Pediatric Surgery: The Newborn

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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

Newborn Physiology

- 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

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Hernia and Hydorcele

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

Hernia and Hydorcele

- Fluid may get trapped in tunica but PV closed: non-communicating hydorcele
- 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 + 6-8:1
- Premature: up to 70% have hernia
- 60% incarcerate first 6 mos
- Inguinal incision, high litigation sac, excision of hydorcele

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 Daiphragmatic 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
  - Decreases/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

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Congenital Diaphragmatic Hernia

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Congenital Diaphragmatic Hernia

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Abdominal Wall Defects

- Omphalocele
  - Sac compose of peritoneum and amniotic membrane
  - Comes through umbilical cord
  - Contains liver
  - Failure 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 exstrophy, colon, atresia, ARM's, sacral anomalies, meningomyelocele
  - Beckwith-Wiedemann syndrome: macroglosia, giantism, 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 report ventral hermia 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

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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: Gastroschisis

- Initial Management
  - IVF
  - Antibiotics
  - Bowel bag
  - NG decompression
- Operative Management
  - Primary closure – 80%
  - Staged closure

Abdominal Wall Defects: Gastroschisis

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

Abdominal Wall Defects: Gastroschisis

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Abdominal Wall Defects

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Tracheoesophageal Fistula and Esophageal Atresia

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

Tracheoesophageal Fistula and Esophageal Atresia

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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 polyhydraminios
  - 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
  - Gatrostomy 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

- Hypertophy 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 lleus
  - Electrolyte abnormalities
  - Sepsis
  - NEC
- History
  - Polyhydraminios on prenatal US
  - Bilious emesis
  - Abdominal distention
  - Failure to pass meconium

Neonatal Bowel Obstruction

- 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

Neonatal Bowel Obstruction

- 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% Downs's syndrome
  - Causes; duodenal atresia/web, malrotation-Ladd's bands, annular pancreas
  - Resection of web
  - Duodenoduodenostomy
  - Ladd's procedure

Duodenal Obstruction

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Duodenal Obstruction

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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 anastamosis (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

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Jejuno-ileal Atresia

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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

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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

Malrotation

- 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

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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
    - Gastorgraffin 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
  - Anastamotic 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: dilated bowel loops
- Gastrografin 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 gangilion cells in intermuscular and submucoast plexuses, 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

Hirschprung's Disease

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

Hirschprung's Disease

- Treatment
  - Colostomy then pull through
  - Primary pull through
- Outcome
  - Anal strictures
  - Enetrocolitis
  - 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%