L . 4 MALNUTRITION :

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Learning objectives:

1. Recognize feature of nutritional deficiency.
2. Assess the severity of malnutrition, classification
3. Search for possible complication of malnutrition
4. Management plane of malnutrition.

Malnutrition refers to **undernutrition** and is defined as an imbalance between nutrient requirements and intake that results in deficits of energy, protein, or micronutrients that negatively affect growth and development.
In 2020, the FAO estimated that 9.9% of the world's population, were undernourished, more than half of them were found in Asia, and more than one third were found in Africa. Worldwide, malnutrition is responsible directly or indirectly for about **a third of all deaths of children under 5 years of age.**
Undernutrition is not confined to low-income countries, and may affects children who are chronically ill, patients with burn, HIV, malignancy…etc.
Protein-energy malnutrition (PEM) is a spectrum of conditions caused by varying levels of protein and calorie deficiencies. According to underlying aetiology PEM can be classified into:

1. **Primary PEM** due to social or economic factors that result in a lack of food.
2. **Secondary PEM** occurs in children with various conditions associated with:
   - increased caloric requirements (infection, trauma, cancer).
   - increased caloric loss (malabsorption).
   - reduced caloric intake (anorexia, cancer, poor oral intake, social factors).
   - or a combination of these three variables.

Classification of malnutrition according to clinical manifestation

The most important physical findings of PEM are Muscle wasting, peripheral Oedema, Skin and Hair changes and according to presence and severity of these feature PEM can be classified into:

1. ***MARASMUS : as a result of the physiologic response to inadequate calories and nutrients. Features of marasmus are:***

- ***Muscle wasting:*** the patient has marked loss of muscle mass and subcutaneous fat stores, the head may appear large but generally is proportional to the body length.
- **Oedema usually is absent.**
- **The skin** is dry and thin and **hair** may be thin, sparse, and easily pulled out.
- Marasmic children may be apathetic, weak, or may be irritable to touched.
- **The weight is severely reduced in marasmus.**

2. ***KWASHIORKOR:*** Kwashiorkor results from **inadequate protein intake in the presence of fair to good caloric intake (**infants are weaned late from the breast and the diet is high in starch.).

- The hypo albuminemia results in **pitting oedema** that starts in the lower extremities at the dorsum of feet and ascends with increasing severity with

involvement of the eyelids and scrotum. In addition, there may be a distended abdomen and enlarged liver (usually due to fatty infiltration)

- kwashiorkor has a relative maintenance of subcutaneous tissue and a marked atrophy of muscle mass.
- **The hair** is sparse, easily plucked, and dull brown, red, or yellow to white. Nutritional repletion restores hair colour, leaving the hair with altered pigmentation followed by a band with normal pigmentation (**flag sign).**
- **Skin changes** are common and range from hyperpigmented hyperkeratosis to an erythematous macular rash (pellagroid) on the trunk and extremities. In the most severe form of kwashiorkor, a superficial desquamation occurs over pressure surfaces ("flaky paint ``rash).
- MOUTH: Angular cheilosis, atrophy of the filiform papillae of the tongue, and monilial stomatitis are common.
- **body weight is slightly lower or near normal for age; and does not accurately reflect the nutritional status because of oedema**

3. ***MIXED MARASMUS-KWASHIORKOR*** These children often have concurrent wasting and oedema in addition to stunting. These children exhibit features of dermatitis, neurologic abnormalities, and fatty liver.

Assessment of severity of nutritional deficiency:

PEM continues to be a major problem in many low and middle-income countries. The WHO recommends that nutritional status is expressed as:

- **Weight For Height** – a measure of wasting **an index of acute malnutrition< 3 months.**
- **MUAC** in sever PEM (<115 mm).
- **Height For Age** (or length for age for children <2 years) Wt for age <-3SD regards as ***Stunting***, or **chronic** undernutrition.

Admission criteria: Children with PEM regardless of the degree should be admitted to nutritional rehabilitation center for the management of severe acute malnutrition (SAM) in **presence of any:**

1. Mid-upper arm circumference **<115 mm** **or**
2. W**eight-for-height/length < –3 Z-score** **or**
3. Bilateral edema (regardless of the degree).
4. Poor appetite.
5. Danger signs according to IMCI , or complications (hypoglycemia, hypothermia, shock, dehydration or infections)

Nutritional rehabilitation:

The body of the malnourished child may have compensated for micronutrient deficiencies by lowering both metabolic and growth rates due to **Reductive adaptation** (the body slows metabolic processes and growth to minimize the need for nutrients and uses its stores of glycogen, fat, and protein to maintain normal metabolic requirements during starvation).

During refeeding when the metabolic rate increases, stimulating anabolism and increasing nutrient requirements and the deficiency may be more obvious, ***So Nutritional rehabilitation should be initiated and advanced slowly to minimize these complications***, once nutritional rehabilitation is initiated, calories can be safely started at 20% above the child's recent intake

- **1. Initial phase:** with **F-75formula** (special therapeutic milk) 130ml/kg/ day in 12 feeding per day given every 2 hr for 2-5 days then once the patient tolerated feeding well, the volume of feeds increases with reducing no. of feeds to 8 feeds given every 3 hr, then every 4hr (6 Feeding/ day).
- **2. Rehabilitation phase:** once the patient tolerates the f-75 formula well every 4 hours, mostly within 5 days, he will be ready to shift to **F-100 formula,** the volume of f-100 formula then gradually increase (by 10-20 ml/ feed), keeping in mind not to exceed the maximum volume for the patient`s weight (220ml/ kg /day)
- **3. Treatment of complications or problems need urgent interventions:-**

A. Hypoglycaemia: when RBS less than 3 mmol = 54mg/dl

- Risk factors:
  - Sever muscles wasting
  - Poor feeding, vomiting
  - Cold weather.
  - Infection.
- **Treatments: If the patient is conscious and can take oral feeds:**
  *Give him 50 ml of 10 % GW orally.
  * Then start f-75 as in initial phase, but the volume should be divided to 4 quarters each quarter should be given every 30 min for 2 hour, then 2 hourly feeding are continued throughout day and night.
- **If the patient is unconscious:**
  - Start with 5 ml per kg of 10 % GW given I.V.
  - once he regains his conscious level, give him 50 ml of 10 % GW orally.
  - then start f-75, as 4 quarters each quarter should be given every 30 min for 2 hr then 2 hourly feeding are continued throughout day and night.

B. HYPOTHERMIA: When rectal Temp. < 35.5^{0}C

Risk factors: (Sever muscles wasting., Poor feeding, Cold weather, recent bathing, and Infection.)

- Treatment of hypothermia: Re warming the child by:-
  - Clothe the child, including the head, can use blankets.
  - Warming using indirect radiant heater
  - Mother skin (mother's bare chest skin to skin (**kangaro position**)
  - Start feeding him with f-75 as above.
  - Give antibiotics for infections .
  - Check RBS and treat hypoglycemia.

C. DEHYDRATION

- Dehydration is common in patients with PEM due to diarrhea and vomiting, **Don`t use the IV route for rehydration except in cases of shock.**
- Oral route is the best routs for correction of dehydration in malnourished patients using special rehydration solution called **ReSoMal** which can be prepared by adding **1 sachet of 1 liter ORS solution + 2 liters of water + 40 ml mineral mixed solution + 50 gram sugar**
- **Rate :** 5 ml/ kg /30 min for 2 hr **Then:** 5-10 ml/kg /4 -10 hours.
- **Monitor the patient : input, Out put, PR, RR , puffiness of face.**
- **start** feeding Breast feeding **+ f-75 milk.** + Resomal 50-100ml / after each diarrhea stool.

D* INFECTION:

Because of decreased immunity Treat /prevent infection routinely on admission by giving: Broad-spectrum antibiotic + Measles vaccine if > 6m and not immunized.

Choice of broad-spectrum antibiotics:

a) If the child appears to have no complications give oral Amoxicillin syrup.

b) If the child is severely ill (apathetic, lethargic) or has complications (hypoglycaemia; hypothermia; broken skin; or infection) give:

- Ampicillin 50 mg/kg **IM/IV** 6-hourly for 2 days, followed by oral amoxicillin 15 mg/kg 8-hourly for 5 days, or if amoxicillin is not available, continue with ampicillin but given orally 50mg/kg 6-hourly .
- + Gentamicin 5 mg/kg **IM/IV** once daily for 7 days

E. shock:

The severely malnourished child is considered to have shock if he//she:

• **Is lethargic or unconscious and Has cold hands plus either:**

1) slow capillary refills (longer than 3 seconds or

2) weak or fast pulse

Shock from dehydration and sepsis are likely to coexist in severely malnourished children. They are difficult to differentiate on clinical signs alone. Children with dehydration will respond to IV fluids. While patients with septic shock and no dehydration will not respond. To start treatment of shock:

- Give oxygen
- Give sterile 10% glucose (5 ml/kg) by iv.
- Give iv fluid at 15 ml/kg over 1 hour. Use ringer's lactate with 5% dextrose; or half-normal saline with 5% dextrose; or half-strength Darrow's solution with 5% dextrose; or if these are unavailable, ringer's lactate .
- Measure and record pulse and respiration rates every 10 minutes.
- Give antibiotics.
- If there are signs of improvement (pulse and respiration rates fall): repeat iv 15 ml/kg over 1 hour; then switch to oral or nasogastric rehydration with ReSomal, 10 ml/kg/h for up to 10 hours.

- Then Give ReSomal in alternate hours together with f-75, then continue feeding with f-75 formula .
- If the child fails to improve after the first hour of treatment (15 ml/kg), **assume that the child has septic shock, in this case.**
- Give maintenance iv fluids (4 ml/kg/h) and prepare blood, Once blood is available transfuse fresh whole blood at 10 ml/kg *slowly* over 3 hours.
- If the child gets worse during treatment (breathing increases by 5 breaths or more/min and pulse increases by 25 or more beats/min): stop the infusion to prevent the child's condition worsening.

Severe anaemia in malnourished children A blood transfusion is required if: *Hb is less than 4 g/dl /l

*or if there is respiratory distress and Hb is between 4 and 6 g/dl

Give: whole blood 10 ml/kg body weight slowly over 3 hours.

+ furosemide 1 mg/kg IV at the start of the transfusion.

. If the severely anaemic child has signs of cardiac failure, transfuse packed cells (5-7 ml/kg) rather than whole blood.

4. **Continue cautious feeding and Correct micronutrient deficiencies**

a. All severely malnourished children have vitamin and mineral deficiencies. Although anaemia is common, do NOT give iron initially but wait until the child has a good appetite and starts gaining weight (usually by the second week),, as giving iron early can make infections worse.

b. Give: Vitamin A orally on Day 1 (for age >12 months, give 200000 IU; for age 6-12 months, give 100000 IU; for age <6 months, give 50000 IU)

c. Multivitamin supplement Give daily for at least 2 weeks:

- Folic acid 1 mg/d (give 5 mg on Day 1)
- Zinc 2 mg /kg/d
- Copper 0.3 mg/kg/d
- Iron 3 mg//kg//d but only when gaining weight.

5. **Monitor child weight gain and catch-up growth**
   during rehabilitation a vigorous approach to feeding is required to achieve good intakes and rapid weight gain of >10 g gain/kg/day
6. **Provide sensory stimulation and emotional support.**
   Good feeding practices and sensory stimulation should be continued at home. Show parent how to feed frequently with energy and nutrient dense foods and give structured play therapy**.**
7. **Prepare for follow-up after recovery.** A child who is 90% weight-for-length (equivalent to -1SD) can be considered to have recovered. The child is still likely to have a low height-for-age because of stunting.

Key message Children with SAM are at risk of life threatening problems and they need careful assessment prioritized for immediate admission to nutritional rehabilitation wards with proper case management of severe acute malnutrition (SAM) and follow up care the lives of many children can be saved and the case fatality rate can be lowered from over 30% to less than 5%.

Reference:

1. Training course on management of severe acute malnutrition (WHO)
2. Nelson text book of paediatric 22th edition .
3. Nelson essentials Textbook of Paediatrics , 7th edition.
4. Illustrated text book of paediatrics 5th edition.