Metabolism and Nutrition

Dr Muhammad Ibrar Hussain

FCPS(Pak) MRCS (England)
Assistant Prof. of Surgery
College of Medicine
Taibah University
Al-Madina Al-Munawarah
Learning Objectives

- Metabolism of carbohydrates, proteins & fats
- The impact of trauma, surgery and sepsis on metabolism
- Causes of malnutrition and its impact on the outcome of patients
- Assessment of nutritional status
- Types of nutrition with pros and cons
- Indications and contraindications of each type of nutrition
- Complications of enteral and parenteral nutrition
Metabolism

- Proteins
- Carbohydrates
- Fats
Protein Metabolism

Protein requirement:

- Contribute 10-15% of normal energy expenditure
- Each gram – converted to 4 kcal of energy
- Daily Protein requirement of normal individual-0.8 to 1 g/KG
- Nitrogen requirement = Protein req. / 6.25
Estimated Protein Requirements in Various Disease States

- **Mild metabolic stress** - 1.00–1.10 g/kg body wt
  (elective hospitalization)

- **Moderate metabolic stress** - 1.20–1.40 g/kg body wt
  (complicated postoperative care, infection)

- **Severe metabolic stress** - 1.50–2.50 g/kg body wt
  (major trauma, pancreatitis, sepsis, ...
Carbohydrate metabolism

- Contribute 50-60% of normal energy expenditure
- Each gram of glucose provides 4 kcal of energy
- It inhabits protein breakdown, and store as glycogen in liver & muscles
- It essential for wound healing but excess amount can cause neutrophilic dysfunction and impair wound healing
Lipids Metabolism

- Contributes 30-40% of energy requirement
- Each gram of lipids provides 9 kcal
- Stress, steroids, glucagon, catecholamines stimulate lipolysis while insulin inhabits
- During starvation lipids provides majority of the energy in form of ketone bodies
Metabolism

anabolism ↔ catabolism
Hypercatabolic state

- Chronic illness, immobilization, sepsis, trauma, burns, pancreatitis
- Adrenalin, noradrenalin, cortisol, glucagon, growth hormones - stress hormones
- There is increase oxygen, energy and nitrogen requirement
Glycogen breakdown
1st 24 hours

Gluconeogenesis - protein breakdown
Day 2 onwards

Lipolysis - ketone bodies - 2-3 weeks

Stress metabolism
Nutrition
Nutrition

- **Nutrition**—The process of utilizing exogenous substances for the production of energy and the synthesis of new tissue.

- **Food**—any substance that can be used by the body to produce energy or some essential nutrients
Malnutrition

- 30-50% of hospitalized patients are malnourished
Causes of malnutrition

- **Difficulty in obtaining food** - Poverty
- **Difficulty in eating** -
  1. Unwanted / unpalatable food
  2. Weak and anorexic patients
  3. Oral ulceration/infection
- **Difficulty in swallowing and retaining food**
  1. Dysphagia
  2. GIT obstruction / Ileus
Causes of malnutrition

- Intestinal failure
  1. Short bowel syndrome
  2. Fistula formation
  3. Extensive small bowel disease like Crohn’s disease

- Increased metabolic demand

  sepsis, burn, pancreatitis
Effects of malnutrition

- Poor wound healing
- Anastomotic leakage
- Delayed fracture healing
- Coagulopathy
- Reduced enzyme synthesis
Effects of malnutrition

- Impaired metabolism of drugs
- Impaired Immune function - increased susceptibility of infection
- Decrease tolerance to radiotherapy and chemotherapy
Indications of nutritional support

- Pre op malnutrition because of poor intake and disease process
- Dysphagia- stricture
- Coma/ ICU admissions
- Burns
- Maxillofacial trauma
- Malignant diseases
Indications of nutritional support

- Post op complications like ileus more than 5 days, fistula formation, sepsis
- Intestinal failure
  1. Short bowel syndrome-massive bowel resection
  2. Extensive small bowel disease like Crohn’s disease,
  3. Acute pancreatitis,
Nutritional Assessment

History

- anorexia, nausea, vomiting
- weight loss i.e 5% in last one month,
  10% over 6 months

General Physical Examination

- Muscle wasting, bony scapula
- Loose and flabby skin, sunken cheeks
- Pallor, glossitis, gingival lesions
Nutritional Assessment

Body mass index (BMI) = weight (Kg)/height (m²)

Normal is 20-25. (Less than 15 is suggestive of severe malnutrition)

Anthropomorphic measurements

- Triceps skin fold thickness (10-13mm)
- Mid arm muscle circumference (23-25cm)
Nutritional Assessment

Biochemical measurements -

- Serum albumin $< 3 \text{ g/dl}, (3.5-5 \text{ g/dl})$

Measurements of immunologic function -

- Total lymphocyte count $< 1500/\text{mm}^3$
  (impaired cellular defense)
Estimation of energy and protein requirement

Depend on weight and clinical status

- Energy = 30 kcal/kg/day (uncomplicated)
- Energy = 35-40 kcal/kg/day (complicated)

- Protein = 1.0-1.5 g/kg/day (uncomplicated)
- Protein = 1.5-2.5 g/kg/day (complicated)

- Nitrogen Requirement = Protein requirement of patient divided by 6.25

- Energy: Nitrogen ratio = 150:1
Methods of Nutritional Support

Enteral

- Oral
- NGT
- NJ T
- Gastrostomy tube
- Jejunostomy tube

Parenteral

- TPN
- PPN
Enteral feeding

- It is indicated in patients who have functional GIT
- It is simple, physiological, relatively inexpensive, well tolerated
- Maintain the GIT cyto architecture and mucosal integrity, absorptive function and normal microbial flora
- This results in less bacterial translocation into blood stream
Enteral Nutritional products
Oral feeding

- Natural way, attempt first
- If inadequate give supplemental cans diet
- It demands

1- **common sense**- adequate, palatable,

2- **Cleanliness**- preparation and serving

3- **Compassion**- good patient care, proper assistance, dental care, oral hygiene
NGT Feeding

- Short period
- Can’t take adequate food by oral route
- Continuous or bolus
Gastrostomy Tube Feeding

- Placement of tube in stomach
  1. Open surgery - Stamm/Janeway
  2. Laparoscopy
  3. Endoscopic (PEG)

  - When NGT feeding is not possible or
  - More than 4 weeks of enteral feeding

- Continuous or bolus
Jejunostomy Tube Feeding

Placement of feeding tube in proximal jejunum

- Open
- Laparoscopic
Jejunostomy Tube feeding
Contraindications of Enteral Feeding

- Mechanical Intestinal obstruction, or ileus,
- Intestinal failure-
  1. Short bowel syndrome
  2. High output entero- cutaneous fistula
  3. motility disorders
  4. extensive small bowel disease like Crohn’s disease,
- GI Bleeding,
- Severe diarrhea, vomiting (Enterocolitis)
Complications of Enteral Nutrition

**Tube related:**
- Wrong placement of tube
- Early accidental removal
- Tube clogging
- Intra peritoneal leakage
  
**Diet related:**
- Diarrhea, Vomiting, abdominal distension
Complications of Enteral Nutrition

- **Metabolic abnormalities**-
  Electrolyte imbalance, volume overload subsequently CCF, hyperglycaemia

- **Tracheo bronchial aspiration**-
  Patients with CNS abnormalities and sedated patients are at risk.
Parenteral Nutrition

**Indications:**

When enteral feeding is not possible or inadequate – for supplementation of enteral feeding

- **Temporary** - prolonged ileus, fistula, abdominal sepsis, severe injury, burns, acute pancreatitis.

- **Permanent** - short bowel syndrome
Types of Parenteral Nutrition

- **Total Parenteral Nutrition**
  
  Intravenous provision of all nutritional requirements without the use of GIT through CV line

- **Peripheral Parenteral Nutrition**
  
  - Administer through peripheral intravenous catheter
  - Lipids, isotonic solutions of AA, 10% dextrose solutions
Adminstration

Central venous catheter

- Internal Jugular vein
- Subclavian vein
- Cephalic vein
Composition of TPN Solutions

- Carbohydrates 50-60%
- Fats 30-35%
- Proteins 10-15%

- Additives:
  - Electrolytes,
  - Vitamins
  - Trace elements
Monitoring of TPN

- **Clinical monitoring**
  - Regular monitoring of vital signs,
  - Fluid intake and output chart
  - Body weight

- **Laboratory Monitoring**

- **Daily**- blood sugar, electrolytes, BUN

- **Twice weekly**- CBC, LFTs, coagulation profile, albumen, Ca, Mg, PO4, 24 urine collection to measure Na and nitrogen losses
Complications of TPN

Catheter related

- Damage adjacent structures-brachial plexus, cardiac perforation, thoracic duct
- Pneumothorax
- Air embolism
- Hematoma
- Thrombosis
- Infection-septicaemia
Complications of TPN

- **Metabolic-**
  - Under/over hydration,
  - Hyper/Hypoglycaemia,
  - Electrolyte imbalance-(Hypokalaemia, hyponatraemia, hypophosphataemia)

- **Hepatic dysfunction**
Thanks

Looking forward to see your feedback on ibrarme@yahoo.com