
جامعة الملك سعود
King Saud University
1957
Nutrition Support
Surgery Team
MED 433
MED 433
طب ٤٣٣

Objectives :

Color Index: Slides & Raslan's () | Doctor's Notes | Extra Explanation | Additional

This work is based on doctor's Slides +Notes and Raslan's only (Does not include the book)

Mind Map

- The lecture parts
  - Nutrition
    - Routes of Nutrition Support
      - Enteral (EN)
        - Long-term nutrition
        - Short-term nutrition
      - Parenteral (PN)
        - Complications of Total Parenteral Nutrition (TPN):
        - Peripheral line
        - Central line
  - Malnutrition
    - Risk Factor for malnutrition:
    - Types of Malnutrition
      - Marasmus
      - Kwashiorkor
    - Consequences of Malnutrition:

INTRODUCTION

Nutrition provides all basic nutrients and energy required for →

1. **Growth**
2. **repair**
3. **maintenance of the body function.**

Nutrition: **comes from**

- Carbohydrate
- Fat
- Protein
- Electrolytes
- minerals
- vitamins.

Malnutrition:

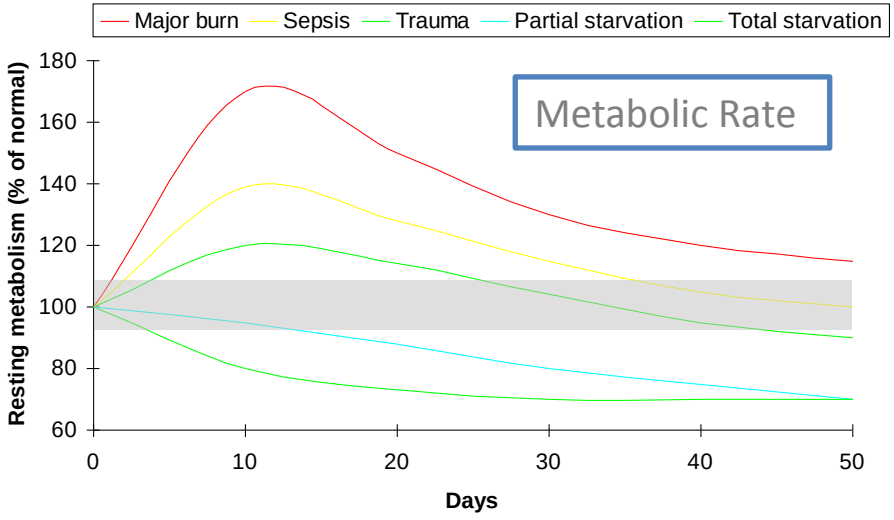
Come from

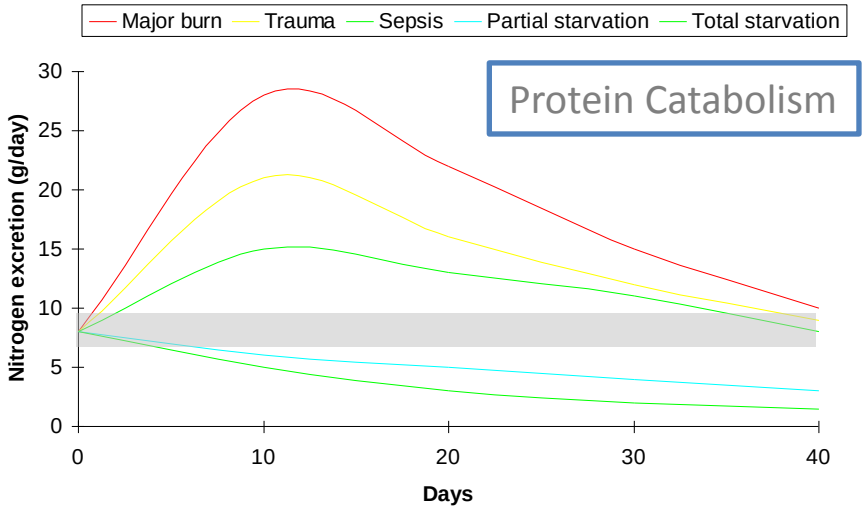
- Extended **inadequate intake** of nutrient
- **Severe illness** burden on the body composition and function (catabolic state) affect all systems of the body.

Metabolic rate and protein catabolism

- ↑ **with stress like (trauma, burns, sepsis)**
- ↓ **with starvation** (to preserve nutrients).

In short, malnutrition is the condition that occurs when the body is not being given enough nutrients. The most dangerous part of malnutrition is when it involves protein loss.





From 431

When we go through any of the conditions above (sepsis, trauma, etc), metabolic rate increases so we need more calories. **Glycogen will be used as a source of energy in the first 3 days** then fat after that catabolize, so ketones are generated; the problem is some cells cannot use ketones as a source of energy so they need glucose which will **come from gluconeogenesis from proteins in our muscles.**

Protein status is assessed by evaluating both somatic and visceral protein status. **Somatic protein** status is a measure of the protein in skeletal muscle while **visceral protein** status is a measure of all other proteins (organs, viscera, serum, blood cells, white blood cells).

Types of Malnutrition

	Kwashiorkor	Marasmus
Definition	**Protein malnutrition** caused by inadequate protein intake in the presence of fair to good calories intake in combination with the stress response	The patient with severe **protein-calorie malnutrition** characterized by calories deficiency. Protein intake can be normal or low.
Common causes	1. Chronic kidney disease (patients don't eat protein products because it is metabolized to urea in blood worsening their symptoms), 2. Liver cirrhosis (protein increase encephalopathy), 3. Trauma , **burns** (loss of protein), 4. hemorrhage, 5. critical illness .	1. **Severe burns** 2. ICU patients, post major surgeries 3. Injuries 4. Systemic infections 5. Cancer 6. Conditions where patient does not eat like : ✓ Anorexia nervosa ✓ Anorexia bulimia ✓ Starvation
Clinical manifestation	1. Marked hypoalbuminemia 2. Edema and ascites 3. Muscle atrophy 4. Delayed wound healing 5. Impaired immune function **(decrease immunoglobulins)** 	1. Weight loss 2. Depletion skeletal muscle 1. adipose (fat) stores 2. Bradycardia 3. Hypothermia 

From Raslan's

Types of Malnutrition

Kwashiorkor	Mixed	Marasmus
Normal somatic proteins, **depleted** visceral proteins. ↓Serum Albumin and transferrin. **Patients appear** Normal or overweight. **Protein malnutrition** e.g. Hypercatabolic critical care patients Chronic diarrhea, chronic kidney disease, trauma, burns, hemorrhage, and liver cirrhosis	**Depleted** somatic and visceral proteins. **Patients appear :** Cachectic and severely malnourished. e.g. Chronic hypercatabolic patients and prolonged starvation or Trauma	**Depleted** somatic proteins, normal visceral proteins (↓Weight). Normal Albumin and transferrin. **Patients appear** Thin and malnourished. **Protein-calorie malnutrition** e.g. Patients with mild to moderate starvation, common severe burns GIT diseases (Crohn's disease: thickening of the small intestine) and alcoholism (high calories, zero nutrition).

Risk Factor for malnutrition:

Severe weight loss:
Is the loss of more than 10% of body weight in 6 month.

1. **Medical causes:**
   - Recent surgery or trauma
   - Sepsis
   - Chronic illness
   - Gastrointestinal disorders
   - Dysphagia
   - Recurrent nausea, vomiting, or diarrhea
   - Inflammatory bowel disease
2. **Psychological:**
   - Anorexia, other eating disorders
3. **Social causes.**

Consequences of Malnutrition:

1. ↑ **Morbidity** and **mortality**
2. ↑ **Recovery period** from illnesses
3. ↓ **Host defenses** (Infections)

The nutritional status of patient play major role on The prognosis of disease

Estimating Energy/Calorie Need: (Details in next slide)

1. Basic Energy Expenditure (BEE):

Also called **Basal metabolic rate (BMR)**
which support the body's most basic functions
when at rest in a neutral, or non-stressful, environment.

It accounts for the largest portion of total daily energy requirements (up to 70%)
(The basic amount of energy that we need for respiration and internal body function, without stress *disease or trauma* and without exercising)

2. Total Energy Expenditure (TEE):

- TEE (kcal/day)

TEE= BEE x stress/activity factor

(Just go through it) "No need to memorize calculation"

1. Basic energy expenditure (BEE) calculation:

We calculate BBE by using **(Harris–Benedict Equations):**

Male

BEE = 66 + (13.7 x actual wt in kg) + (5x ht in cm) – (6.8 x age in y)

Female

BEE = 655 + (9.6 x actual wt in kg) + (1.7 x ht in cm) – (4.7 x age in y)

2. Total Energy Expenditure:

TEE (kcal/day) = BEE x stress/activity factor

A correlation factor that estimates the extent of hyper-metabolism:

1.15 for bedridden patients

1.10 for patients on ventilator support

1.25 for normal patients

The stress factors are:

1.3 for low stress

1.5 for moderate stress

2.0 for severe stress

1.9-2.1 for burn

Example:

Our patient Weight = 50 kg Age = 45 yrs

Height = 5 feet 9 inches (175 cm)

BEE = 66 + (13.7 x actual weight in kg) + (5 x hight in cm) – (6.8 x age in y)

=66 + (13.7 x 50 kg) + (5 x 175 cm) – (6.8 x 45)

=66 + (685) + (875) – (306)

= 1320 kcal

TEE = 1320 x 1.25 (normal activity)

= 1650 kcal

Body Needs

A.Fluid Requirements

We calculate it either by:

1. Normal adult requires approximately 35 cc/kg/d
2. '4/2/1'formula
   - the first 10 kg of body weight requires 4 ml/kg/h
   - ➥ the next 10 kg 2ml/kg/h
   - ➥ rest, each kg of body requires 1ml/kg/h

e.g. The estimated maintenance fluid requirements of a 35 kg child would therefore be: (10 x 4) + (10 x 2) + (15 x 1) = 75 ml/hr
(x24 if you want to calculate the fluid requirements in a day)

3. NRC (National Research Council), recommends 1 to 2 ml of water for each kcal of energy expenditure

B.Calorie sources:

1. 50 to 60% Glucose
2. 20% to 30% Fat
3. 20% Protein

C.Protein Need

The average adult requires about **1.5 gm/kg per day**

Stress (illness) **or** ⬆ **activity level** } ⬆ protein requirement (g/kg/day)

- Baseline 1.5 g/kg/day
- Mild stress 1.8 g/kg/day
- Moderate stress 2.0 g/kg/day
- Severe stress 2.2 g/kg/day

From Raslan's

When To Feed?

- **24 to 48** hr for post-admission patients.
- **7 days** for NPO patients (TPN).
- **1-2 weeks** for pre-surgery patients.
- **3rd day** for post-surgery patients

What To Feed?

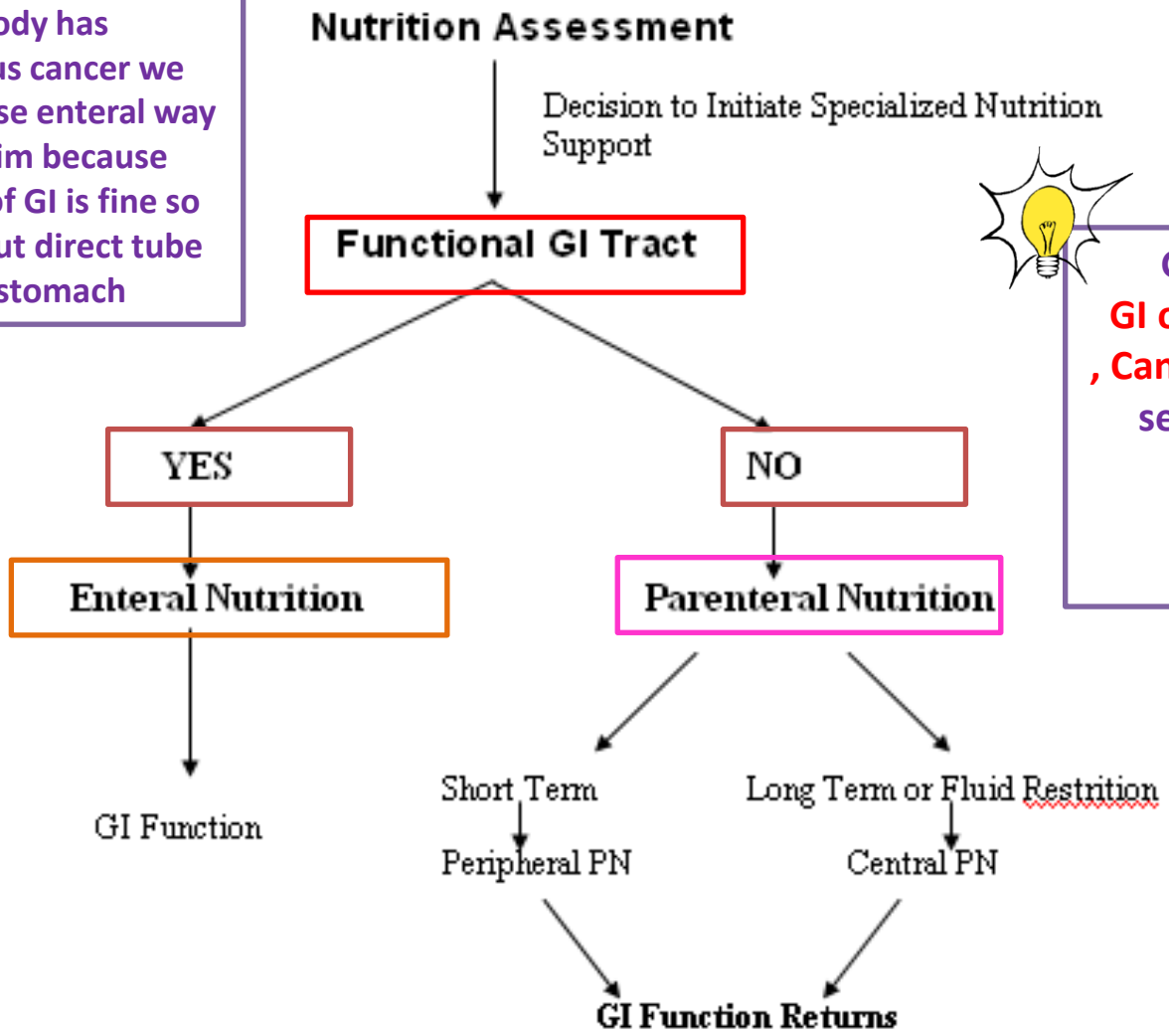
• Energy	25-30 kcl
• CHO	55% ⓘ
• Protein	1-1.5 g/kg ⓘ
• Lipid 20%	0.5-1.5 g/kg
• Electrolyte	
• Antioxidant	

Fat:
1 gm = 9 cal
Protein:
1 gm = 4 cal
Carbohydrates:
1 gm = 4 cal

Routes of Nutrition Support

The nutritional needs of patients are met through either parenteral or enteral delivery route

if somebody has esophagus cancer we can choose enteral way to feed him because the rest of GI is fine so we can put direct tube into the stomach



Give parenteral in case of GI obstruction ,crohn's disease , Cancer patients who suffer from severe nausea and vomiting or after GI surgery to rest the GI Ex: severe pancreatitis

1- Enteral (EN)

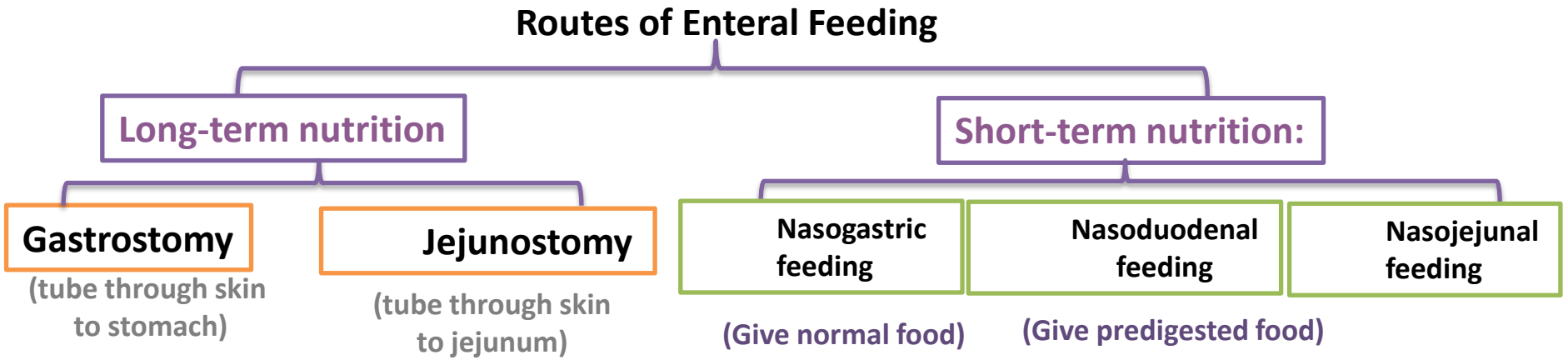
- **The gastrointestinal tract is always the preferred route of support**
- It is **safer** ,**more cost effective**, and **more physiological** than PN.
- **"If the gut works (functional GI), use it"**

Benefits

- Nutrients are metabolized and utilized more effectively via the enteral (because it pass to liver) than parenteral route and less complications.

Contraindications 

1. **Gastrointestinal obstruction**
2. **Severe acute pancreatitis** {these patients are always NPO (nil per os *nothing per mouth*)}
3. **High-output proximal fistulas** (because whatever patient eat will go out from the fistula)
4. **Intractable nausea and vomiting or osmotic diarrhea**



2- Parenteral (PN)

TPN = Total parenteral Nutrition.

PN Goals:

Provide patients with → adequate calories and protein → **to prevent**
- Malnutrition
- Associated complications

PN therapy must provide

- **Protein** in the form of **amino acids**
- **Carbohydrates** in the form of **glucose**
- **Fat** as a **lipid emulsion**
- Electrolytes, vitamin, trace elements, minerals

General Indications for PN:

- Requiring NPO > **5 days**
- Severe gut dysfunction or inability to tolerate enteral feedings.
- **"Can not eat, will not eat, should not eat"**

Special Indications:

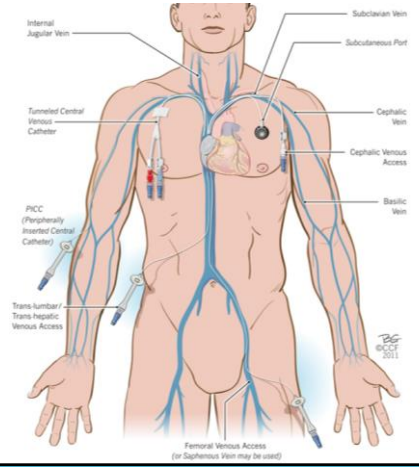
- After major surgery
- Patient with bowel obstruction
- Patient with enterocutaneous fistulas (high and low)
- Massive bowel resection
- Malnourished patients undergo chemotherapy (because chemotherapy induce vomiting)
- NPO for more than 5 days for any reasons
- Necrotizing pancreatitis
- Burns, sepsis, trauma, long bone fractures
- Premature new born
- Short bowel syndrome

Short bowel syndrome is a condition that occurs when part of the small intestine is missing or has been removed during surgery. Nutrients are not properly absorbed into the body

Routes of administration of PN Nutrition:

1. Central line
   - Either through Jugular, Subclavian or Peripheral Inserted Central Catheter (PICC)
2. Peripheral line(**if patient requiring short-term nutrition**)
   - **Inserted in periphery**

   (femoral in case of children, median cubital fossa.. Etc)



Central	Peripheral
• Subclavian line • Long period • High osmolality > 2000 mOsm/L (because central route is inserted in large strong vessels, unlike small vessels in periphery which going to collapse with high osmolar solution) • Full Calories • Minimum volume • More Infections • More complications	• Peripheral line • Short period < 14days • Low osmolality < 1000 mOsm/L • Min. Calories • Large volume • Thrombophlebitis • Less complications High osmolality can cause phlebitis in peripheral line

Investigations to monitor patient taking PN nutrients :

Blood chemistry, BUN & Creatinine, Triglycerides, CBC, PT & PTT, Weight, input and output.

Suggested monitoring schedule

	Baseline	Acute patient	Stable patient
Blood chemistry	Yes	2 - 3 times/week	Weekly
Lytes, BUN, creatinine	Yes	Daily	1 - 2 times/week
Triglycerides	Yes	Weekly	Weekly
CBC w/diff	Yes	Weekly	Weekly
PT, PTT	Yes	Weekly	Weekly
Glucose	3 times/day	3 times/day until <200 consistently	3 times/day until <200 consistently
Weight	Yes	Daily	2 - 3 times/week
I & O	Daily	Daily	Daily
Nitrogen balance	PRN	PRN	PRN

Notes

BUN (blood urea nitrogen), is the best to measure protein level given by PN route (is it more or less?).

- **Most important fatty acids given through PN, is the essential fatty acids (Linoleic acid & linolenic acid) because they are not made the by body.**

Peripheral Parenteral Nutrition (**PPN**) can be infused through central line

Central total Parenteral Nutrition (**TPN**) CANNOT be infused through the peripheral line.

If you give glucose → insulin release →electrolyte move inside the cells →arrhythmia. so you need to correct the electrolyte first and then give calories gradually

Complications of Total Parenteral Nutrition (TPN):

1. Mechanical complication :

- Improper placement of central catheter may cause pneumothorax, vascular injury with hemothorax, and cardiac arrhythmia.
- Venous thrombosis after central venous access.
- **(Catheter sepsis, Pneumothorax, Catheter embolism, Arterial laceration)**

Complications of Central Line insertion

2. Septic complication : (Infections)

- The mortality rate from catheter sepsis as high as 15%
- We can reduce these complications through:
  - Aseptic technique: inserting the venous catheter
  - Aseptic technique: compounding the solution
  - Catheter care at the site: regular dressing

3. Metabolic complication :

Early Complications : early in the process of feeding and may be anticipated	**Late Complications :** caused by supplement of inadequate amount of required nutrients or cause adverse effect by solution composition
• **Volume overload** • **Hyperglycemia** • **Refeeding Syndrome : metabolic disturbance that occur as result of reinstitution of nutrition in patients who severely starved or malnourished.** • **Hypokalemia, Hypophosphatemia, Hypomagnesaemia** • **Hyperchloremic acidosis**	• **Essential fatty acids deficiency** • **Trace minerals deficiency** • **Vitamin deficiency** • **Metabolic bone disease** • **Hepatic steatosis** • **Hepatic cholestasis**

From Raslan's

What Are The Complications Of Both Enteral And Parenteral Feeding?

Enteral feeding	Parenteral feeding
• Aspiration • Pneumonia • Diarrhea	• Catheter sepsis • Hyperglycemia ⓘ • Pneumothorax & hemothorax • Electrolyte imbalance • Azotemia • Increase LFT ⓘ

Why Don't We Use Central Lines?

- **Due to certain complications**, which include infection, pneumothorax, and catheter embolism.
- It's avoided in **severe necrotizing pancreatitis**
- Also, in patients with **nausea and vomiting** issues, it could cause aspiration pneumonia.

Summary and notes from doctor's Slides

1. Nutritional support in the ICU (surgical setting) represents a challenge but it is fortunate that its delivery and monitoring can be followed closely.

2. **Parenteral (PN) represents an alternative approach** when other routes are not succeeding or when it is not possible or would be unsafe to use other routes.

1. The **main goal of PN** is to deliver a nutrient mixture closely related to requirements safely and to avoid complications.

1. Should we use (PN)? When should we start PN in patients?

Recommendation:

- Patients should be fed because starvation or underfeeding in ICU patients is associated with increased morbidity and mortality. (Grade C)

Reasons

- Increased metabolic needs related to stress in ICU patient are likely to accelerate the development of malnutrition which associated with impaired clinical outcome.
- In a randomized study, 300 patients undergoing major surgery received continuous total PN or exclusively glucose 250–300 g/d intravenous administration for 14 days.
- Those on PN had 10 times less mortality than those on glucose.

2. Should we wait for recovery and the ability of the patient to take normal nutrition or should we start PN in pt. who have not resumed normal intake within 10 days ?

Recommendation:

All patients who are not expected to be on normal nutrition within 3 days should receive PN within 24–48 h if EN is contraindicated or if they cannot tolerate EN.(Grade C).

Comments:

- PN is associated with more hyperglycemia than EN
- Hyperglycemia reduces neutrophil chemotaxis and were found to be an independent risk factor for short-term infection in patients undergoing surgery.
- Tight glucose control **(A1c: 6-8 %)** can over come such infection in ICU

(increased glucose A1c: > 8% = Infections and if decreased < 4.5% = high mortality)

3. How much parenteral nutrition should critically ill patients receive?

Recommendation:

- ICU patients should receive 25 kcal/kg/day increasing to target over the next 2–3 days (Grade C).

4. Carbohydrates: which level of glycemia should we aim to reach?

Recommendation:

- Hyperglycemia (glucose >10 mmol/L) contributes to death in the critically ill pt and should also be avoided to prevent infectious complications (Grade B).
- Tighter glucose control (4.5-6.1 mmol/L) increases in mortality rates have been reported in ICU patients.
- No unequivocal recommendation on this is therefore possible at present.

5. Should we use central venous assess peripheral line for PN administration?

Statement:

- Peripheral venous access devices may be considered for low osmolarity (<850 mOsmol/L) mixtures designed to cover a proportion of the nutritional needs and to mitigate negative energy balance (Grade C).
- If peripherally administered PN does not allow full provision of the patient's needs then PN should be centrally administered (Grade C).

Comments:

- PN is usually administered into a large-diameter vessel, normally the superior vena cava or right atrium, accessed via the jugular or subclavian vein.
- For longer-term ICU use,a tunneled-catheter or implanted chamber is occasionally used as alternatives to a standard central venous access device.

Comments:

- PICCs were associated with a lower risk of CVC-associated BSI.
- Antimicrobial-impregnated CVC reduced the risk of CVC-associated BSI (**bloodstream infections**)
- PICC lines offer a suitable middle way between peripheral catheters & conventional central lines.

6.Should we use lipid emulsions in the parenteral nutrition of critically ill patients?

Statement.

- Lipid emulsions should be an integral part of PN for energy and to ensure essential fatty acid provision in long-term ICU patients. (Grade B).

7. Is it safe to administer lipid emulsions (LCT without or with MCT, or mixed emulsions) and at which rate?

Recommendation:

- intravenous lipid emulsions can be administered safely at a rate of 0.7 g/kg up to 1.5 g/kg over 12–24 h (Grade B)

8. How much should be administered to meet protein requirements?

Recommendation

- When PN is indicated, a balanced amino acid mixture should be infused at approximately 1.3–1.5 g/kg ideal body weight per day in conjunction with an adequate energy supply (Grade B)

MCQs (From Raslan's)

1.All of the following are used to assess the nutritional status of the patient except:

(A.)Platelet count
(B)Lymphocyte count
(C)Body weight
(D)Serum albumin
(E)Triceps skin fold

2.Which of the followings is (are) an indication(s) of nutritional support:

(A)Anorexia nervosa
(B)Intestinal fistula
(C)Malignancy
(D)All of the above

3.Metabolic changes after surgery include:

(A)Decreased glycogen breakdown
(B)Decreased lipolysis
(C)Decreased gluconeogenesis
(D)Decreased body weigh

Answers: 1;A , 2;D, 3;D

Thank You..

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