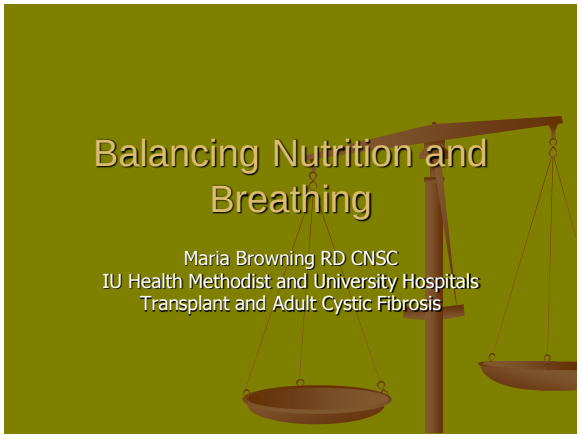


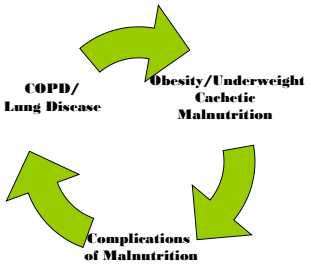
Objectives

- Define basic nutrition terminology and feeding routes
- Understand the relationship between malnutrition and respiration in chronic and acute illness
- Determine appropriate nutrition delivery for chronic and acute illness
- Review relationship between lung disease and micronutrients
- Understand the relationship between Glucocorticoid therapy and nutrition

Nutrition Terms and Feeding Routes

- BMI- Body Mass Index
  - 18.5-24.9 Normal; 25-30 Overweight; 30-35 Obese; 35+ morbid obesity
- Ideal Body Weight- wt associated with the lowest risk of morbidity and mortality
- Resting Energy Expenditure (REE)- calories expended for involuntary metabolism and inactive muscle
- Lean Body Mass (LBM)- body mass other than adipose tissue; muscle, bone and organ tissue
- Cachexia- "wasting" related to decreased appetite and intake, characterized by weight loss and muscle loss
- Enteral Nutrition- the provision of nutrients via the GI tract through a feeding tube
- Parenteral Nutrition- provision of nutrients via IV infusion for patients without a functioning GI tract
- Corpak/Dobhoff Feeding tube- a small feeding tube place past the pylorus into the small bowel

Cyclical Process of Lung Disease and Nutrition



Impact of lung disease on nutrition- Obesity

- Lung disease can lead to sedentary lifestyle
- Sometimes decreased metabolic rate
- Medical therapy to improve lung function can lead to weight gain

Impact of Obesity on Lung Disease

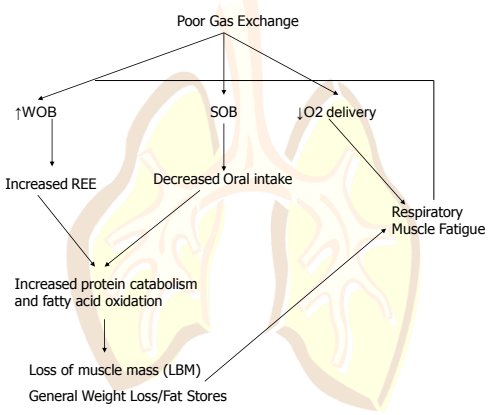
- Obesity- increased work of breathing related to increased blood volume and tissue that requires oxygenation
- Overweight status not indicative of "well nourished"
  - Vitamin and mineral deficiencies which lead to increased infections or poor gas exchange
- Altered Pulmonary Functions related to obesity can be misleading

Impact of lung disease on nutrition Underweight/Cachexia

- Malnutrition- decreased ATP production related to depleted stores of glycogen and phosphate
  - Often seen in groups with increased energy requirements
  - Lung disease can increase energy requirements because work of breathing increased
  - Work of breathing increases related to mismatched ventilation and perfusion- inefficient or decreased gas exchange
  - Poor gas exchange leads to poor O2 delivery to muscle in tissues causing muscle fatigue
  - Muscle fatigue leads to increased work of breathing

Malnutrition and Chronic Lung Disease

- Hypermetabolic related to increased work of breathing
- Decreased PO intake related to fatigue and SOB
- Increased Protein catabolism- related to depleted energy stores and decreased intake
- All lead to LBM depletions

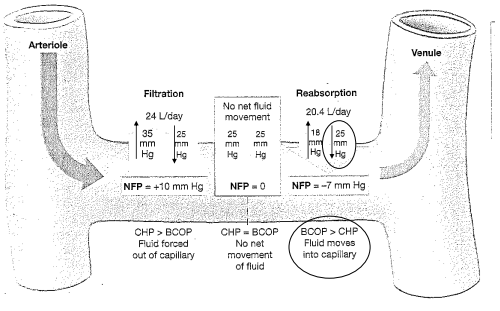


Complications of Malnutrition in Chronic Lung Disease Independent of Weight

- Decreased Immune Response
  - Leads to increased pulmonary infections with decreased ability to repair lung fibers
  - Causes weakened and structurally abnormal lung matrix
- Decreased Surfactant Production
  - Result in dramatic increase in work of breathing
  - Can occur even if starvation period is short lived
- Compromised Antioxidant Protective Mechanisms
  - Protein, vitamin and mineral deficiencies leave tissues open to oxidation
  - Increases inflammation and release of free radicals and proteolytic enzymes

Additional Complications of Malnutrition

- Severe hypoalbuminemia
  - Not limited to underweight or cachetic patients
  - Decreased colloid osmotic pressure in capillaries
  - Increase vascular fluid losses
  - Increased edema/increased extracellular fluid space
    - Reduced intracellular fluid space and decreased functional residual capacity and pulmonary reserve.



Martini, Frederic et al; Fundamentals of Anatomy and Physiology, SanFrancisco, CA; Pearson Benjamin Cummings, 2009.

Additional Complications of Malnutrition

- Refeeding Syndrome- occurs in a malnourished patient capable of anabolism after instituting adequate or supplemental nutrition
  - Characterized by low phosphorus, potassium, magnesium, fluid shifts and glucose abnormalities
  - Low phosphorus levels are best indicator of morbidity and mortality because of phosphorus involvement in energy production and O2 delivery.
    - 2,3 BPG

Impact of Mechanical Ventilation on Nutrition

- Iatrogenic Malnutrition
  - Related to delayed initiation of nutrition support, holding tube feeds for test or intolerance, or inadequate provision of calories
  - Refeeding syndrome
- Pulmonary Edema- related to change in capillary pressure at the point of gas exchange: Heart failure, infection or inflammation
  - Impaired gas exchange
- Increased gastric pH
- Increased aspiration risk- increases as PEEP increases

How Do We Minimize Complications of Malnutrition in Patients with Chronic and/or Acute Lung Disease?

Provision of Adequate Calories

- Overfeeding leads to excessive CO2 production
- Underfeeding leads to inadequate energy production
- PO diet vs Nutrition support dependent ventilation status and degree of malnutrition
  - NG/OG vs Dobhoff/Corpak vs long term enteral access such as PEG or PEGJ vs parenteral nutrition

Nutrition Support Route

- Enteral always preferred over parenteral
- Weigh risks and benefits of feeding stomach vs small bowel
  - If nutrition administered via small bowel there is a decreased risk of tube feeding aspiration to lungs, but increased risk of bacterial growth in stomach related to increase in gastric pH
  - Current ASPEN guidelines suggest gastric feeds are safe unless there is evidence of gastric intolerance
  - Reduce risk of aspiration with gastric feeds by
    - raising HOB to 30°- increased wound risks
    - Use continuous infusion rates as opposed to bolus feedings
    - Use of Prokinetic agents- reglan or erythromycin

Choosing a Formula

- "Patients with ARDS and severe acute lung injury (ALI) should be placed on an enteral formulation characterized by an anti inflammatory lipid profile (omega3 fish oils, borage oil) and antioxidants."
  - Grade A
  - Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill patient: SCCM and ASPEN. JPEN 2009; 33(3): 277-316
- Traditional Pulmonary Formulations
  - High fat to carbohydrate ratio, thought to promote weaning from ventilator
  - No conclusive evidence of decreased ventilator days
  - Key study indicated that overfeeding was more indicative of prolonged ventilation

How much is enough?

- Estimate REE through various methods and calculations
  - Indirect Calorimetry- gold standard, but many limitations
  - Harris Benedict Equation- tends to underestimate needs in COPD patients
  - 25-30 kcal/kg
  - Mifflin St Jeor equation, Penn State Equation, Ireton-Jones equation etc.
    - Calculation chosen based on patients current clinical condition and obese vs non-obese patients

Feeding Rates and Schedules

- Rate dependent on ventilation status, other caloric infusions, type of formula and tube position
  - MIV, sedation
  - Calorically dense formulas run at a lower rate
  - Stomach can handle larger volume than small bowel
- Continuous vs Nocturnal vs Bolus feeds
- Trophic or Goal Rate

Adjusting PO diet

- Decrease intake related to:
  - SOB, early satiety
- Consider smaller more frequent meals
  - Avoid overeating
- Encourage adequate intake early in the morning for energy to last throughout the day
- Avoid foods that cause bloating
- Decreased Na to reduce swelling and total blood volume

Eating to achieve wt goals

- 3500 kcal=1lb
  - Add or subtract 500 kcal/day to gain or lose 1lb/week
- Sometimes calorie goals must be adjusted based on clinical manifestation of gaining or losing

Micronutrient deficiencies

- Vitamin A- Decreased immune response can lead to increased lung infections
- Vitamin D- Decreased specific immunity, decreased bone density
- Vitamin E- hemolytic anemia- decreased total red blood cells
- Zinc- necessary enzyme cofactor for Carbonic anhydrase ($CO_2 + H_2O \rightleftarrows HCO_3 + H$)
  - Lack of carbonic anhydrase can promote CO_2 retention
- Calcium- muscle weakness and neurological impairments
- Iron- Binds O_2
- Selenium- powerful antioxidant

Glucocorticoids and Nutrition

- Increased appetite- weight gain
- Fluid retention
- Steroid induced DM
  - Treat with diet and medication as necessary
- Steroid induced bone loss/osteoporosis
  - Pt with prednisone dose of 7.5mg or more daily should be on a Bisphosphonate
- Delayed wound healing

Questions?????

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