Providing Optimal Nutritional Support on the ICU – common problems and practical solutions

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ICU Nutritional Support

• ACCEPT study showed improved ICU survival when evidence based nutrition guideline is followed
• More complete enteral nutrition delivery without decline of PN if necessary \(\text{(Martin, CMAJ 2004, 170 (2): 179 – 204)}\)
How do we do this?

- What are the common problems?
- Nutritional Assessment
- Route of nutritional support
- Problems with EN
- Problems with PN
- How much to give
- Timing – what to give and when
Nutritional Assessments

• Weight, height, BMI
• Percentage weight loss
• Body composition
• Oedema / obesity
• Metabolic state
• Biochemistry
• Route of feeding
• Grip strength in recovery

» Regular review and reassessment
Weight on ICU

• Drug & nutritional requirements
• Difficulty weighing
• Guessing inaccurate  (Maskin et al Anaesth Intensive Care 2010; 38: 930–934)
• Resuscitation – oedema
• Preadmission weight in notes
• MUAC
MUAC

- BMI = wt (Kg) / height(m)$^2$
- Mid upper arm circumference (MUAC) < 23.5cm = Low BMI
- Female BMI = 1.1 x MUAC − 6.7
- Male BMI = 1.01 x MUAC − 4.7
- Approx. wt = BMI x height(m)$^2$
How can we give nutritional support on ITU?

- Enterally – feed infused into the gut through a tube
- Orally - food or supplements
- Intravenously – Parenteral Nutrition (PN)
Nasogastric feeding
Establishing NG Feed - GRVs

- 50% - 60% ICU patients “high GRVs”
- 125 – 500mls
- GRVs not accurate - ASPEN 09 guidelines:
  - Tolerate gastric residual volumes (GRVs) 300-500ml
  - “Holding EN for GRvs <500ml in the absence of other signs of intolerance should be avoided (Grade B)”
  - ASPEN 2009
Checking Gastric Residual Volumes: A Practice in Search of Science? McClave

Table 1
Secretion of Fluid within the GI Tract

<table>
<thead>
<tr>
<th>Gastrointestinal Water Movement</th>
<th>mL</th>
<th>mL</th>
<th>mL</th>
<th>mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume Secreted/day</td>
<td>Harig (43)</td>
<td>Ganong (44)</td>
<td>Nightingale (45)</td>
<td>Guyton (46)</td>
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<tr>
<td>Saliva</td>
<td>1500</td>
<td>1500</td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td>Stomach</td>
<td>2500</td>
<td>2500</td>
<td>2000</td>
<td>1500</td>
</tr>
<tr>
<td>Bile</td>
<td>1000</td>
<td>500</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td>Pancreas</td>
<td>1000</td>
<td>1500</td>
<td>600</td>
<td>1000</td>
</tr>
<tr>
<td>Intestine</td>
<td>1000</td>
<td>1000</td>
<td>1800</td>
<td>1800</td>
</tr>
</tbody>
</table>
McClave NGT Migration
Raised GRVs

• Trend of GRVs >500mls
• Consider Prokinetics
• NICE CG32 (2006) Grade A evidence
• Whey based formula
• NJ tube
NJ Tube
Gastrostomy / Jejunostomy
Advantages of Enteral Nutrition

• Cheaper
• Less metabolic complications
• May be safer (Heyland JPEN 2003)
• Preserves integrity and gut function
• ESPEN guidelines for critically ill – Grade C evidence should be used if possible
Evidence for EN

- Heyland, JPEN, 2003 Canadian Guidelines
- EN vs PN - 12 level 2 studies & 1 level 1
- No difference in mortality
- Significantly ↓ septic complications with EN
- 8 RCTs of early EN (24-48hrs) v delayed
- Reduced mortality & infections
- Improved N balance and nutritional status
Why is EN beneficial?

- Gut important immunological organ
- Gut Associated Lymphoid Tissue (GALT)
- Modulates Inflammatory Response
ASPEN Guidelines 2009

• Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Patient. JPEN 2009 33(3) 277-316

• Society of Critical Medicine and ASPEN
ASPEN Guidelines EN

• Start enteral feeding within 24-48hrs of admission where possible (C)
• Do not wait for flatus, stool, bowel sounds (B)
• Use NG feeding if possible
When is EN not possible?
When EN is not possible....

- Repeated high GRVs
- NJ not possible
- Leaks – postoperative
- Bowel perforation
- Ischaemic bowel
- Bowel Obstruction
Parenteral Nutrition - PN

ACME TPN
Complications of TPN

• Hyperglycaemia… sepsis
• Hyperlipidaemia
• Hypercapnia
• Abnormal LFTs
• Hepatic steatosis
• Impaired immune function.
• Line sepsis
• Bacterial translocation (Deitch 2002, Surgery, 31(3) 241-4)
• Overfeeding

TPN on ITU...
TPN Meta-analysis

- PN in ICU and surgical patients
- Increased septic morbidity in PN
- Don’t use PN on ICU
- Overfeeding
- Inappropriate lines
- Soy bean oil based lipid emulsions
PN vs EN in the Critically Ill

- A meta-analysis of trials using the intention to treat principle (Simpson & Doig Intensive Care med 2005;31(1):12-23)
- 11 trials included
- ITT trials - reduced mortality with TPN in malnourished
- Prior subgroup analysis attributed this to trials comparing delayed EN to PN
- Increased septic complications in PN but
- Grade B+ evidence for PN in malnourished patients where EN cannot be initiated within 24hrs of ICU admission.
CALORIES Trial

- 33 ICUs, 2388 patients randomised EN or PN
- PN and EN associated with same outcomes including infection rates
- 30 day mortality same
- 50% of patients on both groups failed to meet estimated energy targets

» Avoid overfeeding – outcomes the same
How quickly should we start PN?
PN Early vs Late

- ASPEN - Delay PN on ICU for up to 8 days
- ESPEN
- Start PN after 48 hrs if EN not possible
- ASPEN and ESPEN
- Start PN within 48 hrs if Malnourished and EN not possible
- Van den Burge NEJM 2011: Early Parenteral Nutrition to supplement insufficient enteral nutrition in Intensive Care Patients (EPaNIC)
EPaNIC NEJM 2011

• Delay PN for 8 days
• Excess energy early
• 36kcal/kg from day 2
• Patients not malnourished
• BMI < 17 excluded
• Patients had functioning gut
• GRV of 250mls used
Feeding on the ICU…

- Enteral nutrition should be used if possible
- Preservation of gut barrier
- Beneficial effect on GALT
- Appropriate PN may reduce mortality
- Start PN within 48hrs if EN not possible
- Especially in the malnourished
How Much Nutrition?

The more the better!
How Much?

• Excess energy increases energy expenditure, ↑ lipids, fatty liver, CO2 levels, inflammation and infections

• Only leads to fat weight gain on the ICU (Jeejeebhoy Nut Clin Pract 2003 Jul;124(1):297-305. / NICE CG32 2006)


• Over and under feeding potentially harmful

• How do we explain this?
Inflammatory Response
The inflammatory response

- Similar responses seen in trauma, burns, sepsis and surgery
- Evolved for a reason - positive response
- Provides glucose, amino acids for immune response / acute phase proteins
- Proportional to severity of insult
- Excessive / prolonged response harmful
- Systemic response e.g. SIRS and MODS
Effect of the inflammatory response

- Synthesis of acute phase proteins, white cells, collagen, fibroblasts
- Anorexia
- Muscle catabolism
- Negative N balance
- Weight loss
- Muscle weakness and fatigue
- Especially harmful in malnourished
Effect of the inflammatory response

- Lipolysis - $\uparrow$ triglycerides
- Gluconeogenesis
- Insulin resistance - hyperglycaemia
- Hyperglycaemia $\uparrow$ morbidity & mortality (Van den Berghe (2001))
Bed Rest

- Biolo et al, Am J Clin Nut 2008:88;950-8
- 5 weeks bed rest in 19 healthy volunteers
- Effect of energy balance
- All lost lean muscle mass
- Overfeeding in bed rest - ↑muscle loss
  ↑inflammation (↑CRP)
Muscle Wasting in Critical Illness

- Acute Skeletal Muscle Wasting in Critical Illness
- Puthuheary et al
- 63 ICU patients
- Ultrasound measurement of rectus femoris
- NG fed
- Higher protein intake in first week $\uparrow$ muscle loss
- Greater in MODS
The influence of nitrogen intake on nitrogen balance

Nitrogen Requirements

- Severe depletion
- Moderate depletion
- Normal No injury
- Severe injury/illness
ESPEN 2006 Guidelines

- Avoid excess of 20 –25kcal/kg/day in the initial phase of critical illness
- Severe under nutrition 25-30kcal/kg
- Provide 25-30kcal/kg/day “in the anabolic flow phase”
- How do we recognise this???
- Any time after 10 days into flow phase???
  »ASPEN less at first more in recovery
Recognising recovery

• Signs that a patient is entering an anabolic phase include:
• Oedema resolving.
• Hyperglycaemia resolving & ↓ insulin requirements.
• ↓ C reactive protein levels (CRP)
• Patient is mobilising.
• Appetite returning.
• Serial prealbumin measurements may show the switch to anabolism. Weekly increase over 40mg/l Bernstein et al 1995, Nutrition11(2), 169-171.
Conclusion

- Appropriate nutrition ↓ morbidity & mortality
- Both under and over feeding harmful
- Timing is crucial
- Less acutely unwell
- More in recovery
- Enteral if possible
- Don’t delay PN especially if malnourished
- Weight not a good outcome marker
- Use grip strength in recovery
Bulk or Bounce?

• NICE CG 32 2006 / Jeejeebhoy 1988
• “Most trials showing benefit from short-term nutrition support, do so despite ‘too little nutrition’ being given for ‘too short a time’ for the benefit to accrue from maintaining or improving body energy and protein stores”
• Kursheed Jeejeebhoy BAPEN Key note lecture DDF ExCel London 22-25 June 2015