The Perspective of a RD working with Civilian Total Brain Injury

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Overview

- Rationale for nutrition support in TBI
- Review of evidence supporting IOM Workshop concerns from the perspective of the bedside Nutrition Support Dietitian
Workshop Questions: What evidence supports:

- Nutrition Standards of Practice & Clinical Guidelines
- Enteral or Parenteral Nutrition Use
- Use or avoidance of specific nutrients or diets
- Specific nutrition formulations
- Medication Impact
Rationale for Nutrition Support
Rationale for aggressive Nutrition Support

- TBI patients have metabolic needs ~100 - 200% of basal needs
- Highly catabolic/ strong inflammatory response
  - Non-stressed individuals lose 200-300 g/day
  - TBI pts lose ~1000 g muscle tissue day;
    - ↑ glucose requirements
    - Deriving energy from ketone bodies may not occur
Effect of Injury on Energy Expenditure

- Major Burn
- Major Trauma or Surgery with Critical Illness
- Major Surgery Uncomplicated
- Starvation

% Resting Metabolic Rate vs Days

Normal Range

Insult or Starvation
### Chemical messengers effects on Inflammatory Response

<table>
<thead>
<tr>
<th>Messenger</th>
<th>Function</th>
<th>Result</th>
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<tbody>
<tr>
<td>Cortisol</td>
<td>↑ gluconeogenesis  ↓ proteolysis</td>
<td>↑ rate of muscle catabolism</td>
</tr>
<tr>
<td>Glucagon</td>
<td>↑ gluconeogenesis</td>
<td>↑ rate of muscle catabolism</td>
</tr>
<tr>
<td>Catecholemines (epinephrine, norepinephrine)</td>
<td>↑ insulin resistance</td>
<td>↑ rate of muscle catabolism</td>
</tr>
<tr>
<td>Cytocines (IL-1, IL-6, TNF)</td>
<td>Activates immune response, ↑ RMR</td>
<td>↑ rate of muscle catabolism</td>
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Malnourished TBI patients entering rehabilitation have ~28 days longer length of stay than those who are well-nourished (Denes 2004)
What are the typical Standards of Care at the bedside and what are they based on?
Standards of Care

- Early nutrition (24-72 hrs after injury)
  - Limited studies in TBI population
  - Benefits in other populations include
    - Lower risk of infection
    - Decreased gut permeability
    - Decreased activation/release of inflammatory cytokines
    - Decreased ICU, hospital length of stay
    - Attenuates rate of catabolism of skeletal muscle
  - Must be properly resuscitated prior to initiation of nutrition
When to start nutrition support?

- Evidence of early nutrition (within 5 days of trauma) having positive effect on 2-week mortality after TBI (Härtl, 2008)
What are Energy/Calorie Goals?

- Energy Requirements:
  - Prediction formulas tend to over/under-predict calorie needs
    - Harris Benedict equation + activity factor of 1.2 - 1.5 commonly used
  - Indirect Calorimetry is the gold standard
  - Calorie needs with barbituate coma, Propofol and other sedatives
  - Calorie needs with infection, fever, posturing, storming, other injuries
What are Nitrogen/Protein Goals?

- Protein/Nitrogen needs
  - Nitrogen excretion much higher in TBI pts
  - Typically feed patients 1.5 – 2.0 g/kg protein
  - >2.0 g/kg: varying results regarding correction of negative nitrogen balance in studies
What is the best route of delivery: Enteral vs. Parenteral

- Enteral Nutrition (EN) preferred route
  - Gut barrier maintenance
  - Cost effective
Continuous EN

- Better tolerated than bolus/intermittent EN in ICU setting
  - Limit interruptions!
    - Unnecessary for certain procedures—NPO at midnight should not be automatic
    - Low rate of gastric residuals
Gastric vs. Post-pyloric EN

- Most patients fed in stomach
- Post-pyloric if not tolerated
- Evidence in TBI population that post-pyloric feeds may be better tolerated
- Use of motility agents—Reglan, Erythromycin
Parenteral Nutrition

- Least desirable
- Has place
Determining Nutrition Goals

- Assessment by Registered Dietitian
  - Within 48 hours of admit to ICU (usually <24 hrs)
  - Rounds with team daily
  - IDs nutrition goals
  - Accessibility important
  - Educates healthcare team

- Implementing RD's recommendations correlate with ↓length of stay, ↑albumin, wt gains
  (Braga 2006)
Challenging to reach goals
Nutrition Support for Children with Severe Traumatic Brain Injury (Maloukti, et. Al 2010.; pending publication)

Figure 3. Nutritional Goals Met on PICU Day 7 between 1997-2007 (n = 81)

RDs started rounding with intensivist team.
Implementing Goals

**Nutrition protocols**

- Increases % of goal calories provided
- Likely has greatest impact on successful delivery of EN in 1st week of neurocritical illness (Zarbock, 2008)
Enteral Nutrition Protocol

Harborview Medical Center’s ICU Nutrition Support Protocol

ON ADMISSION:

Should this patient receive nutrition support?

- Yes

  Can EN be started within 24 hours?
  - Yes
    - Can gastric EN be started?
      - Yes
        - Gastric Challenge
          - Insert gastric feeding tube
          - Full-strength formula
          - Routine prokinetic
          - Assess residuals q 4 hours

          At 48 hours:  Is rate ≥50% goal?
            - No
              - Increase to achieve & maintain goal rate
              - Discontinue prokinetic
            - Yes
              - Post-Pyloric Feeds
                - Place post-pyloric or jejunal feeding tube
                  - At bedside (with confirmatory KUB)
                  - With fluoroscopy or endoscopy
                  - In OR (e.g. in open abdomen, pancreatitis)
                  - Full-strength formula (start 25ml/hr)
                  - Continue prokinetic
                  - Ensure bowel program initiated

              - At 5 days:  Is rate ≥50% goal? (or ≥80% if malnourished)
                - Yes
                  - Initiate / continue TPN
                  - Daily EN challenges
                  - Continue EN at maximum tolerated rate
                - No

  - No
    - Possible (but not necessarily absolute) contraindications, to be discussed with primary team, include:
      - Temporarily-stapled bowel
      - Bowel obstruction
      - Massive GI bleed
      - Open abdomen
    - Severe IBD
    - Ischemic bowel
    - Enteric Fistulae

  - Ongoing monitoring of need for nutrition support

Ongoing monitoring of need for nutrition support

Reassess daily for EN eligibility

Total Parenteral Nutrition

- Begin by 5 days

• Temporarily-stapled bowel
• Bowel obstruction
• Massive GI bleed
• Open abdomen
• Severe IBD
• Ischemic bowel
• Enteric Fistulae

Harborview Medical Center’s ICU Nutrition Support Protocol
INTERRUPTION OF ENTERAL FEEDS

Hold feeds for 2 hrs if q 4 hr residual ≥ 300ml
Hold feeds for increasing abdominal distension, abdominal pain or vomiting
Hold feeds for increasing abdominal distension, abdominal pain or vomiting
Hold feeds for increasing abdominal distension, abdominal pain or vomiting

Hold feeds 6 hours prior to surgery if:
- patient currently extubated
- patient will need ETT change in OR (e.g. thoracic surgery)
- oral/ airway surgery (including placing tracheostomy)
- abdominal surgery, proning required (unless surgeon requests otherwise)

FOR ALL OTHER INTUBATED PATIENTS UNDERGOING SURGERY OR ANGIOGRAPHY
- Stop feeds at time of leaving ICU to go to OR

INITIATING ENTERAL FEEDS

Standard Formulas:
(e.g. Promote with Fiber, Jevity 1.2, Osmolite 1.0)

- Gastric
  - Begin full strength at 50ml/hr*
  - Advance by 25ml/hr q 4-8 hours to goal

- Post pyloric
  - Begin full strength at 25ml/hr* for the first 12 hrs
  - Advance by 25ml/hr q 4-8 hrs to goal

Concentrated/Elemental Formulas:
(e.g. Vivonex, Osmolite 1.5, TwoCal HN, Nepro)

- Begin elemental and concentrated formulas at 25ml/hr
- Advance by 25ml/hr q 4-8 hr to goal

*Initiate at a slower rate if concern exists regarding gastric motility
ICU Enteral Nutrition Protocol Orders - Adult

- Place feeding tube; obtain portable supine abdominal radiograph. Resident/Fellow to confirm placement.
- Use existing NGT/OGT; obtain a portable supine abdominal radiograph. Resident/Fellow to confirm placement.
- Begin Full Strength Promite with Fiber at 50mL/hr, goal rate _______________ mL/hr.
- Begin Full Strength Osmolite 1.5 at __________ mL/hr, goal rate _______________ mL/hr.
- Begin ____________ mL/hr, goal rate _______________ mL/hr.
- Adjust tube feeding rate to ____________ mL/hr if Propofol rate is ≥ _______________ mL/hr.
- Begin Prostat ____________ mL per FT.
- Begin Glutamine 1 packet per FT.

- Discontinue previous orders for Metoclopramide.
- Metoclopramide 10mg IV every 6 hours x 2 days (normal renal function), then 10mg IV every 6 hours PRN thereafter to promote gastric emptying and prevent high residuals.
- Metoclopramide 5 mg IV every 6 hours x 2 days if renal impairment (CrCl less than 30 mL/minute), then 5 mg IV every 6 hours PRN thereafter to promote gastric emptying and prevent high residuals.
- Discontinue previous orders for Docosate, Senna and Bisacodyl.
- Docosate 250 mg per FT twice daily, hold for loose stool.
- Senna 10 mg per FT daily, hold for loose stool.
- Bisacodyl 10 mg suppository PR daily until first BM, then daily PRN for constipation.
- Multivitamin with Minerals 15 mL per FT daily.

- Check gastric residual every 4 hours and re-infuse residual content.
  - If residual < 300 mL, advance feeds 25mL until goal rate is reached.
  - If residual > 300 mL, hold for 2 hours then recheck residuals. If residuals are < 300 mL, resume at previous rate. Notify MD if not able to resume feeds.
  - Once at goal rate continue residual checks as indicated above.

- Hold tube feeding for abdominal distention, abdominal pain or emesis and notify MD.

- Continue tube feedings until leaving the ICU for intubated patients not undergoing oral, enteric or planned abdominal surgery. This policy also applies to intubated patients going to angiography.

- Every Monday check: Serum TTHY, CRP, Vit C, Zinc.
- Weekly 24 hr urine Total Nitrogen, collect sample 0630 Sunday - 0630 Monday.
- Dietitian to assess nutrition needs, order tube feeding goal rates, nutrition assessment tests and vitamins.
How to assess efficacy of support
Anthropometric Data

- Patient Weights
  - Mostly influenced by fluid gains/losses
  - Helpful in later stages after injury
Outcome Data

- Nutrition labs—highly inaccurate in ICU due to redirection of synthesis of visceral proteins
  - Look at trends vs. absolute values
  - Consider checking C-Reactive Protein along with visceral proteins

- Measurable Outcomes
  - Wound Healing
  - Ability to wean from mechanical ventilation
  - Ability to participate in rehabilitative therapies
Clinical Guidelines

- Most comprehensive nutrition guidelines from American Society of Parenteral and Enteral Nutrition (ASPEN)/ Society of Critical Care Medicine (SCCM)
  - Most commonly used by dietitians, pharmacists, MDs involved in nutrition support
  - Not specific to TBI population

- Brain Trauma foundation (BTF) nutrition guidelines:
  - Used by those involved in care of TBI patients
  - Uses studies done only on TBI population
  - Non-specific nutrition guidelines
<table>
<thead>
<tr>
<th>Guidelines pertaining to..</th>
<th>ASPEN/ SCCM</th>
<th>BTF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>No specific guidelines in TBI; Met cart gold standard</td>
<td>100-140% replacement of resting metabolism</td>
</tr>
<tr>
<td>Protein</td>
<td>1.2 – 2.0 g/kg in critically ill</td>
<td>15-20% of kcals</td>
</tr>
<tr>
<td>Timing of initiating feeds</td>
<td>24-48 hrs following admission</td>
<td>No recommendation</td>
</tr>
<tr>
<td>Dosing of EN</td>
<td>50-65% of goal by day 7</td>
<td>100% of goal by day 7</td>
</tr>
<tr>
<td>EN vs PN</td>
<td>EN preferred, PN only when necessary</td>
<td>No recommendation</td>
</tr>
<tr>
<td>Nutrition protocols</td>
<td>Should be implemented</td>
<td>No recommendation</td>
</tr>
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Clinical Guidelines

- **ASPEN/SCCM**
  - Experts in the field of critical care and nutrition from both committees
  - Prospective randomized studies primary source
    - Lack of prospective studies
  - Non-randomized studies also used
  - Grading system
  - Expert opinion
Clinical Guidelines

- BTF
  - Randomized clinical trials primary source
  - Grading system
  - Literature search
  - Neurosurgery experts, may benefit from addition of experts in nutrition support
Desirability of Enteral vs. Parenteral Support
Benefits - EN

Benefits of EN:
- Supports gut integrity
- Modulate stress and immune response
- Lower risk of infection than Parenteral Nutrition (PN)
- Reduction in hospital LOS
- Lower cost
- Quicker return of cognitive function (Taylor, et. Al)

Risks of EN:
- Feeding when gut perfusion poor can lead to gut ischemia
- Feeding intolerance in critical illness
- May not reach nutritional goals as quickly as PN
Benefits - PN

- Benefits of PN
  - Fewer interruptions in feeding
    - Reach nutrition goals reached quickly

- Risks of PN
  - Increased risk of infection
  - Increased cost
  - Increased risk of mortality
Are Specific Nutrients or Diets of Concern?

- Unknown in TBI population
- Some question about safety of glutamine
  - Conditionally essential during critical illness
  - Many benefits in other populations:
    - Anabolic/anticatabolic
    - Antioxidant
    - Fuel for dividing cells
Glutamine

- In TBI question of whether glutamine leads to glutamate concentration in interstitial fluid.
- Glutamate in brain associated w/ ICP, cerebral swelling.
Omega 3 Fatty Acids: Critical Care Setting

### Clinical Data
- ↓ inflammatory response
- Reduce sympathetic overactivity
- ↓ cardiac arrhythmias
- ↑ tissue microperfusion
- ↑ graft function
- ↓ cancer in cell lines
- Limits omega-6 immune suppression
- Maturation of CNS
- ↑ clearance

### Biochemical Data
- Biological regulators
- Cell membrane structure and function
- Influences membrane fluidity
- Alters receptors activity
- Eicosanoid metabolism
- Cytokine production
- Gene expression

Effects noted within 3 hours via parenteral route 1-3 days via enteral
Are the Nutritional Formulations Important?

- Currently use high protein, isotonic formula or condensed formula + protein modular
- No solid RCT in TBI population support use of Immune-modulating formulas
- Formulas in the future:
  - High sodium
  - Higher ratio of Omega-3 vs. Omega-6 Fatty Acids
  - Increased provision of antioxidants (Vit. E, C, Selenium)
  - Pre/probiotics
## Drug/Nutrient Interactions

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<thead>
<tr>
<th>Drug</th>
<th>Nutrient Interaction</th>
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<tr>
<td>Barbituates</td>
<td>Decrease metabolic rate</td>
</tr>
<tr>
<td>Propofol</td>
<td>n fat kcal (omega-6; pro-inflammatory)</td>
</tr>
<tr>
<td></td>
<td>n Increased urinary excretion of zinc, iron</td>
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<tr>
<td>Seizure prophylaxis</td>
<td>Increased need for vit D, folic acid</td>
</tr>
<tr>
<td>Dilantin</td>
<td>CHO interfere with absorption</td>
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<tr>
<td>Vasopressors</td>
<td>Decreased gut perfusion</td>
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Conclusions

- Nutrition therapy shown to positively affect outcomes of TBI patients
- Standards of care/ guidelines include early feeding, measurement of kcal needs vs. prediction, nutrition protocols, preference for EN vs. PN
- Lack of data specific to patient population
- Guidelines created by experts in neurosurgery as well as experts in nutrition support warranted
References


