

Enteral and Parenteral Nutrition

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Facts about Clinical Nutrition

- Clinical outcome is positively influenced by optimal nutrition
- Acute illness leads to catabolic state causing protein-energy malnutrition (PEM)
- PEM is associated with higher complication rate, multiple organ failure and worse survival rate
- Frequency of PEM can be as high as 50% in hospitalized patients

Strategy of Clinical Nutrition

- To determine nutritional status (anthropometric and biochemical parameters, their use with caution)
- To determine personal energy requirement
- To provide caloric intake effectively

Common Problems in Clinical Nutrition

- establishing accurate nutritional status and energy requirement
- delayed planning
- unclear personal responsibilities, insufficient number of personnel
- unnecessarily long delay in diagnostic and therapeutic procedures
- „we did not have time for it”

To Estimate Caloric Requirements

- Total energy requirement:
 - basic metabolic rate (BMR or REE)- (60-70%)
 - specific dynamic effect (digestion and metabolism)
 - physical activity
 - energy for growth
 - energy lost with urine and stool

Calculating BMR

- Harris-Benedict , kcal/die (1919)
 - male: $66 + (13,7 \times W) + (5 \times H) - (6,9 \times A)$
 - female: $665 + (9,6 \times W) + (1,8 \times H) - (4,7 \times A)$

W=weight

H=height

A=age (years)

Calculating BMR

- Schoefield, kcal/die (1985)
 - male:
 - 0 - 3 y $0,16 \times W + 15,1 \times H - 617,6$
 - 3 -10 y $19,59 \times W + 1,303 \times H + 414,9$
 - 10 -18 y $16,25 \times W + 1,372 \times H + 515,5$
 - > 18 y $15,057 \times W + 1,004 \times H + 705,8$
 - female:
 - 0 - 3 y $16,252 \times W + 10,232 \times H - 413,5$
 - 3 -10 y $16,969 \times W + 1,618 \times H + 371,2$
 - 10 -18 y $8,365 \times W + 4,65 \times H + 200$
 - > 18 y $13,623 \times W + 23,8 \times H + 98,2$

Energy Requirement

- BMR x Stress factor:
 - sedated, ventilated : 0,8-1
 - bed rest: 1,1
 - low-normal activity: 1,3-1,7
 - catch up growth: 1,5-2
 - sepsis: 1,4-1,5
 - burns: 1,5-2
 - fever: +12%/C degree (?)

How to Provide Calorie?

- Two obvious route:
 - enteral nutrition (EN)
 - parenteral nutrition (PN)

Integrity of the GI tract?

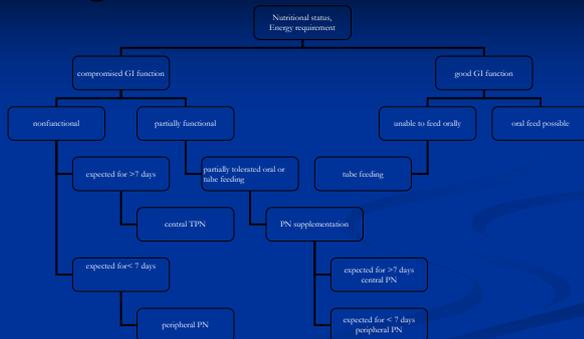
Expected time to return to normal feeding?

Underlying special conditions?

Safe to say.....

- 10% dextrose infusion is well tolerated in children generally, and provides „protein sparing“
- Low protein or protein free diet (EN as well as PN) longer than 5-7 days (3-5) will lead to PEM
- Possibility of „trophic feed“?
- Combination and not competition of the above.....

Algorithm of Clinical Nutrition



Before starting.....

- Not to start EN or PN:
 - acute phase of severe diseases: cc. 12-24 hrs (ebb phase)
 - shock
 - hypoxaemia (paO₂<50 Hgmm)
 - hypercapnia (pCO₂>75 Hgmm, except permissive)
 - lactate level > 3 mmol/L
 - acidosis (pH<7,2)

Enteral nutrition

- always superior to PN
- cheaper
- safer
- maintains GI tract integrity (motility, mucosal integrity, hepatobiliary-pancreatic function)
- decreases infection rate
- lessens metabolic disturbances
- more effective

Techniques of EN

- orogastric (head trauma!), nasogastric tube (bolus or continuous)
- jejunal tube: decreased gastric motility, pancreatitis, reflux (continuous)
- PEG if tube feeding is necessary for >3 month
- PEJ
- Fine Needle Catheter Jejunostomy

Which formula to be used?

- „pureed food” is unacceptable
- Points to be considered:
 - caloric concentration (osmotic activity)
 - protein content
 - suitability for the GI tract used
 - molecular complexity

Standard formula for NG or NJ feeding...

- Most commonly used in general practice:
 - based on cow's milk
 - lactose free
 - contains intact proteins
 - polysaccharides for carbohydrate source
 - triglycerides for lipid source
 - soluble and insoluble ballast materials

Modified high molecular weight formula

- different protein cc.
- different lipid cc.
- different caloric cc.
- may contain unsaturated fatty acids
- modified electrolyte concentrations
- fibers, etc

Chemically modified small molecular weight formula (5-10% of cases, „semielementar” feeds)

- free amino acids/oligo-dipeptides
- medium chain fatty acids
- disaccharides for carbohydrate source
- no fiber content
- suitability (digestion-absorption insufficiencies):
 - intolerance of standard formulas
 - jejunal feed
 - short bowel sy.
 - inflammatory bowel disease
 - acute pancreatitis, etc.

Hydrolyzed, „elemental” formula

- free amino acids
- mono-disaccharides
- suitability (very limited):
 - congenital metabolic diseases
 - severe protein allergy
 - extreme cases of short bowel sy.

Additives to formulas

- Ballasts, prebiotics:
 - fibers, sources of carbohydrates
 - trophic effects on the mucosa
- Probiotics:
 - microorganisms to stabilize or restore intestinal bacterial flora
- Immunomodulants (aminoacides, ribonucleic acids, etc.):
 - decrease inflammatory response
 - polytrauma, burn, etc. ? No statistical difference so far !!!

Problems commonly encountered during EN

- metabolic complications (hypophosphataemia, hypokalaemia, hypomagnesaemia)
- reflux
- diarrhea
- vomiting/aspiration
- constipation (opioids, fluid/fiber)
- mechanical problems with the tube

Parenteral nutrition, basic considerations

- „ultimum refugium” – last resort
- expensive
- numerous complications
- provided calorie cc. 1-1,2xBMR is sufficient
- but.....:
- long term supportive care
- home care treatment

Routes for PN

- peripheral veins: if osm>600, chemical phlebitis, canulas last only for few days
- central veins:
 - peripherally floated catheters
 - jugular, subclavian, femoral veins, cuffed tunnelized catheters

XR confirmation for the position of the catheters

Planning of PN 1.

- Fluid (water) and electrolytes (Na, K, Cl)
- cardiopulmonary status
- renal function
- losses from diarrhea, vomiting, burns, fever, ileus, drains, etc.
- insensible loss (ventilated patient)

Daily control of weight and laboratory values are mandatory

Planning of PN 2.

- Amino acids:
- theoretically they are not for calorie source
- 4 kcal/g amino acid
- Nitrogen (g)=0,145x amino acid (g)
- composition of solutions differs by patients age to provide physiologic serum concentrations

Minimal requirement is to avoid negative Nitrogen balance

Planning of PN 3.

- Special amino acids
- used for specific age groups or special clinical considerations
- *semi-essential amino acids*: cystein, tyrosin, taurine
- *immunomodulants*: alanyl-glutamine (improved nitrogen balance - protein synthesis, decreased inflammatory response, improved immune response) 0,3-0,5 g/kg, but no more then 20% of total

Planning of PN 4.

- Lipids:
- main source of energy in small volume and with low osmolality (9 kcal/g)
- calorie from triglycerides, phospholipids for emulsification
- they are based on soy or olive oil
- available MCT and „structurolipids“
- are they connected to infections and cholestasis?

Gradual build up, reduction during infection or elevated liver enzyme activity, tight control of cholesterol and triglyceride levels

Planning of PN 5.

- Carbohydrates:
- main non-protein energy source (\approx 60-75 % of total, 4 kcal/g) but with highest osmolality
- max. cc: peripheral 12,5%, central 20%
- excessive glucose intake will lead to hyperglycemia, impaired protein metabolism, increased BMR, lipogenesis, cholestasis and increased mortality (frequent control!!!!)

Hyperglycemia in otherwise stable patient can be the first singe of infection

Planning of PN 6.

- Minerals (Fe, Ca, P, Mg), trace elements, vitamins:
- refeeding syndrome !!!!!
- water and lipid soluble vitamins from the beginning
- trace elements after 3 weeks

In average circumstances the use of planning charts and control protocols are acceptable, changes made according to laboratory findings

Main Complications of PN

- catheter related problems (mechanical, thrombosis, pulmonary embolism, infections)
- stability and interactions of the parenteral solutions (the use of particle filters is advised)
- Nutritive and metabolic complications (daily weight, laboratory controls)
- Organ system complications (skeletal, hepatobiliar → cholestasis, etc)

Monitoring is the best way of prevention