Faculty Disclosure

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Dr. Wobser has listed no financial interest/arrangement that would be considered a conflict of interest.

Current Methods of Induction of labor

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Induction of Labor

Labor induction — also known as inducing labor — is a procedure used to stimulate uterine contractions during pregnancy before labor begins on its own. Successful labor induction leads to a vaginal birth.

History of labor induction

- Hippocrates' original descriptions of mammary stimulation and mechanical dilation of the cervical canal
- During the second century AD, Soranus practiced a combination of procedures to induce labor, including artificial rupture of the membranes
- Moshion was the first to describe manual dilation of the cervix, and Casis invented several instruments capable of cervical dilation.
- In 1756, at a meeting held in London, physicians discussed the efficacy and ethics of early delivery by rupturing the membranes to induce labor

Danman T. An Introduction to the Practice of Midwifery. London, J. Johnson, 1794
History of labor induction

- In 1810, James was the first in the United States to utilize amniotomy to induce premature labor.

- Amniotomy and other mechanical methods remained the methods of labor induction most commonly employed until the 20th century.


History of labor induction

- In 1906, Dale observed that extracts from the infundibular lobe of the pituitary gland caused myometrial contractions.

- In 1909, Bell reported the first experience with use of a pituitary extract for labor induction.


History of labor induction

- In 1943, Page suggested that the pituitary extract oxytocin be given in the form of an intravenous infusion.

- Theobald reported his initial results with this form of administration.

- In 1953, the structural of oxytocin was discovered, and synthetic oxytocin has been in use since 1955.


History of labor induction

- In 1968, Karim and colleagues were the first to report the use of prostaglandins for labor induction.

- In 1993, the synthetic prostaglandin analogue misoprostol was shown to be effective and safe in induction of labor.

- Since then, the use of prostaglandins, in different varieties and forms of administration, has become a common method of labor induction.


Stages of Labor

![Diagram showing stages of labor]

Stages of Labor

![Comical cartoon panels depicting stages of labor]
Method of Induction

- Administration of oxytocin by far the most common method of labor induction
- Less successful in women with an "unfavorable " cervix
- Because of this, a ripening process is used prior to administration of oxytocin

Predictors of Success

- Cervical status is the best predictor of success
- In 1964 Bishop introduced an objective measure to predict the likelihood of a successful induction
- 5 Factors:
  - Effacement
  - Dilation
  - Station
  - Consistency
  - Position

Predictors of Success

Score vs cesarean rate for failed induction (1985/1997):

<table>
<thead>
<tr>
<th>Score</th>
<th>Nulliparous</th>
<th>Multiparous</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>45 / 34%</td>
<td>7.7 / 23%</td>
</tr>
<tr>
<td>4-6</td>
<td>10%</td>
<td>3.9%</td>
</tr>
<tr>
<td>7-10</td>
<td>1.4%</td>
<td>0.9%</td>
</tr>
</tbody>
</table>


Cervical remodeling

- Cervical ripening is a complex process that results in physical softening and distensibility of the cervix, ultimately leading to partial cervical effacement and dilatation.

- Remodeling of the cervix involves enzymatic dissolution of collagen fibrils, increase in water content, and chemical changes. These changes are induced by hormones (estrogen, progesterone, relaxin), as well as cytokines, prostaglandins, and nitric oxide synthesis enzymes.
Cervical remodeling

Methods for Cervical Ripening

- 3 general techniques exist for ripening the cervix:
  - Mechanical interventions
  - Cervical ripening agents
  - Oxytocin
Prostaglandins

- Preferred method in unscarred uterus
  - Associated with greater success than induction with oxytocin
  - Causes contractions reducing need for oxytocin
  - Easier to insert than a balloon catheter


Evidence of Efficacy

- Cochrane review comparing use of placebo/no treatment to use of PGE2 resulted in a:
  - Lower risk of unfavorable cervix after 12-24 hours (RR 0.46, 95% CI 0.35-0.62, 5 trials, 467 women)
  - Lower need for oxytocin (RR 0.46, 95% CI 0.73-0.94, 12 trials, 1321 women)
  - Lower rate of failing to achieve vaginal delivery within 24 hours (RR 0.19, 95% CI 0.14-0.25, 2 trials, 384 women)
  - Reduced rate of cesarean section (RR 0.89 95% CI 0.79-1.00, 34 trials 6399 women)

Contraindications and side effects

Contraindications:
Scarred uterus

Side effects:
Tachysystole, fever, chills, vomiting, and diarrhea. Depends on type, route of administration and dose.

Prostaglandin E2
Cervadil (PGE2)

- Vaginal insert containing 10 mg of Dinoprostone in a time release formulation
- Released at 0.3mg/hr. Left in place until labor begins or 12 hrs
- Oxytocin may be administered 30 minutes after removal of insert

Prepadil (PGE2)
Prepadil (PGE2)

- 0.5mg Dinoprostone in 2.5ml gel
- Intracervical administration
- Repeat in 6-12 hrs if required
- Maximum of 1.5mg (3 doses) in 24 hour period
- May initiate oxytocin 6-12 hrs after last dose

Prostaglandin E1 (Cytotec)
Vaginal Cytotec (PGE1) use

- Compared to placebo/no treatment it significantly improved rate of vaginal delivery within 24 hrs (not achieved RR 0.40, 95% CI 0.22-0.70, 2 trial, 112 women) and cervical ripening (unfavorable after 12-24 hrs: RR 0.40, 95% CI 0.01-0.64; 2 trials, 107 women)

Vaginal Cytotec (PGE1) use

- Given vaginally more effective than other prostaglandins. RR of failing to achieve vaginal delivery in 24 hrs 0.78, 95% CI 0.67-0.91; 8 trial, 1995 women

- Oxytocin used less often than with other prostaglandins. (RR 0.69, 95% CI 0.56-0.86, 10 trials, 2276 women)
(Vaginal Cytotec PGE1) use

- Cytotec more effective than oxytocin in:
  - Achieving vaginal delivery within 24 hrs (RR of failure 0.53; 95% CI 0.33-0.84; 1 trial 140 women)
  - Reducing cesarean section rate (RR 0.58, 95% CI 0.37-0.90; 5 trial, 736 women)

Vaginal Cytotec (PGE1) use

- But...
  - Tachysystole more common with cytotec than oxytocin (3X), or balloon catheter (3X)
  - Tachysystole with fetal heart rate changes not increased
  - No clear differences between drugs in perinatal or maternal adverse outcomes
Vaginal Cytotec (PGE1) use

- Optimal dosing not clear
  - Prudent to use 25mcg q3-6 hrs
  - 50mcg dose may be appropriate in cases with lower uterine activity, but associated with higher rates of tachysystole
  - Oxytocin may be administered 4 hrs after final dose

Oral Cytotec (PGE1) use

- Easily administered and effective, but comparison with vaginal use difficult

Sublingual Cytotec (PGE1) use

- Similar efficacy to oral at half the dose
- Similar in efficacy to vaginal cytotec

Mechanical methods

- Foley catheter
- Double balloon catheter
Balloon Catheter

- Large Foley may be more effective than small
- Double balloon equivalent to Foley

Evidence of Efficacy

- As effective as prostaglandins for cervical ripening
- Compared to prostaglandins, a catheter resulted in:
  - Higher rate of oxytocin administration (RR 1.51)
  - Less likely to achieve vaginal delivery within 24 hrs (RR 1.26)
  - Similar rate of cesarean delivery (RR 1.01)
  - Similar rate of failure to ripen cervix after 12-24 hrs (RR 0.96)
  - Main advantage decreased rate of tachysystole (RR 0.19)
Side Effects of Balloon

- Could increase risk of infectious morbidity
- Cochrane Database review studies excluded women with ruptured membranes

Balloon Catheter with Prostaglandins

- The combination resulted in fewer cervixes that were unfavorable/unchanged after 12-24 hrs (RR 0.46, 95% CI 0.32-0.65; 2 trials, 698 women).
- Also resulted in fewer failures to achieve vaginal deliveries within 24 hrs (RR 0.45, 95% CI 0.28-0.71; 3 trials, 1295 women).
- Similar cesarean rate (RR 0.92 95%, CI 0.79-1.08; 8 trials, 1295 women).
Extraamniotic Saline Infusion

- Not hard—It’s EASI
- Saline infused through catheter port.
- Popular 15 years ago. No benefits noted over either balloon alone or prostaglandins

Hygroscopic dilators

- Laminaria tents of natural seaweed placed into cervix
- Dilapan-S similar but a synthetic product
Hygroscopic dilators

- Used primarily for pregnancy termination
- Meta analysis showed No difference in cesarean rates with their use

Amniotomy

- In Cochrane Database review, oxytocin use with amniotomy more efficacious than amniotomy alone, with fewer women undelivered after 24 hrs (RR 0.13 95%, CI 0.14-0.41)
- Unknown if amniotomy and oxytocin more effective than oxytocin alone
Sweeping Membranes

- Increased the likelihood of spontaneous labor with 48 hrs (RR of failure 0.77 95% CI 0.70-0.84)
- Increased likelihood of delivery within 1 week (RR of failure 0.71 95% CI 0.65-0.78)
- Compared to no intervention, it decreased the likelihood of gestation continuing beyond 41 weeks (RR 0.59) and 42 weeks (RR 0.28)
- Reduced frequency of formal induction (RR 0.72 95% CI 0.52-1.00)

Sweeping Membranes

- One small study evaluated GBS colonization associated with sweeping
  - No additional risk but too small to exclude an effect
  - No large study specifically evaluated safety of stripping membranes in known carriers of GBS
Oxytocin in Labor

- A nonapeptide of 9 amino acids
- Produced in the hypothalamus and secreted by the posterior lobe of the pituitary
- “Love” hormone

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Oxytocin in Labor

- Uterus first sensitive to oxytocin at 20 weeks
- Increases with gestational age to 34 weeks
- Once labor begins, the uterine sensitivity increases rapidly
Oxytocin in Labor

- Administered iv

- A common practice is to dilute 60 U of oxytocin in 1 liter crystalloid
- Dose is typically titrated to 200-300 Montevideo units

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Oxytocin in Labor

- Low dose protocol:
  - Start at 1 mU/min and increase by 1mU/min at 40 minute intervals
  - Based on reaching steady state concentrations in 40 minutes
  - Uterus will reach maximum response from each level before an increase
  - Mimics a physiologic approach
Oxytocin in Labor

- High dose protocol:
  - Active management of labor regimens use a higher starting rate and shorter intervals until the next increase.
  - An example would be starting at 6mU/min and increasing at 6mU/min q15 minutes.
  - Most common complication is tachysystole.

Complications of Oxytocin

- Tachysystole (>5 ctx q10 minutes averaged over 30 minutes)
- Hyperstimulation (tachysystole with feal heart rate changes)
Complications of Oxytocin

Management:
- Discontinue IV drip
- Left lateral position
- 10 liters oxygen by non-rebreather
- Fluid bolus 500cc crystalloid
- Terbutaline 0.25mg SQ q 30 minutes
- Atosiban 6.75mg IV over 1 minute
- Nitroglycerine 60-90mcg IV

Complications of Oxytocin

- Uterine rupture
- Amniotic Fluid Embolism
- Hyponatremia
- Hypotension
Vaginal Birth After Cesarean Section

- Review of pooled data showed showed higher rate of rupture with induction vs spontaneous labor (OR 6.15 95% CI 0.74-51.4)
- A well designed large prospective study not included showed an OR of 2.86, 95% CI 1.75-4.67. Absolute risks of rupture were 1% with induction, 0.4% with spontaneous labor

Vaginal Birth after Cesarean Section

- Largest study to evaluate rupture by labor status (17,898 TOLs, 15,801 ERCDs) showed IOL with oxytocin alone had a OR 3.01, 95% CI 1.66-5.08) vs rupture in spontaneous labor
- Rupture by category:
  - ERCD w/o labor, 0
  - Spontaneous labor, 4 per 1000
  - IOL with oxytocin alone, 11 per 1000
  - IOL with balloon with or without oxytocin, 9 per 1000
  - IOL prostins with or without oxytocin, 14 per 1000
Vaginal Birth after Cesarean Section

- A population based Cohort study looked at 20,095 women whose second child was a VBAC. Rate of rupture by category was:
  - ERCD without labor, 1.6 per 1,000
  - Spontaneous labor, 5.2 per 1,000
  - Labor induced without prostins, 7.7 per 1,000
  - IOL with prostins, 24.5 per 1,000

Questions?