Labor and Delivery: Physiology, Normal, Abnormal, and Preterm Labor

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Images: googleimage.com; gabbeobstetrics.com
Objectives

• Describe physiology of initiation of labor
• Define normal and abnormal labor
• Review the mechanics of labor
• Describe diagnosis and management of abnormal labor
• Discuss diagnosis, etiologies and management of preterm labor
Parturition

- Normal Pregnancy
  - Uterine quiescence
  - Immature fetus
  - Closed cervix

- Parturition
  - Coordinated uterine activity
  - Maturation of the fetus
  - Maternal lactation
  - Progressive cervical dilation
Uterine Activity During Pregnancy

**Inhibitors**
- Progesterone
- Prostacycline
- Relaxin
- Nitric Oxide
- Parathyroid hormone-related peptide
  - CRH
  - HPL

**Uterotrophins**
- Estrogen
  - Progesterone
  - Prostaglandins
  - CRH

**Uterotonins**
- Prostaglandins
- Oxytocin

**Involution**
- Oxytocin
  - Thrombin

**Stimulation**

**Activation**

**Quiescence**
Initiation of Labor

• Fetus
  » Sheep
    • Fetal ACTH and cortisol
      » Placental 17 α hydroxylase
      » ↑ Estradiol
      » ↓ Progesterone
      » Placental production of oxytocin, PGF2 α
  » Humans
    • Fetal increased DHEA
      » Placental conversion to estradiol
      » Increased decidual PGF₂ and gap junctions
      » Increased oxytocin and PG receptors
      » Decreased progesterone receptors
Initiation of labor

- **Oxytocin**
  - Peptide hormone
  - Hypothalamus-posterior pituitary
  - Fetal production
    - Maternal serum increase in second stage of labor
  - Oxytocin receptors
    - Fundal location
    - 100-200 x during pregnancy
  - Actions
    - Stimulate uterine contractions
    - Stimulate PG production from amnion/decidua
Calcium channel

Extracellular

Oxytocin receptor

Intracellular

Ca store

Phospholipase C

Ca^+

cAMP

+ Oxytocin + Prostaglandin

MLCK

Uterine contractions
Labor

Regular uterine contractions
(duration 30-60 seconds, every 5 minutes)

and

Progressive cervical dilatation
Management of labor

- Requirements
  - Continued progress
  - Station
  - Continued reassuring fetal status
Mechanisms of labor

- Effacement
- Dilatation
- Three “P’s”
  - Powers
  - Uterine activity
  - Passage
  - Passenger
Powers

- **Uterine contractions**
  - Normal labor
  - Duration 30-60 seconds
  - Q 2-5 minutes
    - 3-5 contractions / 10 minutes
  - Montevedeo units (intrauterine catheter)
    - Baseline to peak, sum of contractions in 10 minutes
    - Adequate: >200-250 MVU

- **Interventions**
  - Induction
  - Augmentation
    - Oxytocin
    - AROM
# Passage

<table>
<thead>
<tr>
<th>Pelvic Inlet</th>
<th>Gynecoid</th>
<th>Anthropoid</th>
<th>Android</th>
<th>Platypelloid</th>
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</thead>
<tbody>
<tr>
<td>Widest transverse diameter of inlet</td>
<td>12 cm</td>
<td>&lt; 12 cm</td>
<td>12 cm</td>
<td>12 cm</td>
</tr>
<tr>
<td>Anteroposterior diameter of inlet</td>
<td>11 cm</td>
<td>&gt; 12 cm</td>
<td>11 cm</td>
<td>10 cm</td>
</tr>
<tr>
<td>Forepelvis</td>
<td>Wide</td>
<td>Divergent</td>
<td>Narrow</td>
<td>Straight</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pelvic Midcavity</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Side walls</td>
<td>Straight</td>
<td>Narrow</td>
<td>Convergent</td>
<td>Wide</td>
</tr>
<tr>
<td>Sacrosciatic notch</td>
<td>Medium</td>
<td>Backward</td>
<td>Narrow</td>
<td>Forward</td>
</tr>
<tr>
<td>Inclination of sacrum</td>
<td>Medium</td>
<td>Wide</td>
<td>Forward (lower third)</td>
<td>Narrow</td>
</tr>
<tr>
<td>Ischial spines</td>
<td>Not prominent</td>
<td>Not prominent</td>
<td>Not prominent</td>
<td>Not prominent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pelvic Outlet</th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subpubic arch</td>
<td>Wide</td>
<td>Medium</td>
<td>Narrow</td>
<td>Wide</td>
</tr>
<tr>
<td>Transverse diameter of outlet</td>
<td>10 cm</td>
<td>10 cm</td>
<td>&lt; 10 cm</td>
<td>10 cm</td>
</tr>
</tbody>
</table>

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Passenger

- **Size**
  - 4500 gram = macrosomia

- **Lie**

- **Presentation**
  - 5% not vertex

- **Attitude**

- **Position**

- **Station**
  - Engagement
    - Widest diameter passes inlet
    - ‘0’ station, vertex
Cardinal Movements of Labor

- Descent
- Flexion
- Internal rotation
- Extension
- External rotation
- Expulsion

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Labor stages

• **First stage** – onset of labor to complete dilatation
  » Latent phase
  » Active phase
• **Second stage**
• **Third stage**
Partogram
**Labor stages**

- **First stage** – onset of labor to complete dilatation
  - Latent phase – onset to rapid cervical change
  - Active phase – rapid cervical change to complete dilatation

<table>
<thead>
<tr>
<th></th>
<th>Nulliparous</th>
<th>Multiparous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latent phase</td>
<td>Mean: 7.3-8.6 hr</td>
<td>Mean: 4.1-5.3 hr</td>
</tr>
<tr>
<td></td>
<td>95th %tile: 17-21 hr</td>
<td>95th %tile: 12-14 hr</td>
</tr>
<tr>
<td>Active phase</td>
<td>1.5 cm/hr</td>
<td>1.2 cm/hr</td>
</tr>
</tbody>
</table>
Labor stages

• **First stage** - onset of labor to complete dilatation
• **Second stage** – complete dilatation to delivery of neonate
• **Third stage**
• **Fourth stage**

<table>
<thead>
<tr>
<th></th>
<th>Nulliparous</th>
<th>Multiparous</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95th % tile</td>
</tr>
<tr>
<td>No epidural</td>
<td>53-57 min</td>
<td>122-147 min</td>
</tr>
<tr>
<td>Epidural</td>
<td>79 min</td>
<td>185 min</td>
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</tbody>
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Labor stages

- **First stage** – onset of labor to complete dilatation
- **Second stage**
- **Third stage**
  - Delivery of the placenta
  - Mean – 6 minute
  - 97th% tile 30 minutes
    - Prolonged
      - EBL >500
      - Need for D&C
      - Drop in HCT by 10%

1/7/2015
Fetal assessment in labor

- External monitoring
- Internal monitoring
Patterns of fetal heart rate monitoring

- Baseline
- Variability
- Periodic changes
  - Accelerations
  - Decelerations
    - Variable
    - Early
    - Late
Patterns of fetal heart rate monitoring

- Baseline
- Variability
- Periodic changes
  - Accelerations
  - Decelerations
    - Variable
    - Late
    - Early
- Normal
  - 120-160
- Tachycardia
  - >160
- Bradycardia
  - <120
Patterns of fetal heart rate monitoring

- **Baseline**
- **Variability**
- **Periodic changes**
  - Accelerations
  - Decelerations
  - Variations
  - Early
  - Late

- **Absent**
  - undetectable
- **Minimal**
  - < 5bpm
- **Moderate**
  - 5-25bpm
- **Marked**
  - >25bpm
Patterns of fetal heart rate monitoring

- Baseline
- Variability
- Periodic changes
  - Accelerations
  - Decelerations
    - Variations
    - Early
    - Late

<32 weeks 10bpm over baseline
>32 weeks 15bpm over baseline
Patterns of fetal heart rate monitoring

- Baseline
- Variability
- Periodic changes
  - Accelerations
  - Decelerations
    - Variable
    - Early
    - Late
Patterns of fetal heart rate monitoring

- Variable decelerations
  - Umbilical cord compression
  - Variable in appearance
  - Processes
    - UV compression
      - Decreased cardiac return
      - Fetal hypotension
      - Fetal increased HR
    - UA compression
      - Increased SVR
      - Decreased fetal heart rate
        - protective
Patterns of fetal heart rate monitoring

- Baseline
- Variability
- Periodic changes
  - Accelerations
  - Decelerations
    - Variable
    - Early
    - Late

- 5-10% of labors
- Vagal reflex
  - Cervical compression on fetal head
Patterns of fetal heart rate monitoring

- Baseline
- Variability
- Periodic changes
  - Accelerations
  - Decelerations
    - Variable
    - Early
    - Late

- Uteroplacental insufficiency - hypoxia
- Reflex late
  - low O2 in CNS, increased sympathetic tone, increased BP, baroreceptor medicated bradycardia
- Myocardial depression
Management of abnormal fetal heart rate patterns

• **Remove potential etiologies**
  » Hypotension
    • Maternal position – left lateral recumbent
    • IVF hydration, ephedrine
  » Maternal $O_2$ administration
  » Cessation of contractions
    • Discontinue oxytocin
    • Uterine relaxants – terbutaline
  » Amnioinfusion
  » Expedite delivery
Pain control in labor

- **Uterine pain**
  - T10-T12
- **Delivery pain**
  - S2-4
- **Cesarean**
  - T4
- **Management**
  - Psychoprophylaxis
    - TENS
    - Acupuncture
    - Prenatal education
  - Systemic opioid
  - Regional analgesia/anesthesia

© Original Artist
Pain control in labor

- **Systemic opioids**
  - Analgesia
  - Sedation

- **Bolus/PCA**
  - Meperidine
  - Nalbuphine
  - Butorphanol

- **Risks**
  - Neonatal depression
  - Delayed gastric emptying

Bucklin BA. Anesthesiology 103:645, 2005
Pain control in labor

- **Regional analgesia/anesthesia**
  - **Epidural**
    - L2-5
    - Local anesthetic
      - Bupivicaine (0.25%)
  - **Spinal**
    - CSE
      - Intrathecal opioid
      - Local anesthetic
  - **Local/pudendal**
Abnormal labor

- Prolonged descent
- Prolonged dilatation
- Assess/correct “3 P’s”
Abnormal labor - interventions

- **Augmentation**
  - **Oxytocin**
    - Achieve adequate uterine contractions
    - Requires reassuring fetal status
  - **AROM**
- **Therapeutic rest**
- **Operative vaginal delivery**
- **Cesarean delivery**
Operative vaginal delivery

• Indications
  » Prolonged second stage
  » Fetal compromise
  » Aftercoming fetal head/breech
  » Maternal indications
    • Cardiac disease
    • CNS disease

• Requirements
  » Consent
  » Completely dilated
  » Ruptured membranes
  » Adequate anesthesia
  » Empty bladder
  » Known fetal position
Operative vaginal delivery

- **Vacuum**
  - Suction cup
  - Sagital suture
  - Maintain flexion
- **Lower success rate**
- **Lower maternal trauma**
- **Increased fetal trauma**
Operative vaginal delivery

- Obstetrics forceps
  - Higher success rate
  - Increased maternal trauma
  - Allow rotational maneuvers
Cesarean Delivery

QuickStats
FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Total and Primary Cesarean Rate and Vaginal Birth After Previous Cesarean (VBAC) Rate — United States, 1989–2003

- 2006 cesarean rate (US)
  » 31.1% 2005

* Per 100 births to women with a previous cesarean delivery.
† Per 100 births.
‡ Per 100 births to women with no previous cesarean delivery.

Year

Rate

1989 1991 1993 1995 1997 1999 2001 2003

VBAC*
Total cesarean†
Primary cesarean‡
Cesarean delivery

- **Indications**
  - **Maternal**
    - CNS/cardiac disease
  - **Fetal**
    - NR fetal status
    - Malpresentation
    - HSV
  - **Maternal-fetal**
    - Arrest of labor
    - Abruption
    - Placenta previa
Vaginal Birth Following Cesarean

- **Success rates**
  - 60-80%
  - Higher success
    - Prior vaginal birth
    - Prior malpresentation
    - Spontaneous labor

- **Risks**
  - Uterine rupture
    - LTCS: 0.5-1.0%
    - LVCS: 0.8-1.1%
    - Classical: 4-9%

- **Candidates**
  - ACOG
    - One prior LTCS
    - No prior rupture/ut scars
    - Immediate cesarean available
  - Others possible
PRETERM LABOR,
PRETERM PREMATURE
RUPTURE OF MEMBRANES
Preterm labor/birth

• Labor/delivery < 37 weeks EGA

• 10-12% of US births with PTB
  » 50-70% of neonatal morbidity and mortality

• Risk factors
  » Prior PTB
  » Multiple gestations
  » SES
  » Uterine anomalies
  » Fetal anomalies
  » First trimester bleeding
  » AMA, <18 years old
Preterm Labor - interventions

- **Primary prevention**
  - Risk factor scoring
  - Early identification
- **Secondary prevention**
  - Tocolysis
- **Tertiary prevention**
  - Improve neonatal outcome
    - Antenatal corticosteroids
    - Surfactant
Evaluation of PTL

- Admission to labor and delivery
- Fetal status and contraction monitoring
- Make diagnosis
  - Regular uterine contractions
  - Examination
- Evaluation for etiologies
  - Cervical/vaginal infection
  - PPROM
  - Intra-amniotic infection
- Interventions
  - ACS
  - Transfer
  - Tocolytics
### Diagnosis of preterm labor

<table>
<thead>
<tr>
<th>Test</th>
<th>Delivery within 7 days</th>
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<tbody>
<tr>
<td></td>
<td>Sensitivity (%)</td>
</tr>
<tr>
<td>Cervix &gt;1 cm</td>
<td>29</td>
</tr>
<tr>
<td>Contractions ≥ 8/hr</td>
<td>42</td>
</tr>
<tr>
<td>Cervical length* (predicting delivery &lt;34 wks)</td>
<td>83</td>
</tr>
<tr>
<td>Fibronectin**</td>
<td>91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status</th>
<th>Delivery &lt;48hr</th>
<th>Delivery &lt; 7 days</th>
<th>Delivery &lt; 32 weeks</th>
<th>Delivery &lt; 35 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>+FFN and CL &lt;30mm</td>
<td>26.3%</td>
<td>44.7%</td>
<td>38.9%</td>
<td>47.4%</td>
</tr>
</tbody>
</table>

Tocolysis

• Goals
  » Prolong pregnancy, prevent PTB
  » Delay preterm delivery
    • Allow administration of ACS
    • Allow maternal transfer

• Agents
  » Magnesium sulfate
  » β mimetics
    • terbutaline
  » Nifedipine
  » Indomethacin
  » Oxytocin receptor antagonists
• **Betamethasone** (12mg IM q 24 hours x 2 doses)
• **Dexamethasone** (6mg IM q 12 hours x 4 doses)

  » Reduction (% reduction)
  • RDS (65%)
  • IVH (52%)
  • NEC (65%)
  • Neonatal death (40%)
- Weekly 17-P (16-36 weeks) in women with prior PTB
  - Reduction PTB  RR 0.66 (0.54-0.81)
  - Reduction in IVH, BW<2500gram, need for supplemental O₂
PPROM

• **Definition**
  » Preterm premature ROM
  » Premature ROM

• **Diagnosis**
  » Vaginal pooling
  » ‘Nitrazine’ positive
  » ‘Ferning’

• **Complications**
  » PTB
  » IAI
  » IUFD/cord accident

• **Management**
  » Admission
  » ACS
  » Delivery at 34 weeks EGA
Antibiotics for PPROM

Antimicrobial therapy in expectant management of preterm premature rupture of the membranes

Brian M. Mercer, Kristopher L. Arheart

• PPROM
  » Antibiotics (ampicillin + erythromycin, IV x 48 hours + po x 5 days)
    • Reduction:
      » Odds of delivery in 7 days: 0.56 (0.41, 0.76)
      » Infant sepsis: OR 0.53 (0.3, 0.93)
Preterm birth effective strategies

- Antibiotics for PPROM
  - Increase latency
  - Reduction in neonatal morbidity
- 17-P for prevention of recurrent PTB
- Antenatal corticosteroids
- GBS antimicrobial prophylaxis
Summary

• **Initiation of labor**
  » Maternal-fetal-placental interactions

• **Optimal maternal-fetal outcome**
  » Normal labor progress
  » Reassuring fetal testing

• **Preterm labor/PPROM**
  » 10-12% incidence/ 50-70% perinatal morbidity
    • TVCL and FFN best predictors of absence or PTB
  » Effective strategies
    • Antenatal corticosteroids
    • PPROM abx
    • 17P in prior PTB