

Refeeding Syndrome: To Feed or Not To Feed?

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Objectives

- Define refeeding syndrome and identify patients at risk
- Identify risk factors, signs and symptoms and lab alterations that characterize refeeding syndrome
- Implement safe feeding advancement practices for pediatric patients with or at risk for refeeding syndrome

Refeeding Syndrome

Definition

- Potential life-threatening metabolic condition in which there are severe shifts in electrolytes and fluid in malnourished patients who are undergoing aggressive refeeding whether orally, enterally or parenterally.
- The hallmark biochemical feature is hypophosphatemia.
- Refeeding syndrome also commonly causes hypomagnesemia and hypokalemia, thiamine deficiency, sodium and fluid imbalances and alteration in glucose.

Refeeding Syndrome

Metabolism

- During starvation, the body switches from carbohydrates to fat and protein as the main source of energy. Intracellular minerals become depleted yet serum concentrations may remain normal. This happens because the intracellular compartment contracts during starvation.
- Once fed, during anabolism, the body switches back to carbohydrates as the main source of energy and there is a surge of insulin when glucose enters the blood. Insulin stimulates the absorption of phosphorus, potassium, magnesium and water into the cell. This process decreases serum levels of these minerals which are already depleted. Sodium and water retention can occur due to decreased renal excretion and cause extracellular fluid overload. Edema can also occur due to low serum albumin levels decreasing oncotic pressure.

Symptoms of Refeeding

Hypophosphatemia	Hypokalemia	Hypomagnesemia	Vitamin/Thiamine Deficiency	Sodium Retention
Impaired oxygen transport and delivery, hypoxia Impaired cardiac function Impaired diaphragm contractility Respiratory failure Paresthesias Weakness Lethargy Somnolence Confusion Disorientation Restlessness Encephalopathy Areflexic paralysis Seizures Coma Death	Nausea Vomiting Constipation Weakness Paralysis Respiratory compromise Rhabdomyolysis Muscle necrosis Alterations in myocardial contraction Electrocardiograph changes ST-segment depression T-wave flattening T-wave inversion Presence of U-waves Cardiac arrhythmias Atrial tachycardia Bradycardia Atrioventricular block Premature ventricular contractions Ventricular tachycardia Ventricular fibrillation Sudden death	Weakness Muscle twitching Tremor Altered mental status Anorexia Nausea Vomiting Diarrhea Refractory hypokalemia and hypocalcemia Electrocardiograph changes Prolonged PR Widened QRS Prolonged QT ST depression Peaked T-wave T-wave flattening Cardiac arrhythmias Atrial fibrillation Torsade de pointes Ventricular arrhythmias Ventricular tachycardia Tetany Convulsions Seizures Coma Death	Encephalopathy (eg, Wernicke-Korsakoff encephalopathy) Lactic acidosis Death	Fluid overload Pulmonary edema Cardiac decompensation

Refeeding Syndrome

Who's at risk?

- $\geq 10\%$ wt loss in 1-2 months
- Underfeeding or fasting for 7-14 days
- Protein calorie malnutrition
- Medical neglect/Social issues
- Diagnoses at higher risk
 - FTT
 - Anorexia Nervosa
 - Oncology
 - Malabsorptive syndromes and GI diseases
 - Uncontrolled DM

Beginning Nutrition Support

- Identify who is at risk for refeeding syndrome.
- The goal is prevention of refeeding syndrome. This can be achieved with cautious nutrition management and continuous communication with the medical team. If you feel someone is at high risk for refeeding, call the medical team immediately and voice your concerns.

Nutrition Support

- Obtain baseline electrolytes, Mg and Phos and begin replacing any abnormal findings. Re-check labs Q 8-12 hrs. I've started Phos supplements before labs are low if trending down to prevent playing catch up.
- Most patients are started on IVF. Some of our severely malnourished patients will begin to refeed from the small amount of dextrose in IVF. Calculate the kcals received from IVF and take this into consideration when advancing nutrition support.

Nutrition Support

Prevention/Nutrition Therapy

- Depending on the degree of malnutrition, there could be many vitamin deficiencies. One of the key vitamin supplements to start immediately is thiamine due its role in carbohydrate metabolism and increased utilization during refeeding.
- Thiamine dose:
 - Children: 10-25 mg/d IM or IV or 10-50 mg/d PO for 14 days
 - Adults: 5-30 mg 3x/d IM or IV for 14 days, then 5-30 mg/d PO x 1 month
- In addition to Thiamine, begin a multivitamin to begin replacing any other potential deficiencies.

Nutrition Support

Starting nutrition support:

- Assess if the GI tract is functioning to determine if nutrition support will be provided enterally or parenterally. Enteral nutrition is always the preferred delivery route.
- Starting nutrition support varies from patient to patient. Obtain a feeding history from the patient or caregiver to estimate caloric intake at home.
- Remember carbohydrates or glucose is the macronutrient that needs to be re-introduced cautiously. Protein and fat can be started at goal.

Nutrition Support

Starting nutrition support:

- Initial kcals can be started at no more than 50% of estimated energy goal but high risk patients need to be started lower than this. Some severely malnourished patients are started at ~50% of BMR and have changes in their electrolytes. Depending on lab trends, kcal delivery is held here for ~1 day.
- Once nutrition support is started, if Phos, Mg and K drop, replace these micronutrients asap and prn.
- On day 2 of nutrition support, advance kcal delivery by 10-20%.
- Continue to advance by 10-20% daily as tolerated until goal volume is reached.

Nutrition Support

Starting nutrition support:

- You do not need to hold feeding advancement until lytes are WNL
- It is appropriate to advance feeds if electrolyte abnormalities are actively being treated
- Holding feeding advancement would delay achieving goal feeding volume and optimal nutrition. It would also potentially increase length of hospital stay.

Labs

Common labs to monitor in a malnourished patient:

- Trend lytes, Mg and Phos at least Q 12 hrs until labs are WNL and stable to prevent/monitor/treat refeeding syndrome
- Check a CBC, once hydrated, to assess for anemia
- Typical micronutrient labs - these are not urgent but should be assessed and treated if abnormal.
 - Vit D 25OH
 - Zinc
 - Iron studies if CBC shows microcytic anemia
 - Vit B12 and folate if CBC shows macrocytic anemia
 - If malabsorption is suspected, check Vit A and Vit E

Electrolyte Management

Phosphorus:

- Can be replaced either IV or EN or both.
- Neutra-Phos is typically used if the GI tract is functioning.
 - Contains: Phosphorus 8 mmol, Sodium 7.125 mEq, Potassium 7.125 mEq per packet
- NaPhos or KPhos is used to replete if given IV.
 - NaPhos contains: Phosphorus 3 mmol, Sodium 4 mEq per mL
 - KPhos contains: Phosphorus 3 mmol, Potassium 4.4 mEq per mL

Electrolyte Management

Phosphorus:

- Severe hypophosphatemia - requires IV replacement
 - Children:
 - If serum Phos level 0.5-1 mg/dL: 0.16-0.32 mmol/kg/dose over 4-6 hours
 - If serum Phos level <0.5 mg/dL: 0.36 mmol/kg/dose over 6 hours
 - Adults: If serum Phos level <2 mg/dL: 15 mmol/dose over 2 hour
- Repletion (IV doses should be added into the IV fluids if possible):
 - Children:
 - PO: 2-3 mmol/kg/day in divided doses; Neutra-Phos 1-2 packet 1-4x/d
 - IV: 0.5-1.5 mmol/kg/day. May be higher if added to PN for optimal Ca:Phos ratio
 - Adults:
 - PO: 50-150 mmol/day in divided doses; Neutra-Phos 1-2 packet 1-4x/d
 - IV: 50-70 mmol/24 hours

Electrolyte Management

Potassium:

- Can be replaced either IV or EN or both.
- IV replacement rate and dose will depend on type of access.
- KCl and/or Neutra-Phos can be used if the GI tract is functioning.
 - KCl: check with pharmacy to see what form is used
 - Neutra-Phos contains: Phosphorus 8 mmol, Sodium 7.125 mEq, Potassium 7.125 mEq per packet
- KCl or KPhos is used to replete if given IV.
 - KCl contains: 10 mEq/100 mL; 20 mEq/50 mL
 - KPhos contains: Phosphorus 3 mmol, Potassium 4.4 mEq per mL

Electrolyte Management

Potassium:

- Severe hypokalemia- requires IV replacement
 - Children: 0.5-1 mEq/kg/dose
 - Adults: 10-20 mEq/hour
- Repletion (IV doses should be added into the IV fluids if possible):
 - Neonates/Infants: 2-6 mEq/kg/day divided every 4-6 hours; maximum dose: 1 mEq/kg
 - Children: 2-5 mEq/kg/day in 2-4 divided doses; maximum dose: 1 mEq/kg/dose up to 40 mEq
 - Adults: 40-100 mEq/day in 2-4 divided doses

Electrolyte Management

Magnesium:

- Can be replaced either IV or EN or both.
- MgSulfate is commonly used for repletion. However, there are other forms of Mg supplementation.
- MgSulfate 1 g = 8.1 mEq Mg = 98.6 mg elemental magnesium

Electrolyte Management

Magnesium: Dose represented as magnesium sulfate

- Children:
 - PO: 100-200 mg/kg/dose, 4 times/day
 - IV: 25-50 mg/kg/dose every 4-6 hours for 3-4 doses; may repeat if hypomagnesemia persists
- Adults:
 - PO: 3 g every 6 hours for 4 doses as needed
 - IV: 1 g every 6 hours for 4 doses

Anthropometric Monitoring

Weights:

- Infants - daily, naked wts using the scale, same time of day and before a feed
- Toddlers - weigh Q other day, same time, same scale, prior to a feed
- Adolescents - weigh 2-3x/wk
- During the initial stages of refeeding, there is typically an increase in weight followed by weight loss. This is due to fluid. Actual weight gain is seen after diuresis and full kcal delivery is achieved for a few days. This is usually during the second week of admission.

Psychosocial

Common questions to ask caregivers to assess potential refeeding risk:

- How much and often does your child eat? Feeding schedule? Nighttime feeds? Does your child finish the entire feed?
- How do you mix formula? Do you add the water first and then the powder?
- How do you get formula? WIC? Purchase?
- How many cans of formula do you use in a month?
- Tolerance? Emesis? Output?

Some patients are started on their reported home feeds and we don't expect them to refeed but their Phos, K and Mg begin to drop:

- Most of the time the feeds can be decreased by 50% or more
- Begin electrolyte replacement and ensure follow up labs are ordered
- Begin thiamine replacement
- Advance feeds by 10-20%

References

Mehanna, Hisham M., Jamil Moledina, and Jane Travis. "Refeeding syndrome: what it is, and how to prevent and treat it." *BMJ* 336.7659 (2008): 1495-1498.

Hisham Mehanna, Paul C Nankivell, Jamil Moledina, Jane Travis. "Refeeding syndrome - awareness, prevention and management." *Head Neck Oncol.* 2009; 1: 4.

Dunn, Rebecca L., Nicolas Stettler, and Maria R. Mascarenhas. "Refeeding syndrome in hospitalized pediatric patients." *Nutrition in clinical practice* 18.4 (2003): 327-332.

Stanga, Z., et al. "Nutrition in clinical practice—the refeeding syndrome: illustrative cases and guidelines for prevention and treatment." *European Journal of Clinical Nutrition* 62.6 (2008): 687-694.

Kraft, Michael D., Imad F. Btaiche, and Gordon S. Sacks. "Review of the refeeding syndrome." *Nutrition in Clinical Practice* 20.6 (2005): 625-633.

Gretchen J. Homan MD, *Am Fam Physician.* 2016 Aug 15;94(4):295-299.