RUTF (READY-TO-USE THERAPEUTIC FOODS) TREATMENT FOR KWASHIORKOR

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ABSTRACT

Kwashiorkor, also known as “edematous malnutrition” is a nutritional disorder most often seen in regions experiencing extreme scarcity of food. It is a form of malnutrition caused by a lack of protein in the diet. These conditions are responsible for a lack of food, which leads to malnutrition. Kwashiorkor is very rare in children in the United States. The World Health Organization (WHO) defines malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions. If kwashiorkor is identified early it can be treated with either specially formulated milk-based feeds or ready-to-use therapeutic food (RUTF). RUTF is typically made up of peanut butter, milk powder, sugar, vegetable oil, and added vitamins and minerals. More intensive treatment in hospital will be needed in severe cases or where there are already complications, such as infections. Hospital treatment will usually involve: Treating or preventing low blood glucose. Keeping the person warm – kwashiorkor can make it harder to generate body heat. Treating dehydration with specially formulated rehydration solution. Treating infections with antibiotics – kwashiorkor greatly increases the risk of infections. Treating vitamin and mineral deficiencies – vitamin supplements are usually included in the special milks or RUTF.

KEYWORDS: Protein Deficiency, Malnutrition, Kwashiorkor, Therapeutic Foods.

KWASHIORKOR

Kwashiorkor, also known as “edematous malnutrition” is a nutritional disorder most often seen in regions experiencing extreme scarcity of food. It is a form of malnutrition caused by a
lack of protein in the diet. People who have kwashiorkor typically have an extremely emaciated appearance in all body parts except their ankles, feet, and belly, which swell with fluid.\textsuperscript{[1]} This disease is more common in very poor countries. It often occurs during a drought or other natural disaster, or during political unrest. These conditions are responsible for a lack of food, which leads to malnutrition. Kwashiorkor is very rare in children in the United States. There are only isolated cases. However, one government estimate suggests that as many as 50\% of elderly people in nursing homes in the United States do not get enough protein in their diet. When kwashiorkor does occur in the United States, it is most often a sign of child abuse and severe neglect.\textsuperscript{[2]} The World Health Organization (WHO) defines malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions."\textsuperscript{[3]}

\textbf{SYMPTOMS}

The symptoms of kwashiorkor include:

1) Change in skin and hair color (to a rust color) and texture
2) Fatigue
3) Diarrhea
4) Loss of muscle mass
5) Failure to grow or gain weight
6) Edema (swelling) of the ankles, feet, and belly
7) Damaged immune system, which can lead to more frequent and severe infections
8) Irritability
9) Flaky rash
10) Shock
PATHOPHYSIOLOGY

The unifying pathophysiologic concept of kwashiorkor is that cell membranes are damaged throughout the body. This damage results in the egress of potassium and water from cells and dysfunction of most major organ systems. It is not a condition of water retention but one where intracellular water moves to the extracellular space, resulting in edema. There is a profound reduction in whole body potassium to about 35mmol/kg (44mmol/kg is normal). This corresponds to the loss of intracellular potassium. Profound, life-threatening hypokalemia, and hypophosphatemia are observed in severe cases. Though hyponatremia occurs, total body sodium is elevated. Cardiac output is diminished on average by 30% in kwashiorkor and renal fractional sodium excretion reduced by up to 70%. Moderate anemia (Hb 8 to 10 g/dL) is seen in most cases, but plasma-free iron is elevated. Fat accumulates in the intracellular space of the liver, which is the result of a decreased ability to transport and metabolically process fat. The villi of the small bowel and white matter of the brain usually show some degree of atrophy.\textsuperscript{[4]}

ETIOLOGY

Kwashiorkor is most common in areas where there is:

1) Famine
2) Limited food supply
3) Low levels of education (when people do not understand how to eat a proper diet)

This disease is more common in very poor countries. It often occurs during a drought or other natural disaster, or during political unrest. These conditions are responsible for a lack of food, which leads to malnutrition.
Kwashiorkor is very rare in children in the United States. There are only isolated cases. However, one government estimate suggests that as many as 50% of elderly people in nursing homes in the United States do not get enough protein in their diet. When kwashiorkor does occur in the United States, it is usually a sign of child abuse and severe neglect.

**DIAGNOSIS**

The physical examination may show an enlarged liver (hepatomegaly) and general swelling. Tests may include:

1. Arterial blood gas
2. BUN
3. Complete blood count (CBC)
4. Creatinine clearance
5. Serum creatinine
6. Serum potassium
7. Total protein levels
8. Urinalysis

**TREATMENT**

If kwashiorkor is identified early it can be treated with either specially formulated milk-based feeds or ready-to-use therapeutic food (RUTF). RUTF is typically made up of peanut butter, milk powder, sugar, vegetable oil, and added vitamins and minerals. More intensive treatment in hospital will be needed in severe cases or where there are already complications, such as infections. Hospital treatment will usually involve: Treating or preventing low blood glucose. Keeping the person warm – kwashiorkor can make it harder to generate body heat. Treating dehydration with specially formulated rehydration solution.

Treating infections with antibiotics – kwashiorkor greatly increases the risk of infections. Treating vitamin and mineral deficiencies – vitamin supplements are usually included in the special milks or RUTF. Slowly introducing small amounts of food before gradually increasing the amount of food. The whole process usually takes between two and six weeks to complete. How well a person recovers from kwashiorkor depends on how severe their symptoms were when treatment began. If treatment was started early, the person will usually recover well, although children may never reach their full growth potential and be shorter than their peers. If treatment was started in the later stages of protein malnutrition, the person
may be left with physical and intellectual disabilities. If kwashiorkor isn't treated or treatment is significantly delayed, it can lead to death.[6]

Kwashiorkor treatment involves both medical treatment and dietary therapy. It is treated just like any other forms of severe protein energy malnutrition. The treatment is done in 3 phases and involves timelines that should be followed correctly.

**TREATMENT PHASES**

**STABILIZATION PHASE**
This is the initial treatment phase that is done within the first 7 days of admission and involves treating the conditions that may easily cause death (life threatening conditions) or complications.

**REHABILITATION PHASE**
This is started from the second week to the sixth week. It involves proper investigations to know the cause of the Kwashiorkor and appropriate treatment.

**FOLLOW UP PHASE**
This starts from week 6 to the 6th month. It involves serial weight measurements during visits to ensure appropriate weight gain.

**STABILIZATION PHASE**
This involves correction of life threatening conditions such as hypoglycemia, dehydration and hypothermia in the 1st and 2nd day of admission.

**CORRECTION OF HYPOGLYCEMIA IN KWASHIORKOR**
Low glucose level in the blood is a frequent cause of death and re-feeding of the child should be commenced and continued subsequently every 2-3 hours. If feeding is not possible, then 50ml of 10% dextrose should be given orally or by use of nasogastric tube (NG Tube). If the child is unconscious or critically ill, then intravenous glucose solution should be given.

**CORRECTION OF HYPOTHERMIA**
Children with Kwashiorkor cannot regulate their body temperature and this becomes worse in the mornings when the environmental temperature is very low. This can be corrected by wearing of warm clothes and the mother can practice kangaroo mother care by holding the child such that her skin and that of the child comes in contact while being covered.
Persistent low body temperature even with the above methods may point to septic shock and other symptoms of shock should be assessed and treated appropriately of which plasma or blood transfusion may be required with antibiotics.

**CORRECTION OF DEHYDRATION IN KWASHIORKOR**

Accurately assessing the level of dehydration in severe forms of protein energy malnutrition can be difficult and is safer to assume there is some level of dehydration. Rehydration should be commenced immediately orally or by use of NG Tube except in cases where the patient is critically ill or unconscious, then intravenous rehydration can be used. Rehydration is corrected in Kwashiorkor and any other form of protein energy malnutrition using a special Rehydration Solution for Malnutrition (ReSoMal) because of its low sodium content, the WHO ORS should be avoided. For severely dehydrated patients or those who presented with septic shock, rehydration should be done with half-strength Darrow’s solution with 5% dextrose or Ringer’s lactate with 5% dextrose or 0.45% normal saline in 5% dextrose.

**CORRECTION OF ELECTROLYTES DISORDERS AND MINERAL DEFICIENCIES**

In Kwashiorkor, there is low potassium, magnesium, copper and zinc in the blood. This can be treated using ReSoMal. Iron therapy should be started when infections have been treated. Vitamin supplements can be given in the form of multivitamin preparations.

**TREATMENT OF INFECTIONS**

Common infections associated with Kwashiorkor include measles, malaria, skin infections, urinary tract infections, respiratory tract infections and septicemia. These infections present atypically and may be difficult to diagnose clinically, hence broad-spectrum antibiotic should be used.

**REHABILITATION PHASE**

The rehabilitation phase requires continued treatment by taking detailed medical history of the condition and appropriate examination to find the cause of the Kwashiorkor. It also involves treatment of any associated conditions such as anemia, xerophthalmia, congestive cardiac failure and dermatosis. The dermatosis (skin lesion) in Kwashiorkor can be treated by zinc supplements or topical application of 0.01% potassium permanganate. Castor oil or zinc ointment can be applied.
FOLLOW UP PHASE
Follow up should be carried out to ensure appropriate weight gain by serial weight measurements.

COMPLICATIONS OF KWASHIORKOR
Severe Infections such as Bronchopneumonia and gastrointestinal tract infections Electrolyte imbalances such as low calcium in blood (hypocalcaemia) and low phosphate (hypophosphatemia) Mental retardation: this occurs during periods of brain development. Growth retardation. Blindness as a result of vitamin A deficiency. Heart failure: not common but may occur as a result of anemia or low potassium (hypokalemia), Low immunity, Coma, Death, Differential diagnosis of Kwashiorkor, Pellagra, Scurvy, Acrodermitis entropathica, Dermatitis herpiformis.

PREVENTION OF KWASHIORKOR
The World Health Organisation (WHO) provided a priority programme known as GOBIF which stands for:
- Growth monitoring for easy detection of failure to thrive
- Oral rehydration therapy for treatment of diarrhea
- Exclusive Breastfeeding
- Immunization to prevent infections
- Family planning[7]

MANAGEMENT APPROACH
Once a provisional diagnosis of kwashiorkor is made, the condition can be categorised as complicated (requiring facility-based care) or uncomplicated (amenable to outpatient therapy). A child's clinical presentation is the primary determinant of the decision, but resources available in the treatment setting must also be considered. The decision to offer hospital care is based on clinical judgement and expert opinion. Treatment should be based on a standardised protocol as the clinical complications of, and electrolyte status in, kwashiorkor are difficult to identify clinically or via laboratory investigation.

To help categorise a child's condition as complicated or uncomplicated, a 30-g test dose of therapeutic food may be given; if the child shows an appetite, he/she is a good candidate for home-based therapy. The child's mental status is also a key factor; marked lethargy or
decreased consciousness requires initial facility-based care. Children with concomitant infection or underlying illness will usually need facility-based care.

Typically, 5% to 30% of children need facility-based care, but for most children, home-based management is associated with equal or superior outcomes compared with hospital care. The WHO, UNICEF, and the World Food Programme published a statement advocating home-based therapy over hospital care, where over-crowding causes frequent spread of infection.

The goals of therapy are treating concomitant infections, resolving oedema, and raising the child's weight for height $z$-score to a level $> -2$. The $z$-score is defined as the deviation of the value from the median of the reference population, divided by the standard deviation of the reference population. Oedema usually resolves within 7 to 10 days, and often within 48 hours.

OPTIMISING NUTRITION IN UNCOMPLICATED KWASHIORKOR
A child with uncomplicated kwashiorkor can be treated at home with ready-to-use therapeutic food (RUTF). This paste-like therapeutic food is nutritionally equivalent to traditional milk-based diets and contains ample micro-nutrients for catch-up growth and replenishment of body stores, when given at 175 kcal/kg/day. The child should receive a supply of RUTF upon enrolment, and should return for follow-up at regular intervals (every 1-2 weeks) for his/her progress to be assessed and to receive subsequent supplies of therapeutic food.

Dietary therapy ceases when oedema has resolved for at least 10 days, and anthropometry and clinical assessment indicates a recovery to $> -2$ standard deviations below the mean weight for height. This is typically between 4 and 8 weeks after diagnosis. Food security should be ensured for the immediate post-discharge period, as recurrence is well recognised if the child returns to the same environment. In the absence of a programme that can offer RUTF, patients are treated as for complicated malnutrition, usually with F-75 and F-100 formula feeds, or locally made equivalents, until nutritional discharge criteria are met.

OPTIMISING NUTRITION IN COMPLICATED KWASHIORKOR
A child with kwashiorkor in an immediately life-threatening condition should be stabilised in an inpatient facility. Hospital care involves feeding small amounts of a milk-based liquid food every 2 to 3 hours, with an initial recommended daily intake of 100 kcal/kg/day. Once the child's condition has stabilized and appetite has returned, the child is best managed in the
same way as a child with uncomplicated malnutrition and treated with home-based dietary therapy. Typically appetite returns slowly, and regulation of a child's dietary intake as the appetite returns is not necessary as long as the child consumes a minimum 100 kcal/kg/day.

MANAGEMENT OF ACUTE COMPLICATIONS

SEPSIS

All children with uncomplicated severe acute malnutrition should be treated with a broad-spectrum oral antibiotic, as sepsis, probably from bacterial translocation, is underappreciated. This recommendation is based on a large randomised, double-blind clinical trial conducted in rural Africa. Amoxicillin or cefdinir have been shown to be effective, and it is likely that other agents may also be effective. Sepsis occurs in 15% to 60% of children with complicated severe malnutrition, and it is standard practice to administer broad-spectrum parenteral antibiotics. If specific infections are identified, specific treatment can be added. If blood cultures indicate resistance to the current treatment, targeted therapy can be given.

MICRONUTRIENT DEFICIENCIES

Vitamin A (retinol) is given orally if there are any signs of xerophthalmia. If the therapeutic diet is not micronutrient fortified then multi-vitamin supplements are given for 2 weeks. Iron is only given when the child has an appetite and oedema has resolved.

SHOCK

Severely malnourished children should be monitored carefully for shock. It may result from cardiac failure, compromised capillary integrity, or, less commonly, fluid losses. Determining shock aetiology will guide treatment and influence outcome. Supplemental oxygen is given when possible. Often, clinicians are concerned that severely malnourished children have hypovolaemic shock from intravascular fluid depletion, because these children take oral fluids poorly, may have a few loose stools daily, and may have altered mental status.

However, these symptoms may be seen in shock of any aetiology. Hypovolaemic shock is more likely if there are 6 stools a day or large volumes of watery stool. Intravenous fluid infusions are rarely given to severely malnourished children. This treatment has been identified as a risk factor for death, even after controlling for the severity of the illness. Standard management recommendations direct that isotonic parenteral fluids should only be given in cases of profuse watery diarrhoea and when the clinician is firmly convinced by
clinical observation that shock is present. Recommencement of oral fluids and feeds as soon as tolerated is recommended.

In the case of confirmed shock, resuscitation with IV fluids should be done cautiously (10-15 mL/kg/hour), assessing for response (reduced heat rate, reduced respiratory rate, improved capillary refill) or over-hydration (increasing heart rate, enlarging liver, increasing respiratory rate). After 2 hours the child should be re-assessed, and if there is an improvement, oral rehydration should be continued in quantities estimated to replace fluid losses, in addition to F-75 therapeutic milk. The standard oral rehydration recommended by WHO, with 70 mmol/L of sodium, is inappropriate because it increases the risk of heart failure, as there is sodium retention, and a renal inability to concentrate and excrete a sodium load, and the heart muscle is thin and atrophied in severely malnourished children. The child should be considered for volume replacement with colloid solution or blood if not responding and not over-hydrated, as non-response may represent septic shock.

DEHYDRATION
This is overestimated and over-diagnosed in malnourished children. However, for children with continual diarrhoea, Rehydration Solution for Malnutrition (ReSoMal) is advised but only to replace estimated losses through vomiting or diarrhoea. It can be given either orally or via a nasogastric tube. WHO oral rehydration salts are too high in sodium and too low in potassium to be given.

Successful treatment will decrease a rapid pulse rate and the child will begin to pass urine. Tears and moisture in the mouth and eyes should return, but many severely malnourished children will not show these signs even when hydrated. Over-hydration is indicated by a raised pulse rate (increase of 25 beats/minute or more) and respiratory rate (increase of 5 breaths/minute or more). Rehydration therapy can be stopped when 3 or more of the following signs occur: child is no longer thirsty, is passing urine, is less lethargic, slowing of respiratory or pulse rates, skin pinch less slow to return, tears, moist eyes, moist mouth. Management of diarrhoea using a standardised oral rehydration protocol has been associated with a reduction in mortality.

HYPOGLYCAEMIA
This is diagnosed as a blood glucose <3 mmol/L (<54 mg/dL). To treat hypoglycaemia in a conscious child, a bolus feed of glucose or sucrose solution can be given. For an unconscious
or convulsing child, 10% glucose, dextrose, or sucrose solution can be given intravenously or via a nasogastric tube. This is followed by a quarter amount of the 2-hourly feed every 30 minutes for the first 2 hours, continued until the blood glucose reaches 3 mmol/L. Repeat blood glucose testing with finger/heel prick of blood is advised after 2 hours. Most children stabilise in 30 minutes, when 2-hourly feeds can be commenced. If unsuccessful, or if rectal temperature falls to <35.5°C (96°F) or level of consciousness deteriorates, treatment can be repeated.

**ELECTROLYTE IMBALANCE**

This is characteristic, though may not be reflected in serum biochemistry. Food should be prepared without salt, and additional F-75 rehydration fluid is recommended initially and ReSoMal if necessary. Phosphate- and potassium-rich diets are recommended.

**HYPOTHERMIA**

To prevent hypothermia, the child is kept dry, wrapped in blankets, and close to the mother's body. If the rectal temperature is <35.5°C (96°F), immediate feeding is advised while maintaining warmth and keeping close to the mother.

**DERMATOSIS**

If the nappy area is affected by dermatosis, it is best left uncovered. If dermatosis affects other areas, zinc oxide ointment or paraffin gauze dressings can help with analgesia and prevent infection. Affected areas should be bathed in 0.01% potassium permanganate for 10 minutes on a daily basis to help prevent infection, although antibiotics are also given.

**ANAEMIA**

Malnourished children often have a low haemoglobin, typically 80 to 100 g/L (8 to 10 g/dL). When in shock, malnourished children look pale; this may prompt the clinician to consider whether anaemia is the cause of their haemodynamic response.

Typically, anaemia does not compromise oxygen delivery to the tissues, and blood transfusions have been identified as a risk factor for heart failure. The WHO recommends giving blood transfusions only if haemoglobin is <40 g/L (4 g/dL) or there is cardiac failure secondary to anaemia. Oral iron is associated with poorer outcome, and should not be administered in the initial phase of treatment.
RESISTANT PATIENTS OR COMORBID INFECTIONS
If oedema fails to respond within 5 to 7 days and diarrhoea continues, the WHO recommends the addition of metronidazole, especially if Giardia is identified in the stool. TB should be considered; family history, CXR, and TB skin testing are helpful although not always positive even in the presence of TB, particularly if there is also HIV infection. If exposed to or infected with HIV, trimethoprim/sulfamethoxazole is commenced and continued long term.\[8\]

CONCLUSION
Kwashiorkor, also known as “edematous malnutrition” is a nutritional disorder most often seen in regions experiencing extreme scarcity of food. It is a form of malnutrition caused by a lack of protein in the diet. If kwashiorkor is identified early it can be treated with either specially formulated milk-based feeds or ready-to-use therapeutic food (RUTF). RUTF is typically made up of peanut butter, milk powder, sugar, vegetable oil, and added vitamins and minerals. More intensive treatment in hospital will be needed in severe cases or where there are already complications, such as infections. Treating or preventing low blood glucose. Keeping the person warm – kwashiorkor can make it harder to generate body heat. Treating dehydration with specially formulated rehydration solution. Treating infections with antibiotics – kwashiorkor greatly increases the risk of infections. Treating vitamin and mineral deficiencies – vitamin supplements are usually included in the special milks or RUTF.

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