Normal Labor

Beth A. Plunkett, MD, MPH
August 10, 2011
Normal Labor

- Clinical diagnosis
- Regular painful contractions
- Progressive cervical dilation and effacement
- Occurs at term
  - 37-41 6/7 weeks
  - 40 weeks = mean duration singleton pregnancy
Physiology of Labor

- Physiologic event
  - Changes in myometrium, decidua and cervix
  - Occurs gradually over days to weeks
  - May be a release from the inhibitory effects of pregnancy
  - Stimulatory mechanisms may also play a role
  - Preceded by biochemical changes in cervix
  - All usually before rupture of membranes
Phases of Myometrial Activity

- Phase 0
  - Quiescent stage
  - Inhibitors active
    - Putative inhibitors include:
      - Progesterone, prostacyclin, relaxin, parathyroid hormone-related peptide, nitric oxide, calcitonin gene-related peptide
Simplified scheme of the endocrinological control of pregnancy and parturition in women.
Phases of Myometrial Activity

- Phase 1
  - Myometrial activation
  - Myometrium becomes responsive to uterotropins (estrogen)
  - Expression of contraction-associated proteins
    - Prostaglandin and oxytocin receptors, activation of specific ion channels, increased connexin-43
  - Primed uterus
Phases of Myometrial Activity

- Phase 2
- Stimulatory phase
- Contractions are stimulated by uterotonic agonists
  - Prostaglandins E2 and F2 alpha and oxytocin
Cartoon of a myometrial cell indicating the intracellular biochemical pathways involved in regulating contractions.

MLCK, myosin light chain kinase; CAM, calmodulin; NO, nitric oxide; OT, oxytocin; FP, PGF receptor; AA, arachidonic acid; PGF, prostaglandin F

©2000 by Endocrine Society
Phases of Myometrial Activity

- Phase 3
- Involution
- After delivery
- Mediated by oxytocin
Initially described in 1954
## Diagnostic criteria for abnormal patterns in active labor

<table>
<thead>
<tr>
<th>Labor pattern</th>
<th>Nullipara</th>
<th>Multipara</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First stage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration (no anesthesia)</td>
<td>16.6 hours</td>
<td>12.5 hours</td>
</tr>
<tr>
<td>Duration (anesthesia)</td>
<td>19.0 hours</td>
<td>14.9 hours</td>
</tr>
<tr>
<td>Protracted dilation</td>
<td>&lt;1.2 cm/h</td>
<td>&lt;1.5 cm/h</td>
</tr>
<tr>
<td>Arrested dilation</td>
<td>&gt;2 h</td>
<td>&gt;2 h</td>
</tr>
<tr>
<td><strong>Second stage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration (no anesthesia)</td>
<td>132 minutes</td>
<td>61 minutes</td>
</tr>
<tr>
<td>Duration (anesthesia)</td>
<td>185 minutes</td>
<td>131 minutes</td>
</tr>
<tr>
<td>Arrest of descent (epidural)</td>
<td>&gt;3 h</td>
<td>&gt;2 h</td>
</tr>
<tr>
<td>Arrest of descent (no epidural)</td>
<td>&gt;2 h</td>
<td>&gt;1 h</td>
</tr>
</tbody>
</table>

Values represent approximately two standard deviations from the mean.

Is Friedman’s labor curve relevant today?
Reassessing the labor curve

Zhang J

- 1329 nullipara term, singleton, vertex
- Spontaneous labor and vaginal birth
- 5.5 hours from 4-10 cm
- 2.5 hours under Friedman curve
- No deceleration phase observed
- No change in cervical dilation for >2 hrs frequently occurred prior to 7 cm

Zhang J, AJOG 2002
Reassessing the labor curve

Albers LL

- Spontaneous labor, NSVD, no oxytocin, no CLE
- 1473 low-risk women in NM
- Duration first stage (4-10 cm)
  - 7.7 hours for nulliparas
  - 5.7 hours for multiparas
- No difference by ethnic group
- Some variation in duration of second stage

Albers LL, Obstet Gynecol, 1996
Reassessing the labor curve

Zhang J

- 26,838 parturients
- National Collaborative Perinatal Project, 12 centers
- 1959-1965
- Singleton pregnancy, spontaneous labor, cephalic, vaginal delivery

Zhang J, Obstet Gynecol 2010
Reassessing the labor curve

- Rate of cervical change depends upon dilation
- Median time
  - 1.2 hours from 3 to 4 cm
  - 0.4 hours from 7-8 cm
- Nulliparas have longer, more gradual curves
- Start active phase after 5cm

Zhang J, Obstet Gynecol 2010
Reassessing the labor curve

- 2 hour threshold for arrest may be too short <6cm
- 4 hour threshold may be too long >6cm

Zhang J, Obstet Gynecol 2010
Evidence for a 4 hour threshold?

Rouse DJ

- Prospective evaluation of term gravidas
- Spontaneous labor with active phase arrest
  - No cervical change over 2 hrs, >4cm dilated
- Oxytocin initiated to achieve 200 Montevideo units for 4 hours or 6 hours augmentation
- Cesarean not performed for arrest until >4 hours
Evidence for a 4 hour threshold?

- 542 women managed by this protocol
- 92% delivered vaginally
- Vaginal delivery with arrest with 2 hours augmentation
  - 91% multiparas
  - 74% nulliparas
- Vaginal delivery with 4 hours of no change
  - 88% multiparas
  - 56% nulliparas

Rouse DJ, Obstet Gynecol 1999
Evidence for a 4-6 hour threshold?

- No severe maternal complications, 1 neonatal infection
- Suggests that protocol is effective and safe
- 92% vaginal delivery rate!

Rouse DJ, Obstet Gynecol 1999
How long is too long for the second stage?

- Rouse, DJ
- 5341 nulliparous women enrolled in a fetal pulse oximetry study
- 4126 reached second stage
- Spontaneous delivery rates declined as length increased

Rouse DJ, AJOG, 2009
How long is too long for the second stage?

- Spontaneous delivery rates
  - 85% < 1 hour
  - 9% ≥ 5 hours

- Adverse maternal outcomes associated with duration (OR 1.3-1.8/hour)
  - Chorioamnionitis, 3rd or 4th degree laceration, atony

- Adverse neonatal outcome
  - Admission to NICU (OR 1.4)
How long is too long for the second stage?

- Chorioamnionitis potential cause of prolonged second stage rather than a result
- Atony likely result of chorioamnionitis
- Conclude that second stage of labor does not need to be terminated based on duration alone
- No upper limit for the second stage
Is there an upper time limit for the management of the second stage of labor?

- Caughey AB, 2009
- ACOG 2000 guidelines define prolonged second stage
  - Arrest >3 hours in nulliparas with CLE and >2 hours in multiparas with CLE
- No RCT
- ACOG acknowledges lack of evidence to support absolute time threshold

Caughey AB, AJOG, 2009
How are our gravid mothers different from Friedman’s?

- Maternal weight
- Maternal age
- Use of regional analgesia
- IOL
Does obesity alter labor?

- Duration of first stage of labor is proportional to maternal weight
  - 509 women at term undergoing IOL enrolled
  - 71% nulliparous
  - For each 10 kg increment of weight, rate of dilation increased by 0.04 cm/hr
    - Adjusted multivariate regression model

Nuthalapaty FS, Rouse DJ, Owen J Obstet Gynecol 2004
Does obesity alter labor?

- Longer duration of labor from 4-10 cm in overweight and obese women
  - 612 nulliparas, 1995-2002
  - Duration of labor from 4-10 cm:
    - Normal BMI (<26 kg/m²) 6.2 hours
    - Overweight (26.1-29.0 kg/m²) 7.5 hours
    - Obese (>29.1 kg/m²) 7.9 hours
Does obesity alter the second stage of labor?

- Probably not
- Equivalent pressure generated
  - Prospectively measured in 71 women
  - AUC was calculated as estimate of contractility
  - Comparable across normal weight (n=40), overweight (n=14) and obese women (n=14)

Buhimschi CS Obstet Gynecol 2004
Does obesity alter the second stage of labor?

- All participants (n=71) delivered vaginally
- Univariate analysis demonstrated positive relationship between BMI and duration of labor
- Obese women labored longer during the first stage but had comparable second stage duration

Buhimschi CS Obstet Gynecol 2004
Does labor length vary by maternal age?

- Yes
- Greenberg MB
- Retrospective cohort study
- Term, laboring, singleton gestations
- UCSF, 1980-2001
- 31,976 births
- Multivariate analysis
- Age >39, longer labor and prolonged labor as compared to younger women

Greenberg MB and Caughey AB, AJOG, 2007
Does CLE slow labor down?

- Wong CA (2005)
- Compared cesarean risk with early v. late CLE
- 750 nulliparas, at term, spontaneous labor/ROM
- Women were randomized to early neuraxial analgesia (intrathecal fentanyl) at first pain request with SVE < 4 cm versus iv/im hydromorphone
- Epidural analgesia was initiated at second request in early group and at 4 cm in systemic analgesia group or 3rd request

Wong CA NEJM 2005
Does CLE slow labor down?

- No difference in rate of cesarean
  - 17.8% after intrathecal versus 20.7% after systemic analgesia
- Interestingly….duration of labor was *shorter* in early CLE group
  - 295 minutes vs. 385 minutes, P <0.001, respectively
- AND, time to vaginal delivery was shorter
  - 398 minutes vs. 479 minutes, P <0.001
- Apgars <7 occurred less frequently in early CLE group (P<0.01)

Wong CA NEJM 2005
Does CLE slow labor down?

- May depend upon the CLE
  - Study used intrathecal fentanyl followed by PCA of dilute bupivacaine/fentanyl solution
  - Minimal motor blockade
  - May not be generalizable to all neuraxial analgesia
- Raises possibility of early neuraxial analgesia in the setting of spontaneous labor
  - Improved pain control
- Request for early analgesia independent risk factor for cesarean delivery

Wong CA NEJM 2005
How about with IOL?

- Wong CA (2009)
- 806 nullipara with IOL
- SVE < 4cm, randomized to early CLE v. late
- Same analgesic regimen as previous study
- Primary outcome cesarean delivery rate

Wong CA, Obstet Gynecol 2009
How about with IOL?

- No difference in cesarean delivery rate
- 32.7% (early) versus 31.5% (late), $P>0.05$
- No difference in operative delivery or Apgars
- Improved pain relief AND shorter labor in early group
- 528 minutes (early) and 569 minutes (late), $P=0.047$

Wong CA, Obstet Gynecol 2009
Early CLE

- May be beneficial in both spontaneously laboring women and IOL
- Again, may depend upon the type of CLE provided and the patient population
- Level I evidence, reproducible in subsequent study
IOL

- In 2006, IOL occurred in 22.5% of all births
  - National Center for Health Statistics; 2009
- Essentially doubles the cesarean delivery risk
  - Nulliparous women, at term
    - Ehrenthal DB, Obstet Gynecol 2010
What constitutes a failed IOL?

36 year old nulliparous women present to L&D at 41 0/7 week for scheduled IOL
Cervix is 1 cm dilated, long, firm, posterior
She receives 25 mcg of cytotec and 4 hours later is 2 cm dilated, with contractions every 2-3 minutes
Membranes are ruptured at this time
Oxytocin is initiated when her contractions peter out
What constituted failed IOL?

She continues to contract every 2-3 minutes without cervical change. She asks how long you will let her go on without cervical change

- A. 6 hours from ROM
- B. 12 hours from ROM
- C. 24 hours from ROM
- D. Will wait and see
IOL

- No established definition of “failed IOL”
- ACOG suggests that “allowing at least 12-18 hours of latent labor before diagnosing a failed induction may reduce the risk of cesarean delivery.”
  - ACOG Practice Bulletin No. 107, Obstet Gynecol 2009
Failed Labor Induction: Toward an Objective Diagnosis.
Rouse, Dwight; Weiner, Steven; Bloom, Steven; Varner, Michael; Spong, Catherine; Ramin, Susan; Caritis, Steve; Grobman, William; Sorokin, Yoram; Sciscione, Anthony; Carpenter, Marshall; Mercer, Brian; Thorp, John; Malone, Fergal; Harper, Margaret; MD, MS; Iams, Jay; Anderson, Garland

DOI: 10.1097/AOG.0b013e318207887a

<table>
<thead>
<tr>
<th>Time Since Start of Oxytocin With Ruptured Membranes</th>
<th>Labor Status at End of Interval (for Those Who Started Interval in the Latent Phase)</th>
<th>Eventual Delivery Route</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Vaginal</td>
</tr>
<tr>
<td>0 to less than 3 h</td>
<td>Achieved active phase</td>
<td>425/1,347 (31.6)</td>
</tr>
<tr>
<td></td>
<td>Remain in latent phase</td>
<td>918/1,347 (68.2)</td>
</tr>
<tr>
<td></td>
<td>Were delivered in latent phase</td>
<td>4/1,347 (0.3)</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>851/1,347 (63.2)</td>
</tr>
<tr>
<td>3 to less than 6 h</td>
<td>Achieved active phase</td>
<td>506/918 (55.1)</td>
</tr>
<tr>
<td></td>
<td>Remain in latent phase</td>
<td>408/918 (44.4)</td>
</tr>
<tr>
<td></td>
<td>Were delivered in latent phase</td>
<td>4/918 (0.4)</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>547/918 (59.6)</td>
</tr>
<tr>
<td>6 to less than 9 h</td>
<td>Achieved active phase</td>
<td>235/408 (57.6)</td>
</tr>
<tr>
<td></td>
<td>Remain in latent phase</td>
<td>162/408 (39.7)</td>
</tr>
<tr>
<td></td>
<td>Were delivered in latent phase</td>
<td>11/408 (2.7)</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>207/408 (50.7)</td>
</tr>
<tr>
<td>9 to less than 12 h</td>
<td>Achieved active phase</td>
<td>76/162 (46.9)</td>
</tr>
<tr>
<td></td>
<td>Remain in latent phase</td>
<td>71/162 (43.8)</td>
</tr>
<tr>
<td></td>
<td>Were delivered in latent phase</td>
<td>15/162 (9.3)</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>64/162 (39.3)</td>
</tr>
<tr>
<td>12 or more h</td>
<td>Achieved active phase</td>
<td>48/71 (67.6)</td>
</tr>
<tr>
<td></td>
<td>Were delivered in latent phase</td>
<td>23/71 (32.4)</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>28/71 (39.4)</td>
</tr>
</tbody>
</table>

Data are proportions (%).

28/71 (39.4%) delivered vaginally with 12 hours or more in latent phase
Failed IOL

- With each additional hour, increased risks:
  - chorioamnionitis (OR 1.12, CI 1.07-1.17)
  - uterine atony (OR 1.13, CI 1.06, 1.19)

- Neonatal outcomes not related to duration of latent phase
Reassessing the labor curve

- May be important to alter our definition of a normal curve
  - Slower, more gradual curve
  - More forgiving of our obese/older patients
- Change our definition of arrest
  - 4-6 hours in first stage
  - No limit in the second stage
- Allow for longer latency periods in our IOL
Thank you.