Newborn Physiology

• Thermoregulation
  – Increase metabolic activity and heat production (brown fat)
  – Heat produced at high cost energy and oxygen
  – Takes energy/oxygen away from vital organs

• Smaller more premature then worse heat loss
• Incubators: “penalty box”
• Radian warmers
• Warming blankets
• “French fry lights”
Newborn Physiology

• Fluid and Electrolyte Management
  – Neonate’s TBW 80% weight at birth
  – Extracellular 40% birth weight
  – Adult TBW (60%) and ECCF volume (20%) reached by 1 year of age
  – DOL #1: prediuretic (UO 1ml/kg/hr)
  – DOL #2 and 3: diuretic (UO 7ml/kg/hr)
  – DOL #4 on: UO and natriuresis depend

Newborn Physiology

• DOL #1 – 3: 60-80 ml/kg/day
• DOL #4: 100 ml/kg/day
• Make changes PRN
• Replace GI losses (obstruction, NEC)
• Replace Evaporative losses (gastroschisis)

Newborn Physiology

• Metabolism and Nutrition
  – Increased requirements due to rapid growth and development
  – Add illness, temperature regulation
  – Fetus: glucose and easy way
  – Neonate: glycogenolysis, gluconeogenesis, exogenous sources
  – Provide 100-110 kcal/kg/day infants
Newborn physiology

- Respiratory
  - Growth: starts in utero and continues up to age 8
  - Maturation: type II pneumocytes for surfactant production
  - Fetal circulation: ductus arteriosis and foramen ovale shut blood away from lungs

Newborn Physiology

- Transition: closure of DA, FO when drop in pulmonary vascular resistance at birth
- Support with mechanical ventilation: pressure vs. volume cycles
- Oscillating ventilator
- Nitric oxide
- Extracorporal Membrane Oxygenation

Newborn Physiology

- PICTURE HERE
Hernia and Hydorchle

- Testes start intrabdominal and descent
- 20% patent processus vaginalis
- Hernia sac anteromedial to cord (retroperitoneal)
- Open processus can result in hemia (viscera) or communicating hydorchle (peritoneal fluid)

Hernia and Hydorchle

- Fluid may get trapped in tunica but PV closed: non-communicating hydorchle
- No operation necessary for non-communicating hydrocele
- Repair recommended for communicating hydrocele and hernia

Hernia and Hydrocele

- Most infant hernias indirect
- Incidence 0.8-4.4%
- Male; female + 6:1
- Premature: up to 70% have hernia
- 60% incarcerate first 6 mos
- Inguinal incision, high litigation sac, excision of hydrocele
Hernial and Hydrocele

- Recurrence <1%
- Testicular atrophy 1%
- Damage to cord?
- Reduction of “incarcerated hernia”
  - Elevation
  - Push sac sac down at ring and up from scrotum
  - Sedation seldom necessary

Congenital Diaphragmatic Hernia

- Development of diaphragm several components
- Completion of closure by 8-10 weeks
- Bowels return to peritoneal cavity 10-14 weeks
- 85% defects left
- Most defects posterior-lateral (Bochdalek Hernia)

Congenital Diaphragmatic Hernia

- Incidence 1/3500 live births
- Male-female
- 30% associate anomalies
- Bilateral pulmonary hypoplasia
- Pulmonary hypertension: persistent fetal circulation
Congenital Diaphragmatic Hernia

• Physiology
  – Hypoxia and hypercarbia
  – Metabolic acidosis
  – Worsening PHTN-more PFC
  – Break cycle with mechanical ventilation, nitric oxide, oscillating ventilator, ECMO

Congenital Diaphragmatic Hernia

• Presentation
  – Respiratory distress: cyanosis, tachypnea
  – Decreased/absent breath sounds
  – Shifted PMI
  – Scaphoid abdomen

• Initial management: intubate, NGT, CXR

Congenital Diaphragmatic Hernia

• Management of respiratory failure
  – Mechanical ventilation
  – Fluid administration
  – Inotropes/pressors
  – Oscillator
  – Nitric oxide
  – ECMO
Congenital Diaphragmatic Hernia

• Operative Management
  – When patient is stable for 48 hrs.
  – At 48-72 hours age if been stable since birth
  – After ECMO
  – During ECMO

Congenital Diaphragmatic Hernia

• PICTURE HERE

Congenital Diaphragmatic Hernia

• PICTURE HERE
Congenital Diaphragmatic Hernia

- PICTURE HERE

Abdominal Wall Defects

- Omphalocele
  - Sac composed of peritoneum and amniotic membrane
  - Comes through umbilical cord
  - Contains liver
  - Failure of abdominal wall folds to fuse
  - Incidence 1-4000 live births

Abdominal Wall Defects

- Omphalocele
  - Associated anomalies common 37-81%
  - Cardiac anomalies 40%
  - Trisomy 21, 18, 13
  - Lower midline syndrome: bladder/cloacal extrophy, colon, atresia, ARM's, sacral anomalies, meningomyelocele
  - Beckwith-Wiedemann syndrome: macroglossia, gigantism, hypoglycemia, tumors
Abdominal Wall Defects: Omphalocele

• Diagnosis
  – Prenatal ultrasound
  – Exam at delivery

• Initial Management
  – Fluids/glucose
  – Respiratory support if needed
  – Bowel bag, heat
  – NC decompression
  – Antibiotics

Abdominal Wall Defects: Omphalocele

• Treatment Options: must cover to prevent heat/fluid loss, sepsis, volvulus
  – Primary closure
  – Silo with delayed closure
  – Skin flap closure primarily
  – Skin graft closure with repair ventral hernia later.

Abdominal Wall Defects: Omphalocele

• Mortality: 20%
• Usually due to associated anomalies
• Sometimes due to necrosis bowel/liver form having no room in abdomen
Abdominal Wall Defects: Omphalocele

- PICTURE HERE

Abdominal Wall Defects: Gastroschisis

- No sac
- Almost never contains liver
- Defect to right of umbilical cord
- May be due to rupture of abdominal wall or intrauterine rupture of omphalocele

Abdominal Wall Defects: Gastroschisis

- Diagnosis
  - Prenatal ultrasound
  - Clinical exam

- Associated anomalies uncommon
  - Mostly GI: small bowel atresia, malrotation
Abdominal Wall Defects: Gastrochisis

• Initial Management
  – IVF
  – Antibiotics
  – Bowel bag
  – NG decompression

• Operative Management
  – Primary closure – 80%
  – Staged closure

Abdominal Wall Defects: Gastrochisis

• Mortality – 10%
• Early post-op
  – Respiratory distress
  – Ileus
  – Sepsis
• Late post-op
  – Short bowel syndrome
  – Growth delay
  – Bowel obstruction

Abdominal Wall Defects: Gastrochisis

• PICTURE HERE
Abdominal Wall Defects

- PICTURE HERE

Tracheoesophageal Fistula and Esophageal Atresia

- Failure of separation of trachea and esophagus
- Occurs by 4th week
- Incidence 1/2500 live births
- Male = Female

- PICTURE HERE
Tracheoesophageal Fistula and Esophageal Atresia

• Prognostic Factors
  – Birth weight <2500 gm
  – Pneumonia
  – Associated anomalies
  – Associated anomalies: VACTERL
  – Survival: 95%, 80%, 20%

Tracheoesophageal Fistula and Esophageal Atresia

• Presentation
  – Prenatal polyhydramnios
  – Excessive salivation /vomiting feeds
  – Respiratory distress
  – Recurrent pneumonia

• Diagnosis
  – Can’t pass NGT: CXR, barium study
  – bronchoscopy

Tracheoesophageal Fistula and Esophageal Atresia

• Treatment
  – R/O associated anomalies
  – NGT to drain upper pouch
  – Ligation of fistula and primary repair of esophagus
  – Gastrostomy and delayed repair if long gap
  – Myotomies of proximal esophagus
  – Esophageal replacement
Tracheoesophageal Fistula and Esophageal Atresia

- Outcome
  - Anastomotic leak - 20%
  - Anastomotic stricture - 20%
  - GE reflux - all, 35% need fundoplication
  - Tracheomalacia
  - Recurrent fistula

Hypertrophic Pyloric Stenosis

- Hypertrophy of pyloric muscle - believed to be acquired
- Familial: 3-15 times
- Male:female = 5:1
- Usually first born males
- Presents at 3-6 weeks of age
- Nonbilious, projectile vomiting

Hypertrophic Pyloric Stenosis

- Physical Exam
  - Dehydration
  - Weight loss
  - Palpable olive
- Diagnosis
  - Exam
  - Ultrasound
  - UGI
Hypertrophic Pyloric Stenosis

- **Treatment**
  - NPO +/- NGT
  - Correction of electrolytes; hypokalemic hypochloremic metabolic alkalosis
  - Correct dehydration
  - Ramstedt pyloromyotomy; urgent but not emergent
  - Outcome: 100% cure, mortality rare

Neonatal Bowel Obstruction

- **Medical Causes Ileus**
  - Electrolyte abnormalities
  - Sepsis
  - NEC

- **History**
  - Polyhydramnios on prenatal US
  - Bilious emesis
  - Abdominal distention
  - Failure to pass meconium

- **Physical Exam**
  - Distended abdomen +/- peritonitis
  - Anus present and patent

- **X-rays**
  - KUB
  - Limited UGI
  - Water-soluble contrast enema
Neonatal Bowel Obstruction

• Initial Management
  – NG decompression
  – Fluid resuscitation
  – Antibiotics
  – Evaluate for associated anomalies

• Non-operative Management
  – Meconium plug syndrome
  – Meconium ileus

• Operative Management
  – All babies with peritonitis get ex lap
  – Transverse incision above umbilicus
  – Resection/anastamosis/stomas

Neonatal Bowel Obstruction

• Duodenal Obstruction
  – Double bubble on KUB
  – 30% Down’s syndrome
  – Causes; duodenal atresia/web, malrotation-Ladd’s bands, annular pancreas
  – Resection of web
  – Duodenoduodenostomy
  – Ladd’s procedure
Duodenal Obstruction

- PICTURE HERE

Duodenal Obstruction

- PICTURE HERE

Jejuno-ileal Atresia

- 1/330 to 1/11500 live births
- Associated anomalies less common
- Due to vascular accidents in utero
- KUB-dilated bowel loops
- LGI-microcolon, R/O lower tract abnormalities
Jejuno-ileal Atresia

- Types
- Surgical Technique
  - Check for multiple atresia (20%)
  - Resection and anastomosis (tapering, end to back)
  - Preserve bowel length
  - Stomas seldom necessary

Jejuno-ileal Atresia

- Outcomes
  - 100% survival most series
  - Anastamotic leak
  - Delayed return bowel function (proximal segment)
  - Short bowel syndrome: 20cm/40cm
  - Malabsorption (terminal ileum lost)

Jejuno-ileal Atresia

- PICTURE HERE
Jejuno-ileal Atresia

- PICTURE HERE

Malrotation

- Etiology: bowels fail to rotate and fix property on return to abdominal cavity
- Normal rotation duodenum 270 degrees clockwise around SMA
- Normal rotation cecum 270 degrees clockwise over SMA
- Defined radiographically as abnormal LOT

Malrotation

- Volvulus of the Midgut
  - 90% occur first month
  - Bilious emesis
  - Abdominal distention, peritonitis
  - Septic shock
  - Rectal bleeding
  - Absolute surgical emergency; detorsion, Ladd procedure, possible bowel resection
Malrotation

• Diagnosis
  – KUB: normal, dilated bowel loops
  – UGI: LOT in abnormal position, corkscrewing
  – Duodenal obstruction; compression by Ladd’s bands
  – Barium enema; cecum may be high (RUQ or LUQ), may be normal

• Treatment
  – Brief pre-operative stabilization
  – Emergent laparotomy: detorsion bowel, Ladd procedure, appendectomy, bowel resection if necessary

• Outcome
  – 2-10% recurrent volvulus
  – Short bowel syndrome
  – High mortality
Meconium Ileus

- Bowel obstruction due to inspissated meconium at terminal ileum
- 99% time pt has cystic fibrosis
- Occurs in 7-25% patients with CF
- Incidence 1/1150 to 1/2500 live births
- Two types: simple, complicated

Meconium Ileus

- PICTURE HERE

Meconium Ileus

- Presentation
  - Family history 10-30%
  - Distention, bilious emesis
- Diagnosis
  - KUB: dilated bowel loops, soap bubbles
  - Gastrograffin enema: pellets of meconium in terminal ileum, can be therapeutic
Meconium Ileus

- Treatment
  - Uncomplicated
    - Gastorgaffin enema, IVF, mucomyst
    - Surgical evacuation via exploratory laparotomy
  - Complicated
    - Volvulus
    - Atresia
    - Perforation
    - Exploratory laparotomy, resection dead bowel (anastomosis or stoma)

Meconium Ileus

- Outcome
  - Pulmonary complications: later
  - Bowel obstruction
  - Anastomotic leak
  - Malabsorption
  - Meconium ileus equivalent
  - Rectal prolapsed
  - Initial mortality low

Meconium Peritonitis

- Foreign body reaction of peritoneum to meconium form prenatal perforation
- Usually due to intestinal obstruction
  - Volvulus
  - Intussusceptions
  - Congenital bands
  - Atresia
- Pseudocyst formation, adhesions, calcifications
Meconium Peritonitis

- Diagnosis
- KUB: calcifications
- Treatment
- Operative:
  - Intestinal obstruction, peritonitis, persistent leak (free air/fluid)
  - Exercise pseudocyst
  - Resect nonviable bowel (preserve length)

Meconium Peritonitis

- Outcome
- Mortality 50% early reports to 0-30% later reports
- Short bowel syndrome

Meconium Plug Syndrome

- Plug of meconium forms in colon from slow motility
- Presents as distal bowel obstruction
- KUB: diluted bowel loops
- Gastrograffin enema: plug, can be therapeutic
- Check for CF and Hirschprung’s
Colon Atresia

- Incidence 1/5000 to 1/20,000 live births
- Vascular accidents
- Present as distal bowel obstruction, abdominal mass
- 30% associated anomalies
- Diagnosis: KUB, LGI
- pre-op treatment: IVF antibiotics

Colon Atresia

- Treatment
  - Exploratory laparotomy: colostomy, resection and primary repair
- Outcome
  - Mortality<5%
  - Good GI function

Hirschprung’s Disease

- Absence of ganglion cells in intermuscular and submucosalplexuses, poor motility
- Incidence 1/3500 live births
- Family history
- 10% Down’s syndrome
- Associated anomalies: cardiac, GU, neural crest
Hirschprung’s Disease

• Presentation
  – No passage meconium in 48 hours after birth
  – Obstructive symptoms
  – Constipation in older children
  – Enterocolitis
  – Paradoxical diarrhea

• Diagnosis
  • KUB: distal obstruction
  • LGI: transition zone
  • Suction rectal biopsy: 90%
  • Full thickness rectal biopsy
  • Anorectal manometry: unreliable in newborns

• Treatment
  • Colostomy then pull through
  • Primary pull through

• Outcome
  – Anal strictures
  – Enterocolitis
  – Low mortality
Anorectal Malformations

- Incidence 1/1500 live births
- Failure separation of GU sinus and hindgut at 5-6 weeks
- Classification: high/low, Describe defect
- 90% have a fistula
- 10% rectal atresia without fistula: Down’s syndrome

Anorectal Malformations

- Fistulas
  - Rectal-bladder neck
  - Rectal-urethral
  - Rectal-vaginal
  - Rectal-vestibular
  - Rectal-perineal
  - Cloaca

Anorectal Malformations

- Associated anomalies: VACTERL
  - More with higher defect
  - GU 40% (renal agenesis, VUR)
  - GI: malrotation, duodenal atresia, TEF
- Diagnosis
  - Physical exam
  - Lateral x-ray with hips elevated
  - VCUG, renal US, echocardiogram
Anorectal Malformations

• Management
  – NGT, IVF
  – Evaluate for associated anomalies
• Operative
  – Colostomy, PSARP at 6 mos–1 yr
  – Anoplasty in newborn period for perineal fistula:
    limited PSARP, transposition

Anorectal Malformations

• Outcomes
  – Mortality related to associated anomalies
  – Continence better with lower defect: 100% for perineal fistula vs. 0-20% for bladder neck fistula
  – Constipation common lower defects

Necrotizing Enterocolitis

• Inflammation of bowels, primarily disease of prematurity
• Etiology
  – Immature gut
  – Stress (hypoxia, hypotension, hypothermia
  – Substrate for bacteria (feeding)
  – Bacteriologic
Necrotizing Enterocolitis

• Presentation
  – Abdominal distention, bilious emesis
  – Disturbances: temperature instability, glucose, apnea, bradycardia, thrombocytopenia, acidosis

• Diagnosis
  – Clinical picture
  – KUB: pneumatosis intestinalis, pneumoperitonium, portal vein gas

Necrotizing Enterocolitis

• Management
  – Resuscitation, NPO, NGT, broad spectrum antibiotics, serial labs and KUB
  – Operative: perforation, failure to improve with medical management
  – Laparotomy vs. peritoneal drains: VLBW infant (<100gm), unstable baby with perforation
  – Late operative: obstruction after recovered form acute period

Necrotizing Enterocolitis

• Outcomes
  – Short bowel syndrome: 9%
  – Late bowel obstruction: stricture 10%
  – Survival if need operation: 56% in VLBW infant
  – Overall NEC mortality 30%