Optimizing Nutritional Status Prior to Surgery
Enhancing Recovery and Patient Outcomes

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Objective

- Discuss Enhanced Recovery After Surgery (ERAS) protocols and implementation
- Describe the benefits of Enhanced Recovery pathways on clinical outcomes
- Review the prevalence and impact of malnutrition
- Highlight key points of nutrition management of surgical patients
Malnutrition
Surgical outcomes

Malnutrition – most important modifiable risk factor


Corkins M et al. JEPEN 2014. 38(2):186-95
Malnutrition
Prevalence

Up to 1 in 2 (30-50%) patients are malnourished at ICU admission

A 2012 study found 79% of patients identified as malnourished were normal weight, overweight, or obese

*Risk of malnutrition is highest in GI and Oncologic surgery

Estimated up to 80% of advanced patients with cancer have malnutrition

Norman K et al. *Clin Nutr* 2008; 2(1):5-15
Overweight & Obese Population

Objective
Determine demographics of today’s ICU and describe most appropriate EN delivery

Design
- Retrospective analysis of 2,000 ICU patient encounters
  - Length of stay: 14 days
- 30-day readmission: 19.3%
- 70% overweight or obese

Results
- 62.2 years old / 55.2% male
- Hosp LOS: 13.6 days / ICU LOS: 6.9 days
- Days on mechanical ventilation: 4

*Muscle protein catabolism is a hallmark feature of critical illness, regardless of BMI

Protein & Nutrient Deficiencies
Sarcopenia
Sarcopenic Obesity

- Disproportional loss of muscle with accumulation of adipose tissue
  - Added inflammatory burden of adiposity (adipokines)
- Loss of muscle mass & muscle strength strongly accelerated in sarcopenic obese ICU pts
  - Both are independent predictors of ICU survival

- **BMI ignores the composition of weight**
  - Sarcopenia can occur at any BMI

- High body weight with low contribution of metabolically active FFM can lead to overestimation of energy needs = overfeeding


IMAT = intramuscular adipose tissue
FFM – fat free mass
Estimating Energy Needs

Energy needs are highly variable and not consistently captured by predictive equations

- Energy requirements based on weight alone are poor assessments of energy needs
- 43% outside of rec’d range
  - Off by ~50% (over or under prediction)

### Objective Data to Guide pre-op Nutrition Risk and Personalized Nutrition Needs

**Table 1. New Personalised Nutrition Care Monitoring Devices for Muscle/Body Composition and Energy Needs**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Endpoint</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle Ultrasound</td>
<td>Muscle Mass</td>
<td>Ultrasound-based measurement of skeletal muscle mass as well as quality measures of intramuscular glycogen content (IMGC), intramuscular Adipose Tissue (IMAT), and muscle size (MSI).</td>
</tr>
<tr>
<td>Lean Body Mass via CT Scan</td>
<td>Muscle Mass</td>
<td>Lean body mass obtained from admission abdominal CT scan. Hounsfield Unit boundaries analysed by Slice0matic software to reflect whole-body muscle</td>
</tr>
<tr>
<td>Segmental Bioelectrical Impedance Spectroscopy (S-BIS)</td>
<td>Muscle Quality/ Intracellular Water</td>
<td>Segmental BIS can distinguish intracellular water (ICW) and extracellular water (ECW). ICW reflects muscle cell mass, whereas ECW represents the sum of interstitial and ECW are only affected by segmental volume, so the ECW/ICW ratio could indicate the ratio of non-contractile tissue to contractile tissue regardless of assessed somatotype (age, gender, disease state).</td>
</tr>
<tr>
<td>Indirect calorimetry</td>
<td>Resting Metabolic Rate</td>
<td>Measures the oxygen consumption (V02) and the carbon dioxide (VCO2) production at the mouth (mask or ventilated hood) in a non-invasive way. V02 and VCO2 corresponds to the whole-body cellular respiration and makes it possible to calculate the whole-body energy expenditure (EE) and resting metabolic rate (RMR).</td>
</tr>
</tbody>
</table>
Key Nutrition Components of ERAS

1st Nutrition Risk Screening

Adequate Protein Intake to Support Anabolism

Nutrition Counseling and Intervention

Early Oral/Enteral Feeding

CHO Loading and Avoidance of Fasting

Pre-Op

Post-Op

The Future of Pre-op Screening

Evaluation of lean body mass via abdominal CT scan

- Assess pre-op metabolic reserve and nutritional risk
- More accurate estimation of energy needs post-op
- Images can be segmented by trained technicians using image analysis software
- CT imaging is routinely preformed for diagnostic purposes

Examples of Image analysis software:
- SliceOmatic v5.0 (Tomovision, Montreal, QC, Canada)
- MIM software (MIM 6.5, MIM Software, Cleveland, OH)
  - uses Hounsfield Unit boundaries

Cross-sectional analysis of tissue at the third lumbar vertebra (L3) strongly correlates with total body adipose and muscle mass

Muscle Ultrasound

Non-invasive measurement of skeletal muscle mass done at ICU bedside

Can Measure:

- Intramuscular Glycogen Content (IMGC)
  - Monitor nutrition delivery & utilization
- Intramuscular Adipose Tissue (IMAT)
  - Muscle quality *i.e. muscle strength*
- Muscle size

Muscle specific U/S device
(Musclesound Inc, Colorado, USA)

- Handheld, easy to carry
- Connects to portable tablet device
- Rapid, accurate measures of LBM
- Built-in guidance to ensure reproducible measurements

Figure 1. Examples of Muscle Quality and Mass evaluation via CT Scan (level L3) and MuscleSound® analyses (short-axis rectus femoris muscle) assessed at the same time.

Nutrition Screening

Tools

- Screening Tools
  - NRS 2002, MST, MUST, SGA, SNAQ

- NRS 2002
  - Validated for surgical patients
  - Allows for a gradation of disease
    - specific scoring for abdominal surgery & ICU patients
  - No nutritional or specialized training required by examiner

✔ Automatic Nutrition Referral

✔ Aggressively treat those found with risk of malnutrition

- Initiate goal-directed nutrition therapy
- Oral supplements, protein modular and/or enteral nutrition as appropriate


NRS = Nutrition Risk Screening, MUST = Malnutrition Universal Screening Tool, MST = Malnutrition Screening Tool, SGA = Subject Global Assessment, SNAQ = Short Nutritional Assessment Questionnaire
Key Nutrition Components of ERAS

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Pre-Op

Post-Op

Preoperative Nutrition
Nutrition Counseling/Intervention

When to Focus on Nutrition Optimization?
*The earlier the better*

**Minimum of 7–14 days**

- NOTE: 5–7 days of pre-op nutrition therapy in malnourished can lead to a 50% reduction in post-op morbidity

IMPORTANT to weigh the risk of delaying surgery against the significant risk of operating on a malnourished patient

If able to postpone surgery...

- Nutrition consult
  - GI referral for feeding tube placement?
- Physical Medicine/Rehab/PT

Preoperative Nutrition

Nutrition Counseling/Intervention

Reaching protein goal MORE IMPORTANT than total calories in Pre-op period

**Goal:** Protein intake >1.2 g/kg/day (~1 g/lb/day of IBW/ABW for obese pts)

- up to 2g/kg/day in stressed pts

- Whey & Casein – best quality protein for muscle synthesis

Protein goals can be achieved with:

- High-Protein ONS (2-3x/day, minimum 18g protein/dose)
- IMN formulas (arginine, fish oil, nucleotides)

Recommend feeding tube placement for enteral nutrition (EN) if unable to orally achieve goals

- Initiate EN pre-operatively for at least 7 days


IBW – Ideal Body Weight; ABW – Adjusted Body Weight
IMN – Immunonutrition; ONS – Oral Nutrition Supplement
Immunonutrition (IMN)

Specific nutrients:
- Arginine
- Omega-3 (n-3) fatty acids
- Nucleotides
- Antioxidants

**Recommended use**: 5-7 days pre-op and 5-7 days post-op (strongest evidence-based outcomes)

**NOTE**: still see benefit with post-op use alone

- IMN should be considered for all major elective surgeries
  - especially major abdominal surgery and oncologic surgery
- Modulate metabolic response to surgery (stress) by enhancing immune function

Outcomes include: ↓ infectious complications, ↓ length of stay, ↑ wound healing

Immunonutrition in Critical Care

Marik & Zaloga, 2008

Meta-analysis of 24 RCT's comparing outcome of critically ill pts on IMN vs. control

- 12 studies included ICU pts, 5 w/ burn pts, 7 w/ trauma pts

IMD with Fish Oil improved the outcome of medical ICU patients (with SIRS/sepsis/ARDS)

IMD with arginine without Fish Oil did not offer advantage over standard EN formulas in ICU, trauma and burn pts

Synergistic Effect

Effect of IMD on acquisition of new infections

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Pre-Op

Post-Op

Preoperative CHO Loading

**What we know:**

- Surgery (stress) induces peripheral insulin resistance which and lead to hyperglycemia
- Pre-op load of 50g complex CHO (e.g. maltodextrin) stimulates an insulin response which can improve insulin sensitivity by ~50%
  - It is unclear if attenuating post-op insulin resistance effects significant outcomes
    - *i.e. LOS, complications*
- Can improve energy stores (glycogen)
  - *Start surgery in metabolically fed state vs catabolic state*

**We can feel confident that:**

- Safe – no increased risk of aspiration
- **Reduces patient discomfort**
  - ↓ pre-op thirst, hunger & anxiety

*Bottom Line: Avoid going into surgery starved and dehydrated*

Preoperative CHO Loading

**Contraindications**

- Gastroparesis/delayed gastric emptying* or severe GERD
  *Gastric retention of >10% at 4 hours
- Fluid restricted (e.g., dialysis, CHF)
- Difficult airways
- Type 1 Diabetes; Insulin pump
- S/p major GI resection (e.g., esophagectomy, Whipple, gastrectomy)
- **Type 2 Diabetes**?…

Preoperative CHO Loading: Type 2 Diabetes

**Gustafsson et al, 2008**

35 Subjects (OAD-treated=14, Insulin-treated=11, Healthy Control=10)

- Similar gastric emptying times for DM & non-DM
  
  \[\text{slightly faster in DM patients}\]

- Peak glucose higher in DM subjects (242 vs. 138 mg/dl) and occurred later (60 vs. 30 min) (P<0.01)

- Glucose levels back to baseline at 180 min in DM vs. 120 min healthy subjects (P<0.01)

**Rushakoff et al, 2019**

- Little-to-no data on this population (prediabetes, IGT, DM)

- CHO loading in DM doesn’t reduce IR, but dose induce hyperglycemia
  
  \[\text{possibly increasing risk of adverse events}\]

**Pre-op CHO drink **NOT recommended in DM patients on an ERAS pathway

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IGT = Impaired Glucose Tolerance
IR = Insulin Resistance; OAD = Oral Anti-Diabetic Drugs

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POQI Nutrition Six

**Figure 2. Summary of key recommendations for perioperative nutrition care. POQI indicates Perioperative Quality Initiative.
Implementation of ERAS programs have resulted in:

- Shorter postsurgical admissions
- Fewer post-op complications
- Decreased use of opioids
- Improved functional recovery

**Potential need for post-op ICU admission should be discussed with the patient PRE-operatively.**
Enhanced Recovery After Surgery (ERAS)

**Mission:** develop peri-operative care and improve recovery through research, education, audit and implementation of evidence-based practice

### 9 ERAS Society Guidelines Available
- Colonic surgery
- Pancreaticoduodenectomy
- Elective rectal/Pelvic surgery
- Radical cystectomy
- Liver
- Bariatric
- Head and Neck cancer surgery
- Gastrectomy
- Breast surgery

### Modified ERAS Guidelines exist for
- Colorectal liver metastasis surgery
- Gynecology
- Thoracic
- Vascular
- Pediatric
- Urologic
- Orthopedic
- Esophagectomy

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Key Nutrition Components of ERAS

How to achieve:

✓ Care bundles for early nutritional interventions

✓ Implementation of nutritional protocols (developed by multidisciplinary ICU teams)
  - Additional nutrition-specific aspects: minimizing postoperative nausea and vomiting, fluid optimization, and early feeding of normal food with automatic inclusion of high-protein oral nutritional supplements
Key Components for ANY Successful ERAS Program

- Multidisciplinary steering committee
- Regular [weekly] meetings
- Physician and Nurse Champions
- Involve inpatient and outpatient staff
- Staff education - continuous

- Patient Education
- Audit of outcomes
  - Disseminate results to committee and stakeholders
- Celebrate Teams accomplishments
- Continue to engage patients and family

Know that it takes time to change culture

...but it’s worth it!
Learning Assessment Question #1

Malnutrition is a modifiable risk factor shown to impact which of the following:

a) Wound healing  
b) Length of stay  
c) Hospital costs  
d) All of the above
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Learning Assessment Question #2

Which of the following is best for assessing pre-operative nutrition risk and guiding daily estimated energy needs?

a) BMI
b) Weight
c) Muscle ultrasound
d) Albumin
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