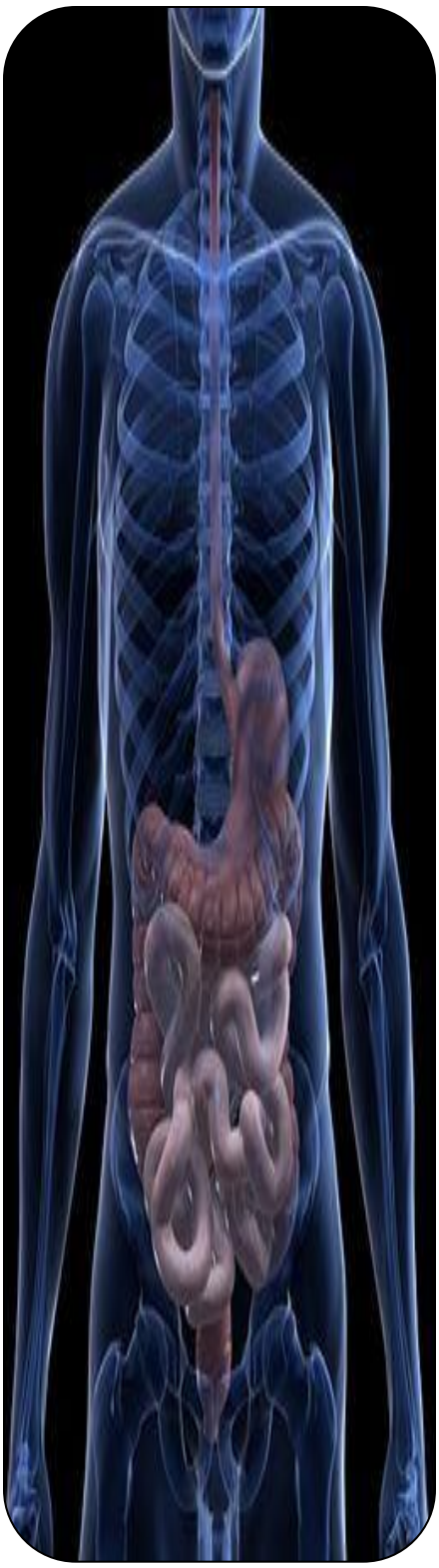


Pharmacology Team

NUTRITION SUPPORT

Done by:
***Reem AlSalman**

Blue color for note
Red color for important things

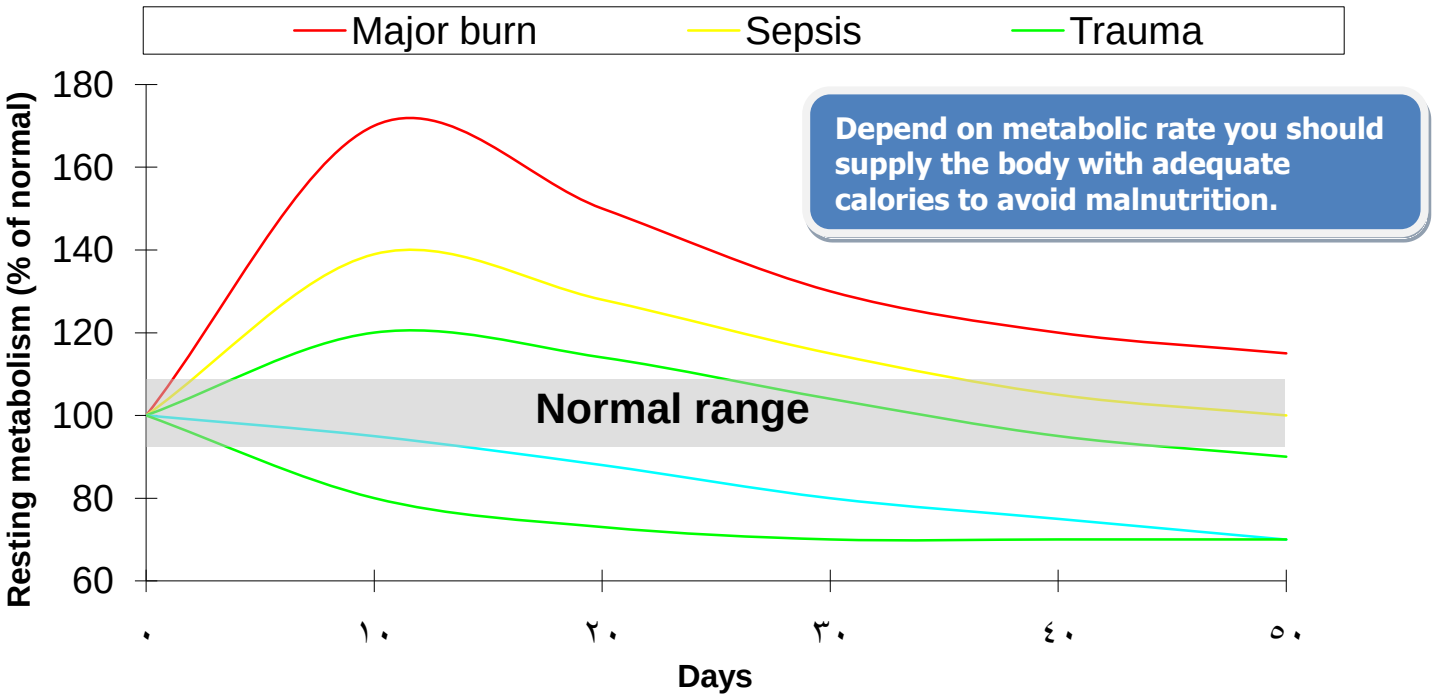
Nutrition

- 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.

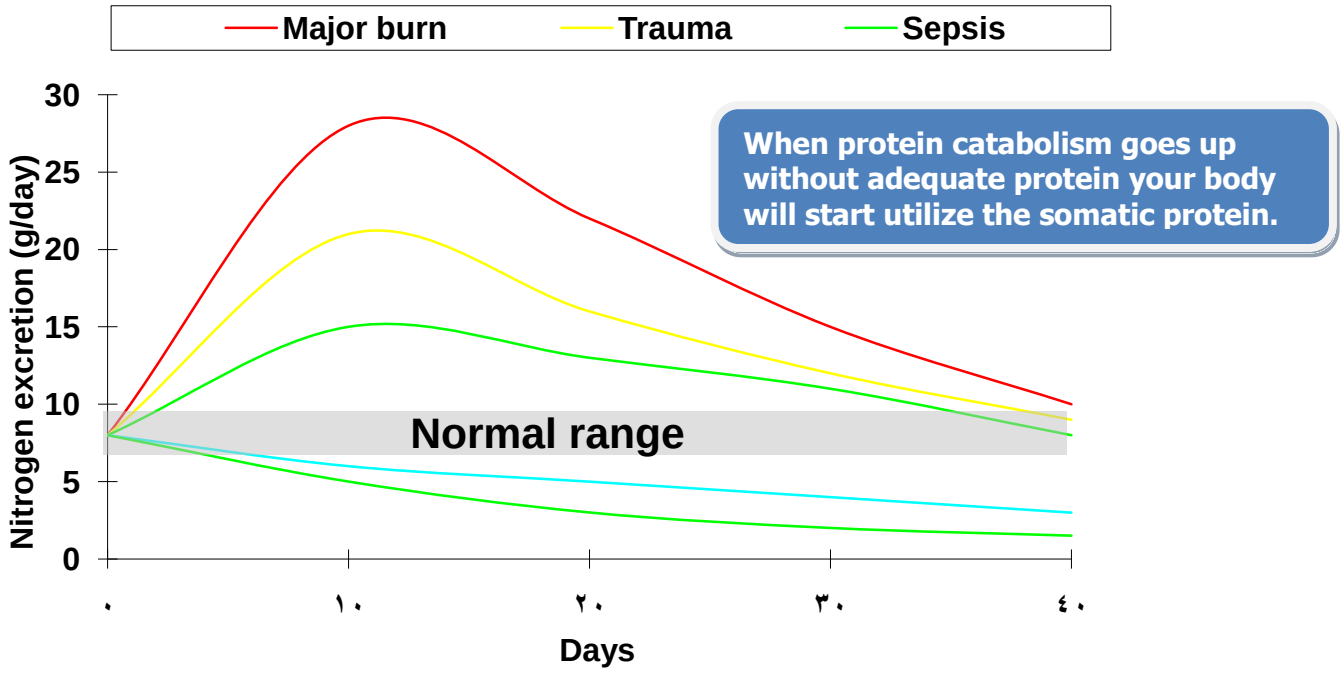
Malnutrition

- Come from extended inadequate intake of nutrient or
- Severe illness burden on the body composition and function—affect all systems of the body Like malabsorption and increase lost.

Metabolic Rate



Protein Catabolism



Types of malnutrition

- Kwashiorkor: (kwa-shior-kor) is protein malnutrition
- Marasmus: (ma-ras-mus) is protein-calorie malnutrition

	Kwashiorkor	Marasmus
Type of malnutrition	Protein , inadequate protein intake in the presence of fair to good calories intake in combination with the stress response	Protein-calories ,malnutrition characterized by calories deficiency
casuse	chronic kidney disease, liver cirrhosis, trauma , burns, hemorrhage, and critical illness	severe burns ,injuries, systemic infections, cancer etc or conditions where patient does not eat like anorexia nervosa and starvation
Clinical Manifestations	▪ Marked hypoalbuminemia ▪ Edema and ascites ▪ Muscle atrophy ▪ Delayed wound healing ▪ Impaired immune function	▪ Weight loss ▪ Depletion skeletal muscle and adipose (fat) stores ▪ Bradycardia ▪ Hypothermia

Risk factors for malnutrition

Medical causes	Psychological & Social causes
▪ Recent surgery or trauma ▪ Sepsis ▪ Chronic illness ▪ Gastrointestinal disorders ▪ Anorexia, other eating disorders ▪ Dysphagia ▪ Recurrent nausea, vomiting, or diarrhea ▪ Inflammatory bowel disease.	▪ Alcoholism, drug addiction ▪ Poverty, isolation ▪ Disability ▪ Anorexia nervosa

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

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

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: $p < 0.001$.

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 because of malnutrition disease and complication.

Standard monogram for Height and Weight in adult-male

Height	Small Frame	Medium Frame	Large Frame
4'10"	102-111	109-121	118-131
4'11"	103-113	111-123	120-134
5'0"	104-115	113-126	122-137
5'1"	106-118	115-129	125-140
5'2"	108-121	118-132	128-143
5'3"	111-124	121-135	131-147
5'4"	114-127	124-138	134-151
5'5"	117-130	127-141	137-155
5'6"	120-133	130-144	140-159
5'7"	123-136	133-147	143-163
5'8"	126-139	136-150	146-167
5'9"	129-142	139-153	149-170
5'10"	132-145	142-156	152-173
5'11"	135-148	145-159	155-176
6'0"	138-151	148-162	158-179

You decide the frame upon the external shape of the body

A pt with 110 lbs and Ht 5' 9" (Percent weight loss)

*Small frame
129 lbs – 110 lbs = 19 lbs
19/129 x 100 = 15%

* Medium frame
139 lbs – 110 lbs = 29 lbs
29/139 x 100 = 20%

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

Second: BMI

Average Body Mass Index (BMI) for Adult

Classification	BMI (kg/m^2)	Obesity Class
Underweight	**<18.5**	
Normal	**18.5-24.9**	
Overweight	**25.0-29.9**	
Obesity	**30.0-34.9**	**I**
Moderate obesity	**35.0-39.9**	**II**
Extreme obesity	**>40.0**	**III**

Third: fat storage

- **Assessment of body fat**

Triceps skin fold thickness (TSF)

* A value used to estimate body fat, which is measured on the right arm halfway between the olecranon process of the elbow and the acromial process of the scapula; normal: ♂ 12 mm; ♀ 23 mm;

Compare the patient TSF to standard monogram

Fourth: Somatic and visceral protein

- **Assessment of the fat-free muscle mass (Somatic Protein)**

Mid-upper-arm circumference (MAC)

* a measurement of the circumference of the arm at a midpoint between the tip of the acromial process of the scapula and the olecranon process of the ulna. It is an indication of upper arm muscle wasting.

Compare the patient MAC to standard monogram

Vitamins deficiency

Vitamin Bs (B1,B2, B6, B12,) , Vitamin C , Vitamin A , Vitamin D , Vitamin K.

-	Clinical Sign or Symptom	Nutrient
General	Wasted, thin	Calorie
-	Loss of appetite	Protein-calorie
Skin	Eczematous scaling	Zinc
-	*Pallor	Folate, iron, vitamin B12, copper
-	Follicular hyperkeratosis	Vitamin A
-	Flaking dermatitis	Protein-calorie, niacin, riboflavin, zinc
-	*Bruising	Vitamin C, vitamin K
-	Pigmentation changes	Protein-calorie, niacin
-	Scrotal dermatosis	Riboflavin

Neck	Goiter	Iodine
-	Parotid enlargement	Protein
Thorax	Thoracic rosary	Vitamin D
Abdomen	Diarrhea	Niacin, folate, vitamin B_{12}
-	Distention	Protein-calorie
-	Hepatomegaly	Protein-calorie
Extremities	*Edema	Protein, thiamine
-	Bone tenderness	Vitamin D
-	Muscle wasting	Protein, vitamin D, selenium
-	*Hyporeflexia	Thiamine
-	Ataxia	Vitamin B_{12}
Nails	*Spooning	Iron
-	Transverse	Protein

*doctor didn't stress on it and went through it very quickly.

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)

No need to memorize it :")

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

Our patient Wt = 50 kg Age =45yrs
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) – (6.8x 45)
=66 + (685) + (875) – (306)
= 1320 kcal
TEE = 1320 x 1.25 (normal activity)
= 1650 kcal

Calorie sources

- 60 to 80% of the caloric requirement should be provided as glucose
- The remainder 20% to 40% as fat "it the storage form in body"
- 15% can be from protein "by gluconeogenesis"
- To include protein calories in the provision of energy is controversial specially in parentral nutrition

Fluid Requirements

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

To be more scientific:

- 1st 10 kilogram ~>100 cc/kg
- 2nd 10 kilogram ~>50 cc/kg
- Rest of the weight ~>20 to 30 cc/kg

if pt is 50 kg
1st 10 kg x 100cc = 1000 cc
2nd 10 kg x 50cc = 500cc
Rest 30 kg x 30cc = 900cc
total = 2400 cc

Protein Needs

- The average adult requires about 1 to 1.2 gm/kg 0r average of 70-80 grams of protein per day

Stress or activity level Initial protein requirement (g/kg/day)

- Baseline 1.4 g/kg/day
- Mild stress 1.8 g/kg/day
- Moderate stress 2.0 g/kg/day
- Severe stress 2.2 g/kg/day

Routes of Nutrition Support

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

Enteral Nutrition

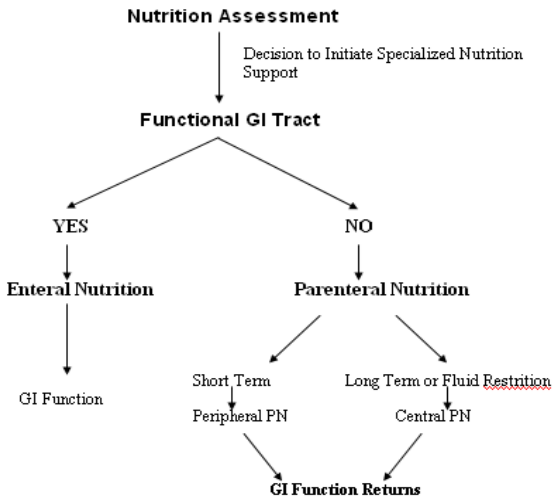
- The gastrointestinal tract is always the preferred route of support (Physiologic)
- EN is safer, more cost effective,and more physiologic that PN "If the gut works, use it"

Safety:

- Catheter sepsis
- Pneumothorax

Contra

*Gastr
*Severe



- Catheter embolism
- Arterial laceration

*High-output proximal fistulas
*Intractable nausea and vomiting or osmotic diarrhea

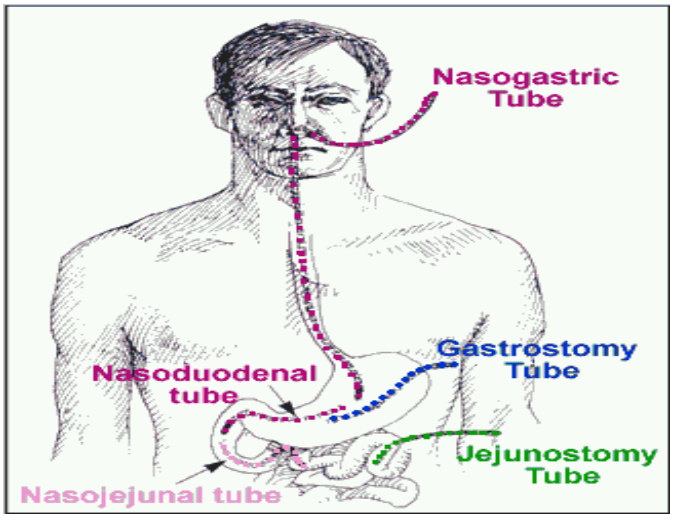
Enteral nutrition (EN)

- Long-term nutrition: e.g coma, spinal cord injury

Gastrostomy e.g. in esophagus cancer
Jejunostomy

- Short-term nutrition:

Nasogastric feeding
Nasoduodenal feeding
Nasojejunal feeding



To make it easy for you choosing the way is depend on the GI function. For example, in esophagus cancer pt the GI tract work probably except esophagus so we choose gastromy which will allow food to enter body without passing by esophagus :")

Category	Subcategory	Characteristics	Indications
Polymeric = Intact food	Standard	Similar to average diet	Normal digestion
	High nitrogen	Protein > 15% of total kcal	• Catabolism • Wound healing
	Caloric dense	2 kcal/ml	• Fluid restriction • Volume intolerance • Electrolyte abnormalities
	Fiber containing	Fiber 5-15 g/L	Regulation of bowel function
Monomeric =Predigested food	Partially hydrolyzed	One or more nutrients are hydrolyzed. Composition varies.	Impaired digestive and absorptive capacity
	Elemental		
	Peptide based		

Continuous	• Initiation of TF • Crtically ill patient • Small bowel feeding • Intolerance of intermittent or bolus TF	• Pump Assisted • Minimizes risk of high gastric residuals and aspiration • Minimizes risk of metabolic abnormalities	• Restricts ambulation • Infused over 24 hr/d • Increased cost due to equipment and supplies
Intermittent	• Noncritically ill patient • Home TF • Rehabilitation patient	• Flexibility of feeding regimen • Inexpensive (less equipment and supplies) • Feeding over short time period allows free time between feedings	• Higher risk of aspiration, nausea, vomiting, abdominal pain, distention, and diarrhea • Potential GI intolerance to goal TF infusion rate • May require formula with more calories and protein

*doctor didn't stress on it and went through it very quickly.

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

	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

Patient Selection

General Indications

Requiring NPO > 5 - 7 days

- Severe gut dysfunction or inability to tolerate
- enteral feedings.
- Can't eat, will not eat, should not eat

Special Indications :

- After major surgery
- Pt with bowel obstruction
- Pt with enterocutaneous fistulas (high and low)
- Massive bowel resection
- 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)

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

*doctor didn't stress on it and went through it very quickly.

Central Nutrition	Peripheral Nutrition
▪ Subclavian line	▪ Peripheral line
▪ Long period	▪ Short period < 14days
▪ High osmolality > 2000 mOsm/L	▪ Low osmolality < 1000 mOsm/L
▪ Full Calories	▪ Min. Calories
▪ Minimum volume	▪ Large volume
▪ More Infections	▪ Thrombophlebitis
▪ More complications	▪ 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

First: 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

Second: Septic complication

- 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

Third: Metabolic complication

- 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

If your pt is hypokalemia, hypophosphatemia or hypomagnesemia don't give him TPN or EN until you balance them or your pt will end up with refeeding syndrome then will die!

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	