Refeeding Syndrome: To Feed or Not To Feed?

Mayumi Nakamura, MPH, RD, CNSC, CSP
Lauren Okamura, RD, CNSC
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

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

| | Convulsions | | |
| | Seizures | | |
| | Coma | | |
| | Death | | |
Refeeding Syndrome

Who’s at risk?

• >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.
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.
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 labs 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%


