Home enteral feeding:

Monitoring and long term management

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The good news……

- Complications for PEG tubes are rare
  - All cause overall mortality (study of 10,952 PEG procedures)[1] =
  - 7 day = 4%
  - 30 days = 14%

1. K Bodger et al. Gut. 2010
2. E Clarke et al. Gut 2015

The good news……

- Recent study examined the long-term mortality and morbidity in community managed patients post PEG insertion
- Mortality
  - 350 patients
  - No deaths and few complications directly related to PEG insertion
  - 3 months mortality = 16%
  - 12 months mortality = 35%
  - >12 months mortality = 54%

  } cumulative
- Morbidity
  - 3 month = 10%
  - 12 months = 15%

  - 38% required treatment for an insertion site infection
  - 70% of these had more than one infection.

E Clarke et al. Gut 2015

Early monitoring

Early monitoring

- Site
- Education / patient management of tube
- Drug review – methods of administration
- Bowel function
- Nutritional state
- Define nutritional goals

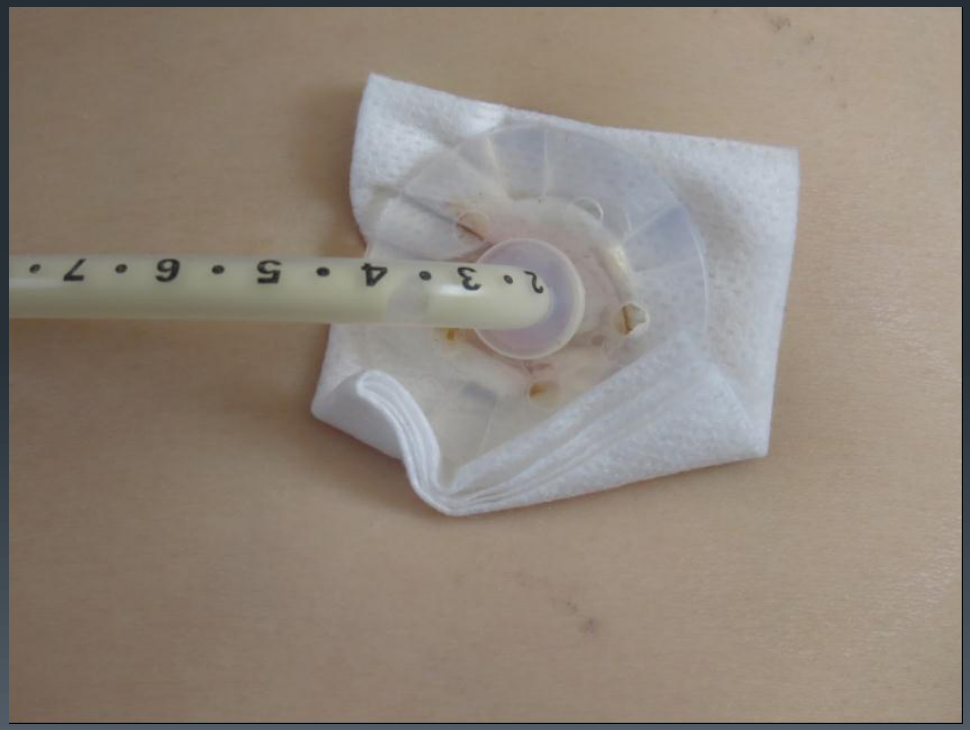
Early monitoring

- Commenced while the patient is still in hospital
  - Assess and monitor for potential complications
    - Aspiration pneumonia
    - Bleeding
    - Peritonitis
    - Infection
  - up to 58% of patients have evidence of a pnuemoperitoneum post PEG.
    - Asymptomatic pneumoperitoneum should be treated conservatively

Toussaint et al. Clin Nutr. 2015

Early monitoring - Site

- Position of tube
  - number of centimeters at the skin
  - Movement of the tube



Early monitoring – GI function

- Bowel function
  - Constipation
    - Can increase intolerance to feeding
  - Diarrhoea
    - May require alteration of feed composition due to osmotic load
    - May require alteration of method of feed delivery (bolus vs. pump)
- Nausea / vomiting
- Abdominal pain

Early monitoring - Nutrition

- Baseline nutritional assessment
  - Height / weight / BMI
  - Validated nutrition screen

Early monitoring - nutrition

- Indication for PEG
- Concurrent medical and/or surgical problems
- Age
- Metabolic demands
- Fluid requirements
- Baseline nutritional status
- Current addition dietary intake

Early monitoring - nutritional

- Risk of re feeding syndrome
  - one or more of the following:[3]
    - BMI less than 16kg/m_2
    - Unintentional weight loss greater than 15% within the last 3-6 months
    - Little or no nutritional intake for more than 10 days
    - Low levels of potassium, phosphate or magnesium prior to feeding.

  - Or if the patient has two or more of the following:[3]
    - BMI less than 18.5 kg/m_2
    - Unintentional weight loss greater than 10% within the last 3-6 months
    - Little or no nutritional intake for more than 5 days
    - A history of alcohol abuse or drugs including insulin, chemotherapy, antacids or diuretics

Early monitoring - Nutrition

- Monitoring for re-feeding syndrome
  - Day 1 = 2 x a day UEC. glucose, magnesium and phosphate
  - Day 2 – 6 = daily monitoring
  - Day 7 – 10 = weekly monitoring

Hofer et al. Nutrition 2013
ESPEN guidelines 2011

Early monitoring – patient education

- Feeding
- Psychosocial assessment
- Care of the stoma site
- Daily cleaning routine
- Do’s and Don’ts
- Trouble shooting
  - Tube dislodgement
  - Infection

Long term monitoring for Home Enteral Nutrition patients

Long-term monitoring

- Recommended that stable patients are reviewed every 3 – 6 months depending on goals of care[1].

- Care should be provided by a multi-disciplinary team:
  - Registered nurse
  - Dietician
  - Medical Specialist
  - GP
  - Speech pathologist
  - Pharmacist

1. ACI and GENCA guidelines: 2014

Long term monitoring

1. Site
2. Device
3. Bowel function
4. Nutritional assessment
5. Psychosocial assessment

Site

- Hyper-granulation is the most common complication of PEG insertion occurring in up to 2/3rd of patients

- Infection
  - occurs in ~ 40% of patients
  - Frequently recurrent

- Position

- Movement

ACI & GENCA guidelines 2014

Device

- No standardised time frame in which a device must be changed.
  - Wilson Cook = “PEG replacement is recommended every **three** months or at the discretion of the physician”.
  - Kimberly Clarke = “1-8 months”

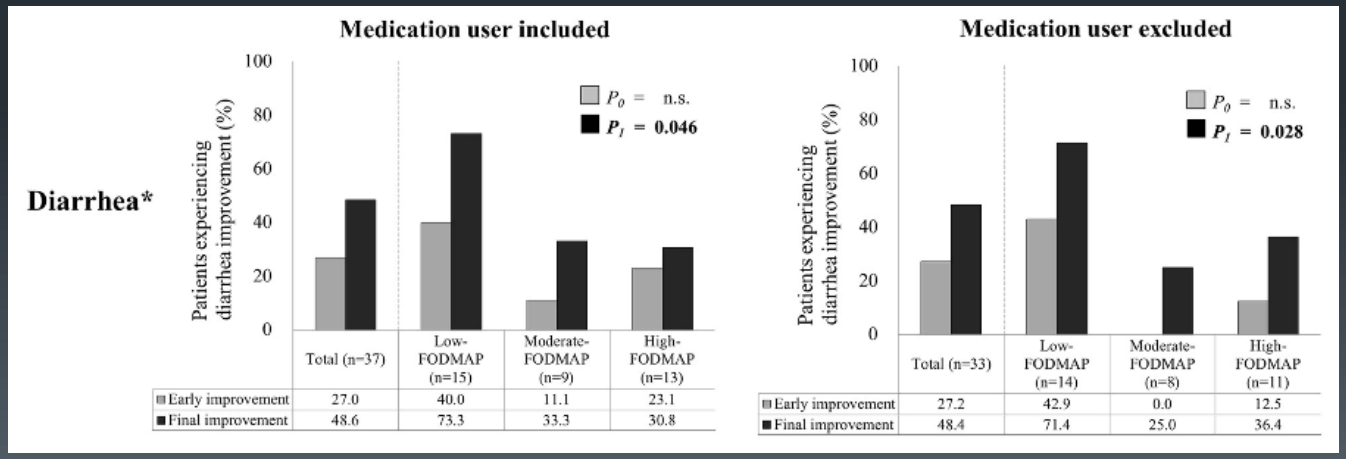
Bowels

- Upt to 70% of patients describe constipation
  - Many feeds are very low in fibre
  - Changing to a fiber enriched may be helpful

Ojo. O. Nutrients. 2015
Bittencort et al. Nutr Clin Pract. 2012

Bowels

- Diarrhoea
  - Think constipation!!
    - Overflow diarrhoea is very common
  - Osmotic load of feed
  - Fiber content of feed[1]
  - FODMAP content of feed[2]



1. Zarman et al. World J gast. 2015
2. Yoon et al. Nutr J. 2015

Body composition

Body composition

- Nutritional assessment
  1. “end-of-the-bed-o-gram”
  2. Weight / height / BMI
     - Does not give reliable measure of Fat mass and Fat free mass

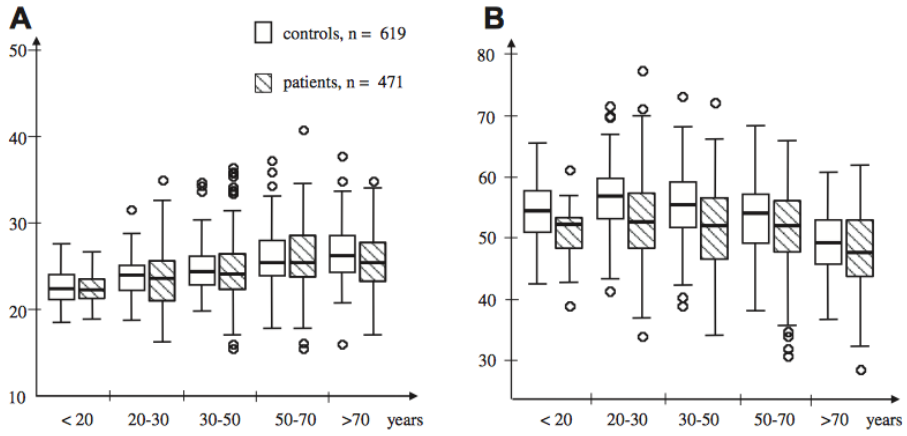
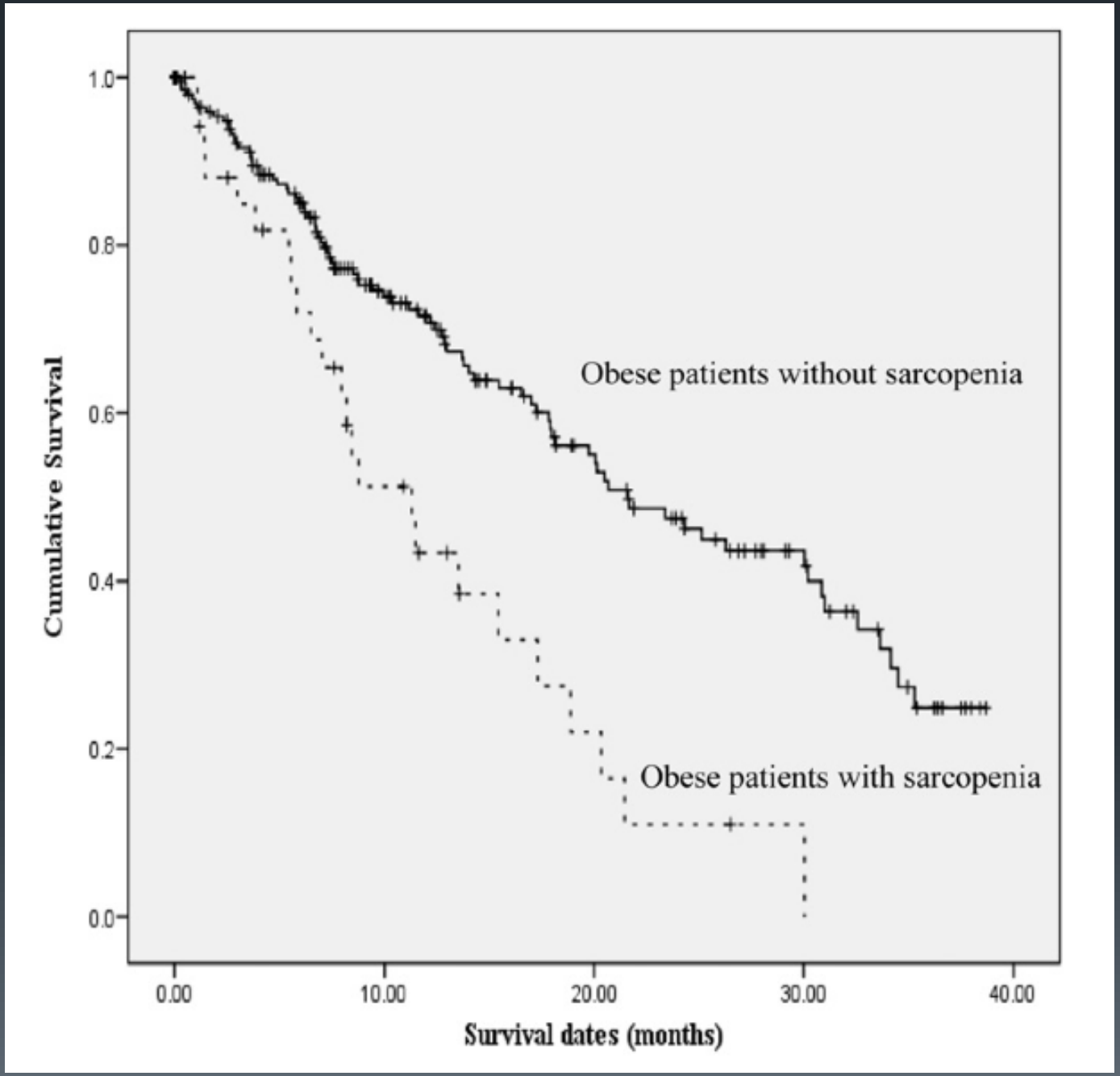


Fig. 2. Body Mass Index (BMI) (kg/m^2) (A) and fat-free mass (FFM) (kg) (B) (mean ± SD) measured by bioelectrical impedance analysis in 471 men at hospital admission and 619 sex and age- matched control subjects according to age (adapted from Kyle et al.[38]). BMI in patients at hospital admission remains statistically similar to BMI of healthy sex and aged paired-matched subjects, whereas FFM in patients is significantly lower than in healthy subjects in each age categories.

Body composition

- Body composition correlates with nutritional risk and clinical outcome
  - Length of stay
  - Clinical prognosis
  - Survival
  - Complication rates


Cumulative Survival
1.0
0.8
0.6
0.4
0.2
0.0
Obese patients without sarcopenia
Obese patients with sarcopenia
0.00
10.00
20.00
30.00
40.00
Survival dates (months)

Body composition

- Body composition correlates with nutritional risk and clinical outcome
  - Length of stay
  - Clinical prognosis
  - Survival
  - Complication rates
- Documents efficiency of nutrition support
- Allows optimization of nutritional support

Body composition

1. Anthropometry
2. Dual-energy X-ray Absorptiometry (DEXA)
3. Bioelectric impedance analysis (BIA)
4. Computerized tomography

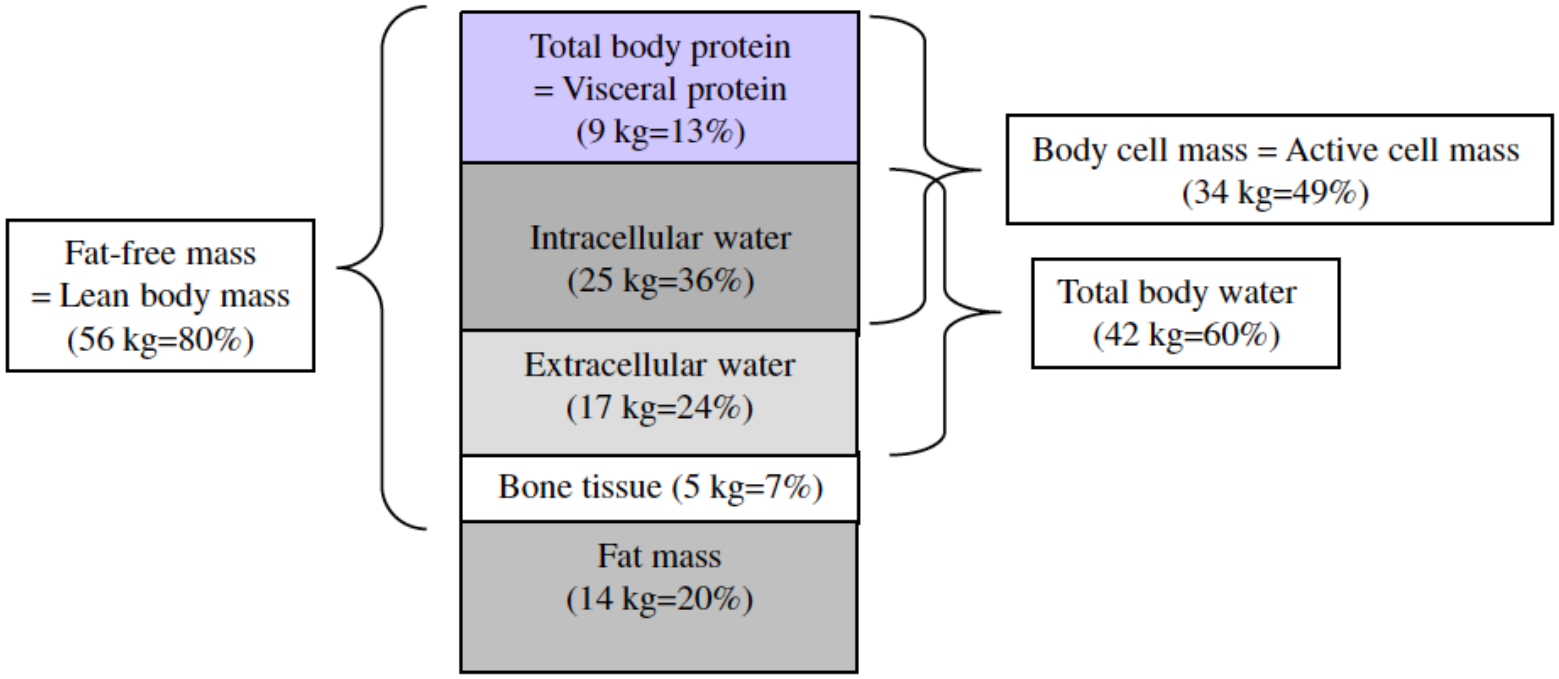


Fig. 1. Mean values of body composition compartments in an healthy human subject of 70 kg (adapted with the permission of the publishers from Kyle et al.[30]).

Thibault et al. Clin Nutr 2012

Body composition

1. Anthropometry
   - 4 skin fold measures
   - mid-arm muscle circumference

- Advantages
  - Cheap
  - Non invasive
  - No risk
  - Easily available

- Disadvantages
  - Poor reproducibility
  - Low sensitivity and specificity
  - Can be time consuming
  - Markedly effected by hydration status

Thibault et al. Clin Nutr 2012

Body composition

2. DEXA

- Advantages
  - Reference method of body composition
  - reproducible
  - Provides measures of:
    - Fat Free Mass
    - Bone mineral
    - Fat mass
- Disadvantages
  - Expensive
  - Requires radiation
  - low accessibility
  - Requires trained staff

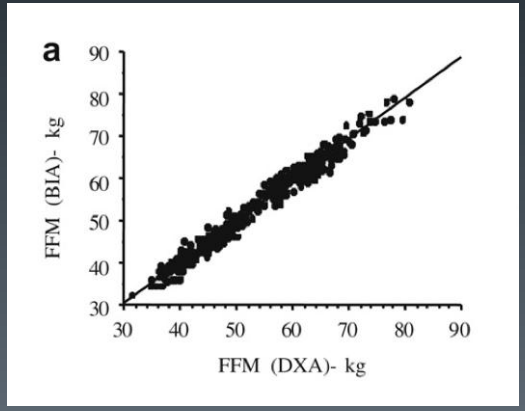
Thibault et al. Clin Nutr 2012

Body composition

3. Bioelectrical impedance analysis (BIA)

- Advantages
  - Relatively inexpensive
  - Very easy to perform
  - Non invasive
  - Validated against DEXA (BMI 16 – 34)
  - Linear follow up in patients at extremes of BMI
  - No radiation
  - Easily available

- Disadvantages
  - Not validated in cancer patients
  - Not recommended in patients with abnormal hydration



Thibault et al. Clin Nutr 2012

Table 4
Principles, advantages, inconveniences and indications of the different techniques of bioelectrical impedance analysis (BIA) (from Kyle et al.,[30,31] Lorenzo et al.,[53] Ward et al.[54]).

	Single frequency BIA (SF-BIA)	Multi-frequency BIA (MF-BIA)	Segmental BIA	Bioimpedance spectroscopy (BIS)	Bioimpedance vector analysis (BIVA)
Principles	Measurement of WB impedance at a single frequency; 50 kHz	Measurement of WB impedance at multiple frequencies: 1, 5, 50, 100, 200–500 kHz	• Measurement of trunk and limbs impedance • WB impedance misestimates trunk FFM (trunk impedance = 10% of WB impedance and 50% of WB mass)	• Measurement of current path resistance at 0 and infinite frequencies to predict ECW and TBW • Detection of altered tissue electrical properties	• Measurement of the impedance vector which is the graphical plotting of resistance (x) and reactance (y) standardized for height • Allows the estimation of changes in tissue hydration and BCM
Advantages	• Easy • Non-invasive • Very limited inter-observer variations • Relatively inexpensive • Measurement of phase angle	• Easy • Non-invasive • Direct evaluation of ECW, ICW and TBW • Measurement of phase angle	Estimation of muscle volume and appendicular lean body mass	• Accurate in healthy subjects • Low intersubject variability • Optimal prediction of ECW and TBW	• Stand-alone procedure not depending on equations or mathematical models • Only affected by impedance measurement error
Inconveniences	• Inaccuracy if fluid changes • Use of empirical linear regression models • Not measuring directly TBW but the sum ECW + ICW	• Use of empirical linear regression models • Poor reproducibility for frequencies <5 kHz and >200 kHz • Inability to detect ECW and ICW changes in the elderly	Need of standardization of the type of electrodes used	Mathematical modelling neding further validation in diseases for the evaluation of BCM	• High intersubject variability • Gives only a qualitative indication of nutritional status and fluid variations: no distinction between FFM and FM and no quantification of fluid volumes
Presumed indications	• Assessment of FFM and FM in numerous clinical conditions • Prognosis value of phase angle	• Assessment of body composition in patients with ECW increase (fluid retention, malnutrition) • Determination of TBW for healthy, obese and chronic renal failure subjects • Prognosis value of phase angle	• Body composition in neuro-muscular diseases • Determination of fluid variations in the pulmonary or abdominal region of the trunk • Determination of fluid variations in ICU, hemodialysis, ascitis, and post-surgery	Determination of fluid variations: further validation is needed	• Determination of fluid variations in renal and ICU patients and obese subjects • Prognosis value

BCM, body cell mass; ECW, extracellular water; FFM, fat-free mass; FM, fat mass; ICU, intensive care unit; ICW, intracellular water; TBW, total body water; WB, whole body.

Thibault et al. Clin Nutr 2012

Body composition

3. Computer tomography (CT)

- Provides assessment of fat free mass and fat mass at the level of the L3 vertebrae

- Advantages
  - Can be integrated into patients normal care

- Disadvantages
  - Radiation exposure
  - Poor accessibility
  - Specific software required

Thibault et al. Clin Nutr 2012

Micronutrients & biochemistry

Micronutrients & trace elements

- 146 patients with either neurological indication or head and neck cancer were studied pre PEG
  - 122 (84%) had zinc deficiency
  - 31 (21%) had selenium deficiency
  - 16 (11%) had copper deficiency
  - 69 (47%) had iron deficiency
  - 6% had chromium deficiency

Santos et al. Clin nutr. In press 2015

Micronutrient deficiency

- Feeds are nutritionally complete BUT:

- High rates of micronutrient deficiencies[1,2]
  - i.e. out of 37 patients with PEG feeds
    - zinc deficient = 30 patients
    - Selenium deficient = 1 patient
    - Copper deficient = 2 patients

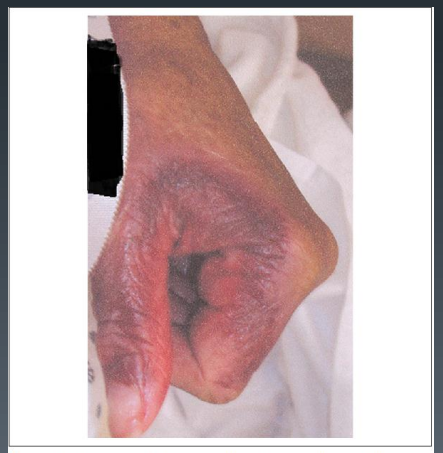


Figure 2. Acrodermatitis enteropathica (acquired zinc deficiency) with acral erythema and bullous lesions.

Figure 1. Acquired zinc deficiency demonstrated by erythema and superficial desquamation of the feet.

1. Oliver et al. Ann Clin Biochem 2005
2. Santos et al. Nutr Hosp 2014
3. Changela et al. JPEN. 2012

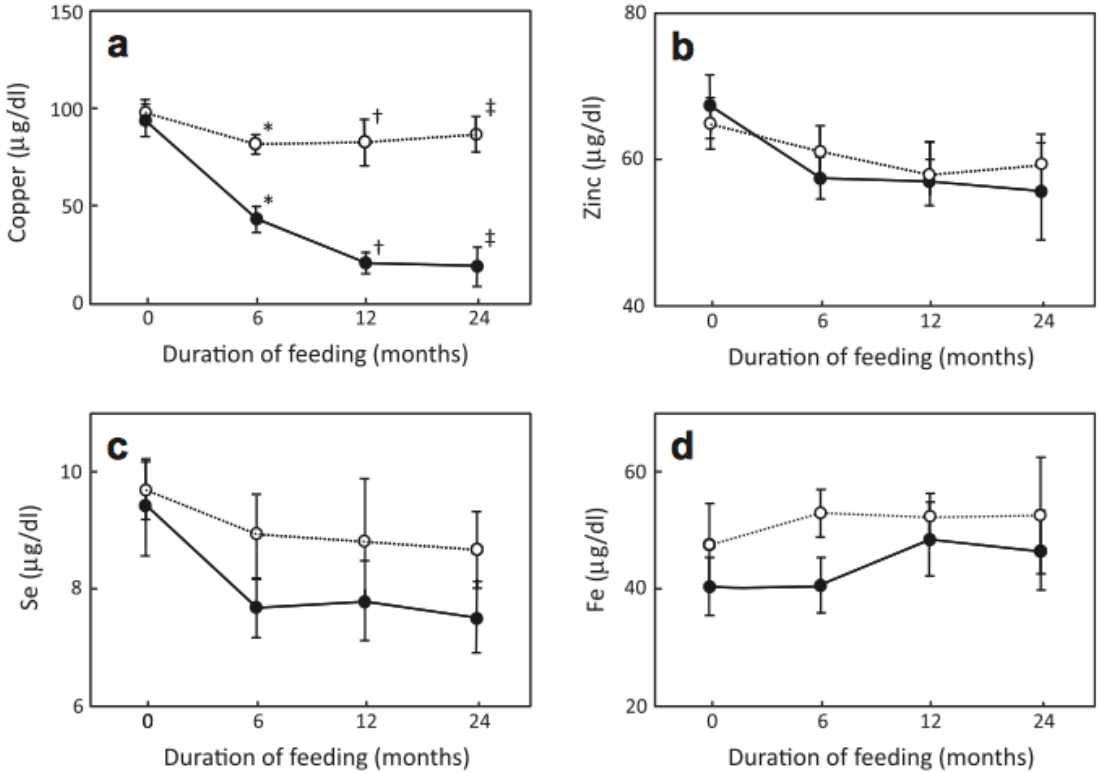


Fig. 1. The serum concentrations of copper (a), zinc (b), selenium (c) and iron (d) in the PEJ (closed circles) and PEG group (open circles) from immediately before to 24 months after enteral feeding. The *p*-values for the two groups for copper concentration were 0.35 immediately before enteral feeding, <0.001 at 6 (*), 12 (†), and 24 (‡) months. There were no significant differences in zinc, selenium and iron concentrations throughout the observation period. The reference ranges of copper and zinc are 68–128 μg/dl and 65–110 μg/dl, respectively. The reference range of selenium is not available. The reference ranges of iron for males and females are 60–180 μg/dl and 43–66 μg/dl, respectively.

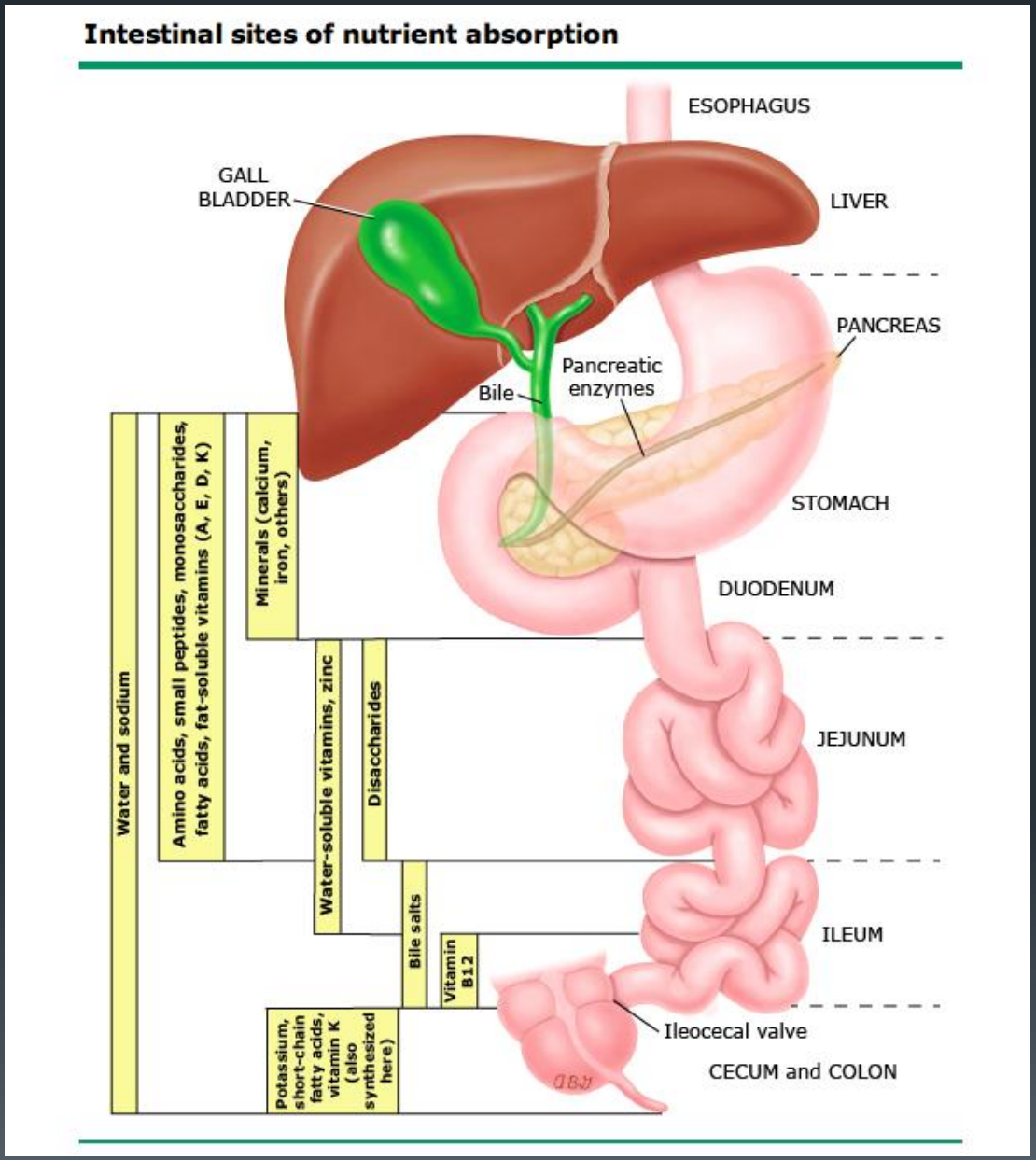
Nishiwaki et al. Clin Nutr 2011

Micronutrient & trace elements

- Long term biochemical monitoring
  - Individualised depending on baseline status, risk factors and proportion of daily requirements administered via supplemental nutrition

  - Special patient groups
    - IBD / short gut syndrome
      - increased likelihood of vitamin B12 or iron deficiency
    - Jejunal feeding
      - increased frequency of copper and iron deficiency

NICE guidelines 2012


Intestinal sites of nutrient absorption
ESOPHAGUS
GALL BLADDER
LIVER
PANCREAS
Pancreatic enzymes
Bile
STOMACH
DUODENUM
JEJUNUM
ILEUM
Ileocecal valve
CECUM and COLON
Water and sodium
Amino acids, small peptides, monosaccharides, fatty acids, fat-soluble vitamins (A, E, D, K)
Minerals (calcium, iron, others)
Water-soluble vitamins, zinc
Disaccharides
Bile salts
Vitamin B12
Potassium, short-chain fatty acids, vitamin K (also synthesized here)

Uptodate

Routine monitoring?


Very little evidence

Biochemistry

Biochemical test	frequency
UEC	Daily initially then weekly
LFT/INR	Second daily then weekly
Magnesium	Daily or twice daily initially
Glucose	twice initially then weekly
Phosphate	Daily or twice daily initially
Calcium, albumin	Daily initially
Zinc, copper	Baseline, monthly
selenium	baseline
FBE	weekly
Iron studies	Baseline, every 3 – 6 months
B12	Baseline, monthly

NICE guidelines 2012

Current practice…

- In stable patients who are not at particular risk of nutritional inadequacy
  - Baseline – full nutritional screen including selenium
  - 3 monthly – FBE, LFT, iron studies, UEC, Ca2+, Phosphate, magnesium
  - 6 monthly – as per 3 monthly review plus Zinc, Copper, vitamin D, Vitamin B12, fat soluble vitamins

How we structure our clinic…

- Patients are seen post PEG insertion
  - Assessment of site and device
  - Assessment of bowel function
  - Baseline nutrition assessment
    - Micronutrient and trace element screen
    - Body composition with BIA
- Patients reviewed every three months (or six monthly if stable and no high risk features)
  - Assessment of site and device
  - Assessment of bowel function
- Routine bloods three monthly with repeat trace elements, micronutrients and BIA every six months
  - If abnormalities detected more frequent monitoring undertaken until normalized

?