Enhancing Recovery After Surgery: Maximizing the Role of Nutrition

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Disclosures

• The content of this program has met the continuing education criteria of being evidence-based, fair and balanced, and non-promotional.
• This education program is supported by Abbott Nutrition Health Institute, Abbott Nutrition.
• This presentation represents the views and opinions of the speaker and does not necessarily reflect those of OhioHealth.
• Dr. Evans discloses institutional research support from Abbott Nutrition, Lyric, Merck, Atox*Bio, Shionogi, ContraFect, Tetraphase and Consultant/Speaking Honoraria from Coram / CVS Home Infusion, Lyric, Atox*Bio, Abbott Nutrition, Alcresta.
Objectives
At the conclusion of this session, participants will be able to:
• Discuss the latest enhanced recovery after surgery (ERAS) guidelines and nutrition components of ERAS
• Discuss how Clinical Nutrition Managers can integrate with multidisciplinary teams to incorporate perioperative nutrition into their practice
• Identify challenges associated with implementation of perioperative nutrition across patient types

Enhanced Recovery After Surgery (ERAS)
A strategy designed for all surgical patients
Standardized, coordinated, perioperative care plan using evidenced-based interventions to:
• Minimize surgical stress
• Improve physiologic and functional recovery
• Reduce complications
• Facilitate earlier discharge from the hospital

Feldman et al. Sc Am Surgery.
Enhanced Recovery After Surgery

Key aspects

- Avoidance of long periods of pre-operative fasting
- Re-establishment of oral feeding as soon as possible
- Integration of nutrition into overall patient management
- Metabolic control (e.g. blood glucose)
- Early mobilization
- Attenuate stress to minimize catabolism & ileus

ERAS Program Benefits

Meta-analysis of 42 Studies
ERAS programs significantly reduced
- Length of Stay
- Total Complications
- Total Costs
- Time to first flatus (less ileus with ERAS)
- Time to first bowel movement

Economic Impact Analysis
“Every $1 invested in ERAS would bring $3.8 (range $2.4–$5.1) in return” – Alberta Province-Wide ERAS Program


Feldman et al. Sc Am Surgery.
ERAS

Pre-Op  Intra-Op  Post-Op

Pain Management  PONV

Early Feeding  Early Mobilization

Immunonutrition  Minimize drains, catheters

Feldman et al. Sc Am Surgery.

Path to Home Guide: Bowel Surgery

Day of Surgery  1 Day After Surgery  2 Days After Surgery  3 Days After Surgery

Breathing exercises  

Activities  

Pain control  

Nutrition  

Tubes & lines

Feldman et al. Sc Am Surgery.
Enhanced Recovery After Surgery

- Evidence in decreasing length of stay and complications is strongest in colorectal surgery

- Early evidence
  - Orthopedics
  - Urology
  - Gynecology
  - Foregut surgery
  - Hepato-Pancreatic-Biliary Surgery

..the possibilities are limitless...

Feldman et al. Sc Am Surgery.

ERAS Protocol for Colon Surgery

Mid-thoracic epidural anesthesia/analgesia
No nasogastric tubes
Prevention of nausea and vomiting
Avoidance of salt and water overload
Early removal of catheter
Early oral nutrition
Non-opioid oral analgesia/NSAIDs
Early mobilization
Stimulation of gut motility
Audit of compliance and outcomes

Preadmission counseling
Fluid and carbohydrate loading
No prolonged fasting
No/selective bowel preparation
Antibiotic prophylaxis
Thromboprophylaxis
No premedication

Short-acting anesthetic agents
Mid-thoracic epidural anesthesia/analgesia
No drains
Avoidance of salt and water overload
Maintenance of normothermia (body warmer/warm intravenous fluids)

**Nutrition and Surgery**

- Importance of Screening
- Protein: pre- and post-op
- Immunonutrition
- Reducing insulin resistance - Carbohydrate Loading

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**The Perioperative Period**

**PRE-OPERATIVE**

**OPERATION**

**POST-OPERATIVE**

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**ERAS Care Improves Insulin Sensitivity After Surgery**

via techniques to reduce stress and minimize insulin resistance

Carbohydrate Loading Protocol

- 12.5% iso-osmolar high-carbohydrate clear beverage
  - Stomach empties within 2 hrs
  - 100 g of carbohydrate the night before surgery
  - 50 g of carbohydrate 2 hours before surgery


Inappropriate Options:
- Sports Drinks
- Fruit Juices
- Pasta

Carbohydrate Loading Benefits

- Reduced insulin resistance
- Improved nitrogen sparing
- Retention of lean body mass
- Reduction in PONV
- Improved thirst, hunger, anxiety
- Quicker return of bowel function
- Decreased LOS after CRS
- Prevention of surgery-induced immunosuppression

Feldman et al. Sc Am Surgery.
Pre-operative fasting

- Current ASA guidelines for patients undergoing elective surgery

Appendix 1: Summary of Fasting and Pharmacologic Recommendations

Summary of Fasting Recommendations

<table>
<thead>
<tr>
<th>Ingested Material</th>
<th>Minimum Fasting Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear liquids</td>
<td>2 h</td>
</tr>
<tr>
<td>Breast milk</td>
<td>4 h</td>
</tr>
<tr>
<td>Infant formula</td>
<td>6 h</td>
</tr>
<tr>
<td>Nonhuman milk</td>
<td>6 h</td>
</tr>
<tr>
<td>Light meal</td>
<td>6 h</td>
</tr>
</tbody>
</table>

Feldman et al. Sc Am Surgery.

Insulin sensitivity is better with CHO loading

Table 2 Randomised clinical trials investigating the effect of preoperative carbohydrate on insulin resistance

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Type of surgery</th>
<th>Intervention groups</th>
<th>Technique</th>
<th>Conclusions</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Okabayashi,</td>
<td>26</td>
<td>Hepatic resection</td>
<td>1. Control – no additional dietary supplement</td>
<td>Artificial pancreas with a closed loop system (STG-22)</td>
<td>IS better in Aminoleban® EN group</td>
<td>0.039</td>
</tr>
<tr>
<td>Kaska,</td>
<td>221</td>
<td>Colorectal resection</td>
<td>1. Control – overnight fasting IV 500ml 10% glucose with 10ml 7.45% KCl and 10ml 20% MgSO₄, – pm and am</td>
<td>Quantitative insulin sensitivity check index</td>
<td>IS reduced in control group</td>
<td>0.05</td>
</tr>
<tr>
<td>Faria,</td>
<td>21</td>
<td>Laparoscopic cholecystectomy</td>
<td>1. Overnight fasting</td>
<td>HOMA-IR</td>
<td>IS higher in CHO group than fasted group</td>
<td>0.03</td>
</tr>
<tr>
<td>Svanfeldt,</td>
<td>12</td>
<td>Colorectal resection</td>
<td>1. High CHO group – 125mg/ml CHO</td>
<td>HN clamp – measured before and on the first postoperative day</td>
<td>No effect seen on postoperative peripheral IS</td>
<td>0.049</td>
</tr>
<tr>
<td>Svanfeldt,</td>
<td>6</td>
<td>Simulated preoperative setting; no overnight fasting CHO 800ml – pm</td>
<td>1. Overnight fasting CHO 800ml – pm</td>
<td>HN clamp – measured 120 minutes after morning drink</td>
<td>IS increased by 50% 3 hours after morning drink</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Pay Attention to Gastric Emptying – Not All Products are Equal
Nakamura 2014 Anesthesia Analgesia 118:1268

MRI study of gastric emptying

18% Carbohydrate, 4.5 g Arginine, & Trace Minrl. (Osmolarity 545)
2.5% Carbohydrate + Electrolyte only (Osmolarity 270)


1. Pre-op/Post-op Nutrition Screening Essential
2. Protein more important than calories
3. Stop feeding late pre-op, restart early post-op
4. Consider Oral Nutrition Supplements for All
5. Oral before enteral before parenteral
6. Nutrition management is a team game

Wischmeyer, Carli, Evans, et. al. Anesthesia & Analgesia 2018
Nutrition Screening – ERAS Pre-Op Evaluation

Wischmeyer, Carli, Evans, et. al. Anesthesia & Analgesia 2018

83% of GI surgeons believe preoperative nutrition supplements reduce surgical complications

22% of patients actually receive nutrition supplements!!

Advocate Health Quality Improvement Program

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Control Group</th>
<th>QIP Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital admission</td>
<td>6 months, from October 13, 2013 to April 2, 2014</td>
<td>6 months, from October 13, 2014 to April 2, 2015</td>
</tr>
<tr>
<td>Nutrition screening</td>
<td>Internally developed, non-validated tool</td>
<td>MST on admission, as part of EMR</td>
</tr>
<tr>
<td></td>
<td>• Up to 72 hours after admission</td>
<td>• On admission, as part of EMR</td>
</tr>
<tr>
<td></td>
<td>• Administered by RN</td>
<td>• Administered by trained RN</td>
</tr>
<tr>
<td>ONS ordered by</td>
<td>Admitting RN, MD, or RD</td>
<td>Admitting RN, MD, RD, and/or auto-drop</td>
</tr>
<tr>
<td>ONS received by patient</td>
<td>After RD consultation</td>
<td>Before or after RD consultation</td>
</tr>
<tr>
<td>Time to ONS order in hours</td>
<td>Up to 72 hours after RD consultation</td>
<td>Within 48 hours of admission</td>
</tr>
</tbody>
</table>

EMR, electronic medical record; MD, medical doctor; MST, Malnutrition Screening Tool; ONS, oral nutrition supplements; QIP, quality improvement program; RD, registered dietitian; RN, registered nurse.

Sriram K et al. JPEN 2018

Nutrition-Focused Quality Improvement Program Results in Significant Readmission and Length of Stay Reductions for Malnourished Surgical Patients

46.9% reduction in surgical readmissions

Sriram K et al. JPEN 2018
# Early Postoperative Feeding Significantly Reduced Postoperative Complications

<table>
<thead>
<tr>
<th>Study</th>
<th>Early</th>
<th>Traditional</th>
<th>OR</th>
<th>95% CI</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sagar</td>
<td>3 of 15</td>
<td>5 of 15</td>
<td>0.53</td>
<td>0.08</td>
<td>3.78</td>
<td></td>
</tr>
<tr>
<td>Ryan</td>
<td>2 of 7</td>
<td>7 of 7</td>
<td>0.03</td>
<td>0</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Schroeder</td>
<td>4 of 16</td>
<td>7 of 16</td>
<td>0.46</td>
<td>0.07</td>
<td>2.91</td>
<td></td>
</tr>
<tr>
<td>Binderow</td>
<td>0 of 32</td>
<td>0 of 32</td>
<td>1</td>
<td>0.02</td>
<td>61.41</td>
<td></td>
</tr>
<tr>
<td>Beer-Holgersen</td>
<td>8 of 30</td>
<td>19 of 30</td>
<td>0.22</td>
<td>0.05</td>
<td>1.08</td>
<td></td>
</tr>
<tr>
<td>Carr</td>
<td>0 of 14</td>
<td>4 of 14</td>
<td>0.08</td>
<td>0</td>
<td>2.06</td>
<td></td>
</tr>
<tr>
<td>Ortiz</td>
<td>17 of 93</td>
<td>18 of 95</td>
<td>0.96</td>
<td>0.24</td>
<td>3.77</td>
<td></td>
</tr>
<tr>
<td>Hartseil</td>
<td>1 of 29</td>
<td>1 of 29</td>
<td>1</td>
<td>0.07</td>
<td>13.42</td>
<td></td>
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<tr>
<td>Nessim</td>
<td>3 of 27</td>
<td>4 of 27</td>
<td>0.75</td>
<td>0.11</td>
<td>5.01</td>
<td></td>
</tr>
<tr>
<td>Stewart</td>
<td>10 of 40</td>
<td>12 of 40</td>
<td>0.78</td>
<td>0.17</td>
<td>3.56</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>48 of 303</td>
<td>77 of 305</td>
<td>0.55</td>
<td>0.34</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Post-2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Han-Geurts</td>
<td>12 of 56</td>
<td>13 of 49</td>
<td>0.76</td>
<td>0.18</td>
<td>3.27</td>
<td></td>
</tr>
<tr>
<td>Delaney</td>
<td>7 of 31</td>
<td>10 of 33</td>
<td>0.69</td>
<td>0.14</td>
<td>3.38</td>
<td></td>
</tr>
<tr>
<td>Lucha</td>
<td>1 of 26</td>
<td>1 of 25</td>
<td>0.96</td>
<td>0.07</td>
<td>12.99</td>
<td></td>
</tr>
<tr>
<td>Zhou</td>
<td>23 of 161</td>
<td>70 of 165</td>
<td>0.21</td>
<td>0.06</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>Han-Geurts</td>
<td>22 of 48</td>
<td>20 of 50</td>
<td>1.37</td>
<td>0.33</td>
<td>5.61</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>65 of 320</td>
<td>114 of 312</td>
<td>0.62</td>
<td>0.26</td>
<td>1.51</td>
<td></td>
</tr>
</tbody>
</table>

| Pooled           | 113 of 623 | 191 of 617 | 0.55 | 0.35 | 0.87 |       |

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### Modern Postoperative Diet Principles

- Avoid clear liquid diets
- Incorporate protein in all phases of the diet
- Don’t need to wait for flatus / bowel movements to feed
- OK to feed intestinal anastomosis after elective surgery
- Minimize nausea
- Meals stimulate gastrocolic reflex

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**TO CLEAR LIQUID DIETS !!!**
Consider Protocols to Incorporate in Your Hospital

Enhanced Recovery After Surgery – Adherence to Protocol
ACS NSQIP Registry – Adherence Matters!

13 Components Audited in NSQIP
- Allow clear liquids
- Thoracic epidural
- Multimodal pain management
- Normal temperature on arrival to PACU
- Multimodal antiemetic prophylaxis
- Mobilization within 24 hours
- Clear liquid diet within 24 hours
- Mobilization within 24–48 hours
- Solid diet within 24–48 hours
- Foley removal within 48 hours
- Intravenous fluid discontinued in 24 hrs
- Mobilization within 48–72 hours

The Other Piece of the Puzzle—Immunonutrition

Surgical Immunonutrition Supplements for Pre- and Post-Op Use

- High Protein
- Extra arginine (Beneficial Amino Acid)
- EPA + DHA (omega-3 fatty acids / fish-oil derived)
- Not intended as a meal replacement

2-3 shakes per day for 5-7 days before and after surgery

Summary of the evidence:

Immune-modulating formula in GI surgery meta-analysis

- Analysis of 26 RCT (2496 patients)

- Results:
  - 5-7 days required to show benefit
  - 26/26 reported infectious complications (36%)
  - 20/26 reported non-infectious complications (18%)
  - 20/26 reported length of stay (LOS)
  - 26/26 reported no benefit in mortality

Real World Application of Immunonutrition Preoperative Oral Supplements: The Strong for Surgery Project

- Elective Colorectal Procedures w/ anastomosis
- Composite Adverse Event Rate (Reintervention, Infection, Anastomotic Leak and/or Death)
  - No preoperative supplements 9.4%
  - Preoperative immunonutrition 7.1%
    - Did not reach statistical significance
- Length of Stay improved with immunonutrition


Immunonutrition – Guidelines in Brief

<table>
<thead>
<tr>
<th>Expert Group</th>
<th>Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016 ASPEN/SCCM ICU Guidelines</td>
<td>We suggest the routine use of an immune-modulating formula in the SICU for the postoperative patient who requires EN.</td>
</tr>
<tr>
<td></td>
<td>Preoperative or perioperative provision of immunonutrition is more important for metabolic conditioning than for the nutritional value of the formula.</td>
</tr>
<tr>
<td></td>
<td>We suggest the use of either arginine containing immune-modulating formulations or EPA/DHA supplement... in patients with TBI</td>
</tr>
<tr>
<td>2017 ESPEN Surgery Guidelines</td>
<td>Peri-op (Pre- and Post-) or at least postoperative immunonutrition for major cancer surgery (Grade B)</td>
</tr>
<tr>
<td></td>
<td>No clear evidence for preoperative use only but immunonutrition is preferred</td>
</tr>
<tr>
<td>2018 Perioperative Quality Improvement / American Society for Enhanced Recovery</td>
<td>Preoperative IMN should be considered for all patients undergoing elective major abdominal surgery</td>
</tr>
<tr>
<td></td>
<td>IMN should be considered in all postoperative major abdominal surgical patients for at least 7 d</td>
</tr>
</tbody>
</table>

ERAS Bundle Guidelines

• 2018 ESPEN/ERAS Colonic Surgery Guideline:
  — Recommend periop immunonutrition

• 2012 ESPEN/ERAS Pancreaticoduodenectomy Guideline:
  — 5-7 days preop immunonutrition + postop should be considered to reduce the rate of infectious complications

• 2012 ESPEN/ERAS Rectal / Pelvic Guideline:
  — No mention of immunonutrition

Combining ERAS and Immunonutrition – Emerging Evidence

Perioperative immunonutrition reduces complications including infection in ERAS

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Without Perioperative Immunonutrition</th>
<th>With Perioperative Immunonutrition</th>
<th>RR (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage with any complications*</td>
<td>35.20%</td>
<td>23.00%</td>
<td>0.547 (0.312–0.960)</td>
<td>0.035</td>
</tr>
<tr>
<td>Percentage with any surgical complications*</td>
<td>21.30%</td>
<td>17.20%</td>
<td>0.768 (0.405–1.455)</td>
<td>0.417</td>
</tr>
<tr>
<td>Anastomotic leak</td>
<td>8.20%</td>
<td>4.90%</td>
<td>0.579 (0.204–1.647)</td>
<td>0.301</td>
</tr>
<tr>
<td>Incision</td>
<td>13.10%</td>
<td>8.20%</td>
<td>0.492 (0.257–1.361)</td>
<td>0.213</td>
</tr>
<tr>
<td>Others</td>
<td>0.80%</td>
<td>3.30%</td>
<td>4.102 (0.452–37.238)</td>
<td>0.175</td>
</tr>
<tr>
<td>Percentage with any infectious complications*</td>
<td>23.80%</td>
<td>10.70%</td>
<td>0.382 (0.188–0.778)</td>
<td>0.007</td>
</tr>
<tr>
<td>Surgical site infection</td>
<td>17.2%</td>
<td>5.70%</td>
<td>0.293 (0.119–0.717)</td>
<td>0.005</td>
</tr>
<tr>
<td>Superficial and Deep incisional</td>
<td>16.4%</td>
<td>5.70%</td>
<td>0.310 (0.126–0.764)</td>
<td>0.008</td>
</tr>
<tr>
<td>Organ/Space</td>
<td>2.40%</td>
<td>0.80%</td>
<td>0.328 (0.034–3.196)</td>
<td>0.313</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>3.30%</td>
<td>1.60%</td>
<td>0.492 (0.088–2.736)</td>
<td>0.408</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>0.80%</td>
<td>0.80%</td>
<td>1.000 (0.062–16.171)</td>
<td>1.000</td>
</tr>
<tr>
<td>Venous catheter infection</td>
<td>7.40%</td>
<td>3.30%</td>
<td>0.426 (0.127–1.421)</td>
<td>0.154</td>
</tr>
<tr>
<td>Mortality</td>
<td>0%</td>
<td>0%</td>
<td>0.708 (0.275–1.826)</td>
<td>0.474</td>
</tr>
<tr>
<td>Reoperation rate</td>
<td>9%</td>
<td>6.60%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RR = relative risk with 95% confidence interval in ()
*Note that a patient may experience more than one complication.


The “Art” of Enhanced Recovery

- Making a Case / Developing a Vision
- Building the Team
- Communicating in a Positive Encouraging Way
- Counter the Resistance
- Measurement + Dissemination of Findings
- Keeping Momentum / Celebrating Small Victories
# ERAS Takes A Team

- Consider target audience / target surgeons
- Consider resources / mechanisms in place to leverage
- Communicate
- Communicate some more
- Nutrition is an important part of ERAS! But not the only one

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## Putting it All Together – A Nutrition Supplement Plan

<table>
<thead>
<tr>
<th>Time</th>
<th>Nutritional Support</th>
</tr>
</thead>
</table>
| PRE-OPERATIVE | Immunonutrition  
Protein  
Arginine  
DHA+EPA  

2-3 shakes/day
for 5-7 days
before and after surgery |
| SURGERY      | Carbohydrate Loading  
Night before surgery  
Redose up to 2 hours before surgery |
| POST-OPERATIVE | Immunonutrition  
Protein  
Arginine  
DHA+EPA  

2-3 shakes/day
for 5-7 days
before and after surgery |
|             | High-Protein Supplements  
High Protein  
Vitamins & Minerals  
Consider HMB  
For Continued Recovery Up to 90 Days |
## Enhanced Recovery Implementation – An Example From Cincinnati

### Postoperative Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Traditional (n = 160)</th>
<th>Enhanced Recovery Pathway (n = 146)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of stay, d, median</td>
<td>5.0</td>
<td>3.0</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Days with patient-controlled analgesia, mean</td>
<td>3.3</td>
<td>1.3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Total narcotic dosage, MED, mean (95% CI)</td>
<td>720.2 (524-915)</td>
<td>211.7 (131-291)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Days until diet advanced, median</td>
<td>2.0</td>
<td>1.0</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Surgical site infection, %</td>
<td>5.0</td>
<td>4.1</td>
<td>0.71</td>
</tr>
<tr>
<td>30-d readmission, %</td>
<td>11.9</td>
<td>11.0</td>
<td>0.8</td>
</tr>
<tr>
<td>30-d mortality, %</td>
<td>0.6</td>
<td>0.7</td>
<td>0.94</td>
</tr>
</tbody>
</table>

### Cost

<table>
<thead>
<tr>
<th>Cost</th>
<th>Traditional (n = 160)</th>
<th>Enhanced Recovery Pathway (n = 146)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total direct cost, $, mean (95% CI)</td>
<td>11,508 (10,601-12,414)</td>
<td>9,791 (9,065-10,516)</td>
<td>0.004</td>
</tr>
</tbody>
</table>