INTRAPARTUM MONITORING

... AND ITS IMPACT ON FETAL OUTCOME

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Causes of fetal compromise during labor

Maternal
• Low blood pressure (e.g. Cava syndrome)
• Fever
• Drugs
• Low oxygen saturation etc.

Placental
• Placental insufficiency
• Placental abruption
• Cord prolapse
• Cord compression

Fetal
• Head compression
• Sepsis

Consequences

The Hospital in Fribourg has to pay 33 Million CHF for a baby with cerebral palsy acquired during delivery (BGE 4A_48/2010 of July 9 2010)

Correct monitoring
↓
Correct interpretation
↓
Correct decision to deliver
↓
Good outcome

Die Familie X.________ (Beschwerdegegner 1-6) und die Eidgenössische Invalidenversicherung (Beschwerdegegnerin 7) sind der Auffassung, dass die Schäden, an denen A. X.________ leidet, auf ärztliche Kunst- und Behandlungsfehler zurückzuführen sind. Wenn die richtigen Untersuchungen rechtzeitig durchgeführt, deren Ergebnisse richtig analysiert und die richtigen Entscheidungen und Massnahmen getroffen bzw. veranlasst worden wären, wäre kein Gesundheitsproblem eingetreten, insbesondere nicht, wenn rechtzeitig ein Kaiserschnitt durchgeführt worden wäre.
Cardiotocogram (CTG)

A cardiotocogram contains information on fetal heart rate and its (autonomic nervous system, baro-, chemoreceptors) control mechanism in relation to fetal activity and contractions.

Cardiotocography

- Tocography: Piezzo-Element
  (non-calibrated intrauterine pressure)
- Cardiography (external): Doppler ultrasound
- Cardiography (internal): Silver electrode

Cardiogram

Maternal heart rate

Tocogram

Fetal movements
1. Short term changes in fetal heart rate (<20")

(Baseline variability)

Criteria:

a) Variability
Criteria: oscillation frequency around the baseline

b) Amplitude range (peak to through)

Types:

0) absent
1-4 minimal
5-9 moderate
10-24 normal
≥25 marked, saltatoric

c) beat-to-beat variation

2. Long term changes of baseline heart rate (>3')

a) Bradycardia

b) Tachycardia

Severe bradycardia due to av block III
Tachycardia in a fetus with chorioamnionitis

3. medium-term changes of fetal heart rate (< 3’)
   a) Accelerations
      episodic (contraction-independent; fetal movement dependent)
      periodic (contraction dependent)
   b) Decelerations
      Episodic (contraction-independent)
      Periodic (contraction dependent)
      i. Dip 1 (mirror image of contraction)
      ii. Dip 2 (late deceleration)
      iii. variable deceleration (variable for shape, amplitude and duration)

Variable decelerations
   mild    moderate    severe

Bad criteria: loss of shoulder, u-shape, w-shape, loss of variability during Nadir
Highly abnormal CTG

Sinusoidal pattern indicating fetal anemia

Decelerations and their pathomechanism
(simplified)

- **Dip I**: Vegetative disorder (or compression of fetal head)
- **Dip II**: Hypoxemia (Placenta)
- **Variable decelerations**: Hemodynamic problem (e.g. cord compression)

CTG - influencing factors

<table>
<thead>
<tr>
<th>Maternal</th>
<th>Feto-placental</th>
<th>Fetal</th>
<th>Exogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posture</td>
<td>Placental insufficiency</td>
<td>Movements</td>
<td>Drugs</td>
</tr>
<tr>
<td>Activity</td>
<td>Cord compression</td>
<td>Activity</td>
<td>Smoking</td>
</tr>
<tr>
<td>Fever</td>
<td>Chorioamnionitis</td>
<td>Gestational age</td>
<td>Illegal drugs</td>
</tr>
<tr>
<td>Circulation</td>
<td>Hypoxemia</td>
<td></td>
<td>Shaking</td>
</tr>
<tr>
<td>Contractions</td>
<td>Anemia</td>
<td></td>
<td></td>
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Sings of fetal hypoxia

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline frequency</td>
<td>Tachycardia (&gt;160) or Bradycardia (&lt;110)</td>
</tr>
<tr>
<td>Floatingline</td>
<td>Absent accelerations</td>
</tr>
<tr>
<td></td>
<td>Late decelerations</td>
</tr>
<tr>
<td></td>
<td>Variable decelerations with bad criteria</td>
</tr>
<tr>
<td>Oscillationen</td>
<td>Fluctation amplitude &lt;5</td>
</tr>
<tr>
<td></td>
<td>Amplitude range &lt;2</td>
</tr>
</tbody>
</table>

CTG – Results of studies

Sensitivity: almost 100%
### Continuous cardiotocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour (Review)

- decreased early neonatal seizure rate
- unchanged perinatal mortality rate
- increased operative delivery rate

*lack of evidence is not evidence of lack

### CTG – Results of studies

**PPV <<50%**

### Pattern Definition Present in

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Definition</th>
<th>Present In</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachycardia</td>
<td>Baseline heart rate &gt;160 for more than 10 minutes</td>
<td>- Fetal activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Anemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Infection (Amni, Fetus)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Mild hypoxia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Beta mimetics</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>Baseline heart rate &lt;110 for more than 3 minutes</td>
<td>- Vena cava-Compression</td>
</tr>
<tr>
<td>Decreased variability</td>
<td>PPV variability &lt;10/Min</td>
<td>- Long lasting contraction</td>
</tr>
<tr>
<td>Sinusoidal pattern</td>
<td>Sinusoidal shape of baseline heart rate</td>
<td>- Severe hypoxia</td>
</tr>
<tr>
<td>Early deceleration (Dip I)</td>
<td>Periodic deceleration symmetric to contraction (mirror image), duration &lt;3</td>
<td>- Head compression</td>
</tr>
<tr>
<td>Late decelerations (Dip II)</td>
<td>Periodic deceleration onset at the peak of the uterine contractions and the return to baseline after the contraction has ended, duration &lt;3</td>
<td>- Hypoxia</td>
</tr>
<tr>
<td>Variable Decelerations</td>
<td>Periodic deceleration, variable for shape, amplitude and duration</td>
<td>- Cord compression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Placental compression</td>
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<td>- ?</td>
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### Fetal Monitoring

The PPV of the intrapartum CTG has decreased, because high risk cases such as IUGR and post term pregnancies are delivered electively. (PPV is prevalence dependent)

### Alternatives for CTG

- Fetal blood gas analysis
- Pulse oximetry
- Fetal ECG

Fetal heart rate tracings = reading tea leaves?
Fetal scalp blood sampling

- Blood gas analysis (pH, BE, pCO2, lactate)

- Uncomfortable for the mom
- Invasive for the baby (cave HIV etc.)
- Technically demanding
- Often rejected by testing equipment
- Only after PROM and Dilation 4cm
- Snapshot, no continuous monitoring
- Time consuming
- Delay in delivery in emergency situations
  → abandoned in many centers

Reflexion Pulse Oximeter

- Only after PROM
- Cut-off: Saturation <35%

Results: Sensitivity less than CTG

Combination of tests

- Hypoxic fetuses
- fO2 saturation
- Decrease c-section rate?
Fetal ECG (fECG)

Hypoxia

- Anaerobic metabolism
- Glycogenolysis
- Change in membrane potential due to liberation of potassium
- ST segment elevation & high T waves

Detectable by fECG

STAN 21
Changes in the ST segment & T wave

ST rise – a fetus responding to hypoxia

Biphasic ST – a fetus not fully capable of responding or has not had time to respond

Fetal electrocardiogram (ECG) for fetal monitoring during labour (Review)

Main results:

- From 1990 including a total of 8622 women were included. In comparison to continuous electronic fetal heart rate monitoring alone, the use of additional ECG monitoring added in cases of 8/2 women (95% confidence interval 5.1-11.6%; 7.7% vs 10.6%) in the conventional (54% vs 64.7%; 7.7% vs 11.6%) group in the comparative (7.4% vs 11.4%; 7.7% vs 14%) group.

- Interpretations:
  - Sensitivity of fECG is worse than CTG
  - In a substantial part of cases monitoring is technically not possible
  - Only after ruptured membranes
  - Internal electrode
  - The benefit seen in RCT’s resulted from the fact that health professionals delivered more often immediately when CTG and fECG were abnormal
Conclusion

- In the near future the CTG will remain the leading monitoring system because of its high sensitivity.
- Additional monitoring tools could lower c-section rate but definitely will decrease sensitivity.
- For legal reasons these tools will not be used routinely in practice.