

Perinatal Monitoring

Arthur Jones, EdD, RRT

This Presentation is Approved for
1 CRCE Credit Hour

Learning Objectives

- > Describe common fetal risk factors & partum misadventures, including their consequences
- > Interpret findings from perinatal monitoring

Fetal Risk

Sources of Risk to Fetus

- > Parental sources
- > Endogenous sources
- > Peri-partum misadventures

Maternal Risk Sources

- > Age less than 16
 - ❖ Maternal problems
 - Immature uterus, cervix
 - Mother still growing - competes with fetus for resources
 - ❖ Risks
 - Stillbirth
 - Prematurity, low birthweight
 - Infant death

Maternal Risk Sources

- > Age greater than 35
 - ❖ Maternal problem - aging of germ cells → mutations
 - ❖ Risks
 - Chromosomal abnormalities, e.g. Down syndrome
 - Stillbirth
 - Cesarean section delivery

See links below for maternal age risk chart

Maternal Risk Sources

- > Grand multiparity: > 5 potentially viable infants
 - ❖ Diabetes
 - ❖ Breast cancer
 - ❖ Obstetrical complications - NOT
- > History of miscarriage (20% of pregnancies end in miscarriage)
 - ❖ Chromosomal abnormalities
 - ❖ Pre-eclampsia

Maternal Risk Sources

- > Rh incompatibility - erythroblastosis fetalis
 - ❖ Mom Rh negative, fetus Rh positive
 - ❖ Mom generates immunity to fetal blood
 - ❖ Prevented with Rhogam, if suspected
- > Mother born premature or small for gestational age (SGA) - risk for premature, small newborn

Maternal Risk Sources

- > Maternal obesity - risks
 - ❖ Difficult labor (dystocia)
 - ❖ Diagnostic barriers, e.g. imaging
 - ❖ Neural tube defects, e.g. spina bifida
 - ❖ Cardiovascular anomalies
 - ❖ Diabetes
 - ❖ Obesity - childhood, adulthood

FYI see links below for article on maternal obesity

Maternal Risk Sources

- > Infectious disease
 - ❖ Syphilis: rash, pneumonia
 - ❖ Toxoplasmosis: retardation, deafness
 - ❖ Rubella: retardation, deafness, blindness, seizures
 - ❖ Cytomegalovirus: prematurity, microcephaly, blindness, pneumonitis
 - ❖ Herpes virus: encephalitis, rash, blindness

See links below to view congenital CMV rash

Maternal Risk Sources

- > Choramnionitis: inflammation of fetal membranes from ascending infection
 - ❖ Usually associated with premature rupture of amniotic membrane (PROM)
 - ❖ Signs - mother
 - Fever
 - Elevated white blood cell count
 - Malodorous discharge

See links below to view fetal choramnionitis

Maternal Risk Sources

- > Choramnionitis
 - ❖ Signs fetus - tachycardia
 - ❖ Risk to fetus
 - Sepsis
 - Intraventricular hemorrhage (IVH)

Maternal Risk Sources

- **Cardiopulmonary disease**
 - ❖ Greatest PO₂ to fetus is 29 mm Hg
 - ❖ Any condition that impairs maternal oxygenation or perfusion profoundly affects fetus, causing fetal-neonatal asphyxia

Maternal Risk Sources

- **Pre-eclampsia: preterm delivery**
- **Hypertension: impairs blood flow to fetus**
 - ❖ Fetal growth restriction
 - ❖ Placental abruption
- **Anemia: fetal-neonatal asphyxia**

Maternal Risk Sources

- **Medications**
 - ❖ Phenytoin (Dilantin): oral clefts
 - ❖ Vitamin A: neural crest defects (toxic levels in bearded seal liver)
 - ❖ Diethylstilbestrol (DES): medication to prevent miscarriage
 - Reproductive organ anomalies
 - Cervical cancer

FYI see links below for more information on DES

Maternal Risk Sources

- **Asthma**
 - ❖ Neonatal-fetal asphyxia
 - ❖ Preterm birth
 - ❖ Low birthweight
- **Genetic conditions passed to fetus**
 - ❖ Cystic fibrosis
 - ❖ Sickle-cell anemia
 - ❖ Muscular dystrophy
 - ❖ Spinal muscle atrophy

Maternal Risk Sources

- **Diabetes mellitus (DM): infant is called infant of diabetic mother (IDM)**
 - ❖ Respiratory distress syndrome, even with longer gestation
 - ❖ Macrosomia (large baby)
 - ❖ Congenital diabetes
 - ❖ Small for gestational age - in presence of peripheral vascular disease (retards growth)

Maternal Risk Sources

- **Gestational diabetes: mother becomes diabetic during pregnancy**
 - ❖ Affects 3 - 10% of pregnancies
 - ❖ Maternal hormones → insulin resistance → glucose intolerance
 - ❖ Same risks to fetus as DM
 - ❖ Management
 - Diet
 - Exercise
 - Diabetic medications, e.g. insulin

Maternal Risk Sources

- > Occupations may expose mother to teratogens → birth defects
- > At-risk occupations (inconclusive)
 - ❖ Agriculture (pesticides): oral clefts, limb defects
 - ❖ Hairdressers (chemicals): oral clefts
 - ❖ Cleaning (solvents): oral clefts
 - ❖ Healthcare (infections, gases, radiation)

FYI see links below for article on occupational exposure

Maternal Risk Sources

- > Low socioeconomic status
 - ❖ Poor nutrition, e.g. folic acid deficiency
 - ❖ Lack of prenatal care: emergency room, delivery room unpleasant surprises

Maternal Risk Sources

- > Low socioeconomic status
 - ❖ Poor nutrition, e.g. folic acid deficiency
 - ❖ Lack of prenatal care: emergency room, delivery room unpleasant surprises
 - ❖ Unawareness of
 - Maternal health issues
 - Symptomatology
 - Risks
 - Available resources

Maternal Risk Sources

- > Social history
 - ❖ Multiple sexual partners - sexually transmitted diseases
 - ❖ Smoking
 - Intrauterine growth retardation
 - Newborn nicotine withdrawal
 - Fetal-neonatal asphyxia - mortality
 - Impaired arousal of newborns - SIDS?
 - Future obesity
 - Future behavioral problems

Maternal Risk Sources

- > Social history
 - ❖ Illicit drugs, e.g. narcotics
 - Nutrition & general health?
 - Congenital neural defects
 - Intrauterine growth retardation
 - Addiction → withdrawal

Maternal Risk Sources

- > Social history
 - ❖ Alcohol - fetal alcohol syndrome (FAS)
 - Intrauterine growth retardation
 - Physical anomalies
 - CNS dysfunction
 - ❖ Caffeine - fetal growth restriction

FYI see links below for article & pictures of FAS plus article on fetal risk from caffeine

Paternal Risk Sources

- > Paternal age > 45: risks
 - ❖ Oral clefts
 - ❖ Cardiac anomalies
 - ❖ Childhood cancers
 - ❖ Neuropsychiatric conditions
- > Paternal age < 20: risks
 - ❖ Preterm delivery
 - ❖ Low APGAR
 - ❖ Increased neonatal & infant mortality

Endogenous Risk Factors

- > Prematurity (< 37 weeks)
 - ❖ RDS
 - ❖ Immature organs
- > Post-maturity (> 42 weeks)
 - ❖ Amniotic fluid reabsorbed - impaired mobility of fetus
 - ❖ Meconium aspiration
 - ❖ Large fetus
 - ❖ Hypoglycemia

Endogenous Risk Factors

- > Multiple gestation: the more, the merrier - NOT
 - ❖ Preterm labor
 - ❖ Twin-to-twin syndrome: unequal blood flow among fetuses
 - ❖ Monoamniotic monochorionic twins: umbilical tangling, compression

FYI see links below for article on extreme multiple births

Endogenous Risk Factors

- > Congenital conditions
 - ❖ Airway anomalies
 - ❖ Cardiac anomalies
 - ❖ Abdominal anomalies
- > Macrosomia (> 4500 g) - often IDMs
 - ❖ Cesarean section delivery
 - ❖ Birth trauma

Peri-Partum Events (L & D)

- > Dystocia
- > Cord pathology
- > Abnormal presentations
- > Placental pathology
- > Disorders of amnion
- > Forceps delivery
- > Birth trauma
- > Anesthetic drugs, misadventures
- > Pre-eclampsia

Antepartum Fetal Monitoring

Antepartum Fetal Monitoring

- Parameters to monitor
 - ❖ Growth
 - ❖ Heart rate & responsiveness
 - ❖ Movement
 - ❖ Genetic traits
 - ❖ Biochemical factors

See links below for interesting fetal sonogram

Biophysical Profile

- Most reliable risk indicator
- Components
 - ❖ Fetal movement
 - ❖ Amniotic fluid volume
 - ❖ Fetal tone
 - ❖ Fetal respirations
 - ❖ Reactive heart rate

FYI see links below for biophysical profile

Heart Rate Responsiveness

- Ability of fetal heart to react appropriately to stimuli
- Reactive heart rate → capability to endure delivery
- Internal electrode: invasive
- External electrode: noninvasive

Heart Rate Responsiveness

- Non-stress: compares FHR with normal fetal movements
- Stress (OCT): uterine contractions induced with oxytocin
- Non-responsiveness of FHR → inability to survive labor

FYI see links below for video of non-stress test

Genetic Predisposition

- Family hx, maternal age raise red flags
- Amniocentesis or choramniotic bx
- Amniotic fluid submitted for cell culture
- Maternal plasma DNA sequencing

FYI see links below for video of amniocentesis plus article on noninvasive screening for trisomy 21

Ultrasonography: Noninvasive

- Growth
- Gender
- Many anomalies
- Gestational age
- Multiple gestation

See links below for video of 3D ultrasound

Biochemical Determinations

- Fetal lung maturity tests
 - ❖ Lecithin:sphingomyelin (L:S) ratio
 - ❖ Phosphatidyl glycerol (PG): diabetic moms
- Amniotic bilirubin: suggests hemolysis, e.g. Rh incompatibility

Biochemical Determinations

- Maternal serum alpha fetoprotein (MSAFP)
 - ❖ Primary purpose: to detect neural tube defects, e.g.
 - Spina bifida
 - Anencephaly
 - ❖ Elevated MSAFP associated with risk for sudden infant death syndrome (SIDS)

Peri-Partum Events & Monitoring

Fetal Heart Rate Monitoring

- Heart rate: normal = 120 - 160/min
- Heart rate patterns with contractions
 - ❖ Early deceleration (normal)
 - ❖ Late deceleration (fetal hypoxia)
 - ❖ Variable deceleration (cord compression)

See links below for article with fetal heart rate patterns
FYI see links below for video of fetal monitoring

Stages of Labor

- Stage I
 - ❖ Begins with regular contractions & cervical dilation
 - ❖ Contractions increase in frequency & intensity
 - ❖ Contractions not affected by mother's activity or position
 - ❖ Cervix dilates & effaces
 - ❖ Transitional phase

See links below for illustration of dilation & effacement

Stages of Labor

- Stage II
 - ❖ Begins with complete dilation (10 cm)
 - ❖ Uterine contractions initiate fetal descent
 - ❖ Abdominal contractions augment uterine contractions
 - ❖ Fetus rotates to accommodate shoulders
 - ❖ Newborn positioned & cord is cut

See links below to view childbirth animation

Stages of Labor

- Stage III
 - ❖ Separation of placenta from uterus
 - ❖ Delivery of placenta

FYI see links below for video of examination of the placenta
FYI see links below to view C-section delivery

Transition of Fetus to Newborn

- Respiratory changes
 - ❖ Fetal lung fluid expelled by uterine contractions
 - ❖ First breath requires -40 to -100 cm H₂O
 - ❖ Remaining lung fluid cleared by lymphatics

Transition of Fetus to Newborn

- Circulatory changes
 - ❖ Removal of placenta increases systemic vascular resistance → functional closure of foramen ovale (FO)
 - ❖ Increased PO₂ decreases pulmonary vascular resistance
 - ❖ Ductus arteriosus (DA) remains open for about 15H

FYI see links below for video on fetal circulation

Transition of Fetus to Newborn

- Hypoxemia in newborn →
 - ❖ Increase pulmonary vascular resistance → right-to-left shunt through foramen ovale
 - ❖ Reopen ductus arteriosus with additional right-to-left shunt
 - ❖ Persistent pulmonary hypertension

Transition to Adult Circulation

- DA anatomically closed - 72 hours (becomes a ligament)
- FO anatomically closed - 3 months, but only in about 80% of people
- Ductus venosus (DV) - anatomically closed - 3 to 7 days

Fetal/Neonatal Acid-Base Monitoring

- Purpose: verify perinatal asphyxia
- Indications
 - ❖ Severe intrauterine growth restriction
 - ❖ Multifetal gestations
 - ❖ Breech deliveries
 - ❖ Preterm births
 - ❖ Meconium staining
 - ❖ Abnormal fetal heart rate pattern
 - ❖ Low Apgar scores

Fetal Acid-Base Monitoring

- > Sources of blood
 - ❖ Umbilical cord blood: sampling immediately after delivery
 - ❖ Antepartum umbilical cord blood sampling
 - ❖ Fetal scalp blood
- > Interpretation
 - ❖ pH < 7.25 borderline abnormal
 - ❖ pH < 7.20 abnormal

Partum Misadventures

Dystocia

- > Causes
 - ❖ Greater incidence in primigravida
 - ❖ Weak contractions
 - ❖ Pelvic abnormality
 - ❖ Large fetus
 - ❖ Multiple birth
 - ❖ Abnormal presentation, AKA 'lie', 'breech'

Dystocia

- > Consequences
 - ❖ Cesarean section
 - ❖ Fetal death
 - ❖ Hypoxemic ischemic encephalopathy
 - ❖ Birth trauma
 - ❖ Forceps delivery

See links below for illustration of forceps delivery

Complications With Amnion

- > Rupture of membranes (ROM)
 - ❖ Premature rupture of membranes (PROM): membrane ruptures before onset of labor
 - ❖ Premature preterm rupture of membranes (PPROM): rupture before 37 wks
 - ❖ Prolonged PROM: rupture > 24 H before labor

PROM

- > Causes
 - ❖ Infection (choramnionitis)
 - ❖ Inflammation

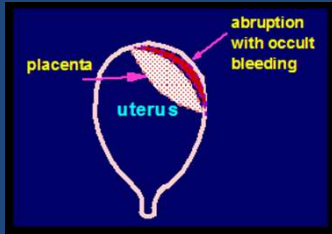
PROM

- > Complications - vary with gestational age
 - ❖ Infection
 - ❖ Placental abruption
 - ❖ Fetal distress, fetal restriction deformities
 - ❖ Pulmonary hypoplasia
 - ❖ Fetal/neonatal death

FYI see links below for article on PROM

Complications With Placenta

- > Abruptio placenta: separation of placenta before delivery



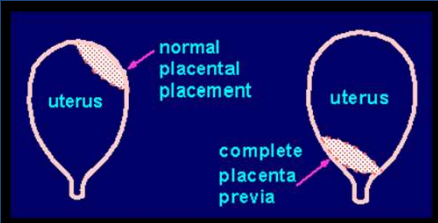
See links below for illustration of placental abruption

Complications With Placenta

- > Abruptio placenta
 - ❖ Complications
 - Fetal distress, mortality
 - Maternal hemorrhage

Complications With Placenta

- > Placenta previa: abnormal placement of placenta



See links below for illustration of placenta previa

Complications With Placenta

- > Placenta previa
 - ❖ Complications - minimized by prenatal care
 - Maternal bleeding
 - Cesarean section delivery

Complications With Umbilicus

- > Compression - between head & pelvis
- > Prolapse: cord precedes infant during delivery
- > Knotting: cord tied in knot

See links below to view prolapsed umbilical cord & umbilical knot with infarcted placenta

Complications With Umbilicus

- > Risk factors (prolapse)
 - ❖ Premature delivery
 - ❖ Multiple births (twins, triplets, etc.)
 - ❖ Excessive amounts of amniotic fluid (polyhydramnios)
 - ❖ Breech delivery (butt first)
 - ❖ Abnormally long umbilical cord

Complications With Umbilicus

- > Complications
 - ❖ Fetal distress
 - ❖ Fetal death

FYI see links below for article on umbilical prolapse

Abnormal Presentations

- > Normal presentation: vertex delivery
 - ❖ Headfirst
 - ❖ Face to mother's posterior
 - ❖ Chin tucked in

Abnormal Presentations

- > Types
 - ❖ Breech (butt-first)
 - ❖ Transverse lie
 - ❖ Face
 - ❖ Shoulder
 - ❖ Footling (foot-first)

See links below to view breech & more abnormal presentations

Abnormal Presentations

- > Complications
 - ❖ Prolonged labor
 - ❖ Fetal distress
 - ❖ Maternal distress - exhaustion
 - ❖ Birth trauma

Birth Trauma

- > Types
 - ❖ Soft tissue injury, e.g. ecchymoses, petechiae
 - ❖ Nerve injury, e.g. brachial plexus, laryngeal nerve, cranial nerves
 - ❖ Bone injury, e.g. clavicles, humerus, ribs

See links below to view complication of forceps delivery & animation of shoulder dystocia

Birth Trauma

- Predisposing factors
 - ❖ Prima gravida
 - ❖ Small maternal stature
 - ❖ Maternal pelvic anomalies
 - ❖ Oligohydramnios
 - ❖ Abnormal presentation

Birth Trauma

- Predisposing factors
 - ❖ Forceps or vacuum extraction
 - ❖ Very low birth weight infant or extreme prematurity
 - ❖ Fetal macrosomia
 - ❖ Large fetal head
 - ❖ Fetal anomalies

Amniotic Embolus

- Rare, extremely dangerous condition for mother - mortality > 60%
- Etiology is unknown
- Amniotic, fetal tissue enter mother's circulation - embolize

Amniotic Embolus

- Manifestations
 - ❖ Fetal distress
 - ❖ Dyspnea
 - ❖ Hypoxemia
 - ❖ Hypotension
 - ❖ Hemorrhage - disseminated intravascular coagulopathy (DIC)
 - ❖ Pulmonary edema
 - ❖ Cardiac arrest

FYI see links below for article on amniotic embolus

Pre-Eclampsia

- Disseminated vascular endothelial dysfunction, AKA 'toxemia'
- Etiology unknown
- Associated with high morbidity & mortality
- Important cause of preterm deliveries & premature infants

Pre-Eclampsia

- Predisposing factors
 - ❖ Hypertension
 - ❖ History of pre-eclampsia
 - ❖ History of pre-eclampsia in mother or sisters
 - ❖ Obesity prior to pregnancy
 - ❖ Multiple fetuses
 - ❖ History of diabetes, kidney disease, lupus, or rheumatoid arthritis

Pre-Eclampsia

- Manifestations
 - ❖ Hypertension
 - ❖ Proteinuria
 - ❖ Edema
 - ❖ Headaches
 - ❖ Excessive weight gain
 - ❖ Hyperreflexia

Pre-Eclampsia

- Complications
 - ❖ Preterm labor - prematurity
 - ❖ Placental abruption
 - ❖ Eclampsia
 - ❖ Seizures
 - ❖ Coma
 - ❖ Death

Summary & Review

- Risk factors
 - ❖ Maternal
 - ❖ Paternal
 - ❖ Endogenous to fetus
- Antepartum monitoring
 - ❖ Biophysical profile
 - ❖ Fetal heart rate responsiveness
 - ❖ Biochemical markers

Summary & Review

- Peri-partum monitoring & events
 - ❖ Fetal heart rate monitoring
 - ❖ Stages of labor
 - ❖ Transition from fetus to newborn

Summary & Review

- Partum misadventures
 - ❖ Placental abnormalities
 - ❖ Abnormalities of amnion
 - ❖ Abnormalities of umbilicus
 - ❖ Abnormal presentations
 - ❖ Birth trauma
 - ❖ Amniotic embolism
 - ❖ Pre-eclampsia, eclampsia

References

- Lydon-Rochelle MT, Cárdenas V, Nelson JL, Tomashek KM, Mueller BA, Easterling TR. Validity of maternal and perinatal risk factors reported on fetal death certificates. *Am J Public Health.* 2005 Nov;95(11):1948-51. Epub 2005 Sep 29.
- Soraisham AS, Singhal N, McMillan DD, Sauve RS, Lee SK; Canadian Neonatal Network. A multicenter study on the clinical outcome of chorioamnionitis in preterm infants. *Am J Obstet Gynecol.* 2009 Apr;200(4):372.e1-6. Epub 2009 Feb 14.
- Lahra MM, Beeby PJ, Jeffery HE. Intrauterine inflammation, neonatal sepsis, and chronic lung disease: a 13-year hospital cohort study. *Pediatrics.* 2009 May;123(5):1314-9.

References

- > Stothard KJ, Tennant PW, Bell R, Rankin J. Maternal overweight and obesity and the risk of congenital anomalies: a systematic review and metaanalysis. JAMA. 2009 Feb 11;301(6):636-50.
- > CARE Study Group. Maternal caffeine intake during pregnancy and risk of fetal growth restriction: a large prospective observational study. BMJ. 2008 Nov 3;337:a2332.
- > Elise de La Rochebrochard, and Patrick Thonneau Paternal age and maternal age are risk factors for miscarriage; results of a multicentre European study Hum. Reprod. 17: 1649-1656.

References

- > Matusiak R, Szymusik I, Kosińska-Kaczyńska K, Borowska A, Myszewska A, Morawski Z, Wielgo? M, Przybo? A. Is grand multiparity an obstetrical risk factor? Ginekol Pol. 2006 Dec;77(12):937-44.
- > Thulstrup AM, Bonde JP. Maternal occupational exposure and risk of specific birth defects. Occupational medicine 2006;56:532-543.
- > Leddy MA, Power ML, Schulkin J. The impact of maternal obesity on maternal and fetal health. Rev Ob Gyn 2008;1:170-178.

References

- > Wang M. Perinatal drug abuse and neonatal withdrawal. eMedicine 2008. <http://emedicine.medscape.com/article/978492-overview>
- > Jazayeri A. Premature rupture of membranes. eMedicine 2008. <http://emedicine.medscape.com/article/261137-overview>