**Introduction to Critical Care Dietetics**

**Energy Requirements:**

The energy expenditure (EE) of critically ill patients is variable, influenced by the impact of the illness and its treatment. Several factors other than the severity of illness modify EE e.g. ventilation modes, sedation, paralysis, cooling and activity.

Henry equation not validated for use in ICU therefore not recommended.

Using 20-25kcals/kg has been recommended by ESPEN and American Societies (Cerra et al. 1997; Singer et al. 2009). Although it is quick and easy to use, it is based on a consensus decision to avoid overfeeding, rather than on any clinical evidence. It is not age, gender, or condition specific and there is ambiguity over which weight to use. Due to these factors it has a very low accuracy rate when compared to MEE (Reid 2007).

***If using 20-25kcal/kg aim lower end in more unwell patients and during the first few days on ICU. Increase to 25kcal/kg once more stable.***

There are published predictive equations designed for use in critically ill patients’ e.g.

 Swinamer (Swinamer et al. 1990)

 Ireton-Jones (Ireton-Jones et al. 1992)

 Penn state (Frankenfield et al. 2004)

 Brandi (Brandi et al 99)

 Faisy (Faisy et al. 2003).

Frankenfield et al (Frankenfield et al. 2009) carried out the largest and most complete validation study of metabolic rate equations for critical care use. Nine different equations were compared to MEE via indirect calorimetry in 202 critically ill patients. The Penn State equation was the most consistent, with it being able to predict energy expenditure within a 10% range in 67% of occasions.

At UHS we estimated EE using the Penn state equation (PSU) using the Miffin equation to start with to provide an estimate of basal metabolic rate:

|  |  |
| --- | --- |
| Mifflin (BMR equation for use in PSU – see below) | Males:  10 (wt kg) + 6.25 (ht cm) – 5 (age) + 5  Females:  10 (wt kg) + 6.25 (ht cm) – 5 (age) - 161 |
| Penn State University (PSU) (Mifflin) | Mifflin (0.96) + Tmax (167) + Ve (31) – 6212  Tmax = max temp in last 24 hrs  Ve = minute volume, median of last 24 hrs readings |

***It is important not to overfeed critically ill patients especially in the first 5 days.***

***Aim for approx 80% of EE in the first week.***

Obesity:

Calculate IBW (BMI 27.5).

Calculate 20-25kcal/kg IBW.

OR calculate Mifflin & PSU based on ABW and IBW then use clinical judgement. In the very high BMI patients start at nearer to IBW values.

**Protein Requirements:**

1.2-1.5g/kg.

Start with 1.2g/kg for majority of patients.

Use 1.5g/kg for CVVH, open chest, open abdo, spinal #s, polytrauma, TBI, large wound losses.

If BMI > 30 use IBW at BMI 27.5.

Prosource tf is used as a modular protein supplement to meet protein requirements.

1 sachet Prosource tf = 45ml, 44kcal, 11g pro.

Minimal electrolytes, fat, CHO.

**Feeding Regimens:**

MetaVision ICU wards use an electronic volume based feed protocol.

The standard ICU feeding protocol is as follows:

Day 1 – Nutrison protein plus @ 40ml/hr

Day 2 – Increase to target as per electronic volume based feeding protocol – see target rate on MetaVision volume based feeding protocol.

If the patient has not been seen by a dietitian the target will default to 25kcal/kg ABW if BMI less than 30 or IBW if BMI > 30.

Non-MetaVision wards will not have access to the electronic feeding protocol and should be fed as follows:

Day 1 & 2 – Nutrison protein plus @ 40ml/hr

Day 3 – Increase feed rate by 20ml/hr as tolerated up to 20ml/kg (25kcal/kg)

Nutrison protein plus is first line feed on ICU.

Other common feeds used:

* Nutrison concentrated (volume restriction, moderate hypernatraemia or hyperkalaemia not for CVVH)
* Low sodium (raised serum sodium)
* Peptisorb (see gastric aspirate and pancreatic insufficiency sections below)
* Peptamen HN / AF( see gastric aspirate and pancreatic insufficiency sections below)

**Ventilation:**

Patients may be intubated via an endotracheal tube (ETT) or tracheostomy.

ETT usually placed initially, patients require sedation.

Tracheostomy usually used for longer term ventilation, patients can be woken up and can have more rehab.

* Normal breathing – negative pressure (active expiration)
* Ventilators are based on positive pressure
  + Actively forces air into the lungs
  + Expiration is a passive process
* Breaths delivered by volume or pressure
* Different modes of ventilation – may be mandatory (PCV-VG / APVCMV, SIMV) or supportive (Bilevel / DuoPAP, Pressure Support / SPONT)
* PEEP = Positive End-Expiratory Pressure – protects airway from collapse and increases time for gas exchange. Usually 5-10.

The minute volume (tidal volume x resp rate) is needed for the PSU equation and can be found on the airway tab on MetaVision.

NG feeds need to be stopped for 6 hours prior to airway procedures (intubation / extubation / trache insertion) except in emergencies. This is to reduce risk of aspiration if a patient vomits on intubation. Feeds should be restarted post extubation / trache when medical team assess it is safe (i.e. they feel patient is not at risk of re-intubation).

Patients who are struggling with ventilation may be “proned”. This means they will be ventilated whilst lying on their fronts. As the patients have a protected airway we can NG feed whilst proned however proning patient is associated with increased gastric aspirates (see below for management).

**ICU specific medications:**

Sedation:

Critically ill patients are routinely provided analgesia and sedation to prevent pain and anxiety, permit invasive procedures, reduce stress and oxygen consumption, and improve synchrony with mechanical ventilation.

Commonly used sedation:

***Propofol – 1kcal/ml lipid based. Short acting. ICU electronic feeding protocol allow for this. Risk of hyper-triglyceridaemia in high doses.***

Fentanyl – opiate. May cause constipation, reduce peristalsis

Remi-fentanyl – similar to fentanyl but shorter acting.

Morphine - opiate. May cause constipation, reduce peristalsis

Dexmedetomidine

Benzodiazepines (Midazolam, diazepam, lorazepam)

Clonidine – often used for agitation in more alert patients.

Ketamine.

Paralysis – cisatracurim, rocuronium. Associated with poor gastric emptying and reduced peristalsis.

Inotropes

Inotrope agents alter the force of muscular contractions; they can cause positive (increase contraction) or negative (decrease contraction) changes. Positive inotropic agents are used to support cardiac output in conditions such as congestive heart failure, MI, septic shock and include **noradrenaline,** **milrinone,** **dopamine, dobutamine, adrenaline**.

Blood supply diverted from peripheral tissues therefore risk of peripheral ischaemia and bowel ischaemia in high doses.

Vitamins

Dietitians can prescribe refeeding vitamins on MetaVision.

* Forceval soluble od
* Thiamine 100mg bd

**Biochemistry:**

Critically ill patients frequently have fluid and electrolyte abnormalities that are caused by a variety of factors. As dietitians we are taught to be acutely aware of re-feeding syndrome and will pay particular attention to levels of potassium, magnesium and phosphate however in most cases low levels in critically ill patient are not related to nutritional status or re-feeding syndrome. Twenty four hours is a long time in the ICU thus blood results from a few days ago may be of little help in assessing the current picture (Runcie and Dougall 1990). Because of this reason biochemistry is carried out frequently in the ICU often twice a day. If one value is abnormally low or high it is best to get a trend before changing nutritional strategies, as frequently the values change by the end of the day and you may be required to amend your plan again. In some cases the levels may be purposefully pushed above normal levels for therapeutic benefits (see below). When manipulating electrolytes in TPN, it is essential to review the drug chart to see which additional supplementation is also being given. All biochemistry results need to be interpreted taking the full clinical situation into consideration. A discussion with the medical team is often required to help guide your decision making.

Potassium:

It is common practice to aim for levels of > 4.5mmol in patients experiencing arrhythmias using additional potassium supplementation either enterally or IV.

Check the “new data” tab on the dietetic review page of MetaVision to see how much K has been supplemented IV in last 24hrs (NB this doesn’t include any enteral supplementation or K given in PN).

Magnesium

Magnesium is used therapeutically to treat ventricular tachycardia (VT) and supraVT arrhythmias, seizures, asthma and post myocardial infarction (MI). Supra-normal levels of 1.5-2mmol are often sought.

Check the “new data” tab on the dietetic review page of MetaVision to see how much Mg has been supplemented IV in last 24hrs.

Sodium

If Na is raised a low sodium feed may be needed. Usually if Na is >148 and rising. Check trends and fluid balance. NG water may also be given to manage hypernatraemia – see below under fluid balance.

**Gastric residual volumes (GRVs) / gastric aspirates:**

Large GRV’s are used as a marker of gastric emptying and assumed to reflect enteral feed intolerance. Other symptoms of delayed gastric emptying are nausea, vomiting, abdominal distension and discomfort. There is no agreement in the literature indicating a definition for a large GRV or management for their occurrence such as whether feed should be withheld after a single high GRV, or how long to withhold feeds before checking GRV’s. The reported values for the designated cut-off for withholding feed varies from 150ml up to 500ml

At UHS we use a GRV cut off of 250ml and our guidelines are as follows:

* Aspirate NGT every four hours
* If aspirate less than 250ml continue current rate of NGT feeding
* If aspirate more than 250ml: replace 250ml and discard the remainder. Maintain current rate and request IV metoclopramide prescription (10mg TDS).
* If two consecutive aspirates above 250ml with metoclopramide prescribed reduce rate by 25ml/hr to a minimum of 25ml/hr and refer to dietitian via E-Quest

If aspirates still high after 24 hours on metoclopramide request IV erythromycin prescription (500mg BD), review after 48 hours and stop if aspirates not improved.

If gastric aspirates are high trial a peptide feed to see if better tolerated.

* Peptisorb – 1kcal/ml / 0.4g pro/ml. May provide more fluid than desirable and low protein content. Low in LCT therefore useful in pancreatic insufficiency (0.9g LCT/100ml).
* Peptamen HN – 1.33kcal/ml / 0.66g pro/ml. 1.5g LCT/100ml.
* Peptamen AF – 1.5kcal/ml / 0.94g pro/ml. Useful in fluid restriction / high protein requirements but contains more LCT therefore not best choice in pancreatic insufficiency (3.1g LCT/100ml).

\*note Peptamen feeds more expensive than Nutrison feeds.

**Bowels:**

Patients often require laxatives whilst on ICU but diarrhoea is also common due to antibiotics, infections. EN is rarely the cause of diarrhoea on ICU.

Fibre feeds can be given to help constipation but often worsen diarrhoea. A short term trial may be useful to see if diarrhoea improves with addition of fibre.

Fibre feeds should not be used in patients with poor gastric emptying or high dose inotropes (increased risk of bowel ischaemia).

If a patient has persistent diarrhoea with negative stool sample semi-elemental feeds can be trialled or can use loperamide / codeine in discussion with medical team.

Consider pancreatic insufficiency for patients with known pancreatic disease or multi-organ function.

**Pancreatic insufficiency:**

Use peptisorb or peptamen HN.

Avoid peptamen AF if possible due to higher LCT content.

PERT – Pancrex V in chronic pancreatitis usually requiring PERT or severe acute pancreatitis. PERT may not be needed in acute pancreatitis if on a low LCT feed.

Monitor for symptoms of malabsorption but be aware these can be masked by constipating effects of ICU drugs.

**Renal replacement therapy (CRRT / CVVH):**

Often required in ICU due to new AKI or CKD + AKI.

Continuous renal replacement therapy (CRRT) involves the removal and return of blood through a single cannula placed in a large vein (venovenous therapy). This is known as continuous venovenous haemofiltration (CVVH). Overall, it causes less haemodynamic instability compared to dialysis because fluid removal is slower and there is time for fluid to re-equilibrate between compartments.

Fluid and electrolytes are removed by diffusion and convection.

Fluid is removed as needed according to patient tolerance. If patients are very unwell too much fluid removal may cause blood pressure to drop and will not be tolerated. In these patients if they are already oedematous it may be necessary to fluid restrict the feed. If the nurses are able to remove fluid easily with CVVH fluid restriction is not necessary.

K & PO4 are very efficiently removed by CVVH and restriction is not usually necessary. Supplementation is often required and this is done by nursing staff according to set protocols.

Anticoagulation is required for patients on CRRT to prevent the blood clotting whilst in the filter. Either heparin or citrate is used for anticoagulation. Citrate is routinely used at UHS.

Citrate is metabolised in Kreb’s cycle and provides a source of calories.

If a patient is receiving CRRT with citrate anticoagulation assume 200kcal/d is received from citrate. If you are using the MetaVision volume based feeding protocol this won’t be taken into account automatically. You therefore need to reduce your calorie target in the calorie target box on the dietitian review screen by 200kcal.

SCUF (slow continuous ultrafiltration) may be used to remove fluids without removing electrolytes. This may be used alternately with CVVH.

**Fluid balance:**

Fluid balance is monitored very closely in ICU.

Patients usually receive large quantities of fluids from meds and IVs so do not need additional water flushes via NGTs to meet fluid requirements.

NG water may be given to manage hypernatraemia. This is usually if a patient is intravascularly deplete (raised Na and Ur). Usually start at 20-25ml/hr water given continuously.

Diuretics are commonly used. Frusemide may be given via a continuous infusion when higher doses required or by bolus.

Spironolactone is also commonly used.

Frusemide = Na sparing / K wasting

Spironolactone = K sparing / Na wasting (i.e. if a patient has a high K and is on spironolactone this may be the cause and may improve if stopped; hypernatraemia may be treated with high dose spiro).

**Blood glucose:**

Insulin resistance and raised blood glucose levels are common in critical care even in non-diabetic patients. Patients are started on VRII (actrapid) to keep blood glucose levels within a set range according to protocols. Usual diabetic medication is usually stopped in known diabetics but some patients may be given a background of long acting insulin alongside the VRII.

If BGLs / insulin requirements are very high this may indicate that patient is being overfed.