline FHR variability
- No late or variable decelerations
- Early decelerations may be present or absent
- Accelerations may be present or absent

## Category III

Category III tracings are predictive of abnormal fetal acid-base status at the time of observation. Prompt evaluation is indicated and most parturients will require expeditious intervention, such as provision of supplemental oxygen, change in position, treatment of hypotension, and discontinuation of any tocolytic drugs being administered. Category III tracings include either (1) or (2) below.

1. Absent baseline FHR variability and any of the following:
   - Recurrent late decelerations
   - Recurrent variable decelerations
   - Bradycardia

2. Sinusoidal pattern

## Category II

FHR tracing does not meet criteria for either category I or III and is considered indeterminate.

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NICHD: National Institute of Child Health and Human Development; FHR: fetal heart rate; bpm: beats per minute.

Do not perform continuous CTG in low risk women
Advise continuous CTG if any of the following risk factors occur during labor:

- Suspected chorioamnionitis, sepsis, or temp ≥38°C
- Severe hypertension (≥160/110 mmHg)
- Oxytocin use
- Significant meconium
- Fresh vaginal bleeding

Intrapartum care for healthy women and babies. NICE guidelines [CG190] Published date: December 2014. nice.org.uk/guidance/cg190
NICE, 2014

Do not make any decision about a woman's care in labor on the basis of CTG findings alone

Intrapartum care for healthy women and babies. NICE guidelines [CG190] Published date: December 2014. nice.org.uk/guidance/cg190
Any decision about changes to a woman's care in labor except CTG account the following:

- the woman's report of how she is feeling
- the woman's report of the baby's movements
- assessment of the woman's wellbeing and behavior
- the woman's temperature, pulse and blood pressure
- whether there is meconium or blood in the amniotic fluid
- any signs of vaginal bleeding
- any medication the woman is taking
- the frequency of contractions
- the stage and progress of labor
- the woman's parity
- the results of FBS if undertaken
- the fetal response to scalp stimulation if performed

Intrapartum care for healthy women and babies. NICE guidelines [CG190] Published date: December 2014.nice.org.uk/guidance/cg190
<table>
<thead>
<tr>
<th>Description</th>
<th>Baseline (beats/minute)</th>
<th>Baseline variability (beats/minute)</th>
<th>Decelerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal/reassuring</td>
<td>100–160</td>
<td>&gt; 5</td>
<td>None or early</td>
</tr>
<tr>
<td>Non-reassuring</td>
<td>161–180</td>
<td>&lt; 5 for 30–90 min</td>
<td>Variable decelerations: 1. dropping from baseline by 60 beats/minute or less and taking 60 seconds or less to recover 2. present for &gt; 90 minutes 3. occurring with &gt; 50% of contractions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Variable decelerations: 1. dropping from baseline by more than 60 beats/minute or taking over 60 seconds to recover 2. present for &gt; 30 minutes 3. occurring with &gt; 50% of contractions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Late decelerations: 1. present &lt; 30 minutes 2. occurring with &gt; 50% of contractions.</td>
</tr>
<tr>
<td>Abnormal</td>
<td>&gt;180 or &lt; 100</td>
<td>&lt; 5 for &gt; 90 min</td>
<td>Non-reassuring variable decelerations 1. still observed &gt; 30 minutes after starting conservative measures 2. occurring with &gt; 50% of contractions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Late decelerations: 1. present for &gt; 30 minutes 2. do not improve with conservative measures 3. occurring with &gt; 50% of contractions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bradycardia or a single prolonged deceleration lasting &gt; 3 minutes.</td>
</tr>
</tbody>
</table>

Intrapartum care for healthy women and babies. NICE guidelines [CG190] Published date: December 2014.nice.org.uk/guidance/cg190
NICE, 2014

In cases when 2 or more non-reassuring or 1 or more abnormal characteristics are present objectification of CTG is needed

Intrapartum care for healthy women and babies. NICE guidelines [CG190] Published date: December 2014. nice.org.uk/guidance/cg190
NON INVASIVE TESTS

- The fetal scalp stimulation maneuver (pooled LR + 15.68 CI 95%(3.22, 76.24)
- Easy
- Inexpensive
- Readily available
- Not uncomfortable

Non invasive tests

- Vibroacoustic stimulation (pooled LR + 5.06 95% CI(2.69, 9.50))

Non invasive tests

- Allis clamp (pooled LR +10.40 CI 95%(1.47, 73.61)

Non invasive tests

- **Positive test** – acceleration
  > 15 beats per min in duration of 15 sec

- Failure to elicit an acceleration was not a definitive sign of acidosis (only 30% acidotic)

FBS

Prof. Ernest Saling

The first intrapartal FBS analysis was performed on June 21, 1960

the birthday of the first direct approach to the human fetus before delivery

FBS

- Invasive method – obtaining a sample from fetal presenting part

FBS

- **Contraindications**
  - Absolute (urgent delivery)
  - Relative (positive HIV or HCV infection or fetal thrombocytopenia or coagulopathy)

- **Complications**
  - Bleeding or subsequent infection – rare 1:100
  - Trauma of the fetal head – multiple attempts
  - Cerebrospinal fluid leakage or perinatal hemorrhagic shock – extremely rare 1:10000

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\textbf{pH}

- pH is defined as the decimal logarithm of the reciprocal of the hydrogen ion activity in a solution (Sørensen, 1909)

\[ \text{pH} = - \log_{10}(a_{H^+}) = \log_{10} \left( \frac{1}{a_{H^+}} \right) \]

\textbf{Logarithmic correlation with degree of acydosis}

pH

- "Cut off" value for fetal acidosis in labor < 7.20 (25 percentile)
  - 1. preacidosis – 7.25-7.20
  - 2. mild acidosis – 7.20-7.15
  - 3. medium acidosis – 7.15-7.10
  - 4. heavy acidosis - < 7.10

pH

Meta-analysis of 51 studies including over 480,000 infants, the strongest association between neonatal morbidity and pH was at pH < 7.0

(OR 12.5, 95% CI 6.1-25.6)

Malin GL, Morris RK, Khan KS. Strength of association between umbilical cord pH and perinatal and long term outcomes: systematic review and meta-analysis. BMJ. 2010;340:c1471
**LIMITATION OF pH**

- Compared the consistency of pH results of paired FBS taken 2 min (100 samples)
- 43 had a inconsistency (difference) greater than the laboratory acceptable maximum analytical difference of 0.038.
- **Discordance between the samples in 16 cases had direct impact in decision what to do in labor**

LIMITATION OF pH

- The time interval from decision to result for FBS is long - median time 17 min (IQR 11-22min)
- Body mass index (BMI)
- Grade of operator
- Cervical dilatation

Limitation of pH

- The analysis of pH is complicated
- Needs a relatively large amount of blood (30-50 mcl)
- Sampling failure rates of 11-20%
- Mixture of fetal blood with air, amniotic fluid or maternal blood

LIMITATION OF pH

Does not discriminate between respiratory and metabolic acidemia, the latter being associated with neonatal morbidity

Tuuli MG, Stout MJ, Shanks A, Odibo AO, Macones GA, Cahill AG
LACTATE

- Lactate – direct end product of anaerobic metabolism and predictive of short-term neonatal morbidity and reflects tissue hypoxia

LACTATE

Level of lactate has linear progression especially in the II stage of labor – app. 1 mmol/l every 30 minutes

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>LACTATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL</td>
<td>&gt; 7.25</td>
<td>&lt; 4.1 mmol/l</td>
</tr>
<tr>
<td>PREACIDOSIS</td>
<td>7.20 - 7.25</td>
<td>4.2-4.7 mmol/l</td>
</tr>
<tr>
<td>ACIDOSIS</td>
<td>&lt; 7.20</td>
<td>&gt; 4.8 mmol/l</td>
</tr>
</tbody>
</table>

LACTATE

Sample volume
• 0.3μL
• 1.0μL
• 5.0μL

arkray global business, inc.

KYOTO MIYUKI Bldg. 10F, 689 Takanna-cho,
Nakagyo-ku, Kyoto 604-8153, JAPAN
TEL +81-75-662-8967  FAX +81-75-662-8973
LACTATE VS PH

8-10 times SMALLER sample volume (5 µl vs 30-50 µl)

LACTATE

- RCT - pH analysis (n=1496) or lactate analysis (n=1496) – 2002 – 2005.
- Cut off points: pH (<7.21) or lactate (> 4.8 mmol/l)
- Primary objective
  - Metabolic acidaemia (pH <7.05 and BE > -12 mmol/l)
    or pH <7.00 in cord artery blood
- Secondary objectives
  - Operative interventions (CS or instumental deliveries)
  - Apgar scores < 7 at 5 min
  - Admission to NICU

LACTATE

<table>
<thead>
<tr>
<th>Metabolic acidemia*</th>
<th>pH (n=1496)</th>
<th>Lactate (n=1496)</th>
<th>Relative risk for lactate vs pH (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>47 (3.6)</td>
<td>44 (3.2)</td>
<td>0.91 (0.61 to 1.36)</td>
<td>0.63</td>
</tr>
<tr>
<td>pH &lt; 7.00†</td>
<td>24 (1.8)</td>
<td>21 (1.5)</td>
<td>0.84 (0.47 to 1.50)</td>
<td>0.56</td>
</tr>
<tr>
<td>pH &lt; 7.10†</td>
<td>131 (9.9)</td>
<td>121 (8.8)</td>
<td>0.89 (0.70 to 1.12)</td>
<td>0.32</td>
</tr>
<tr>
<td>Caesarean section</td>
<td>415 (27.7)</td>
<td>452 (30.2)</td>
<td>1.09 (0.97 to 1.22)</td>
<td>0.14</td>
</tr>
<tr>
<td>Forceps/ventouse‡</td>
<td>416 (38.5)</td>
<td>370 (35.4)</td>
<td>0.92 (0.82 to 1.03)</td>
<td>0.15</td>
</tr>
<tr>
<td>OOFD</td>
<td>571 (38.2)</td>
<td>580 (38.8)</td>
<td>1.02 (0.93 to 1.11)</td>
<td>0.77</td>
</tr>
<tr>
<td>Apgar &lt; 7 at 5 min</td>
<td>40 (2.7)</td>
<td>46 (3.1)</td>
<td>1.15 (0.76 to 1.75)</td>
<td>0.51</td>
</tr>
<tr>
<td>NICU admission</td>
<td>164 (11.0)</td>
<td>167 (11.2)</td>
<td>1.02 (0.83 to 1.25)</td>
<td>0.86</td>
</tr>
<tr>
<td>Hypoxic ischaemic encephalopathy:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>4</td>
<td>5</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
<td>1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Perinatal mortality</td>
<td>3</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

LACTATE

1. The higher failure rate and protocol violations in pH group
   11.0% vs. 1.2% [OR 0.13; 95%CI 0.01–0.26]

2. Shorter time for obtaining a sample in lactate group
   120 vs. 230 sec (pH 9% > 30 min)

3. Lactate group without FNR vs. 6 FNR in pH group

LACTATE

Fetal scalp blood lactate estimation is more likely to be successfully undertaken than pH estimation (98.7% vs 79.4%)

**Base Excess**

- Amount of strong acid that must be added to each liter of fully oxygenated blood to return the pH to 7.40 at a temperature of 37°C and a pCO2 of 40 mmHg (5.3 kPa)

\[
\text{Base excess} = 0.93 \times \left( [\text{HCO}_3^-] - 24.4 + 14.8 \times (\text{pH} - 7.4) \right)
\]

Jonathan D. Kibble; Colby R. Halsey (2009), Medical pHysiology: The Big Picture, p. 249-255
Base Excess

- The values base excess do not change significantly during gestation
  \[-2.3 \pm 0.6 \text{ mmol/l}\]

- Linear correlation with degree of metabolic acydosis and the risk of neonatal neurologic morbidity

## Reference range for umbilical artery blood gas values in term newborns

<table>
<thead>
<tr>
<th>Umbilical arterial blood</th>
<th>Mean</th>
<th>5th to 95th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.27</td>
<td>7.15 to 7.38</td>
</tr>
<tr>
<td>PCO₂ (mmHg)</td>
<td>50.3</td>
<td>32 to 68</td>
</tr>
<tr>
<td>HCO₃ (mEq/L)</td>
<td>22</td>
<td>15.4 to 26.8</td>
</tr>
<tr>
<td>Base excess (mEq/L)</td>
<td>-2.7</td>
<td>-8.1 to 0.9</td>
</tr>
</tbody>
</table>

Values represent findings from umbilical artery cord blood analysis after vaginal delivery of 3522 unselected term infants delivered at Shands Hospital, University of Florida, 1992-1993.

Base Excess

- Drop approximately 1 mmol/l every 3-6 hours in I phase of labor and 1 mmol/l every hour in II phase of labor

The threshold of fetal metabolic acidosis at delivery when moderate or severe newborn complications (10%) is in an umbilical artery BE of

> - 12 mmol/l

RCT

1. continuous CTG vs. continuous CTG + FBS – 1 study: Haverkamp, 1979
2. continuous CTG + FBS vs intermittent CTG + FBS – 1 study: Herbst, 1994
RCT CTG VS FBS

<table>
<thead>
<tr>
<th></th>
<th>CTG N=233</th>
<th>CTG+FBS N= 230</th>
<th>X2 TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATIVE DELIVERY</td>
<td>64 (28%)</td>
<td>54 (23%)</td>
<td>0.36</td>
</tr>
<tr>
<td>CS</td>
<td>41 (18%)</td>
<td>26 (11%)</td>
<td>0.03</td>
</tr>
<tr>
<td>CS BECAUSE OF ABNORMAL FHR</td>
<td>16 (7%)</td>
<td>8 (3%)</td>
<td>0.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CTG vs IA</th>
<th>CTG+FBS vs IA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidosis (pH&lt;7.00) umbilical blood</td>
<td>0.45 [0.16-1.29]</td>
<td>1.58 [0.89-2.81]</td>
</tr>
<tr>
<td>Apgar &lt; 7 in 5 min</td>
<td>1.04 [0.75-1.43]</td>
<td>0.66 [0.30 – 1.43]</td>
</tr>
<tr>
<td>Neonatal convulsions</td>
<td>0.51 [0.18-1.44]</td>
<td>0.49 [0.29-0.84]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CTG vs IA</th>
<th>CTG+FBS vs IA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>1.96 [1.24 – 3.09]</td>
<td>1.50 [1.10 -2.06]</td>
</tr>
<tr>
<td>CS because of abnormal FHR</td>
<td>2.64 [1.92-3.64]</td>
<td>2.07 [1.47-2.91]</td>
</tr>
<tr>
<td>Operative delivery</td>
<td>0.45 [0.16-1.29]</td>
<td>1.58 [0.89 – 2.81]</td>
</tr>
<tr>
<td>Operativni porođaj because of abnormal FHR</td>
<td>0.66 [0.30-1.43]</td>
<td>1.04 [0.75 – 1.43]</td>
</tr>
</tbody>
</table>

RTC

- Number of participants in RTC for 25% decrease in different outcomes:
  - CS (incidence 20%)
  - several 100
  - Metabolic acidosis (incidence 1-2%)
  - several 1000
  - HIE (incidence 0.03%)
  - several 10,000
ST Analysis

- STAN S31 fetal heart monitor monitors the fetal ECG during labor
- Software automatically identifies and analyzes changes in the T wave and the ST segment of the fetal ECG
- A visual alert ("ST event") appears when ST changes occur
- 38 - 90 % sensitivity and 83 - 100 % specificity for detecting fetal acidosis


ST Analysis
ST Analysis

- largest RCT of ST analysis (11000 women) no significant differences in the rate of:
  - Cesarean section
  - Operative vaginal delivery
  - Composite outcome (stillbirth, neonatal death, 5 minute Apgar score \( \leq 3 \), cord artery pH \( \leq 7.05 \) and BD \( \geq 12 \), intubation in the delivery room, seizures, neonatal HIE)

Fetal pulse oximetry

- Measures fetal oxygenation during labor
- Sensor placed transcervically against the fetal cheek
- Normal values SpO2 35-65 %
- Metabolic acidosis develops when the value < 30 % for at least 10-15 minutes

Fetal pulse oxymetry

- N = 8013, 7 studies (6 comparing FPO and CTG with CTG alone and one comparing FPO + CTG with fetal ECG + CTG)
- The addition of FPO does not reduce overall CS rates
- A better method than FPO is required to enhance the overall evaluation of fetal well-being in labor

TO TAKE HOME - 1

- Continuous CTG has a high FPR for predicting adverse outcomes and increases the rate of operative intervention
- Continuous electronic FHR monitoring and IA
- The body of evidence indicates that neither test performs better than the other
TO TAKE HOME - 2

- **low risk women** - either intermittent or continuous electronic FHR monitoring is reasonable
- **high risk women** - continuous rather than intermittent intrapartum FHR monitoring
TO TAKE HOME - 3

- I category – “Reassuring”
- II category - “Non-reassuring”
- III category - “Abnormal”

- A major goal of intrapartum FHM is to distinguish the large number of fetuses with category II tracings who are hypoxemic, but well compensated, from the small number who are at risk of acidosis or death. This is also true for category III tracings, except the likelihood of fetal acidosis is much higher in that group.
TO TAKE HOME - 4

- In cases when 2 or more non-reassuring or 1 or more abnormal characteristics are present objectification of CTG is needed

- **Non invasive test** – key step in evaluation of a category II or III FHR tracing is to determine if accelerations are present as a rise of $\geq 15$ beats per minute above baseline lasting for $\geq 15$ seconds almost always assures the absence of fetal acidosis.
**TO TAKE HOME - 5**

**Invasive tests – FBS**
lactate and BE linear correlation with degree of metabolic acidosis
pH logarithmic correlation

<table>
<thead>
<tr>
<th>pH</th>
<th>Lactate</th>
<th>BE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 7.20</td>
<td>&gt; 4.8 mmol/l</td>
<td>&gt; -12 mmol/l</td>
</tr>
</tbody>
</table>
TO TAKE HOME - 6

- ST analysis and fetal pulse oxymetry do not significantly improve the intrapartal care.

- A better method than these is required to enhance the overall evaluation of fetal well-being in labor.
THANK YOU