Nutrition vs food intake: competition or collaboration in the ERAS era?

O. Ljungqvist (SE)
Nutrition vs. food intake: competition or collaboration in the ERAS era?

Olle Ljungqvist MD PhD
Professor Surgery
Örebro University Hospital & Karolinska Institutet
Sweden
Cocoa

- Theobroma cacao
- Drink of Gods (Xocoatl)
  - theo = God
  - broma = drink
- Mexico (Maya, Incas, Aztecs)

- Aphrodisiac
Nutrition and food: collaboration in the ERAS era!

Olle Ljungqvist MD PhD
Professor Surgery
Örebro University Hospital & Karolinska Institutet
Sweden

ESPEN
Geneva, Switzerland
September 2014
Disclosures

Danone Nutricia Advisory Committee – producer of a preop carb drink
Founder and Ownership of stock in Encare AB
Travel and/or honoraria for presentations from BBraun, Nestle, Nutricia, BBraun, Fresenius-Kabi, Merck
Co-Founder of ERAS Society
Perioperative Optimization: Recovery After Surgery
What are we trying to achieve?

Patient back to preoperative function

• Normal gastrointestinal function
  – Normal food intake
  – Bowel movement

• Pain control

• Mobility

• No complication
What is ERAS?

• ERAS = Enhanced Recovery After Surgery
• Consensus on perioperative care*
• International network – ERAS Society
• Team work – multi professional & disciplinary
• Implementation:
  – Audit
  – Control over care

www.erassociety.org
History
From Cuthbertson to ERAS:
70 years of progress in reducing stress in surgical patients.
Wilmore DW.
Henrik Kehlet: concepts

- Epidural anaesthesia
- Multimodal approach to recovery

*British Journal of Anaesthesia* 1997; 78: 606–617

**Multimodal approach to control postoperative pathophysiology and rehabilitation**

H. Kehlet
ERAS Study Group

Highlights:
2001: Initiation
2003: Database
2005: 1st protocol
2006: Implementation
2009: 2nd protocol

Growth:
St Marks: R Kennedy
Nottingham: D Lobo
Charité: C Spies, A Fledheiser

ERAS Study Group
ERAS
Epidural Anaesthesia
Prevention of ileus/prokinetics
CHO - loading/no fasting
Early mobilisation
Peri-op fluid management
DVT prophylaxis
No - premed
Pre-op counselling
No bowel prep
CHO - loading/no fasting
Incisions
No NG tubes
Early removal of catheters/drains
Perioperative Nutrition
Body heating devices
Oral analgesics/NSAID’s
Prevention of ileus/prokinetics
Early removal of catheters/drains
Fearon et al, Clin Nutr 2005
A Non profit Multi-professional Multi-disciplinary Medical Society
Founded in 2010

Mission statement: Enhancing Recovery After Surgery

The mission of the Society is to **develop** perioperative care and to **improve** recovery through

- Research,
- Education,
- Audit and
- Implementation of evidence based practice.
The paradigm shift:

Multi modal
Multi professional
Multi disciplinary

EBM in practice: Implementation
Interactive Team Audit
Large network in collaboration
Philosophy
ERAS Philosophy: The patient’s journey

Integrated ERAS protocol

CLINIC | PRE-OP | SURGERY / ANESTHESIA | POST-OP | WARD | HOME | RECOVERY

FOLLOW UP 30 DAY

Interactive Team audit of outcomes & compliance

Ljungqvist JPEN 2014
ERAS team approach

- Surgeon
- Anesthetist
- HDU specialist
- Ward nurses
- Anesthesia nurses
- Physiotherapist
- Dietitian

- Management

Team work:
- Training
- Implementing
- Planning
- Auditing
- Updating
- Reporting
- Research
ERAS
Securing modern care

**Surgeon:**
- No bowel prep
- Food after surgery
- No drains
- Early removal u-catheter
- No iv fluids, no lines
- Early discharge

**Anesthetist:**
- Carbohydrates no fasting
- No premedication
- Thoracic Epidural Anesthesia (open)
- Balanced fluids
- Vasopressors
- No or short acting opioids

*All evidence based!*
ERAS works!
ERAS Meta analysis

ERAS: shorter length of stay by 2.5 days

Varadhan et al, Clin Nutr 2010
ERAS Meta analysis

ERAS: Reduce complications by 50%

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>ERAS Events</th>
<th>Total</th>
<th>TC Events</th>
<th>Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson 2003</td>
<td>4</td>
<td>14</td>
<td>5</td>
<td>11</td>
<td>6.0%</td>
<td>0.63 [0.22, 1.80]</td>
</tr>
<tr>
<td>Delaney 2003</td>
<td>7</td>
<td>31</td>
<td>10</td>
<td>33</td>
<td>9.6%</td>
<td>0.75 [0.32, 1.71]</td>
</tr>
<tr>
<td>Gatt 2005</td>
<td>9</td>
<td>19</td>
<td>15</td>
<td>20</td>
<td>23.1%</td>
<td>0.63 [0.37, 1.08]</td>
</tr>
<tr>
<td>Khoo 2007</td>
<td>9</td>
<td>35</td>
<td>16</td>
<td>35</td>
<td>14.9%</td>
<td>0.56 [0.29, 1.10]</td>
</tr>
<tr>
<td>Muller 2009</td>
<td>16</td>
<td>76</td>
<td>37</td>
<td>75</td>
<td>27.5%</td>
<td>0.43 [0.26, 0.70]</td>
</tr>
<tr>
<td>Serclova 2009</td>
<td>11</td>
<td>51</td>
<td>25</td>
<td>52</td>
<td>18.8%</td>
<td>0.45 [0.25, 0.81]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>56</td>
<td>226</td>
<td>108</td>
<td></td>
<td>100.0%</td>
<td>0.53 [0.41, 0.69]</td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00; Chi² = 2.26, df = 5 (P = 0.81); I² = 0%
Test for overall effect: Z = 4.81 (P < 0.00001)

Varadhan et al, Clin Nutr 2010
How?
Integration of care

Peri-op fluid management

Epidural Anaesthesia

Remifentany

DVT

No - premed

Pre op counsell

Ear mobilis

Peri N

Bairhugger

Oral analgesics/ NSAID’s

Prevention of ileus/ prokinetics

Early removal of catheters/drain

CHO - loading/ no fasting

Early mobilisation

Peri-operative Nutrition

Bairhugger

Oral analgesics/ NSAID’s

Prevention of ileus/ prokinetics

Early removal of catheters/drain

3 new guidelines 2012

Guidelines for Perioperative Care in Elective Rectal/Pelvic Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations

J. Nygren · J. Thacker · F. Carli · K. C. H. Fearon · S. Norderval · D. N. Lobo · O. Ljungqvist · M. Soop · J. Ramirez
ERAS in Theory
Goals
Back to normal food
Energy and protein

2 Key targets:
Gut working
Metabolism ready
Goals
Back to normal food
Energy and protein

2 Key targets:
Gut working
Metabolism ready

ERAS does both!
Goals
Back to normal food
Energy and protein

2 Key targets:
Gut working
Metabolism ready
The Metabolic Stress Response to Surgery and Trauma

[Diagram showing the metabolic pathways and stress response to surgery and trauma, including hormones and immune system changes.]
The Metabolic Stress Response to Surgery and Trauma

Insulin resistance
Insulin & Recovery

Insulin: main anabolic hormone involved in

• All parts of metabolism
  – Glucose control
  – Fat metabolism
  – Protein

• Regulator of return of key functions

• Central to development of complications

• Affected by many perioperative treatments
Insulin & Recovery

Insulin: main anabolic hormone involved in

- All parts of metabolism
  - Glucose control
  - Fat metabolism
  - Protein
- Regulator of return of key functions
- Central to development of complications
- Affected by many perioperative treatments

- Insulin resistance: a key for understanding and enhancing recovery
- Insulin function key for anabolism
Postoperative Insulin resistance

Definition:
Below normal metabolic effect of insulin
- Glucose uptake
- Reduction in glucose production
- Lipolysis
- Protein breakdown / balance
Insulin sensitivity falls with the magnitude of surgery

Adopted from Thorell et al: Curr Opin Clin Nutr Metab Care 1999

Reduction in Insulin Sensitivity (%)

- Lap cholelithotomy (Lap chol)
- Open hernia repair
- Open cholecystectomy (Open chol)
- Open colorectal surgery

Postop / Preop M-value x 100 (%)

P < 0.001, ANOVA
n = 6-13

More Insulin Resistance

Preop level
Driving forces for hyperglycemia after surgery similar to diabetes

<table>
<thead>
<tr>
<th></th>
<th>Postop</th>
<th>Type 2 DM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hyperglycemia</strong></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Insulin sensitivity</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Glucose production</strong></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Peripheral glucose uptake</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>GLUT4 translocation</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Glycogen formation</strong></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Adopted from Ljungqvist et al, Clin Nutr 2001
Normalizing insulin action normalizes metabolism

Insulin infusion to normalize:
- Blood glucose

Also controlled:
- FFA
- Urea excretion
- Substrate utilization after major surgery

Insulin resistance the key to catabolism

Independent factors predicting length of stay

- Type of surgery
- Perioperative blood loss
- Postoperative insulin resistance

$R^2 = 0.71, \ p < 0.01$
Glucose uptake - stress

Insulin regulated
Concentration regulated

Muscle
Fat
Liver
Kidney
Blood cells
Endothel
Neural tissue

Too little
Too much

[Glucose]
Insulin resistance muscle

- Reduced glucose uptake
- Reduced glycogen storage
- Increased protein catabolism
Insulin resistance muscle

- Reduced glucose uptake
- Reduced glycogen storage
- Increased protein catabolism

Lean body mass
Muscle function
Mobilisation

Energy supply
# Impaired Recovery

<table>
<thead>
<tr>
<th>Postop (days)</th>
<th>Tissues/cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle weakness</td>
<td>muscle</td>
</tr>
<tr>
<td>Infections</td>
<td>leukocytes</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>blood vessels</td>
</tr>
<tr>
<td>Renal failure</td>
<td>kidney</td>
</tr>
<tr>
<td>Polyneuropathy</td>
<td>nerve tissue</td>
</tr>
</tbody>
</table>
Glucose uptake - stress

- Fat
- Liver
- Kidney
- Blood cells
- Endothel
- Neural tissue
- Insulin regulated
- Concentration regulated

Too little
- Muscle

Too much
- Kidney
- Blood cells
- Endothel

[Glucose]
## Complications

<table>
<thead>
<tr>
<th>Postop (days)</th>
<th>Tissues/cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infections</td>
<td>leukocytes</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>blood vessels</td>
</tr>
<tr>
<td>Renal failure</td>
<td>kidney</td>
</tr>
<tr>
<td>Polyneuropathy</td>
<td>nerve tissue</td>
</tr>
<tr>
<td>Muscle weakness</td>
<td>muscle</td>
</tr>
</tbody>
</table>

ERAS®Society
Postoperative insulin resistance increase the risk for complications

273 patients open cardiac surgery, insulin sensitivity determined at the end of op

<table>
<thead>
<tr>
<th>Complication</th>
<th>OR for every decrease by 1 mg/kg/min (≈ 25% reduction in Insulin sensitivity)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>2.33 (0.94-5.78)</td>
<td>0.067</td>
</tr>
<tr>
<td>Major complication</td>
<td>2.23 (1.30-3.85)</td>
<td>0.004</td>
</tr>
<tr>
<td>Severe infection</td>
<td>4.98 (1.48-16.8)</td>
<td>0.010</td>
</tr>
<tr>
<td>Minor infection</td>
<td>1.97 (1.27-3.06)</td>
<td>0.003</td>
</tr>
</tbody>
</table>

The ORs were adjusted for potential confounders

_Sato et al, JCEM 2010; 95: 4338-44_
ERAS

- Epidural Anaesthesia
- Short acting anaesthetics
- Peri-op fluid balance
- DVT prophylaxis
- Pre-op counselling
- Early mobilisation
- Early postop oral feeding
- Maintaining body temperature
- Oral analgesics/NSAID’s
- Prevention of ileus/prokinetics
- Early removal of catheters/drains
- Preop CHO/no fasting
- No bowel prep
- Surgical technique
- No NG tubes
- Fearon et al, Clin Nutr, 2005
ERAS

- Epidural Anaesthesia
- Short acting anaesthetics
- Peri-op fluid balance
- DVT prophylaxis
- Pre-op counselling
- Early mobilisation
- Oral analgesics/NSAID’s
- Prevention of ileus/prokinetics
- Oral feeding
- Maintaining body temperature
- No NG tubes
- Early removal of catheters/drains
- No - premed
- No bowel prep
- Preop CHO/no fasting
- Surgical technique
ERAS elements to reduce insulin resistance

Preoperative
• Preoperative carbohydrates
• Epidural anesthesia

Postoperative
• Pain control
• Early postop feeding
Insulin sensitivity improved with pre op Carb, EDA + post op feed

Post op change in Insulin Sensitivity (%)

Postop / Preop M-value x 100 (%)

-80 -70 -60 -50 -40 -30 -20 -10 0

Lap chol  Open hernia  Open chol  Open colorectal

Preop level

More Insulin Resistance

CHO EDA Post op Feed

Goals

Back to normal food
Energy and protein

2 Key targets:
Gut working
Metabolism ready
Epidural - less paralysis

EDA vs. Iv opiates

Weighted Mean Difference (Random) 95% CI

Favours Epidural LA  Favours opioid based
ERAS: oral intake development
(mean intake postop day 1-4)
Energy intake ± ONS after liver resection

Hendry et al, BJS 2010
Bowel movement after liver resection

Hendry et al, BJS 2010

Laxation – 1 day
ONS – 1 day

Laxation + ONS vs none
3 (3-4) vs 6 (4-7), p = 0.013
ERAS in the old and co-morbid

<table>
<thead>
<tr>
<th>Age and ASA</th>
<th>Early ERAS / ERAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 75 years</td>
<td>n= 160 / 164</td>
</tr>
<tr>
<td>&gt; 74 years, ASA 1-2,</td>
<td>n= 89 / 50</td>
</tr>
<tr>
<td>&gt; 74 years, ASA 3-4</td>
<td>n = 34 / 33</td>
</tr>
</tbody>
</table>

Thus, 39% over 75 years

Colonic resection

J Nygren, Ersta hospital personal communication
Functional recovery
Colonic resection

Postop days, median

- Flatus
- Bowels
- Food
- Drip down
- Mobile 6h

<75
>74 ASA 1-2
>74 ASA 3-4
Insulin sensitivity

Days after surgery

Insulin sensitivity

ERAS Care

Dinner, normal sleep
Carbohydrate treatment
Thoracic Epidural
Immediate feeding & mobilisation

Oral feeding & mobilisation

Preoperative sedation
Overnight fasting

Surgery

Slow return to feeding and mobilisation

Days - weeks

Bowel prep
No nutrition

NPO iv low caloric fluids

Traditional care

ERAS®Society

Ljungqvist JPEN 2012
Insulin sensitivity

Days after surgery

- Dinner, normal sleep
- Immediate feeding & mobilisation
- Oral feeding & mobilisation
- Slow return to feeding and mobilisation
- Days - weeks

**Fluids in balance**

- Preoperative sedation
- Overnight fasting
- Bowel prep
- No nutrition

**Fluid overload**

- NPO iv low caloric fluids

**ERAS Care**

- Carbohydrate treatment
- Thoracic Epidural

**Traditional care**

Ljungqvist JPEN 2012
Gut working

• Avoiding opioids

• Fluid balance

• Chewing gum 3 times daily

• Laxatives
ERAS compliance:  
Length of stay & Readmissions  
Gustafsson et al, Arch Surg 2011  
n = 953  
p < 0.05  
Compliance with ERAS protocol elements  
Single center study consecutive patients  
Colorectal cancer
ERAS compliance: Complications

Gustafsson et al, Arch Surg, 2011

n = 953
P < 0.05

Compliance with ERAS protocol elements
Colorectal cancer

Per cent patients affected

<50% >70% >80% >90%

Complications

n = 953
P < 0.05

Single center study, consecutive patients

Gustafsson et al, Arch Surg, 2011
Reduced mortality?

Table 2. Comparison of mortality rates in the two groups

<table>
<thead>
<tr>
<th></th>
<th>TRAD (n = 3,000)</th>
<th>ER (n = 1,500)</th>
<th>p-value (chi-squared test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead by 1 year</td>
<td>63 (2.1%)</td>
<td>19 (1.3%)</td>
<td>0.05</td>
</tr>
<tr>
<td>Dead by 2 years</td>
<td>114 (3.8%)</td>
<td>40 (2.7%)</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Hip and Knee replacement

Savaridas et al, Acta Orthopedica 2013: 84, 40-43

Traditional

After implementation of ERAS

Causes of death
Higher for Trad: Malignant disease
ERAS Compliance: LOS in open colonic resections

N = 57 own cases (green dot), compared to 934 total cases in 15 other centers
Recovery – what does it mean?

Surgical Research Review

What does it really mean to “recover” from an operation?

Lawrence Lee, MD, MSc, Ting Tian, MD, MSc, Nancy K. Mayo, PhD, Franco Carli, MD, and Liane K. Feldman, MD, Montreal, Canada

From the Steenbergh-Bernstein Centre for Minimally Invasive Surgery and Innovation, Department of Epidemiology, Biostatistics and Occupational Health, and Department of Anesthesia, McGill University Health Centre, Montreal, Canada
2nd World ERAS Congress

- Valencia Spain
- April 23-26, 2014

- Patient, Practice & Outcomes

2nd World ERAS Congress
Cannes
2012
Valencia
2014
Delegates 202,452
Countries 28,39
Abstracts 56,111

3rd ERAS Congress
Washington DC USA
May 9 – 13, 2015
Nutrition vs. food intake: competition or collaboration in the ERAS era?

Olle Ljungqvist MD PhD
Professor Surgery
Örebro University Hospital & Karolinska Institutet
Sweden

ESPEN
Geneva, Switzerland
September 2014
Summary

Gut working
• Avoid opioid induced gut paralysis
• Keep fluids in balance
• Food, ONS combined for energy and protein
• + laxatives for even faster gut recovery
• Chewing gum

Metabolism ready
• Minimize insulin resistance

Combining ERAS elements for best results
Nutrition and food: collaboration in the ERAS era!

Olle Ljungqvist MD PhD
Professor Surgery
Örebro University Hospital & Karolinska Institutet
Sweden

ESPEN
Geneva, Switzerland
September 2014