Nutrition in Surgical Patients

With all courtesy to our colleagues, Raslan and his team, a lot of our work is based on their Manual to Surgery Booklet.

- **Important**
- Mentioned by doctors but not in slides
- Additional notes from Surgical Recall 6th edition or Raslan's booklet
- Not mentioned by the doctor

431 SURGERY TEAM

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Nutrition:

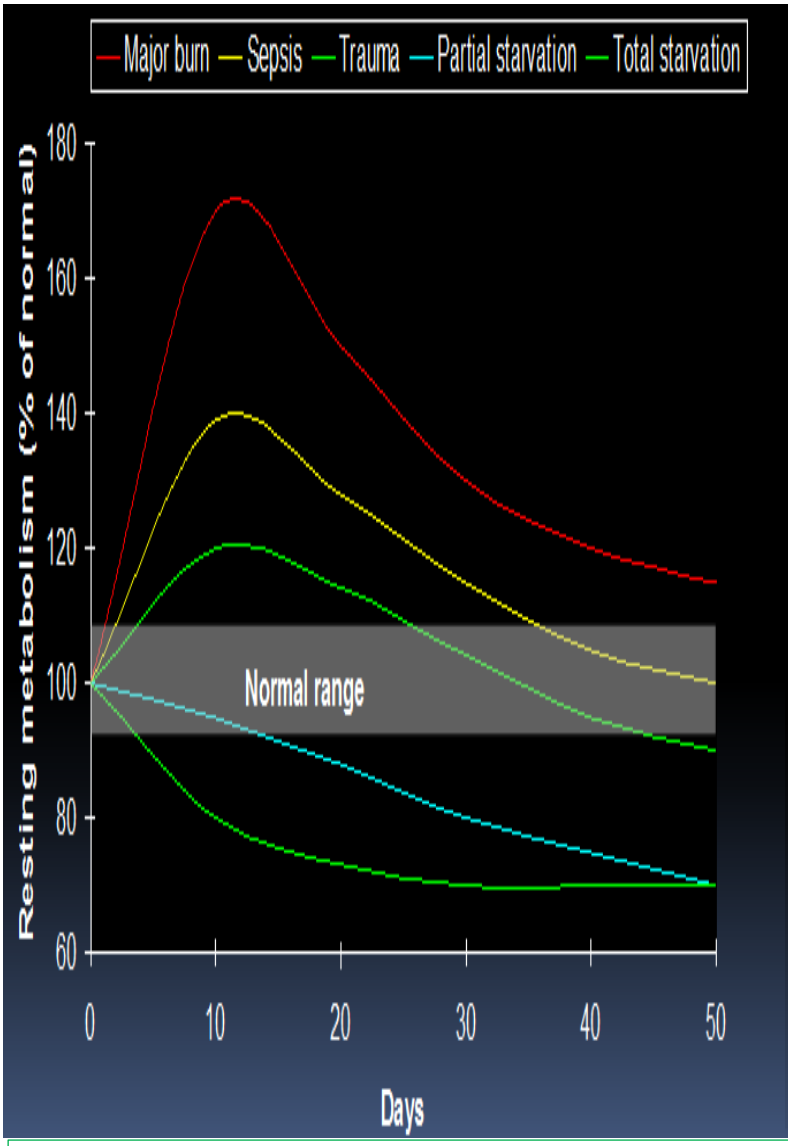
Nutrition—provides with all basic nutrients and energy required for growth, repair and maintenance of the body function. Nutrition comes from carbohydrate, fat, protein, electrolytes, minerals, and vitamins.

Malnutrition: Demand > intake

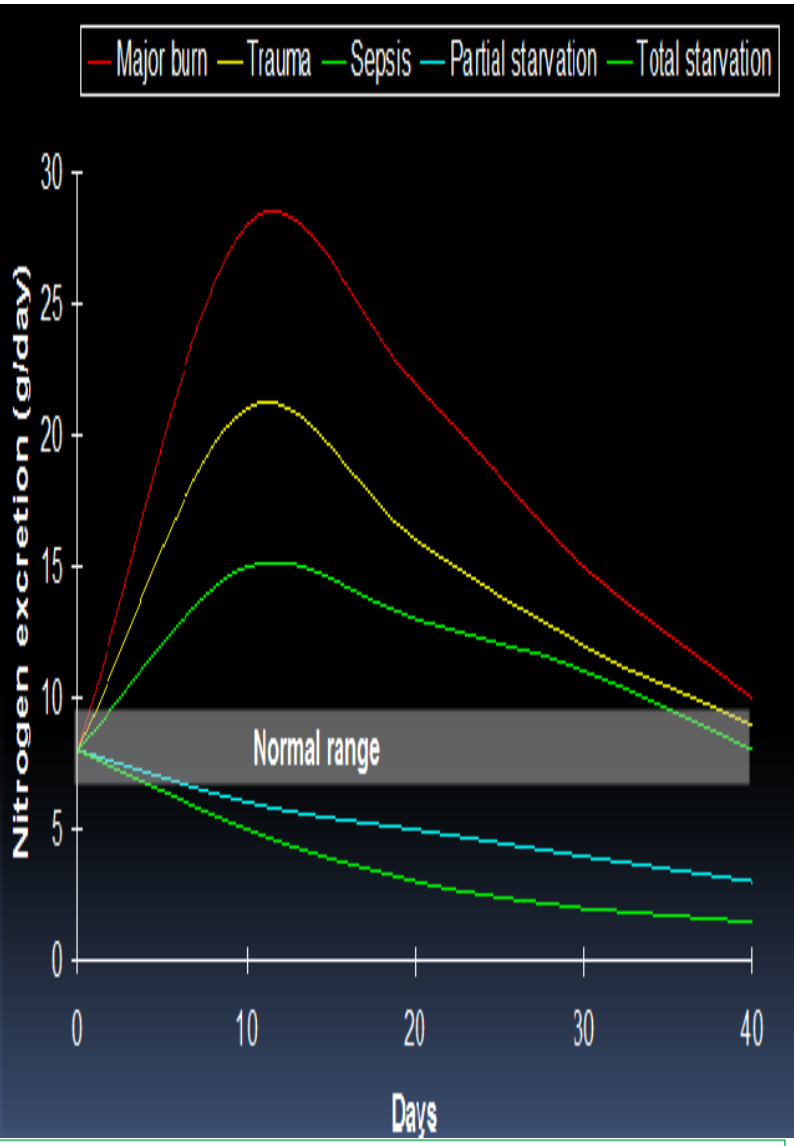
Come from extended inadequate intake of nutrient

Severe illness burden on the body composition and function affect all systems of the body

Metabolic Rate:



Protein Catabolism:



When we 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.

Types of malnutrition:

- Kwashiorkor: protein malnutrition (e.g. Liver cirrhosis, kidney disease, burn patients)
- Marasmus: protein-calorie malnutrition (No protein & No calorie) (e.g. Cancer patient)

Clinical Manifestations:

- Weight loss
- Depletion skeletal muscle and adipose (fat) stores
- Bradycardia
- Hypothermia

Risk factors for malnutrition:

- Medical causes
- Psychological
- Social causes

Medical causes: (Risk factors for malnutrition)

- Recent surgery or trauma
- Sepsis
- Chronic illness
- Gastrointestinal disorders (Celiac disease-Malignancy-TB)
- Anorexia, other eating disorders
- Dysphagia
- Recurrent nausea, vomiting, or diarrhea
- Inflammatory bowel disease (Crohn's disease - Ulcerative colitis)

Consequences of Malnutrition:

- Malnutrition places patients at a greatly increased risk for morbidity and mortality
- Longer recovery period from illnesses
- Impaired host defenses (Infections)

International, multicentre study to implement nutritional risk screening and evaluate clinical outcome:

Table 4 Rate of complication in 'at-risk' *versus* 'not at-risk' patients

	No complication	Complication	Total
'Not at-risk'	88.7 (3021)	11.3 (383)	100 (3404)
'At-risk'	69.4 (1143)	30.6 (504)	100 (1647)

Values shown as % (*N*). Pearson Chi square: $p < 0.001$.

Not at risk" = good nutrition status "At risk"= poor nutrition status

Results: Of the 5051 study patients, 32.6% were defined as 'at-risk' At-risk' patients had more complications, higher mortality and longer lengths of stay than 'not at-risk' patients.

(Explanation: If we have 2 Pts. with the same disease.

1st one : **good** nutrition status

2nd one : **poor** nutrition status

The prognosis of the 1st one will be better than 2nd one)

Severe weight lost:

Time	Significant Weight Loss (%)	Severe Weight Loss (%)
1 week	1-2	>2
1 month	5	>5
3 months	7.5	>7.5
6 months	10	>10

Estimating: Energy/Calorie

Basic energy expenditure (BEE):

- Basal metabolic rate (BMR), also called the basic energy expenditure (BEE) 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%)

Harris–Benedict Equations: (Energy calculation**)**

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)

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

Calculation:

Patient Wt = 50 kg Age = 45 yrs Height = 5 feet 9 inches (175 cm)

BEE = 66 + (13.7 x actual wt in kg) + (5x ht 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

Calorie sources:

- **50** to **60%** of the caloric requirement should be provided as **glucose**
- The remainder **20%** to **30%** as **fat**
- **20%** can be from **protein**
- To include protein calories in the provision of energy is controversial specially in parentral nutrition
- 1 gram of:
  - Fat provides 9 calories.
  - Carbohydrates and proteins provide 3-4 calories.
- Body can utilize glucose 5-7 ml/min/kg without going into hyperglycemia, fat 2.5 grams/kg without developing hyperlipidemia.
- When you take more protein, is that more beneficial to you? Actually **No**, but Protein is a building block, so excess of protein will be beneficial to you if you need building block e.g. burns … etc. But normally excess will be converted and stored then when needed it'll convert to glucose.. so no point in giving pts protein which will convert to carbs.

Fluid Requirements:

- The average adult requires approximately **35-45 ml/kg/d**
- NRC recommends **1 to 2 ml of water for each kcal** of energy expenditure (NRC= National research council)

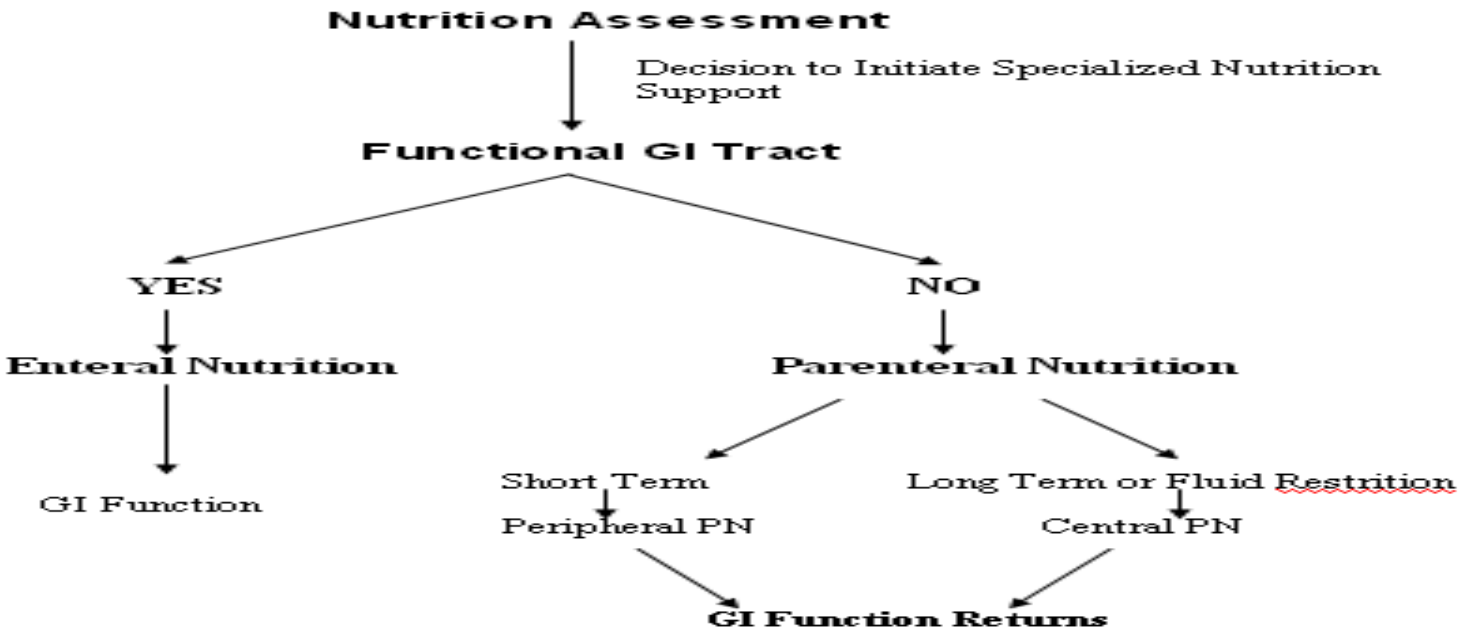
Protein Needs:

- The average adult requires about **1.5 gm/kg** or average **of 100 grams of protein per day**

Stress or activity level Initial 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 (Surgery, sepsis, trauma, etc)

Routes of Nutrition Support:



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

1- Enteral Nutrition:

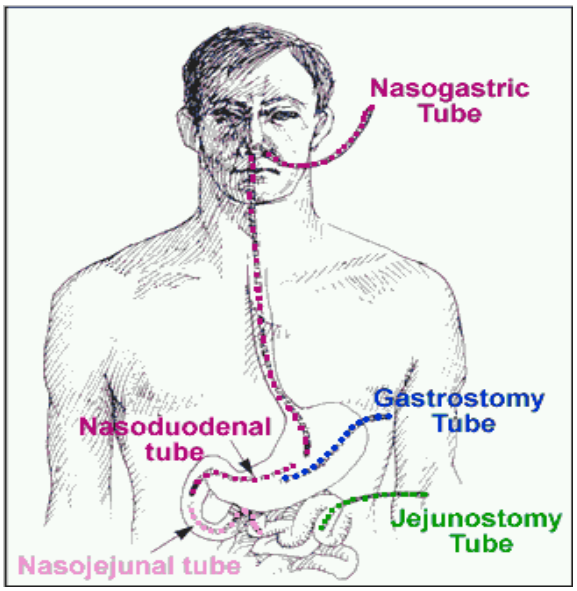
- The gastrointestinal tract is always the preferred route of support (Physiologic)
- EN is safer, more cost effective, and more physiologic that PN
- "If the **gut works**, use it" , e.g. dysphagia, esophegeal cancer and some stomach problems use enteral because the gut is still working.

Potential benefits of EN over PN:

- Nutrients are metabolized and utilized more effectively via the enteral than parenteral route

Enteral nutrition (EN):

- Long-term nutrition **> 6months: (e.g. dysphagia, stroke)**
  - Gastrostomy tube (Intact food)
  - Jejunostomy tube (Partially digested food)
- Short-term nutrition:
  - Nasogastric feeding
  - Nasoduodenal feeding
  - Nasojejunal feeding



2- Total Parentral Nutrition

PN Goal:

- Provide patients with adequate calories and protein to prevent malnutrition and associated complication
- 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

Safety: Complications from central line insertion:

- Catheter sepsis
- Pneumothorax
- Catheter embolism
- Arterial laceration

Contraindications: (You must know them)

- Gastrointestinal obstruction
- Severe acute pancreatitis
- High-output proximal fistulas
- Intractable nausea and vomiting or osmotic diarrhea(aspiration)

Patient Selection:

General Indications:

- Requiring NPO > 5 - 7 days
- Severe gut dysfunction or inability to tolerate enteral feedings.
- **Can not eat, will not eat, should not eat**

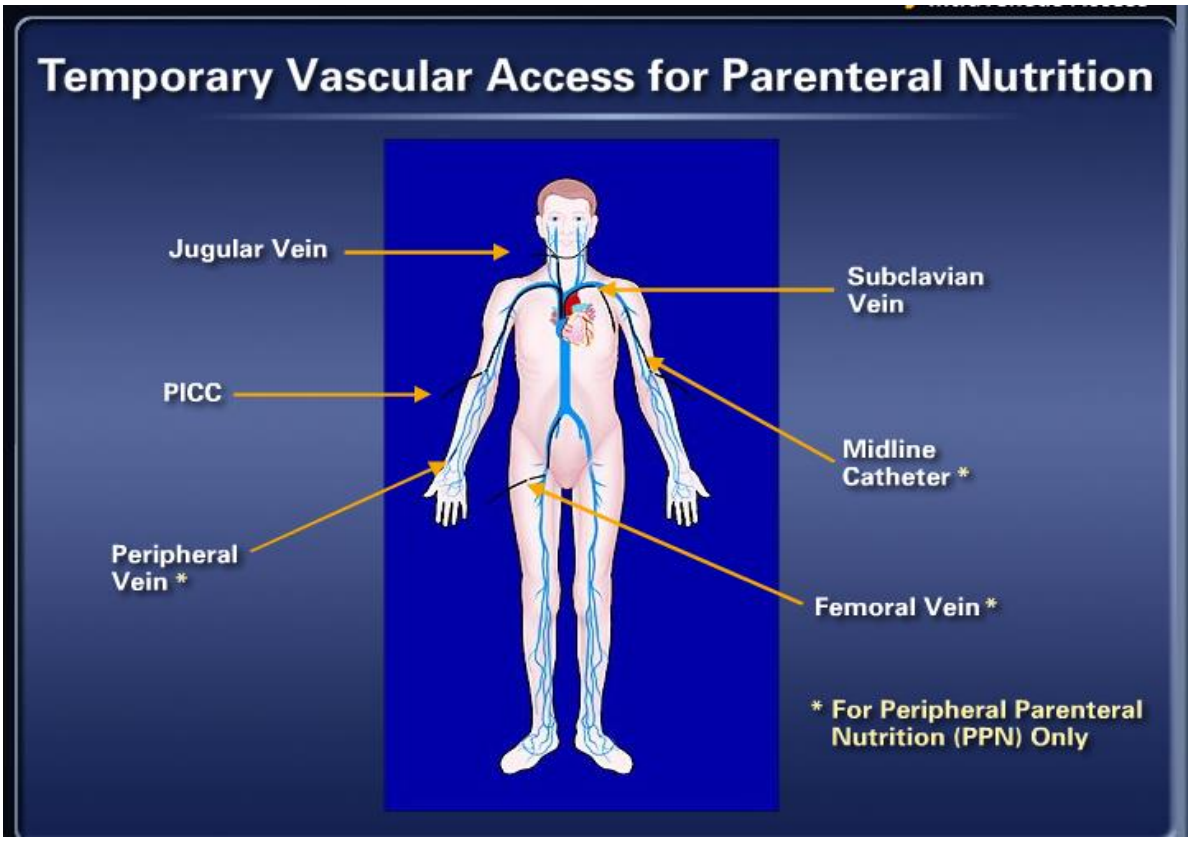
Special Indications (To use TPN):

- After major surgery
- Pt with bowel obstruction
- Pt with enterocutaneous fistulas (high and low)
- Massive bowel resection (unable to absorption)
- Malnourished patients undergo chemotherapy
- NPO for more than 5 days for any reasons
- Necrotizing pancreatitis
- Burns, sepsis, trauma, long bone fractures
- Premature new born
- Renal, hepatic, respiratory, cardiac failure (rarely)

	Standard Range	Maximum
Calories kcal/kg/day	Infants = 90 - 100 Children = 70 - 100 Adolecents = 40 - 55 Adults = 28 - 30	Adults = 40
Protein g/kg/day	Infants = 2.0 - 2.5 Children = 1.5 - 2.0 Adolecents = 0.8 - 2.0 Adults = 0.8 - 1.0	Adults = 2.0
Dextrose rate	4 - 5 mg/kg/min	7 mg/kg/min
Fat	15 - 30% kcal	60% kcal

Electrolyte requirements

	Usual adult range	Infants/children
Sodium	60 to 200 mEq/day	2 to 4 mEq/kg/day
Potassium	60 to 200 mEq/day	2 to 4 mEq/kg/day
Magnesium	8 to 40 mEq/day	0.25 to 0.5 mEq/kg/day
Calcium	10 to 30 mEq/day	0.5 to 3 mEq/kg/day
Phosphorus	10 to 40 mMol/day	0.5 to 2 mMol/kg/day
Chloride	As needed to maintain acid-base balance	Same as adults
Acetate	As needed to maintain acid-base balance	Same as adults



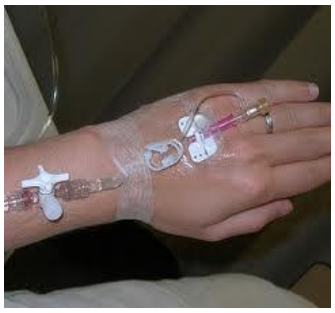
PICC is a new way to insert the central line through peripheral veins, more comfortable but can cause more thrombosis.

Administration:

Central line

- Subclavian line
- Long period
- High osmolality
  - 2000 mOsm/L
- Full Calories
- Minimum volume
- More Infections
- More complications
- Used in fluid restericted pts because you can deliver much calories in little volume.

Peripheral line



- Peripheral line
- Short period <14 days
- Low osmolality
  - < 1000 mOsm/L(<900 in KKUH)
- Min. Calories
- Large volume
- Thrombophlebitis
- Less complications

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

You also need to do LFT because pts can develop cholestasis.

Complications Associated with PN:

- Mechanical complication
- Septic complication
- Metabolic complication

Mechanical Complication:

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

Infectious Complications:

- The mortality rate from catheter sepsis as high as 15%
- Aseptic technique - inserting the venous catheter
- Aseptic technique - compounding the solution
- Catheter care at the site – regular dressing

Metabolic Complications:

- **Early complication** -early in the process of feeding and may be anticipated
- **Late complication** - caused by not supplying an adequate amount of required nutrients or cause adverse effect by solution composition

Metabolic complications of PN

Early complications	Late complications
Volume overload	Essential fatty acid deficiency
Hyerglycemia	Trace mineral deficiency
Refeeding syndrome	Vitamin deficiency
Hypokalemia	Metabolic bone disease
Hypophosphatemia	Hepatic steatosis
Hypomagnesemia	Hepatic cholestasis
Hyperchloremic acidosis	

Refeeding syndrome: A syndrome which results from refeeding a patient that is starving and having low K, Mg and Po. Feeding the patient aggresively will result in an increase in insulin levels which will drive the ions into the cells so their concentrations will further decrease leading to many problems including arrhythmias. Therefore, correct **electrolyte BEFORE nutrition.**

Summary *from the doctor's slides, he mentioned that these are the guidelines, and time didn't allow him to go through them*

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

   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 pt. 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 can over come such infection in ICU.

3. **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.
   - PICC lines offer a suitable middle way between peripheral catheters & conventional central lines.

4. **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).

5. **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.

7.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).

8. 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)

9. 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)

Questions from surgical recall:

Chapter 25 Surgical Nutrition

What is the motto of surgical nutrition?	"If the gut works, use it"
What are the normal daily dietary requirements for adults of the following:	
Protein	1 g/kg/day
Calories	30 kcal/kg/day

By how much is basal energy expenditure (BEE) increased or decreased in the following cases:

- **Severe head injury** — Increased ≈1.7 ×
- **Severe burns** — Increased ≈2–3 ×

What are the calorie contents of the following substances:

- **Fat** — 9 kcal/g
- **Protein** — 4 kcal/g
- **Carbohydrate** — 4 kcal/g

What is the formula for converting nitrogen requirement/loss to protein requirement/loss? — Nitrogen × 6.25 = protein

What is RQ? — **Respiratory Quotient**: ratio of CO_2 produced to O_2 consumed

What is the normal RQ? — 0.8

What can be done to decrease the RQ? — More fat, less carbohydrates

What dietary change can be made to decrease CO_2 production in a patient in whom CO_2 retention is a concern? — Decrease carbohydrate calories and increase calories from **fat**

What lab tests are used to monitor nutritional status? — Blood levels of:

- **Prealbumin** ($t_{1/2}$≈2–3 days)—acute change determination
- Transferrin ($t_{1/2}$≈8–9 days)
- Albumin ($t_{1/2}$≈14–20 days)—more chronic determination
- Total lymphocyte count
- Anergy
- Retinol-binding protein ($t_{1/2}$≈12 hours)

Where is iron absorbed? — Duodenum (some in proximal jejunum)

Where is vitamin B12 absorbed?	Terminal ileum
What are the surgical causes of vitamin B12 deficiency?	Gastrectomy, excision of terminal ileum, blind loop syndrome
Where are bile salts absorbed?	Terminal ileum
Where are fat-soluble vitamins absorbed?	Terminal ileum
Which vitamins are fat soluble?	**K, A, D, E ("KADE")**
What are the signs of the following disorders:	
Vitamin A deficiency	Poor wound healing
Vitamin B12/folate deficiency	Megaloblastic anemia
Vitamin C deficiency	Poor wound healing, bleeding gums
Vitamin K deficiency	↓ in the vitamin K–dependent clotting factors (II, VII, IX, and X); bleeding; elevated PT
Chromium deficiency	Diabetic state
Zinc deficiency	Poor wound healing, alopecia, dermatitis, taste disorder
Fatty acid deficiency	Dry, flaky skin; alopecia
What vitamin increases the PO absorption of iron?	PO vitamin C (ascorbic acid)
What vitamin lessens the deleterious effects of steroids on wound healing?	Vitamin A
What are the common indications for total parenteral nutrition (TPN)?	NPO >7 days Enterocutaneous fistulas Short bowel syndrome Prolonged ileus

What is TPN?	Total Parenteral Nutrition = IV nutrition
What is in TPN?	Protein Carbohydrates Lipids (H_2O, electrolytes, minerals/vitamins, ± insulin, ± H_2 blocker)
How much of each in TPN:	
Lipids	20% to 30% of calories (lipid from soybeans, etc.)
Protein	1.7 g/kg/day (10%–20% of calories) as amino acids
Carbohydrates	50% to 60% of calories as dextrose
What are the possible complications of TPN?	Line infection, fatty infiltration of the liver, electrolyte/glucose problems, pneumothorax during placement of central line, loss of gut barrier, acalculus cholecystitis, refeeding syndrome, hyperosmolality
What are the advantages of enteral feeding?	Keeps gut barrier healthy, thought to lessen translocation of bacteria, not associated with complications of line placement, associated with fewer electrolyte/glucose problems
What is the major nutrient of the gut (small bowel)?	Glutamine
What is "refeeding syndrome"?	Decreased serum **potassium, magnesium,** and **phosphate** after refeeding (via TPN or enterally) a starving patient
What are the vitamin K–dependent clotting factors?	2, 7, 9, 10 (Think: 2 + 7 = 9, and then 10)
What is an elemental tube feed?	Very low residue tube feed in which almost all the tube feed is absorbed
Where is calcium absorbed?	Duodenum (actively) Jejunum (passively)

What is the major nutrient of the colon?	**Butyrate** (and other short-chain fatty acids)
What must bind B12 for absorption?	Intrinsic factor from the gastric parietal cells
What sedative medication has caloric value?	Propofol delivers 1 kcal/cc in the form of lipid!
Why may all the insulin placed in a TPN bag not get to the patient?	Insulin will bind to the IV tubing
What is the best way to determine the caloric requirements of a patient on the ventilator?	Metabolic chart
How can serum bicarbonate be increased in patients on TPN?	Increase acetate (which is metabolized into bicarbonate)
What are "trophic" tube feeds?	Very low rate of tube feeds (usually 10–25 cc/hr), which are thought to keep mucosa alive and healthy
When should PO feedings be started after a laparotomy?	Classically after flatus or stool PR (usually postoperative days 3–5)
What is the best parameter to check adequacy of nutritional status?	Prealbumin

Questions:

1. **What is the definition of Kwashiorkor and what is the most common cause of it ?**
    a. It's a type of malnutrition caused by adequate intake of protein and inadequate intake of calories most commonly caused by systemic infections and cancer
    b. It's a type of malnutrition caused by inadequate intake of protein-calorie characterized by calories deficiency seen in severe burns injury or some conditions like anorexia nervosa
    c. Its type of malnutrition caused by inadequate intake of protein in the presence of good calorie intake commonly caused by chronic kidney disease and liver cirrhosis
    d. Its type of malnutrition caused by inadequate intake of protein in the presence of good calorie intake commonly caused by cancers

2. **Patient comes to you with bradycardia , hypothermia and weight loss . which ONE of the following diseases has this clinical feature ?**
    a. Marasmus
    b. Kwashiorkor
    c. Liver cirrhosis
    d. IBS

3. **Which ONE of the following is considered as malnourished paint ?**
    a. 3% weight loss over 6 months or 10 % weight loss over 1 month
    b. 10 % over 6months or 5 % over 1 month
    c. 30 % over 6 months or 50 % over 1 year
    d. 10 % over 6 months or 3 % over 1 month

4. **Patient with severely elevated Lipase and you suspect a pancreatic problem . Which ONE of the following route you choose to feed him ?**
    a. Parenteral route
    b. Enteral route
    c. Normal feeding route from the mouth
    d. Nasogastric tube route

5. **Patient in the ward with severe heart failure and peripheral edema , now he is NPO . Which type of nutrition you choose for him ?**
    a. High nitrogen
    b. Peptide based
    c. Caloric dense
    d. Fiber containing

6. **Which ONE of the following is not an indication for total parentral nutrition ?**
    a. Patient who should not eat, will not eat or cannot eat
    b. NPO > 5-7 days
    c. Enterocutaneous fistulas
    d. After minor surgery

7. **Patient came to you with severe malnutrition , you take a brief history from him, what is your next step ?**
    a. Ask for 0.9 normal saline
    b. Ask for Dextrose 5 %
    c. Admit him to ICU
    d. Check his potassium and phosphate before giving him dextrose 5% to avoid cardiac arrest
8. **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

9. **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

10. **Metabolic changes after surgery include:**
    a. Decreased glycogen breakdown
    b. Decreased lipolysis
    c. Decreased gluconeogenesis
    d. Decreased body weight

11. **Patient underwent gasterectomy and he will be NPO for a long period, physician is deciding to start PN for this patient, he is 170 cm (hight) and 120 kg (weight), what is the amount of calories needed for this patient?**
    a. 1700 Kcal
    b. 1900 Kcal
    c. 2184 Kcal
    d. 2600 Kcal

Answer Keys:

1-C, 2-A, 3-B, 4-A, 5-C, 6-D, 7-D, 8-A, 9-D, 10-D, 11- ? (Age is missing)