ICU Nutrition...A Team Sport

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- Southlake Regional Health Centre, Newmarket Ontario
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Disclosures

- Invited speaker for Nestle, Baxter, Fresenius Kabi, Abbott
- No conflicts of interest to declare with regard to the content of this talk
Objectives

- Why are Critically Ill patients at risk for malnutrition?
- What are the benefits of enteral nutrition
- Why Critically Ill patients tend to be underfed...what is intolerance really and how to troubled problems
- How we do increase Nutrition provision in Critically Ill patients...ICU nutrition...a team sport
TEAM SPORT..

T - Tell the story of ICU malnutrition to your whole team 😊

E - Evaluate what nutrition is going in to your pt... RD, RN

A - Advocate for adequate intake - RD, MD, PT, RN, Pharmacist

M - Manage complications by asking your team for help ...RN, RD, MD, Pharmacist
What is Malnutrition?

Malnutrition

- A state of nutrition in which deficiency or excess (or imbalance) of energy, protein, and other nutrients causes measurable adverse effects on tissue, body form and function, and clinical outcome.

Characterized by
- Weight loss (BMI does not reflect muscle mass)
- Body composition changes (increased muscle loss with aging)

Prevalence of malnutrition in Canada*

- 69% moderate or severe using SG;  
  - tertiary care general medical ward¹
- 59% moderate risk or malnourished, several measures;  
  - older adults, general medicine, orthopedics²
- 40% high risk of PEM using comprehensive assessment;  
  - geriatric rehab³
- 45-57% under nutrition, comprehensive assessment;  
  - geriatric rehab⁴
- 40-60% moderate or severe; long term care facilities⁵

* Data from Canadian Malnutrition Task Force

2. Azad N et al. CMAJ 1999; 161(5); 511-15
Implications of Malnutrition

- Morbidity ↑
- Wound healing ↓
- Infections ↑
- Complications ↑
- Convalescence ↓

Mortality ↑

Treatment ↑

Length of hospital stay ↑

Costs ↑

Quality of life ↓

Treatment costs for malnourished patients may increase by 300% compared with costs for well-nourished patients.

Why critically ill patients are at risk for malnutrition?

- Critical illness....
- Disease and complications
- Hypermetabolic/inflammatory state
- Protein catabolism/LBM depletion
- Surgical stress
- Overall poor nutritional intake
- Inadequate nutrient delivery
- Gastrointestinal intolerance
Goals of Nutrition Support in Critically Ill Patient?

- Provide nutritional substrates to meet protein, energy vitamin/mineral requirements
- Help protect vital organs and reduce break down of skeletal muscle
- To provide nutrients needed for repair and healing of wounds and injuries
- To maintain gut barrier function
- To modulate stress response and improve outcome
- Avoid complications - physical, metabolic, infectious

Surrogate markers of success - preservation of LBM, preventing macro and micronutrient deficiencies and preventing complications associated with nutrition support
Starvation versus Stress Response

Starvation

- Metabolic rate falls
- Reduction in metabolically active tissue, activity
- In the non stressed starved state 90% calories are from fat and 5-8% from protein

Stress

- Alteration in energy needs and production
- In critical illness fat is not readily available for energy instead there is catabolism of body glucose and protein stores
- Ebb and Flow phase of critical illness
Consequences of Malnutrition

- Weight loss
- Weakness and fatigue
- Impaired ventilatory drive
- Depression / apathy
- Poor wound healing
- Impaired immune function

→ DEATH

Sarcopenia - the age related loss of LBM...the anorexia of aging
Protein Catabolism... a big problem!

- Breakdown of muscle increases in critical illness
- Use free amino acids for new protein synthesis at sites of tissue injury and at other locations in the body to regulate inflammatory and immune responses.
- The rate of muscle protein loss exceeds the gain of proteins elsewhere - body nitrogen balance strongly negative.

- Why Critically Ill Patients Are Protein Deprived L. John Hoffer and Bruce R. Bistrian *JPEN J Parenter Enteral Nutr* 2013 37: 300

From ¹Lady Davis Institute for Medical Research, Jewish General Hospital, McGill University, Montreal, Quebec, Canada, and ²Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts.
Malnutrition in the Critically Ill

A hit of injury or illness on top of sarcopenia may cause a muscle loss in 3 days that takes 3 months to regain.
Malnutrition is associated with increased morbidity

Prospective, observational study of 50 ICU patients in Israel showed strong correlation between negative energy balance and total complications

\[ P < 0.01, r = 0.75 \]

TEAM SPORT

Tell the story of ICU malnutrition to your whole team 😊
Why are we at risk for underfeeding in the ICU?

- No Enteral access
- Stoppage of feeds for tests etc.
- Gut intolerance
- Hemodynamic instability
- Guidelines - ASPEN
- Nutrition a low priority
Cohort study: % of energy and protein received between standard care n=24 an intensive medical nutrition therapy n=25

- Both groups had an accumulating calorie deficit!!
- The group with ‘no interruptions’ had a lower calorie deficit but still significant
- Likely due to delayed initiation, slow ramp-up
- Trophic feeds at request of surgeon
Cohort study: continued

- Gastrointestinal bleed
- Ileus
- Lack of an order

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Sheenan et al. Journal of the Academy of Nutrition and Dietetics

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<table>
<thead>
<tr>
<th>Reason</th>
<th>Standard care (n=24)</th>
<th>Intensive MNT (n=25)</th>
<th>P value</th>
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<tr>
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<td>0.57</td>
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<tr>
<td>Gastrointestinal bleed</td>
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<td>15</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Ileus</td>
<td>4</td>
<td>16</td>
<td>0.02*</td>
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<tr>
<td>No enteral access</td>
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<td>3</td>
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<tr>
<td>No EN prescription</td>
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<tr>
<td>Unstable</td>
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<td>2</td>
<td>0.26</td>
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*Statistically significant at P<0.05.
Prospective observational study in single, tertiary-care, level 1 trauma center - Tracked causes for interruptions and outcomes 94 pts

- Underfeeding a major challenge ICU - 30%-50% of patients do not meet their daily protein and energy requirements.
- Early and sufficient delivery of proteins as well as calories shown to influence clinically relevant outcomes such as ventilator-free days (VFDs), ICU and hospital lengths of stay (LOS), wound healing, incidence of nosocomial infections, and mortality.
- Yet, worldwide, critically ill patients receive only about 50% of prescribed enteral nutrition in the first 2 weeks after ICU admission.
Demonstrated that the most common reasons for interruptions in EN were:

1. Re/intubation/extubation
2. Major bedside interventions (tracheostomy/PEG tube placement)
3. For imaging studies

26% of these interruptions were considered avoidable

GRV > 500 mL
Prospective, multi-institutional study in 201 units from 26 countries

3390 mechanically ventilated patients in the unit and received artificial nutrition for at least 96 h

Focus on subgroups of ‘high risk’ patients (those with >7 days of mechanical ventilation, body mass index of <25 or ≥35, and those with a Nutrition Risk In the Critically ill (NUTRIC) score of)

Report low rates of novel enteral nutrition delivery techniques and supplemental parenteral nutrition in these high risk patients

Clinical Nutrition 2014
On average:

- EN was started 38.8 h after admission
- patients received 61.2% of calories and 57.6% of protein prescribed
- 74.0% of patients failed to meet the quality metric of receiving at least 80% of energy targets
- no clinically important differences in nutrition outcomes or rates of iatrogenic underfeeding in patients in different BMI groups nor by NUTRIC score
- Of all at-risk patients, 14% were ever prescribed volume-based feeds, and 15% of patients ever received supplemental parenteral nutrition.
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Calorie Deficits - Villet et al
Clinical Nutrition 2005

- 55 surgical ICU patients
- Nutritional status on admission not significant
- Neg energy balances are very frequent during severe critical illness.
- Underfeeding is correlated with ↑ number of complications - particularly infections
- Energy debt is a good marker of nutritional risk
The relationship between increasing calories/day and 60-day mortality by Body Mass Index (BMI) Alberda et al CCM

↑ Energy and Protein associated with better clinical outcomes of critically ill patients, particularly if their BMI is < 25 or > 35.

A Multicenter, Multinational Observation Study

Patients in the ICU ≥4 days (n = 2828) and a subsample in the ICU ≥12 days (n = 1584).

Percentages of prescribed protein and energy intake were compared with mortality outcomes.

Mean intake for the 12-day sample, mean intake was protein 57 g (66.7% of prescribed) and 1200 kcal (70.7% of prescribed).

Achieving at least 80% of prescribed protein intake may be important to survival and shorter time to discharge alive in ICU patients.
Adequate Nutrition May Get You Home
Effect of Caloric/Protein Deficits on the Discharge Destination of Critically Ill Surgical Patients - Yeh et al JPEN 2015

- Adult surgical ICU patients receiving >72 hours of enteral nutrition ...interventions in the early phases of critical illness may strongly influence long-term clinically important outcomes

- Of 213 critically ill surgical patients receiving EN, an accumulation of >6000 kcal or a >300-g deficit within the first 14 days of ICU stay was associated with a greater than 3-fold risk of discharge to another facility

- Conclusions: In surgical ICU patients, inadequate macronutrient delivery is associated with lower rates of discharge to home. Improved nutrition delivery may lead to better clinical outcomes after critical illness
Nutritional and Non-nutritional Benefits of Early Enteral Nutrition

- Reduce gut/lung axis of inflammation
- Maintain MALT tissue
- ↑ Production of secretory IgA at epithelial surfaces
- ↑ Muscle function, mobility, return to baseline function
- Provide micro & macronutrients, antioxidants
- Maintain lean body mass
- ↓ Muscle and tissue glycosylation
- ↑ Mitochondrial function
- ↑ Protein synthesis to meet metabolic demand
- Maintain gut integrity
- ↓ Gut permeability
- Support commensal bacteria
- Stimulate oral tolerance
- ↑ Butyrate production
- Promote insulin sensitivity, ↓ hyperglycemia (AGES)
- ↑ Absorptive capacity
- Influence anti-inflammatory receptors in GI tract
- ↓ Virulence of pathogenic organisms
- ↑ Motility, contractility
- Attenuate oxidative stress
  ↓ Systemic Inflammatory Response Syndrome (SIIRS)
- ↑ Dominance of anti-inflammatory Th2 over pro-inflammatory Th1 responses
- Modulate adhesion molecules to ↓ transendothelial migration of macrophages and neutrophils

Used with permission of Dr Daren Heyland
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Have I have you convinced that there is a problem?

What are we going to do?
Enteral Intolerance...what is it?

- Nausea, vomiting, reflux, fullness, bloating
  - Medications, tube position, delayed gastric emptying, obstruction

- Diarrhea
  - Malabsorption, c. difficile, medication

- Constipation
  - Lack of fibre, dehydration, inactivity
What actions can we take?

- Maximize nutrition intervention - make the most of what you are doing
- Prokinetics - motility agents, manage GRV ???
- Consider topping up with PN
- Don’t treat all pts the same - focus of the at risk pt - >7 days of mechanical ventilation; BMI of <25 and 35; and those with a modified NUTRIC score of 5 (Heyland 2014)
Pep Up protocol

- Goal based feeding
- Nurse driven protocol
- Start at goal rate
- Protein flush
- Use of prokinetic

**Volume Based Feeding Schedule**

<table>
<thead>
<tr>
<th>Goal total mL formula per 24h</th>
<th>Hours remaining in the day to feed 24h volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400</td>
<td>24  23  22  21  20  19  18  17  16  15  14  13  12  11  10  9</td>
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<td>2050</td>
<td>24  23  22  21  20  19  18  17  16  15  14  13  12  11  10  9</td>
</tr>
</tbody>
</table>
Fig. 2. Proportion of prescribed energy from EN according to initial EN delivery strategy.
CCPGs 2015...strategies that should be considered to optimize delivery of *Enteral Nutrition* in critically ill adult patients

- starting at target rate within 24-48h
- volume-based feeding strategies
- higher threshold of gastric residual volumes
- use of prokinetics
- concentrated feeding solutions
- small bowel feedings) should be considered
Parenteral Nutrition - when?

Dysfunction of the gastrointestinal tract

- Parenteral nutrition (PN) may be a life-saving therapy in patients with severe and chronic gastrointestinal dysfunction 1,2,3

Contraindications to oral or enteral feeding (e.g., ileus [post-surgery], risk of aspiration)

Insufficient oral or enteral intake to meet caloric requirements 4

- PN may be used to supplement enteral nutrition
- PN may also be used as the primary source of nutrition in conjunction trophic enteral feeding

Keep EN as well on if possible
Avoid early PN (Ebb phase) high glucose IV solutions (48h)

5. Thibault et al. Swiss Med Wkly. 2014;144:w13997
Consider Supplemental PN

- PN not be started in critically ill patients until all strategies to maximize EN delivery
- Early supplemental PN and high IV glucose not be used in unselected critically ill patients (i.e. low risk patients with short stay in ICU) ...based on Caesar NEJM
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Summary

• Malnutrition is a significant issue in critically ill patients
• Malnutrition can have a negative impact on patient outcomes
• Nutritional support can be delivered through the oral, enteral or parenteral route
• Enteral nutrition is indicated in patients with a functional GI tract whose oral nutrient intake is insufficient to meet needs
• Parenteral nutrition (PN) may be a life-saving therapy in patients with severe and chronic gastrointestinal dysfunction
Thank You!

What will you change in your practice?