Nutritional Support may supplement normal feeding, or completely replace normal feeding into the gastrointestinal tract
Benefits of Nutritional Support

- Preservation of nutritional status
- Prevention of complications of protein malnutrition
- ↓ Post-operative complications
Who requires nutritional support?

- Patients already with malnutrition - surgery/trauma/sepsis
- Patients at risk of malnutrition
Patients at risk of malnutrition

Depleted reserves
Cannot eat for > 5 days
Impaired bowel function
Critical Illness
Need for prolonged bowel rest
How do we detect malnutrition?
Nutritional Assessment

- History
- Physical examination
- Anthropometric measurements
- Laboratory investigations
Nutritional Assessment

History

- Dietary history
- Significant weight loss within last 6 months
  - > 15% loss of body weight
  - compare with ideal weight
  - Beware the patient with ascites/oedema
Nutritional Assessment

Physical Examination

- Evidence of muscle wasting
- Depletion of subcutaneous fat
- Peripheral oedema, ascites
- Features of Vitamin deficiency
  - eg nail and mucosal changes
- Echymosis and easy bruising
- Easy to detect >15% loss
Nutritional Assessment

Anthropometry

- Weight for Height comparison
- Body Mass Index (<19, or >10% decrease)
- Triceps-skinfold
- Mid arm muscle circumference
- Bioelectric impedance
- Hand grip dynamometry
- Urinary creatinine / height index
Nutritional Assessment

Lab investigations

- albumin < 30 mg/dl
- pre-albumin < 12 mg/dl
- transferrin < 150 mmol/l
- total lymphocyte count < 1800 / mm$^3$
- tests reflecting specific nutritional deficits
  - e.g. Prothrombin time
- Skin anergy testing
Types of Nutritional Support

Enteral Nutrition
Parenteral Nutrition
Parenteral Nutrition
Parenteral Nutrition

Allows greater caloric intake

BUT

Is more expensive
Has more complications
Needs more technical expertise
Who will benefit from parenteral nutrition?

Patients with/who:

- Abnormal Gut function
- Cannot consume adequate amounts of nutrients by enteral feeding
- Are anticipated to not be able to eat orally by 5 days
- Prognosis warrants aggressive nutritional support
Two main forms of parenteral nutrition

- Peripheral Parenteral Nutrition
- Central (Total) Parenteral Nutrition

Both differ in:
- composition of feed
- primary caloric source
- potential complications
- method of administration
Peripheral Parenteral Nutrition

Given through peripheral vein

- short term use
- mildly stressed patients
- low caloric requirements
- needs large amounts of fluid
- contraindications to central TPN
What to do before starting TPN

Nutritional Assessment
Venous access evaluation
Baseline weight
Baseline lab investigations
Venous Access for TPN

Need venous access to a “large” central line with fast flow to avoid thrombophlebitis

- Long peripheral line
- subclavian approach
- internal jugular approach
- external jugular approach

Superior Vena Cava
Baseline Lab Investigations

- Full blood count
- Coagulation screen
- Screening Panel # 1
- $\text{Ca}^{++}, \text{Mg}^{++}, \text{PO}_4^{2-}$
- Lipid Panel # 1
- Other tests when indicated
Steps to ordering TPN

- Determine Total Fluid Volume
- Determine Non-N Caloric needs
- Determine Protein requirements
- Determine Electrolyte and Trace element requirements
- Determine need for additives

Decide how much fat & carbohydrate to give
Steps to ordering TPN

- Determine Total Fluid Volume
- Determine Caloric needs
- Determine Protein requirements
- Determine Electrolyte and Trace element requirements
- Determine need for additives

Decide how much fat & carbohydrate to give
How much volume to give?

- Cater for maintenance & on going losses
- Normal maintenance requirements
  - By body weight
  - alternatively, 30 to 50 ml/kg/day
- Add on going losses based on I/O chart
- Consider insensible fluid losses also
  - eg add 10% for every °C rise in temperature
Caloric requirements

Based on Total Energy Expenditure

- Can be estimated using predictive equations
  \[ TEE = REE + \text{Stress Factor} + \text{Activity Factor} \]

- Can be measured using metabolic chart
Caloric requirements

Stress Factor

- **Malnutrition** - 30%
- **peritonitis** + 15%
- **Soft tissue trauma** + 15%
- **Fracture** + 20%
- **Fever (per °C rise)** + 13%
- **Moderate infection** + 20%
- **Severe infection** + 40%
- **<20% BSA Burns** + 50%
- **20-40% BSA Burns** + 80%
- **>40% BSA Burns** + 100%
Caloric requirements

Activity Factor

- Bed-bound + 20%
- Ambulant + 30%
- Active + 50%
How much CHO & Fats?

• “Too much of a good thing causes problems”
  • Not more than 4 mg / kg / min Dextrose
    (less than 6 g / kg / day)
  • Not more than 0.7 mg / kg / min Lipid
    (less than 1 g / kg / day)
    *Moore & Cerra, 1991*
How much CHO & Fats?

- Fats usually form 25 to 30% of calories
  - Not more than 40 to 50%
  - Increase usually in severe stress
  - Aim for serum TG levels < 350 mg/dl or 3.95 mmol/l

- CHO usually form 70-75% of calories
Steps to ordering TPN

- Determine Total Fluid Volume
  - Determine Caloric needs
    - Determine Protein requirements
      - Determine Electrolyte and Trace element requirements
        - Determine need for additives
  - Decide how much fat & carbohydrate to give
How much protein to give?

- Based on calorie : nitrogen ratio
- Based on degree of stress & body weight
- Based on Nitrogen Balance
Calorie : Nitrogen Ratio

Normal ratio is
150 cal : 1g Nitrogen

Critically ill patients
85 to 100 cal : 1 g Nitrogen in
Based on Stress & BW

- Non-stress patients 0.8 g / kg / day
- Mild stress 1.0 to 1.2 g / kg / day
- Moderate stress 1.3 to 1.75 g / kg / day
- Severe stress 2 to 2.5 g / kg / day
Based on Nitrogen Balance

Aim for positive balance of
1.5 to 2g / kg / day
Electrolyte Requirements

Cater for maintenance + replacement needs

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>Requirement</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na⁺</td>
<td>1 to 2 mmol/kg/d</td>
<td>(or 60-120 meq/d)</td>
</tr>
<tr>
<td>K⁺</td>
<td>0.5 to 1 mmol/kg/d</td>
<td>(or 30 - 60 meq/d)</td>
</tr>
<tr>
<td>Mg²⁺</td>
<td>0.35 to 0.45 meq/kg/d</td>
<td>(or 10 to 20 meq /d)</td>
</tr>
<tr>
<td>Ca²⁺</td>
<td>0.2 to 0.3 meq/kg/d</td>
<td>(or 10 to 15 meq/d)</td>
</tr>
<tr>
<td>PO₄²⁻</td>
<td>20 to 30 mmol/d</td>
<td></td>
</tr>
</tbody>
</table>
Trace Elements

Total requirements not well established
Commercial preparations exist to provide RDA

- Zn 2-4 mg/day
- Cr 10-15 ug/day
- Cu 0.3 to 0.5 mg/day
- Mn 0.4 to 0.8 mg/day
Other Additives

- Vitamins
  - Give 2-3x that recommended for oral intake
  - Us give 1 ampoule MultiVit per bag of TPN
  - MultiVit does not include Vit K
    - can give 1 mg/day or 5-10 mg/wk
Other Additives

• Medications
  • Insulin
    • can give initial SI based on sliding scale according to glucose q6h (keep <11 mmol/l)
    • once stable, give 2/3 total requirements in TPN & review daily
  • alternate regimes
    – 0.1 u per g dextrose in TPN
    – 10 u per litre TPN initial dose

• Other medications
Clinical Review

- clinical examination
- vital signs
- fluid balance
- catheter care
- sepsis review
- blood sugar profile
- Body weight
Lab investigations

- Full Blood Count
- Renal Panel #1
- Ca\(^{++}\), Mg\(^{++}\), PO\(_4\)\(^{2-}\)
- Liver Function Test
- Iron Panel
- Lipid Panel
- Nitrogen Balance

- weekly, unless indicated
- daily until stable, then 2x/wk
- daily until stable, then 2x/wk
- weekly
- weekly
- 1-2x/wk
- weekly
**Nutritional Balance**

**Nutritional Balance** = $N_{\text{input}} - N_{\text{output}}$

- $1 \text{ g N} = 6.25 \text{ g protein}$
- $N_{\text{input}} = (\text{protein in g} \div 6.25)$
- $N_{\text{output}} = 24\text{h urinary urea nitrogen} + \text{non-urinary N losses}$

*(estimated normal non-urinary Nitrogen losses about 3-4g/d)*
Complications related to TPN

- Mechanical Complications
- Metabolic Complications
- Infectious Complications
Mechanical Complications

Related to vascular access technique

- pneumothorax
- air embolism
- arterial injury
- bleeding

- brachial plexus injury
- catheter malplacement
- catheter embolism
- thoracic duct injury
Mechanical Complications

Related to catheter in situ

Venous thrombosis
catheter occlusion
Metabolic Complications

Abnormalities related to excessive or inadequate administration

- hyper / hypoglycaemia
- electrolyte abnormalities
- acid-base disorders
- hyperlipidaemia
Metabolic Complications

Hepatic complications

Biochemical abnormalities

Cholestatic jaundice
  • too much calories (carbohydrate intake)
  • too much fat

Acalculous cholecystitis
Infectious Complications

• Insertion site contamination
• Catheter contamination
  • improper insertion technique
  • use of catheter for non-feeding purposes
  • contaminated TPN solution
  • contaminated tubing
• Secondary contamination
  • septicaemia
Stopping TPN

- Stop TPN when enteral feeding can restart
- Wean slowly to avoid hypoglycaemia
- Monitor hypocounts during wean
  - Give IV Dextrose 10% solution at previous infusion rate for at least 4 to 6h
  - Alternatively, wean TPN while introducing enteral feeding and stop when enteral intake meets TEE