Introduction

- The major factor of morbidity and mortality in the neonate is the degree to which the organ systems have not yet developed.

- The earlier in gestation that birth occurs, the higher the degree of morbidity and mortality.
Introduction

Some of the complications experienced by premature infants include:
- respiratory distress syndrome (RDS)
- bronchopulmonary dysplasia (BPD)
- retinopathy of prematurity (ROP)
- necrotizing enterocolitis (NEC)
- intraventricular hemorrhage (IVH)
- pulmonary interstitial emphysema (PIE)
- apnea
Retinopathy of Prematurity (ROP)

- Formerly retrolental fibroplasia (RLF)
- Early seen that oxygen usage led to RLF
- With ↓ use of O\textsubscript{2}, ↑ CP & ↑ mortality
- Factors contributing to ROP
  - ↑ O\textsubscript{2} levels
  - Retinovascular immaturity
  - Circulatory & respiratory instability
Retinopathy of Prematurity (ROP)
Incidence (ROP)

- 25 – 35% of premature infants (<36 weeks)
- 5-10 % have at least stage 3
- 3-5 % result in blindness
Pathophysiology (ROP)

- $\uparrow$ PaO2 → retinal vasoconstriction
- Retinal vessel necrosis (vaso-obliteration)
- Surviving blood vessels proliferate
- Proliferation into vitreous
- Vessels in vitreous hemorrhage
- Hemorrhages form scar tissue
- Retinal detachment & blindness
Many Factors Involved (ROP)

Immaturity, hyperoxia, hypoxia, blood transfusions, IVH, apnea, infection, hypercapnia, PDA, prostaglandin synthetase inhibitors, vitamin E deficiency, lactic acidosis, bright lighting, early intubation, hypotension, NEC
Treatment (ROP)

- Vitamin E modest benefit
- **Cryotherapy**: A probe that has been cooled to –20 C with nitrous oxide is introduced behind the eye and the avascular portion of the retina is frozen preventing further abnormal vessel proliferation.
- **Laser therapy**: the avascular portion of the retina is photocoagulated.
- **Surgical interventions**: such as vitrectomy and lensectomy.
Prevention (ROP)

- Cautious use of oxygen in premature infants
- Usually PaO2 50-80 mm Hg
Bronchopulmonary Dysplasia (BPD) - Incidence

- Follows treatment for RDS
- Primary etiologic factors
  - High pressures of ventilation
  - High FIO₂
  - Prematurity
- Other contributing factors
  - Presence of PDA
  - Fluid overload
- Exact etiology unknown
Definition (BPD)

- Radiographic features as described by Northway et al (1967)
- Oxygen dependence past 28 days following mechanical ventilation
- Oxygen dependence beyond 36 weeks without mechanical ventilation (also neonatal chronic lung disease – NCLD or Wilson-Mikity Syndrome)
Radiographic Staging of BPD

- Stage I (first 3 days): bilateral ground glass (RDS)
- Stage II (3-10 days): opaque with obscuring of cardiac shadow
- Stage III (10-20 days): multiple cyst formation; visible cardiac shadow
- Stage IV (>28 days): ↑ lung density and formation of large, irregular cysts
Radiographic Staging of BPD

• Stage I (first 3 days): bilateral ground glass (RDS)
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• Stage IV (>28 days): ↑ lung density and formation of large, irregular cysts
Treatment (BPD)

- Mechanical ventilation
  - Small ET tube with small leak
  - High frequency ventilation
  - Humidification of inspired gases
- CPT: PRN, not on regular schedule
- Careful aseptic suctioning
- Corticosteroids
- Aerosolized bronchodilators
- Theophylline
- Fluid therapy/diuretics
- Digoxin
- Nutrition
- Vitamin E (inconclusive)
- Prevention: low pressure, low FIO₂
Pulmonary Interstitial Emphysema (PIE)

- PIE occurs when air dissects throughout the interstitial tissue of the lungs.
- It results from the chronic use of high PEEP, peak inspiratory pressures and prolonged inspiratory times.
- PIE is classified into:
  - Intrapulmonary interstitial pneumatosis (when air remains within the lung tissue)
  - Intrapleural pneumatosis: extra alveolar air is confined by the visceral pleura, forming blebs.
Pulmonary Interstitial Emphysema (PIE)

- As the air dissects and collects in the interstitium, the small airways and vessels are compressed.
- V-Q mismatches follow and lead to a deterioration in blood gases
- High ventilator pressures required to correct the worsening blood gases, cause more air leak into the interstitium and V-Q mismatch worsens again.
Pulmonary Interstitial Emphysema (PIE)

- Hyper aerated lung fields in a 27 week infant with PIE
Pulmonary Interstitial Emphysema (PIE)

- Shortly before the death of this infant, lungs remain hyperaerated.
Treatment of PIE

• PIE is best treated by prevention
• Low ventilation pressures may help avoid the onset of PIE
• Selective intubation of the unaffected lung may allow injured lung to heal.
Intraventricular Hemorrhage (IVH)

Factors

- Immaturity
- Fluctuating cerebral blood flow

Mechanical Ventilation Effects

- ↑ MAP may retard blood return
- Variations in PaO₂ & PaCO₂ may induce cerebral vasoconstriction &/or vasodilation
Necrotizing Enterocolitis (NEC)

Definition

• Ischemia & necrosis of the intestine

Etiology

• Mucosal wall injury
• Bacterial invasion
• Formula feeding (breast milk seems to be protective)
Necrotizing Enterocolitis (NEC) Signs

- Blood in stool (guaiac positive)
- Abdominal distension
- Lethargy
- Poor feeding tolerance/residuals
- Vomiting
- Apnea
- Temperature instability
- DIC
Necrotizing Enterocolitis (NEC) Signs
Necrotizing Enterocolitis (NEC) Treatment

- Prevention: good handwashing
- Stop oral feedings
- NG suction
- Antibiotics (ampicillin & gentamicin)
- Abdominal X-rays
- Increased FIO$_2$
- Surgical intervention following perforation
Necrotizing Enterocolitis (NEC)

X-Ray Findings

- Pneumatosis intestinalis (gas trapped in intestinal wall)
- Portal vein gas
- Free air in peritoneum – usually indicates perforation
Pneumatosis intestinalis
Apnea

- Periodic breathing: Short, recurring pauses in spontaneous ventilation of 5 to 10 seconds duration – considered normal in premature infant
- Clinical definition of apnea: Complete cessation of breathing for a period of 20 seconds or any pause in breathing accompanied by bradycardia, ↓ in SpO₂, and/or color change
- Definition of apnea in adult sleep apnea: repeated episodes of complete cessation of airflow for 10 seconds or longer
Causes of Apnea

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Causes of Apnea

- Respiratory: RDS, congenital upper airway anomalies, airway obstruction, postextubation, CPAP, pneumonia, hypoxia
- Cardiovascular: CHF, PDA, anemia, polycythemia, tachycardia & bradycardia, sepsis, polycythemia
- CNS: IVH, meningitis, seizures, sedation, kernicterus, immaturity of respiratory centers, tumors
- GI: NEC, gastroesophageal reflux, stooling
- Metabolic: Hypoglycemia, hypo- & hypernatremia, hypocalcemia, hypo- & hyperthermia
- Environmental: inappropriate temperature, suctioning, feeding

See Table 10-5
Treatment

- Identify and correct underlying problem
- CPAP
- Oxygen
- Mechanical ventilation
- Drugs
  - Mehtylxanthines: theophylline, aminophylline, caffeine
  - Doxapram
- Apnea monitors