Optimal feeding
Not just a 'Christmas issue'...

Nepean WTET summary 22/12/20

Background and Rationale

- Critical illness is associated with a hypermetabolic state. Early observational studies suggested an association with improved clinical outcomes (fewer infections, shorter duration of mechanical ventilation and lower mortality) for patients receiving a higher % of their calculated caloric needs
- However over-feeding risks hyperglycaemia (infection, impaired wound healing, dehydration from osmotic diuresis), hyperlipidaemia (immunosuppression, hyperviscosity and pancreatitis), hypercarbia causing tachypnoea and delayed liberation from invasive ventilation. In addition to increased feed intolerance (and associated risks)
- Overfeeding is particular a risk in those at extremes of weight (under and over-weight), where there are errors in measurement (height and weight) and a fluctuant use of relevant infusions (propofol and dextrose containing drugs)
- Indirect calorimetry measures oxygen consumption and carbon dioxide production to better understand personalised energy requirements

Advantages and Disadvantages

- Advantages permissive underfeeding (non-protein calories)
  - Reno-protective in animal models
  - Less feed intolerance; gastric residual volumes (vomiting/aspiration/VAP risk), less use of prokinetics (with side effects) and less hyerpglycaemia
  - Some nutrition (and keeps starvation ketosis at bay), as well as stress ulcer prophylaxis effect, without significant increase in splanchnic blood flow in a hypermetabolic patient
  - ?Physiological response (rationale); less oral intake when unwell
- Advantages of goal-rate feeds (non-protein calories)
  - Increased metabolic demand with critical illness
  - Not just calories – usually hand-in-hand with other nutritional requirements (protein intake important for recovery)
  - Higher risk over-feeding (especially early in critical illness) with inaccurate equations and fluctuating intakes e.g. propofol requirement, infusion rates (those made in dextrose
  - Overweight vs underweight; one-size fits all approach may not be appropriate
  - Early enhanced nutrition (goal rate) may be beneficial in certain groups e.g. head injury

Key studies

- TICACOS 2011 Intens Care Med
  - SS (pilot) RCT; General ICU patients mechanically ventilated with expected ICU stay >3d. Excluded FiO2 >0.6, air leak (through ICC), iNO, CRRT, pregnant, cardiac surgery, severe TBI and severe liver disease. Randomised to tightly REE (resting energy expenditure) guided nutritional support by indirect calorimetry (IC) versus weight-based measurements (25kcal/kg/d). N=130
  - Primary outcome; hospital survival. Hospital mortality was significantly lower in IC group (28.5% vs 48.2%, P=0.023). But duration of mechanical ventilation and ICU LOS was longer, with trend towards higher VAP in IC group. No difference in APACHE2 or other baseline data
  - Higher predicted energy requirements with IC than calculated. More energy and protein in given in IC group (P=0.001 for both)

- EDEN 2012 JAMA
    - MC (44) RCT; Patients <48h onset of ALI (P/F<300, bilateral infiltrates, oedema not secondary to left atrial hypertension) with mechanical ventilation <72h and eligible for enteral nutrition. Randomised to trophic (10-20kcal/h) or full enteral feeding (25ml/h escalating to goal rate 25-30kcal/kg/d ASAP, gastric residual volumes 6hrly) for first 6d mechanical ventilation. Stratified by site and presence of shock. N=1000
    - Primary outcome; ventilator free days by d28 (if died = 0); no difference (14.9 vs 15.0). No difference in 60d mortality or development of infections. Less feed intolerance with trophic
    - 272 patients trophic group also randomised to OMEGA study (2x2 omega-3 fatty acids and anti-oxidants) -this did not affect primary outcome
- PermiT 2015 NEJM
    - MC (7) RCT; Enterally fed <48h of ICU admission randomised to permissive underfeeding (40-60%) vs standard-feeding (70-100%) for 14d or until ICU discharge, palliation, death, or oral feeding. Calculation of actual intake included other infusions (propofol/dextrose). Protein and volume delivery equal in groups (added protein and water/saline). N=894
    - Primary outcome; all-cause 90d mortality 27.2% vs 28.9% (RR 0.94, 95% CI 0.76-1.17, P=0.58)
    - Less renal replacement therapy with permissive underfeeding
- TARGET 2018 NEJM
    - MC (46) DB RCT; invasively ventilated, about to commence enteral nutrition (or <12h of commencement) and expected to receive enteral nutrition in ICU more than day after randomisation. Randomised to energy-dense (1.5kcal/ml) vs routine (1kcal/ml) enteral nutrition at 1ml/kg/h based on IBW aiming to reach target by 48h, for 28d or til enteral nutrition discontinued, patient died or discharged from ICU. More fat and CHO per ml in energy dense, but same protein. Stratified to site. N=3957
    - Primary outcome; all-cause mortality within 90d; 26.8% vs 25.7%, RR 1.05 95% CI 0.94-1.16, P=0.41 with no difference in subgroups also
    - In the energy-dense group there was more feed intolerance (higher gastric residual volumes, more prokinetic use, more regurgitation/vomiting) and hyperglycaemia
    - There was no overfeeding, increased hypercapnoea or increased mechanical ventilation time with energy-dense feeds. Standard arm were underfed. Both groups had the same amount of protein intake (which met guidelines)

Summary (my practice)

- Whilst nutrition is important and I am proactive in commencing enteral feeds, I specifically aim to avoid overfeeding early in critical illness (and underfeeding late), and consider extra-nutritional intakes (dextrose containing infusions, propofol) when considering total caloric intake
- More important however than calories per se, is protein intake (underfeeding not proven to be harmful in early critical illness) – as a rule therefore I rarely use energy dense feeds (for same target calorie intake the patient will receive less protein); I carefully consider the balance of benefit-risk of energy-dense feeds in only a few patients where necessary volume restriction is not manageable by other means (e.g. diuresis/RRT)
- Theorhetically high CHO intake produces relatively more CO_2 (higher respiratory quotient) – and whilst I do not use specific use 'low CHO feeds' in patients that are difficult to ventilate e.g. ARDS, I do pay extra particular attention to avoiding overfeeding in this group and may target permissive underfeeding as long as protein requirements can be met
- Calorimetry may have an evolving role in personalising nutritional requirements beyond other methods such as 'per body weight' (actual vs ideal) calculations – different disease states may have specific differing needs and a one-rule fits all may not hold