NUTRITION IN CRITICALLY ILL

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Overview

- Nutrients and energetic requirements
- Indications for nutritional support
- Route of nutrition
- Enteral and parenteral nutrition
- Complications of nutritional support

Is it important ?

- Up to 60 % of patients in hospital are either malnourished or at risk of becoming malnourished

- Leads to increased hospital days
  - Number of complications
  - Mortality

Is it important ?

Inadequate nutrition of critically ill patients leads to **muscle wasting** that would lead to worse prognosis, increased complications and at the end worse survival rate

Malnutrition

- Deficiency either of total energy or of protein (or other nutrients) leads to a reduction in body cell mass and organ dysfunction

- As the result of
  - Inadequate intake
  - Reduced absorption
  - Or increased requirements

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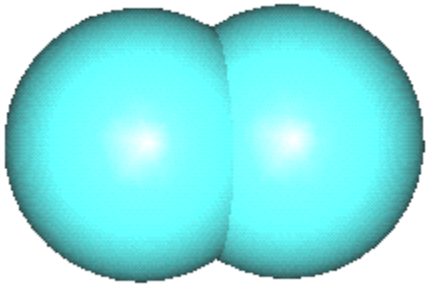
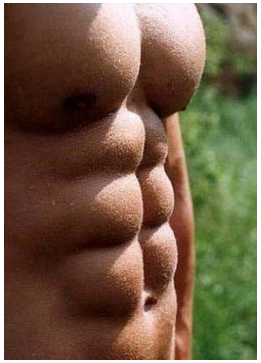
  - Inadequate intake
  - **Reduced absorption – abnormal nutrient processing**
  - Or increased requirements

Energy conversion

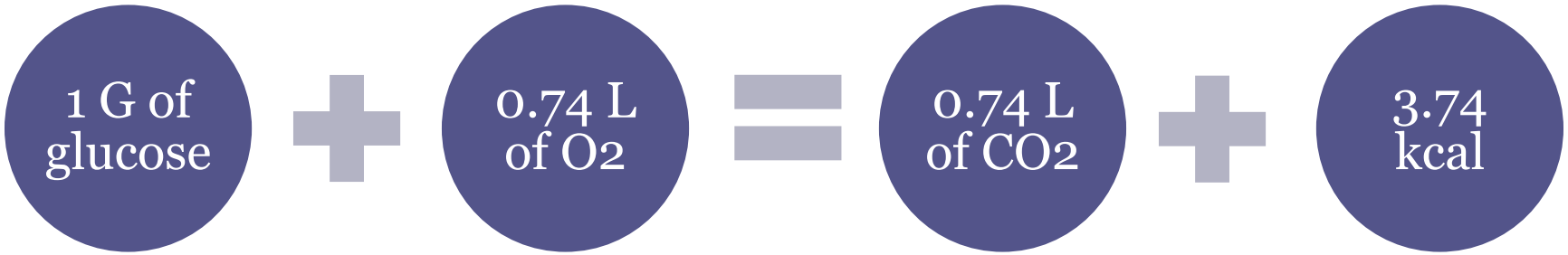




waste

Nutrients - fuel

- Carbohydrates
- Lipid
- Protein


1 G of glucose
0.74 L of O2
0.74 L of CO2
3.74 kcal

Oxidative metabolism of organic fuels

Fuel	VO2 (L/g)	VCO2 (L/g)	RQ	Energy yield(kcal/g)
Lipid	2,0	1,4	0,7	9,1
Protein	0,96	0.78	0,8	4,0
Glucose	0,74	0,74	1,0	3,7

Respiratory quotient = VCO_2/VO_2

Daily energy expenditure

- Predictive equation
- Indirect calorimerty
  - Based on VO_2 and CO_2 production
  - Measured over 15 to 30 minut, extrapolated to 24 hours
  - Problems: bulky, expensive, not reliable in hypercatabolic state

Predictive equation

- Harris Benedict Equation - basal metabolic rate

In kcal/day.

- For ♂: BMR = 13.75 x **weight** (kg) + 5 x **height** (cm) – 6.78 x **age** (years) + 66

- For ♀: BMR = 9.56 x weight (kg) + 1.85 x height (cms) – 4.68 x age (years) + 65

Nutritional requirements

- Around 25 kcal/kg/day
- Macronutrients : protein, lipid and carbohydrate provides the energy requirements
- Micronutrients (vitamins and minerals)
  - Cofactors for enzymes
  - Vitamins - organic compounds
  - Trace elements - ions

Carbohydrates

- EssentiaL fuel for CNS
- Provides 3.75 kcal/g in vivo
- 2 – 2,5 g/kg BW/day - max 250 g/day
- Around 70% of the nonprotein calories
- CNS relies on glucose as fuel source

Problems with too much sugar

- Stimulate insulin release
  - Inhibition of lipolysis
- Promotes lipogenesis – RQ = 8
- High RQ
  - CO_2 abundance
- Need for regular glycaemia checks – stormy changes of sugar metabolism in criticaly ill
- Many patients will need cont. insulin

Lipids

- Critically ill have difficulties in mobilizing their own lipids
- Provides 9.3 kcal/g – highly energetic
- Calories from lipid should be limited to 30% of total calories
- Source of essential fatty acids – linolenic acid (an omega-3 fatty acid) and linoleic acid (an omega-6 fatty acid)

Lipids

- Omega 6 (arachidonic acid, linoleic acid) have anti-inflammatory and procoagulant effect
  - Deficiency – dermopathy, cardiac dysfunction, ↑ susceptibility to infection

- Metabolites of Omega 3 lipids improve cellular, anti-carcinogenic, anti-inflammatory and vasodilating and anti-agregation effects

Lipids - contraindications

- Shock
- Serious coagulation disorders and haemorrhagic conditions
- Severe hyperlipaemia
- Fat embolism

Proteins

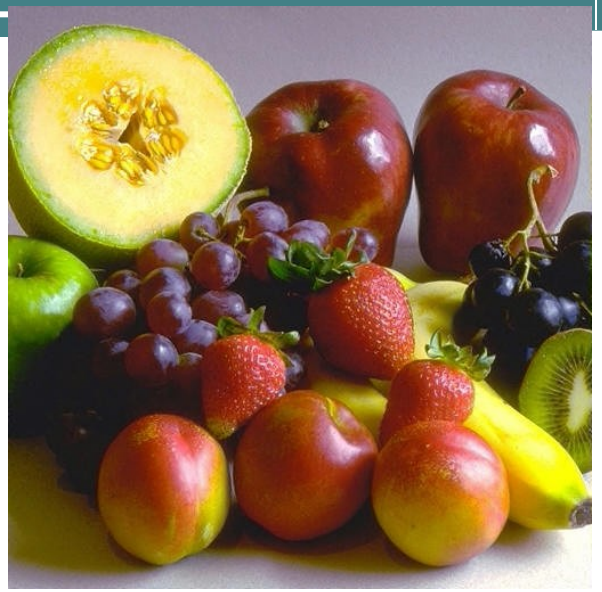
- Around 1.5 g/kg/day
- Provides 4 kcal/g
- Higher intake in hypercatabolism

Nitrogen balance

- N balance = (protein intake/6,25) – (UUN+4)

- **Negative N bala**nce = High urinary Nitrogen = protein breakdown
- **Positive N balance** = enough calories to spare own proteins from being degraded
- Choice of amino-acids is very individual with monitoring urea levels in plasma and urine

Vitamins



- 12 essential
- Antioxidant vitamins
  - Vitamin C and E
- B1 – thiamine
  - Deficiency presents with
    - Cardiac dysfunction – beri beri
    - Wernicke's encefalopathy
    - Lactic acidosis
    - Peripheral neuropathy

Essential trace elements

- Seven trace elements
- Substance that is present in the body in less then 50 μg/g of body tissue

- Iron
- Selenium
  - antioxidant

Assessment of nutritional status

- ?

- Skin fold thickness
- Albumin, haemoglobin, transferrin
- BMI

- DO NOT REFLECT ACUTE CHANGE IN NUTRITIONAL STATUS

Assessment of nutritional status

- Targeted history and examination

- 1. Weight change
- 2. Changes in food intake
- 3. Gastrointestinal symptoms - nausea, vomiting, diarrhoea and anorexia
- 4. Functional impairment – muscle wasting oedema, ascites

Aim of nutritional support

- Correct and prevent malnutrition
- Optimize patient's metabolic status
- Decrease morbidity and shorten recovery

Nutritional support

- I. Indications – meeting criteria for nutritional support
- II. Setting of actual energetic requirements
- III. Route of nutrition
  - Oral
  - Enteral
  - Parenteral

Indications for nutritional support

- Malnutrition
- Burns, sepsis, polytrauma, MOF, etc
- Pre-op preparation and post-op care
- GI impairment - pankreatitis, Morbus Crohn, colitis ulcerosa

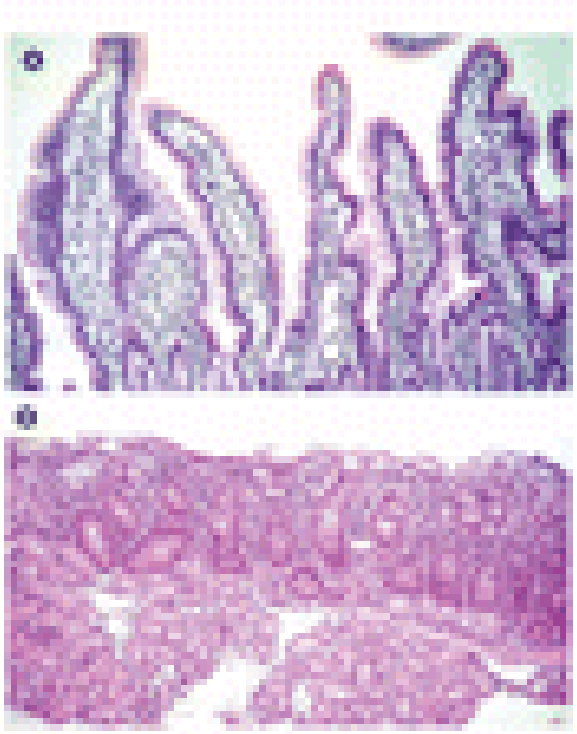
Indications for nutritional support

- Neurologic indications – myastenia, cerebrovascular disease
- Aktino and chemo therapy
- Geriatric patients

Route of nutrition

- Oral
- Enteral - via a tube directly into gastrointestinal tract
- Parenteral - intravenous (peripheral or central vein)

Depletion of nutrients in the bowel lumen is accompanied by degenerative changes in the bowel mucosa



Route of nutrition - preferred

- **Oral**
- **Enteral**

- Far cheaper
- More physiological
- Reduce the risk of peptic ulceration
- Minimize mucosal atrophy
- May reduce **translocation**

Enteral nutrition

- Indicated when oral nutrition inadequate for 1-3 days
- Short term - 3 to 6 wks
  - Nasogastric or nasojejunal tube
- Long term – more then 6 wks
  - Surgical jejunostomy or percutaneous gastrostomy

Enteral nutrition

- **Nasogastric** – most common in ICU
- Potential problems - malposition, difficulty swallowing or coughing, discomfort, sinusitis and nasal tissue erosion
- Nasal tube - contra-indicated in a patient with a base of skull fracture
- **Orogastric** – to reduce sinusitis

Enteral nutrition - *post-pyloric feeding*

- **Nasojejunal or jejunostomy**
- Avoids the problem of gastroparesis
- Recommended for patients at high risk of aspiration
- Patients who are intolerant of gastric feeding

Enteral nutrition - contraindications

- Acure abdomen
- Bowell obstruction
- Profuse vomiting, diarrhoe
- Gastroparesis, ileus
- Narrow stenosis of GI trackt
- Toxic megacolon
- Relative CI: pancreatitis, GI fistulae, ischemia

Feeding formulas

- **Caloric density** – Carbohydrate content
- Energy high formulas – Excessive daily energy need and fluid restriction
- **Osmolality** – carbohydrate content dependent
- Calorie: nitrogen ratio
- Carbohydrate: lipid ratio

Polymeric feeding formulas

- Mixture of intact proteins, fats and carbohydrates
- Require digestion prior to absorption
- Balanced amount of nutrients, vitamins and trace elements
- Tend to be lactose-free
- Low viscosity
- Preserved resorption
- Nutrison, Fresubin

Elemental (oligomeric) feeding formulas

- Macronutrients in a readily absorbable form
- Oligopeptides, oligosacharides, dextrines, essential fatty acids
- Low osmolality and viscosity
- In patients with decreased absorption of GI tract
  - Severe malabsorbtion of pancreatic insuficiency

- PEPTI 2000 , Peptisorb, Survimed

Disease-specific formulae

- Usually polymeric

- 1. Liver disease - low Na and altered amino acid content (to reduce encephalopathy)
- 2. Renal disease - low phosphate and potassium, 2kcal/ml (to reduce fluid intake)
- 3. Respiratory disease - high fat content reduces CO2 production.

Specific additives

- Glutamine
  - Thought to promote anabolism
  - Intestinal growth factor

- Omega-3-fatty acids
- Fiber – alleviates diarrhoea

Parenteral nutrition

- Unphysiological, bypasses liver
- Rapid atrophy of GI mucosa
- Expensive
- Risk of infections and thrombotic complications

- Central vein - hypertonic solutions
- Peripheral – isotonic solutions – large volumes

Parenteral nutrition

- Can be used to supplement enteral nutrition - short gut syndrome
- Sole source of nutrition: total parenteral nutrition
- Evidence that PN is better than no nutritional support
- Given as separate components or all-in-one

Parenteral nutrition

- Proteins - given as amino acids including essential amino acids
- Lipid - commonly given as Intralipid
  - an emulsion made from soya with chylomicron sized particles
- Carbohydrates – glucose
- Electrolytes & Micronutrients – included or given separately

Complications of nutritional support

- Refeeding syndrome
- Overfeeding
- Hyperglycaemia
- Specific complications of enteral nutrition
- Specific complications of parenteral nutrition

Refeeding syndrome

- Severely malnourished or prolonged starvation
- Starvation causes a loss of IC electrolytes (Na K pump failure) – IC stores depleted
- Carbohydrate causes an insulin-dependent influx of electrolytes rapid and severe drops in serum levels of **P, Mg, K** and Ca
- Weakness, respiratory failure, cardiac failure, arrhythmias, seizures and death
- Solution – feed slowly

Overfeeding

- Deliberate overfeeding has been tried in an attempt to reverse catabolism but this does not work and is associated with a poor outcome.
- Can cause uraemia, hyperglycaemia, hyperlipidaemia, fatty liver, hypercapnia

Hyperglycaemia

- critically ill - insulin resistant as part of the stress response
- Tighter BM control reduces in-hospital mortality, length of stay, ventilator days, incidence of septicaemia
- Continuous insulin infusion

Specific complications of enteral nutrition

- Aspiration of feed causing pneumonia
- Diarrhoea – exclude other causes of diarrhoea, then a feed with more fiber can be tried

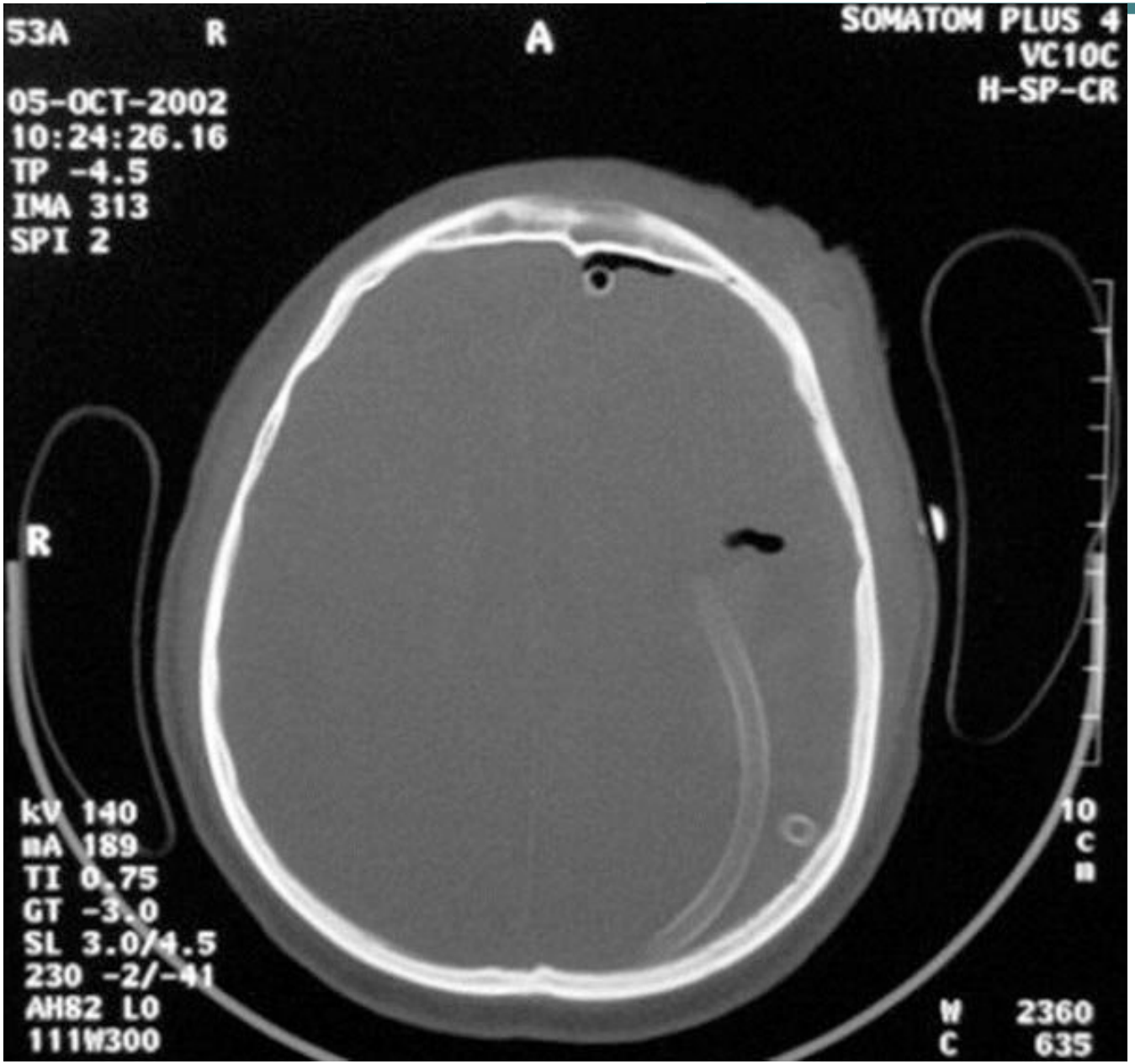
Specific complications of parenteral nutrition

- Related to insertion and presence of a central venous catheter
- Infection, trombosis
- Hepatobiliary disease - fatty liver, cholestasis and acalculous cholecystitis

Summary

- Malnutrition is associated with a poor outcome in critical illness
- Enteral nutrition is the mainstay and should be started early
- Parenteral nutrition only in selected patients
- Glucose control with insulin therapy and important not to overfeed

Questions ?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