MYTHS AND FACTS REGARDING NUTRITION THERAPY IN CRITICALLY ILL ADULTS

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FINANCIAL DISCLOSURES
LEARNING OBJECTIVES

Upon completion of this presentation, the learner will be able to:

1. Understand what albumin and prealbumin can or can not tell us about critically ill patients.
2. Describe the benefits of early enteral nutrition.
3. Understand what indirect calorimetry is and why it is done.

MYTH OR FACT?

- Mr. Jones was in his usual state of health at his home when he started having difficulty breathing. He was brought to the hospital and admitted to the ICU with respiratory failure secondary to community acquired pneumonia. Mr. Jone’s CMP revealed a serum albumin level of 2.6 g/dL (NL 3.5 – 5 g/dL). There is a pending consult for the dietitian: Please see pt for malnutrition. From this information an appropriate assumption would be that the patient had not been receiving adequate protein in his diet at home.
MYTH OR FACT?

- Myth
- It is not appropriate to use an albumin level in a critically ill patient to assess the patient’s nutritional status.

“Serum albumin is of virtually no value in assessment or monitoring of nutritional status but is mentioned here because, surprisingly, there still remain some clinicians who use it as part of their nutritional assessment.”

STRUCTURE OF SERUM ALBUMIN

- Polypeptide chain
- ~580 amino acids
- Folded into three structural domains
- Does not contain carbohydrate moieties

http://www.ebi.ac.uk/
ALBUMIN

- Large body pool
- Half-life (14 - 20 days)
- Synthesized by the liver (about 14g/day)
- Only about 5% is synthesized daily
- ~40% of albumin is in the blood stream
  ~60% is in interstitial spaces
- Albumin moves between intravascular and extravascular spaces often
- A negative acute phase reactant

ALBUMIN

- Serum carrier protein
  - Transports fatty acids released by adipose tissue
  - Transports bilirubin from extrahepatic tissues to the liver.
  - Transports many medications such as some antibiotics and anti-inflammatories
- Aids in regulating oncotic pressure
  - The negative charges on albumin cause positive ions to move from the cells into the plasma. This increases the oncotic pressure in the blood.
- Causes some potential toxins to be harmless
- Part of human serum that provides most of antioxidant capacity
**Albunin**

Aspects that decrease albumin levels:
- Overhydration/ascites
- Liver failure
- Infection
- Burns
- Kwashiorkor
- Inflammation/acute phase response
- Cancer
- Corticosteroid Use
- Zinc deficiency
- Pregnancy

Aspects that increase albumin levels:
- Dehydration
- Blood transfusion
- IV albumin
ACUTE PHASE RESPONSE

1. Event/condition $\rightarrow$ $\uparrow$ in pro-inflammatory cytokines (IL-6, TNF-alpha, etc)

$\downarrow \uparrow$ production of positive acute phase proteins (factor B, fibrinogen, CRP, etc)

$\downarrow \downarrow$ production of negative acute phase proteins (alb, PAB, ILGF I)

$\uparrow$ Rate of transcapillary escape into interstitial fluid

PREALBUMIN (TRANSTHYRETIN)

Functions:
- Transports thyroxine
- Carrier for retinol binding protein

Aspects that may increase PAB levels
- Severe renal failure
- Oral contraceptives
- Corticosteroid medications
PREALBUMIN
(TRANSTHYRETIN)

Aspects that may decrease PAB
- Liver failure
- Infection
- Acute phase response
- Dialysis
- Hyperthyroid
- Pregnancy
- Significant hyperglycemia
- Trauma

ALBUMIN AND OUTCOMES

There is evidence that serum albumin is a good prognostic indicator.

Lower levels are associated with increased morbidity, mortality, LOS and complication rates.

We want to ensure that these sicker patients receive optimal nutrition therapy.
CASE STUDY

- 65 year old male with PMH of bladder cancer. He is s/p resection and radiation.
- Nutrition Consult: Pt is too weak to fix meals. Ordering pre-albumin. Pt cachetic.
- Nutrition diagnosis statement: Malnutrition r/t poor intake 2/2 weakness/inability to prepare meals AEB significant weight loss past 30 days.
- Glu 100, Na 127, K 4.5, BUN 13, Cr 0.7, Ca 8.4, Cl 88, CO2 36
- Prealbumin 29mg/dL (Reference range: 18 – 38)

MYTH OR FACT

- Mrs. Jones was admitted to the ICU with hypoxic respiratory failure secondary to sepsis at 8:00 am Monday morning. One of the goals of the interdisciplinary team is to start enteral nutrition support before 8:00 am Wednesday morning.
MYTH OR FACT

- Fact
- Early Enteral Nutrition (EEN) has been defined as “within 24-48 hours from admission to ICU”.
- Dr. McClave and Dr. Heyland reported in their article, “The physiologic response and associated benefits from provision of early enterl nutrition.” that there is a “window of opportunity” in the first 24 – 48 hours to obtain the benefits of EEN.

BENEFITS OF EEN
WHAT IS YOUR GUT FEELING?
EFFECTS OF NO NUTRITION ON GUT IN CRITICAL ILLNESS

- Loss of functional and structural integrity of the intestinal epithelium
  - The sicker the patient, the greater the opening of the paracellular channels between epithelial cells.
  - Decreased contractility of the gut increases the population of pathogenic bacteria.
  - These bacteria (e.g., Pseudomonas aeruginosa) change into a virulent phase.
  - Increased permeability allows bacteria to activate macrophages when activated cause neutrophils to travel to other sites (lungs, liver, kidneys) and contribute to further oxidative stress.
  - Increases risk of developing pneumonia and ARDS.

BENEFITS OF ENTERAL NUTRIENTS FOR THE GUT

- Less gut permeability
- Stimulate intestinal contractility
- Stimulate release of IgA
- Anti-inflammatory effect is created
- Promotes good bacteria – produce SCFA (e.g., butyrate)
OUTCOMES OF EEN IN CRITICALLY ILL ADULTS

1. EEN, when compared to delayed nutrient intake, is associated with a trend towards reduction in mortality in critically ill patients.
2. EEN, when compared to delayed nutrient intake, is associated with a significant reduction in infectious complications.
3. EEN, when compared to delayed nutrient intake has no effect on ICU or hospital length of stay.
4. EEN, when compared to delayed nutrient intake improves nutritional intake.

OUTCOMES OF EEN IN CRITICALLY ILL ADULTS

- A cumulative caloric deficit of > 10,000 kcals in the first week of hospitalization is associated with worse clinical outcomes.
  - Longer ICU LOS
  - More days on mechanical ventilation
  - More complications
- ABCD?
  - Airway
  - Breathing
  - Circulation
  - Diet
- EEN OBSESSION!
MYTH OR FACT

- There are many predicative equations to calculate a patient’s resting energy expenditure (REE). Therefore, it is not worth the increased time or expense required to check an indirect calorimetry.

MYTH OR FACT

- Myth
- Indirect Calorimetry is still the gold standard for determining a patient’s energy needs.
CALORIMETRY

- Direct Calorimetry: the measurement of the amount of heat produced in chemical reactions by a person in a closed chamber.

INDIRECT CALORIMETRY

Factors that effect accuracy of predictive eqns

- Trauma
- Multi-system organ failure
- Use of paralytic agents/sedation
- Large or multiple open wounds
- Spinal cord injury
- Not responding to nutrition support as predicted
- Sepsis
- SIRS
- Burns
- Organ transplants
- Malnutrition with altered body composition
INDIRECT CALORIMETRY

- The Purpose: to determine a patient’s resting energy expenditure (REE).

Why do we care?

- The metabolic stress of acute illness superimposed on malnutrition is associated with negative patient outcomes and increased healthcare costs”.

  Jennifer A. Wooley, MS, RD, CNSD

- Multiple studies have shown that a caloric deficit (4,000 – 10,000 kcals) worsens outcomes such as mortality, ICU LOS, vent days, ARDS and sepsis.
CONSEQUENCES OF OVER OR UNDER FEEDING

<table>
<thead>
<tr>
<th>Overfeeding</th>
<th>Underfeeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hyperglycemia</td>
<td>• Decreased respiratory muscle strength</td>
</tr>
<tr>
<td>• Azotemia</td>
<td>• Failure to wean from vent</td>
</tr>
<tr>
<td>• Failure to wean from mechanical</td>
<td>• Impaired organ function</td>
</tr>
<tr>
<td>ventilation</td>
<td>• Immunosuppression</td>
</tr>
<tr>
<td>• Immunosuppression</td>
<td>• Poor wound healing</td>
</tr>
<tr>
<td></td>
<td>• Increased risk of infection</td>
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</tbody>
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INDIRECT CALORIMETRY

- The measurement:
  - Metabolic cart
  - VO2 and VCO2 are measured
  - Modified Weir Equation
  - Provides the REE in kcals/day
  - Respiratory Quotient (RQ) is also provided in an indirect calorimetry report.
INDIRECT CALORIMETRY

- RQ (respiratory quotient) is calculated by the ratio of VCO2 to VO2.
- The amount of oxygen consumed and carbon dioxide produced are constant for each type of nutrient.

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>RQ</th>
</tr>
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<tbody>
<tr>
<td>Fat</td>
<td>0.70</td>
</tr>
<tr>
<td>Protein</td>
<td>0.80</td>
</tr>
<tr>
<td>Carbohydrate (Glucose)</td>
<td>0.95-1.00</td>
</tr>
<tr>
<td>Mixed Diet</td>
<td>0.85</td>
</tr>
</tbody>
</table>
INDIRECT CALORIMETRY
INTERPRETING IC MEASUREMENTS:

- The RQ should not be used to determine if a patient is being under or overfed due to the low sensitivity and specificity of the RQ.

- RQ stays in relatively narrow range of 0.67 – 1.2 in humans. Outside this range suggest an invalid test

- Nutrition support should be evaluated by comparing the amount of calories infused with the caloric requirements as measured by the REE.

INDIRECT CALORIMETRY
CONDITIONS THAT LIMIT ACCURACY OF IC

- Significant changes in vent in last 2 hours
- Respiratory rate >35 breaths/min
- PEEP >10
- Air leaks in respiratory circuit
- FIO2 >60%
- Pain/agitation
- Receiving bicarbonate solution
- Significant nursing cares in last 2 hours
- HD in last 2-3 hours
- <24 hours after surgery
INDIRECT CALORIMETRY
CONDITIONS FOR OPTIMAL RESULTS

- Nutrition can be running if it is continuous
- Without continuous feeds, pt should be fasting for at least 5 hours
- No recent significant physical activity
- Typical room conditions
- In synchrony with ventilator
- Achieve steady state for 5 consecutive minutes
- If unable to achieve steady state but the coefficient of variation is 9.0 or less, study should be conducted for 30 minutes.

INDIRECT CALORIMETRY
OTHER CONSIDERATIONS

- Types of Indirect Calorimeters
  - Metabolic cart
  - Handheld indirect calorimeter
  - Integrated calorimeter

- Costs
  - Metabolic cart
  - Calibration gasses
  - Sample lines
  - Time of personnel to conduct and interpret studies.
CONCLUSION

- Albumin and Prealbumin are not good indicators of nutritional status in critically ill patients. These values should not be used to assess the efficacy of nutrition support.
- Early enteral nutrition has many benefits and should be initiated in critically ill patients with a functional GI tract within 24-48 hours of admission or intubation.
- It is difficult to estimate the energy needs of critically ill patients. Indirect Calorimetry is the most accurate way to determine energy needs in this population.

QUESTIONS
REFERENCES


