



# Normal Labor

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# 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

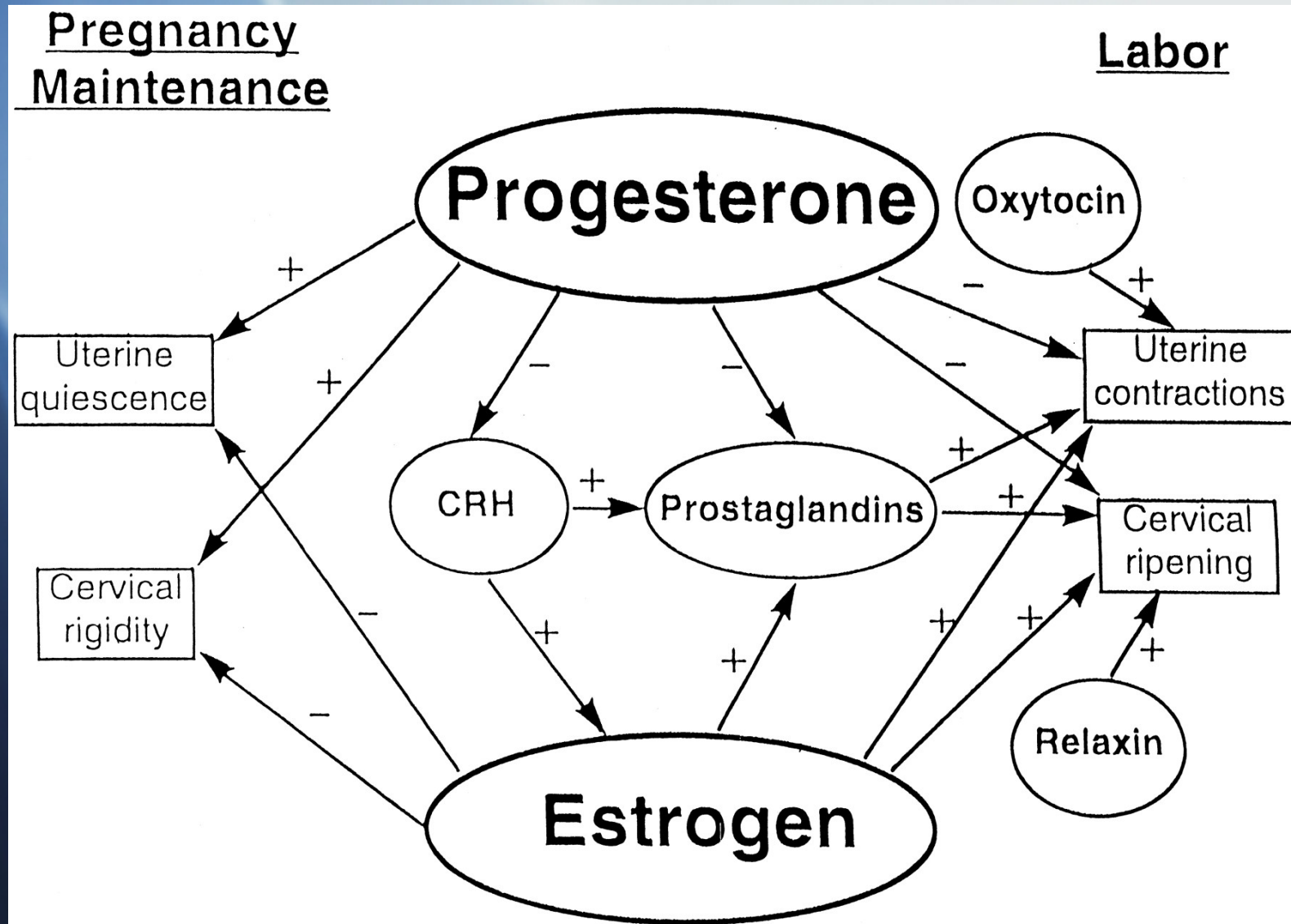
# Physiology of Labor

- 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.



Weiss G JCEM 2000;85:4421-4425

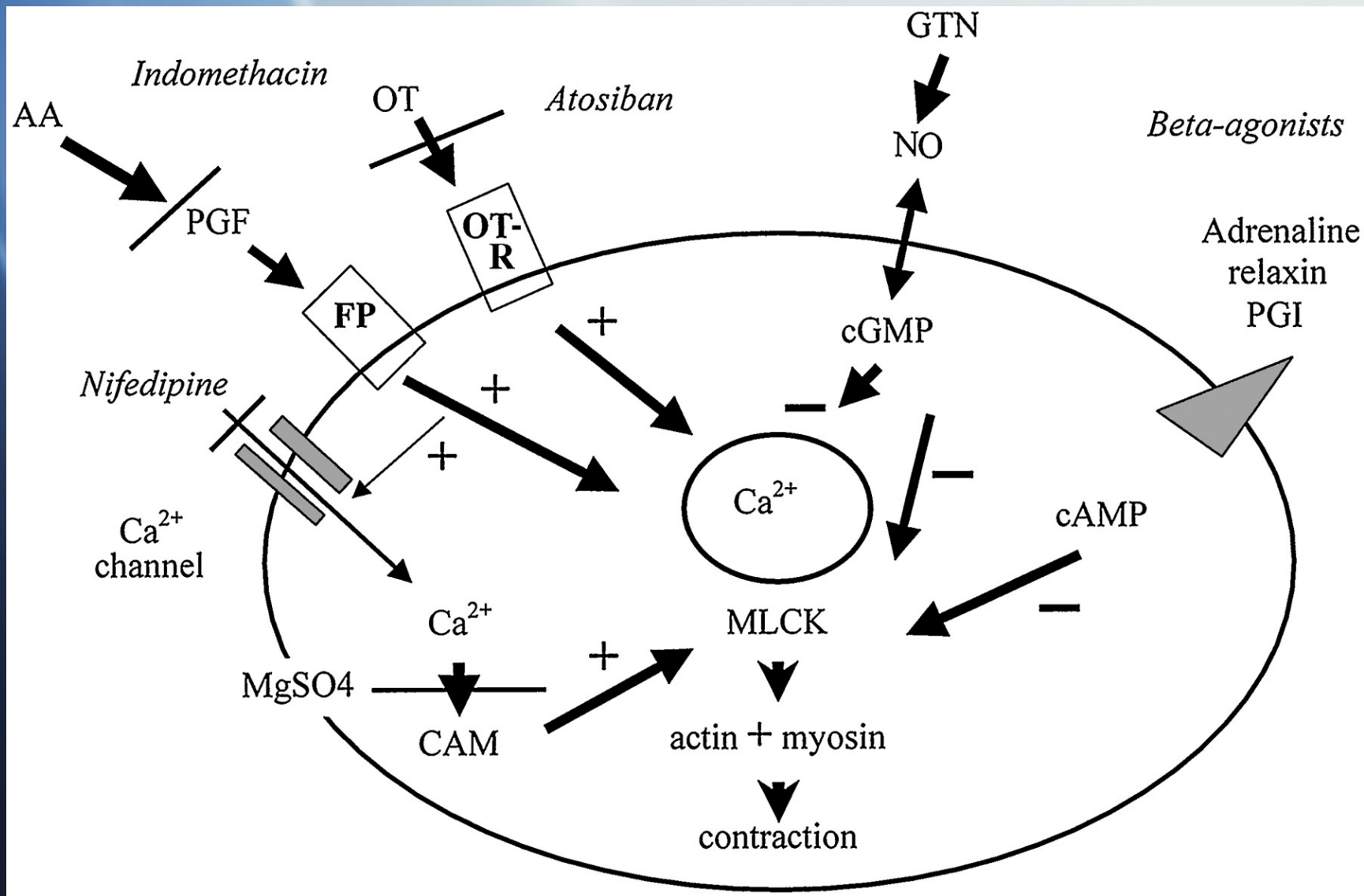
# Phases of Myometrial Activity

- 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, arachadonic acid; PGF, prostaglandin F

Challis J R et al. *Endocrine Reviews* 2000;21:514-550

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**ENDOCRINE  
REVIEWS**

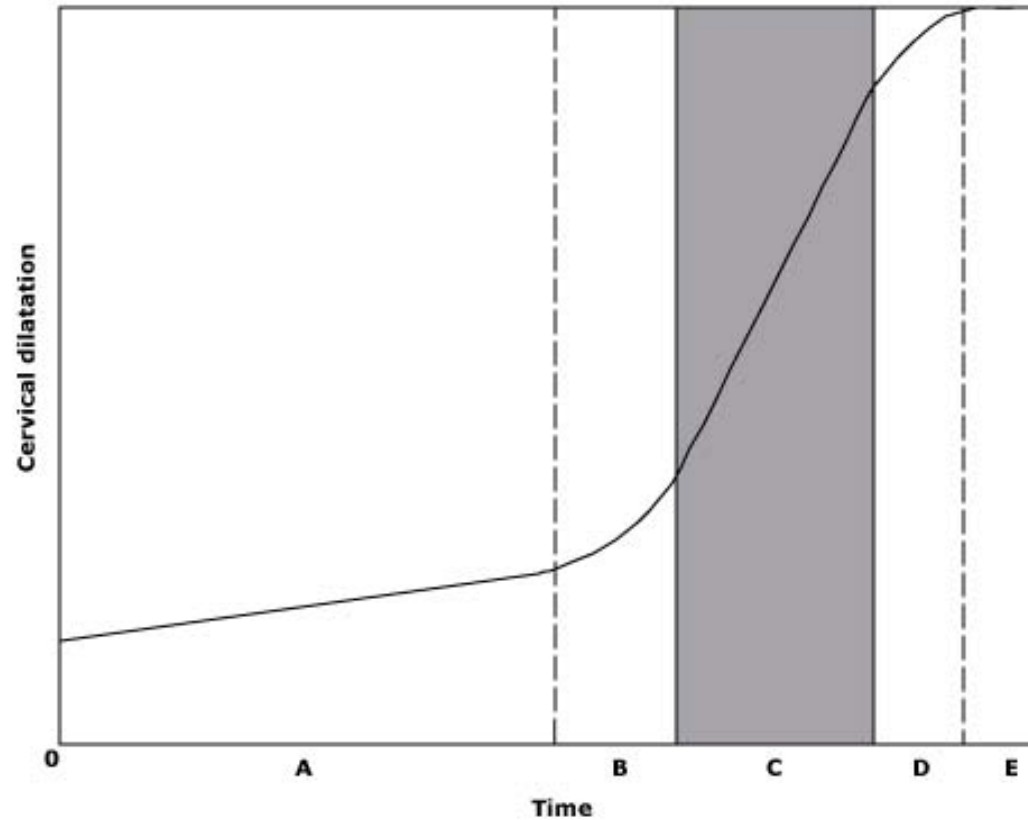


# Phases of Myometrial Activity

- Phase 3
- Involution
- After delivery
- Mediated by oxytocin

## Progress of labor curve

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First stage = A + B + C + D where A=latent phase; B=acceleration phase;  
C=phase of maximum slope; D=deceleration phase

Second stage = E

*Adapted from: Friedman. Labor: Clinical evaluation and management, 2nd ed,  
Appleton, New York 1978.*

Initially described in 1954

## Diagnostic criteria for abnormal patterns in active labor

Labor pattern	Nullipara	Multipara
<b>First stage</b>		
Duration (no anesthesia)	16.6 hours	12.5 hours
Duration (anesthesia)	19.0 hours	14.9 hours
Protracted dilation	<1.2 cm/h	<1.5 cm/h
Arrested dilation	>2 h	>2 h
<b>Second stage</b>		
Duration (no anesthesia)	132 minutes	61 minutes
Duration (anesthesia)	185 minutes	131 minutes
Arrest of descent (epidural)	>3 h	>2 h
Arrest of descent (no epidural)	>2 h	>1 h

Values represent approximately two standard deviations from the mean.

*Data compiled from: Kilpatrick SJ, Laros, RK. Obstet gynecol 1989; 74:85 and Friedman, EA, ed. Labor clinical evaluation and management. 2nd ed New York. Appleton-Century — Crofts, 1978 and American College of Obstetrics and Gynecology Committee on Practice Bulletins-Obstetrics. ACOG Practice Bulletin Number 49, December 2003: Dystocia and augmentation of labor. Obstet Gynecol 2003; 102:1445.*

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

# 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

# Reassessing the labor curve

Zhang J

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

# 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



# Reassessing the labor curve

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

# 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

# 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!

# 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

# How long is too long for the second stage?

- Spontaneous delivery rates
  - 85% < 1 hour
  - 9%  $\geq$  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



# 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

# 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/m <sup>2</sup> )	6.2 hours
■ Overweight (26.1-29.0 kg/m <sup>2</sup> )	7.5 hours
■ Obese (>29.1 kg/m <sup>2</sup> )	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)

# 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

# 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

# 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

# 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 ( $P < 0.01$ )



# 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

# 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

# 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),  $P = 0.047$

# 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% 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 0/7week 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 12-18hours 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

Obstetrics & Gynecology. 117(2, Part 1):267-272, February 2011.  
DOI: 10.1097/AOG.0b013e318207887a

**Table 2. Length of Latent Phase and Delivery Mode**

Time Since Start of Oxytocin With Ruptured Membranes	Labor Status at End of Interval (for Those Who Started Interval in the Latent Phase)	Eventual Delivery Route	
		Vaginal	Cesarean
0 to less than 3 h	Achieved active phase	425/1,347 (31.6)	121/425 (28.5)
	Remain in latent phase	918/1,347 (68.2)	371/918 (40.4)
	Were delivered in latent phase	4/1,347 (0.3)	4/4 (100)
	Overall	851/1,347 (63.2)	496/1,347 (36.8)
3 to less than 6 h	Achieved active phase	506/918 (55.1)	166/506 (32.8)
	Remain in latent phase	408/918 (44.4)	201/408 (49.3)
	Were delivered in latent phase	4/918 (0.4)	4/4 (100)
	Overall	547/918 (59.6)	371/918 (40.4)
6 to less than 9 h	Achieved active phase	235/408 (57.6)	92/235 (39.1)
	Remain in latent phase	162/408 (39.7)	98/161 (60.5)
	Were delivered in latent phase	11/408 (2.7)	11/11 (100)
	Overall	207/408 (50.7)	200/408 (49.3)
9 to less than 12 h	Achieved active phase	76/162 (46.9)	40/76 (52.6)
	Remain in latent phase	71/162 (43.8)	43/71 (60.6)
	Were delivered in latent phase	15/162 (9.3)	15/15 (100)
	Overall	64/162 (39.5)	98/162 (60.5)
12 or more h	Achieved active phase	48/71 (67.6)	20/48 (41.7)
	Were delivered in latent phase	23/71 (32.4)	23/23 (100)
	Overall	28/71 (39.4)	43/71 (60.6)

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

The background features a gradient from dark blue on the left to light blue on the right, with several bright, diagonal, glowing lines crossing the frame.

Thank you.