Preterm Labour

Preterm labour is the onset of labour between 20 and 37 weeks of gestational age; it is more commonly associated with the need for operative delivery, and places the neonate at increased risk of morbidity and mortality.

ANESTHETIC CONSIDERATIONS:

- Anesthetic considerations for the parturient
- Tocolytic drugs – maternal-fetal side-effects
  - interactions with anesthetic agents
- Increased incidence of c-section
- Increased neonatal morbidity and mortality – related to complications of prematurity

ANESTHETIC GOALS:

- For vaginal delivery – early epidural insertion to inhibit maternal pushing before complete cervical dilation in malpresentations, relax pelvic muscles for controlled delivery of infant's vulnerable head, and prevent precipitous delivery with its risk of neonatal ICH.
- For c-section – minimize depressant effects of analgesic and anesthetic agents on the immature fetus – neuraxial techniques preferred over GA.
- Ensure NICU availability.

DEFINITIONS

1. Premature rupture of membranges (PROM)
   - Rupture of membranes prior to the onset of labour
   - PPROM = preterm PROM
2. Preterm labour (PTL)
   - 3 criteria for Dx
     - Gestational age (GA) 20-37 wks
     - Established labour
       - ≥4 uterine contractions in 20 min or ≥8 uterine contractions in 60 min
       - Change in cervical dilation or effacement, cervical dilation >2cm, cervical effacement >80%
3. Preterm infant
   - Infant delivered between 20-37 wks gestational age.
4. Small for gestational age
   - Low birth weight infant – weight <2500g at birth
   - Very low birth weight infant – weight <1500g at birth
   - Extremely low birth weight infant – weight <1000g at birth

HISTORY

- Obstetrical
  - Hx of current and previous pregnancies
  - Risk factors for PTL
    - Demographics
      - Non-caucasian
      - Extremes of age (<17 or >35 yrs)
      - Low socioeconomic status
      - Low BMI
    - PMHx
      - Systemic disease (acute or chronic)
      - Abdominal surgery during pregnancy
      - Trauma
      - Substance use (tobacco, street drugs)
      - Physical and/or psychological stress (controversial)
    - Obstetric
      - Hx of preterm delivery
      - Interpregnancy interval <6 mo
      - Abnormal uterine/cervical anatomy
      - Assisted reproductive technologies
      - Uterine distension – multiple gestation, polyhydramnios
      - Abnormal placentation
      - Vaginal bleeding
      - PPROM
      - Infection (systemic or genital tract)
    - Fetal
      - Genetic abnormalities
      - Fetal death
- PMHx
  - Conditions contraindicating tocolytic agents (see Table below)
- PSHx/Anesthesia Hx
  - Gyne surgery
  - Surgery during pregnancy
- Medications

- Allergies
- Last meal

PHYSICAL

- Vital signs
  - Mother
  - Fetus
- Airway
- Cardiopulmonary
- OB
  - Cervical speculum to R/O PPROM
- MSK

INVESTIGATIONS

- **Labs**
- **Imaging**
  - Fetal U/S
- **FHR monitoring**
  - See 'Anesthesia Considerations for the Pregnant Patient'
  - Higher baseline HR if < 34wks GA or β2-agonist tocolysis, lower variability
- **Amniocentesis**
  - Documentation of fetal lung maturity, identify infection

OPTIMIZATION

- **Tocolytic therapy**
  - Indications – GA 20-34 wks, reassuring fetal status, no evidence of infection
  - Contraindications – fetal death, fetal anomalies incompatible with life, nonreassuring fetal status, chorioamnionitis or fever of unknown origin, severe hemorrhage, severe HTN
  - Benefits – may prolong pregnancy by 2-7 days
    - Allow time for corticosteroids (fetal lung maturity), antibiotics (maternal GBS infection), fetal resuscitation, transfer to a tertiary care facility
  - Risks – maternal/fetal sepsis, side-effects of tocolytic drugs, deterioration of compromised fetus
  - Efficacy – all of the following have some evidence for prolongation of pregnancy although none improve neonatal morbidity or mortality

Drug	Contraindications	Maternal side-effects	Fetal/Neonatal side-effects	Evidence
CCBs - Nifedipine	Cardiac disease Renal disease (caution) Maternal hypotension Concomitant MgSO4	Transient hypotension Flushing HA Dizziness Nausea	None	More effective than β2-agonists Fewest side-effects
NSAIDs - Indomethacin - Ketorolac - Sulindac	NSAID-sensitive asthma Active PUD Significant renal/hepatic impairment Coagulation disorder Thrombocytopenia	Nausea Dyspepsia	IVH Constriction of DA Pulmonary HTN Hyperbilirubinemia NEC (controversial) Reversible renal dysfunction (→ polyhydramnios)	Greatest risk of harm to fetus
β2-agonists - Terbualine - Ritodrine	Cardiac arrhythmias Poorly controlled thyroid disease Poorly controlled DM	Tachycardia Arrhythmias Myocardial ischemia Pulmonary edema Hypotension Hyperglycemia Hyperinsulinemia Hypokalemia Na/H2O retention Altered thyroid fxn Tremor Palpitations Anxiety Nausea/vomiting Fever Hallucinations	*Fetal:* Tachycardia Myocardial hypertrophy Myocardial ischemia Hyperinsulinemia Hyperglycemia *Neonatal:* IVH Tachycardia Hypotension Hypoglycemia Hypocalcemia Hyperbilirubinemia	Greatest risk of harm to mother Desensitization with prolonged use
MgSO4	Myasthenia gravis Myotonic dystrophy Renal dysfunction (caution)	Hypotension Palpitations Pulmonary edema Flushing Lethargy HA Muscle weakness Diplopia Dry mouth	Lethargy Hypotonia Respiratory depression Demineralization	Not efficacious May cause harm

		Pulmonary edema Cardiac arrest		
Nitroglycerine		Hypotension HA Flushing		Controversial
Ethanol				No longer indicated
Oxytocin receptor antagonists - Atosiban		Few side-effects	Few side-effects	May be effective Available in Europe

- **Antenatal corticosteroids**
  - Indications – GA 20-34 wks at risk for preterm delivery
  - Benefits – ↓risk of RDS, IVH, neonatal death
  - Risks
  - Drugs – single course of betamethasone or dexamethasone
    - Betamethasone – 12mg IM q24h x 2 doses
    - Dexamethasone 6mg IM q12h x 4 doses
- **Antibiotics**
  - Indications – PPROM (ie: *not* indicated if membranes intact and no other identified infection)
  - Drugs – ampicillin + erythromycin x 48 hrs followed by amoxicillin + erythromycin x 5 days

SETTINGS WHERE ANESTHESIA REQUIRED IN PTL

- Failed tocolysis
- Cervical cerclage
- Uterine relaxation during fetal resuscitation (UPP occurs during uterine relaxation)
- External cephalic version

ANESTHETIC OPTIONS

- Vaginal delivery
  - Epidural – technique of choice
    - ↓Premature maternal pushing and precipitous delivery of vulnerable fetal head
    - ↓Catecholamines → improve uteroplacental perfusion
  - Spinal – if delivery imminent
  - CSE – problems include fetal bradycardia with intrathecal opioid, delayed confirmation of epidural placement disadvantage if urgent c-section required, associated with risk of meningitis
- C-section
  - GA – avoid if possible
    - Immature fetus even more vulnerable to depressant effects of GA
    - Long-term effects of GA agents on immature brain controversial
  - Epidural/spinal – preferred

ANESTHETIC SETUP

- IV access
- Routine monitors
- Emergency drugs
- GA backup

MANAGEMENT OF NEURAXIAL ANESTHESIA FOR VAGINAL DELIVERY

- **Timing of epidural in PTL problematic**
  - Longer latent phase
  - Patient with failed tocolysis may be in advanced labour
  - Preterm infant delivery can occur with less cervical dilation
- **Induction**
  - Early epidural placement if at risk for failed tocolysis
  - NSAIDs not a contraindication to neuraxial anesthesia
- **Maintenance**
  - Preterm infants not as vulnerable to effects of LA as originally thought (unless asphyxia/acidosis present)

MANAGEMENT OF GENERAL ANESTHESIA FOR C-SECTION

- **Outcome data**
  - Routine c-section in PTL does *not* improve neonatal survival beyond 6 days, and ↑s maternal risk in subsequent pregnancies, although may ↓risk of neonatal IVH compared to vaginal delivery
- **Interactions between tocolytics and GA drugs**
  - CCBs
    - Vasodilation, hypotension, myocardial depression, conduction defects, and greater uterine atony/PPH when combined with volatile agents
  - β2-agonists
    - Greater vasodilation, hypotension, tachycardia when combined with volatile agents
    - Avoid agents which exacerbate tachycardia (anticholinergics, pancuronium, ephedrine)
    - Avoid agents which sensitize heart to catecholamines (halothane)

        - Avoid exacerbating hypokalemia (hyperventilation)
        - Shorter onset/recovery from Sux
    - MgSO4
        - Decrease in MAC of volatile agents
        - Greater vasodilation and hypotension when combined with volatile agents
        - Potentiates depolarizing and non-depolarizing neuromuscular blockade – avoid defasciculating dose, use lower dose, monitor with nerve stimulator

DISPOSITION & MONITORING

- **Analgesia**
- **Oxygenation**
- **Positioning**
- **Monitoring**

COMPLICATIONS

- **Neonatal morbidity**
    - Short-term
        - Physiologically less adapted to withstand stress of L+D
            - ↓Hb and O2-carrying capacity
            - ↑Risk intrapartum acidosis and asphyxia
            - ↑Risk of c-section
        - More vulnerable to depressant effects of analgesic and anesthetic drugs
        - Abnormal presentation (eg: breech) more common
        - IVH, ROP, PDA, PHT, RDS, BPD, NEC, infection, hypoglycemia, acid-base disturbances, electrolyte abnormalities, anemia
        - NICU, mechanical ventilation, surfactant, ECMO
    - Long-term
        - CP, developmental delay, hearing loss, blindness, BPD, asthma, HTN, pulmonary HTN, impaired glucose regulation, FTT

(IVH – intraventricular hemorrhage; ROP – retinopathy of prematurity; PDA – patent ductus arteriosus; RDS – respiratory distress syndrome; BPD – bronchopulmonary dysplasia; NEC – necrotizing enterocolitis)

- **Neonatal mortality**
    - Correlates with gestational age (GA):
        - >32 wks GA: mortality <5%
        - 30 wks GA: mortality <10%
        - 26 wks GA: mortality 20%
        - 25 wks GA: mortality 25%
        - 24 wks GA: mortality 50%
        - 23 wks GA: mortality 70%
        - 22 wks GA: mortality 79%
        - 21 wks GA: mortality 100%

PATHOPHYSIOLOGY

- **Epidemiology**
    - Incidence of pre-term delivery (U.S.) – 13%
    - Only 20% of women evaluated for PTL have pre-term delivery

- **Uterine physiology**
    - Myometrium
        - Smooth muscle contraction – actin/myosin, MLCK, calcium signaling, ATP
        - Contains pacemaker cells with spontaneous activity
    - Quiescent phase
        - Various endocrine factors inhibit contraction (eg: progesterone, prostacyclin, relaxin, NO, PTHrp, CRH, hPL, CGRP, adrenomedullin, VIP)
    - Activation phase
        - Before term, uterotropins (eg: estrogen) activate expression of oxytocin receptors, PG receptors, ion channels, connexin levels
    - Stimulation phase
        - Once activated, uterus can be stimulated to contract by uterotonins (eg: oxytocin, PGE2, PGF2α)
    - Involution
        - Uterus returns to baseline function post-partum

- **Pathophysiology of preterm labour**

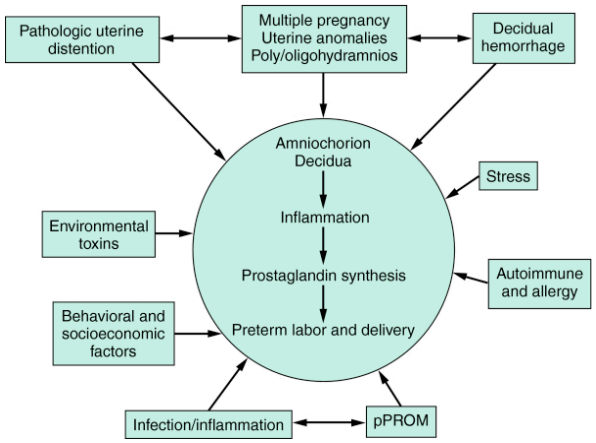

Fig 34-5 (Chestnut): Major etiologic factors in preterm birth, including activation of the maternal or fetal hypothalamic-pituitary axis (stress) resulting in increased ACTH/cortisol secretion, inflammation, decidual hemorrhage, and pathologic distention of the myometrium. The pathways are not mutually exclusive and may overlap, and they share a common biochemical pathway.

- **Predictors of PTL**
  - Home uterine activity monitoring – not useful
  - Biochemical (salivary estriol, cytokines, AFP, CRP) – low sensitivity and specificity
  - Positive fetal fibronectin, short cervical length – useful in symptomatic women
  - Bacterial vaginosis – controversial
  - Absence of fetal breathing movements

- **Prevention of PTL**
  - Prophylactic cervical cerclage – indicated if ≥3 unexplained T2 pregnancy losses or preterm deliveries; perform prior to 24 wks GA
  - Not indicated – prophylactic antibiotics, prophylactic B-agonists
  - Progesterone – investigational, controversial
  - Stress reduction
  - Nutritional supplements
- **Ethical issues in resuscitation of premature infants**
  - CPS and SOGC
    - GA < 22 wks – withhold resuscitation
    - GA 22-23 wks – resuscitation only if GA uncertain or with request of informed parents
    - GA 23-24 wks – consider resuscitation, reassess for need to withdraw therapy
    - GA 25 wks – full resuscitation in absence of lethal anomalies
  - AHA and AAP
    - GA < 23 wks or weight < 400g – resuscitation not indicated (few exceptions)

REFERENCES

- Chestnut Chpt 34