Affecting the Young and the Old: Obesity

Disclosures

• None

Objectives

• Understand Importance of Pediatric Obesity
• Impact on Physiology
• Preoperative Assessment
• Intra-operative Management
• PACU & the obese pediatric Patient
Defining Obesity

- Gender specific charts
- Overweight: BMI ≥85 and ≤ 95 percentile
- Obesity: ≥95 percentile
- Example:
  - 12 yo: 24-25
  - 15 yo: 27-28
  - 18 yo: 29-30
- Example:
- BMI of 20
  - 15 yo: 50 percentile
  - 7 yo: 95 percentile

CDC.gov

How big is the problem?

- Obese & overweight children: 32% percent of population
- 2008: obesity
  - 6-11 yo: 19.6%
  - 12 to 19 = 18.1%
- Rapidly increasing
  - 1960-1980: 4-7% of children were overweight
  - 1990: 16%
- More than 9 million adolescents and children

Long-term effects

- 20% of obese toddlers become overweight adults
- 70-80% of obese adolescents will be obese adults
- Obesity more refractory with higher BMIs
- Of mortality of those with a >95% BMI in adolescence
- Diabetes (Dx in adolescence): shortens life expectancy by 20 years.
Causes

- 90% due to excessive calorie consumption/low energy expenditure
- <10% have a unique medical cause
- 1-5% due to specific syndromes e.g. Prader-Willi, Laurence-Moon-Biedal
- Infants who are SGA and have rapid weight gain in early infancy - prone to central obesity
- Breastfeeding & Duration – inverse association with development of obesity
- Formula feeding – increases likelihood of child becoming overweight

Physiology - Respiratory

- Higher incidence of Asthma (30%)
  - Positive Correlation between increasing BMI & Asthma incidence and severity
  - F > M
- Increased incidence of URI
- PFTs: Similar changes to adult patients
  - Decreased FRC
  - FRC can fall below Closing volume → alveoli closure → atelectasis, V/Q mismatch and hypoxemia
  - ERV, VC, FEV1, Dec FEF25-75, DLCO
  - Decreased lung volumes secondary to cephalad movement of diaphragm.

Respiratory - OSA

- OSA, Sleep disordered breathing
  - 15-30% with BMI >40 with sleep-disordered breathing/sleep apnea
- Severe OSA: Inc. incidence of postoperative respiratory depression & airway obstruction
- Diminished ventilatory response to CO2
- Increased risk of postoperative respiratory depression with use of systemic opioids
  - Some children with OSA increased sensitivity to both analgesic respiratory depressant effects of opioids
Cardiovascular

- Adolescents with obesity
  - HTN
  - LV hypertrophy
- Lower arterial compliance & lower distensibility of arterial vasculature
  - Weight loss leads to reversal of these changes
- CO & blood volume increased
  - CO increased 0.1L/min per KG of adipose
  - Due to inc blood volume and stroke volume

CV Continued

- O2 consumption and CO2 production are increased
- Increased O2 demand leads to increased workload of heart
- Most changes resolve with weight loss
- Adolescents
  - Shown to have higher LV mass
  - BMI >40: cardiac deconditioning – less than half able to achieve anaerobic threshold

Endocrinology

- 40-50% suffer from metabolic syndrome
- 45% of diabetic in children (US) are now caused by type 2 DM
  - Previously 90% of DM was Type I in children
- Insulin resistance/Metabolic syndrome
- Polycystic Ovarian Syndrome
- Dyslipidemia
Gastrointestinal

- GERD – 20% of severely obese children
  - 2% in normal children
  - 2 hour clear liquid fasting remains sufficient
- Steatosis (80%) – generally asymptomatic
- Rare progression to hepatic fibrosis, nonETOH acute steatohepatitis or cirrhosis

Other

- Neurological – Pseudotumor cerebri
- Orthopedic- slipped femoral epiphysis
- Psychological – bias found as early as 6 or 7 years of age

Pre-operative Assessment

- Airway Evaluation
  - As in adults thorough exam is key
  - Look for excess tissue distribution
  - Screen for OSA, sleep disordered breathing
- Co-morbid conditions
  - HTN, DM, asthma, OSA, GERD
- Venous Access
Airway

- Most will not have a difficult mask ventilation, DL, or tracheal intubation
- But increased adipose tissue may be present in tongue, pharynx, neck
- Same incidence of difficult DL? Or more?
- Increased incidence of difficult mask ventilation
- LMA: choose size according to TBW – better ventilation conditions

Intra-operative Management

- Airway
  - Ramping
  - Appropriate LMA sizing
  - Oral/ NP airway
  - Be prepared for difficulties – pre oxygenate if able
- Positioning
- Medications
  - Dosing – obese pediatric patients are both under and overdosed

Pharmacology

- Lack of information of pharmacokinetics and pharmacodynamics of common drugs in obese children
- Possible alteration in hepatic metabolism
- IBW ≠ LBW
  - Obese pt increased adipose tissue + increased LBW
  - LBW = IBW + 0.3 (TBW – IBW)
Pharmacology

• Highly lipophilic - increased Vd in general
  – Not 100% true
  – Propofol does not show increased Vd in obese pts
  – Midazolam increased VD in obese pts
    • No studies in children
• Propofol
  – Initial dose based on IBW
  – Infusion based on TBW
  – Lipophilic but possible less accumulation due to poor perfusion of adipose tissue & significant

Pharmacology

• NMBDs
  – Rocuronium, Vecuronium – distribute to lean body mass
    • Prolonged time to recovery prolonged when dosed according to TBW
  – Succinylcholine: based on TBW
    • Has been studied pharmacokinetically in obese children
    • Is hydrophilic but obese population has increased pseudocholinesterase activity
  – Cisatricurium; prolonged duration of action when given according to TBW (previously reported to not be altered with obesity)

Pharmacology

• Opioids
  – Sufentanil, Fentanyl: increased Vd – distribution to adipose and LBM
    • Dose based on TBW
  – Remifentanil – smaller Vd in obese patients
• Inhalation agents
  – Isoflurane with prolonged recovery compared to sevoflurane and desflurane.
Regional Anesthesia

- Beneficial as peripheral nerve blocks/neuraxial blockade limits systemic opioid
- Obese adults – smaller epidural volume & lumbar CSF with increased block height
  - No data in children

Bariatric Surgery in Adolescents

Criteria
- BMI
  - >35: Type 2 DM, AHI >15, pseudotumor cerebri, severe steatohepatitis
  - >40: AHI ≥ 25 events per hour, HTN, insulin resistance, dyslipidemia
- Tanner stage: IV or V
- Skeletal maturity: ≥ 95%
- Adolescent: ability to understand post-operative changes
- Psychosocial: evidence for social support, motivation, mature decision making and treatment of any comorbid psychiatric conditions

Complications
- Adolescence period of poor compliance with medical regimens (40-50% in other chronic diseases)
- Poor long term compliance with vitamin/mineral supplementation
- Increased length of stay
- Increased incidence of adverse outcomes in peri-operative period
- Increased frequency of unexpected hospital admission
- Increased risk of post-operative upper airway obstruction

Post-operative care
Some specifics

- No difference in postoperative respiratory complications between normal and overweight children
- Significantly higher incidence of complications in obese children

PACU

- Be prepared for post-operative respiratory concerns
- Exercise caution with opioids
- Use alternative medications to opioids
- Recognize airway obstruction

Bibliography

- Fard, Earl S. The epidemiology of obesity and asthma. The Journal of Allergy and Clinical Immunology. 115(3), (2005)897-909.