Starvation and Refeeding in Eating Disorder Patients

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Starvation and Refeeding

- Starvation - severe deficiency in caloric energy, nutrients, and vitamin intake
- an imbalance between energy intake and expenditure >> loss of fat and muscle mass
- common causes - Anorexia nervosa, Bulimia nervosa, major depression, poverty, (famine) digestive diseases, fasting

Starvation and Refeeding

- Early Symptoms - irritability, impulsivity, hyperactivity
- Decreased perception of hunger
- Decreased sense of thirst
- Later - fatigue, apathy, decreased resistance to disease, pain, menstrual irregularities
- Death - fat reserves are exhausted, protein as fuel source >> tissue degradation/electrolyte imbalance >> cardiac arrhythmia or arrest

Starvation and Refeeding

- Refeeding Syndrome
  A syndrome consisting of metabolic disturbances that occur as a result of reinstitution of nutrition to patients who starved for 5 consecutive days or more. Usually occurs within 4 days of starting to feed. Most commonly in those rapid weight loss.

Starvation and Refeeding

- Human Starvation Response
  - Glucose - main metabolic fuel, from dietary sugars and carbohydrates
    - 25% consumed by the brain
  - Glycogen Reserves - glucose from glycogen breakdown stored in the liver and muscles
  - Fat Breakdown - from adipose tissue glycogen and free fatty acids
    - glycerol used in the liver for gluconeogenesis
    - fatty acids-energy for body tissues other than the brain, which uses ketone bodies
  - Protein Breakdown - amino acids released into the blood stream, converted to glucose by the liver results in wasting away of muscle mass

Starvation and Refeeding

- Minnesota Starvation Experiment
- Journal of Adolescent Health Original Article
- Review of recent in-patients
Starvation and Refeeding

• Refeeding Syndrome
  Electrolyte disorders, especially hypophosphatemia occurs.
  Insulin secretion resumes in response to increased glycemia.
  Increased glycogen, fat and protein synthesis.
  Depletes already low stores of phosphate, magnesium, potassium.

Starvation and Refeeding

• Refeeding Syndrome
  Depleted intracellular ATP and 2,3-diphosphoglycerate in RBC's, leads to cellular dysfunction and inadequate O2 delivery to the body organs.
  Intracellular shifts of electrolytes occur, fall in serum K+, Mg, and Phosphate.
  Glucose and Thiamine may fall.

Starvation and Refeeding

• Refeeding Syndrome
  Cardiac workload and heart rate is increased can lead to acute heart failure.
  Cardiac arrhythmias are the most common cause of death.
  Other risks include, confusion, coma, and convulsions.

Starvation and Refeeding

• Minnesota Starvation Experiment
  Ancel Keys, University of Minnesota, 1944
  Why? To gain insight into the physical and psychologic effects of semistarvation and the problem of refeeding civilians who had been starved during World War II
  Who? 36 conscientious war objectors, many from the Historic Peace Churches (Mennonite Brethren, Quaker).

Starvation and Refeeding

• Minnesota Starvation Experiment
  November 1944
  Phase 1: 3 month standardization period
  3200kcal/day
  Walk 22mi/day, daily duties, classes
  February 1945
  Phase 2: 6 month semistarvation period
  1800kcal/day, starvation diet as seen in war torn Europe (potatoes, turnips, dark bread, macaroni, rutabagas)
  August 1945
  Phase 3: 3 month nutritional rehabilitation period
  randomly assigned to 1 of 4 energy intake groups, each level subdivided into 2 protein levels, and each protein level into 2 vitamin levels

• Refeeding Syndrome
  Treatment- traditional goal, refeed slowly, adjust to the degree of malnourishment.
  Monitor fluid replacement, check serum electrolytes, glucose, Mg, and Phosphorous.
  Correct electrolyte and fluid imbalance alongside feeding.
  Monitor cardiac and mental status.
Starvation and Refeeding

- Minnesota Starvation Experiment Tests followed throughout study:
  - Body weight, size, strength, EKGS, bloodwork, metabolic studies
  - Psychomotor and endurance tests
  - Intelligence and personality tests
  - Maintain personal journal

Starvation and Refeeding

- 1. Metabolic rates decreased by 40%
- 2. Food rituals were developed
- 3. Food obsessions, cravings
- 4. Personality changes: irritability, apathy, moodiness, depression
- 5. Exercise manipulation to increase food rations

Starvation and Refeeding

- A Prospective Examination of Weight Gain in Hospitalized Adolescents with Anorexia Nervosa on a Recommended Refeeding Protocol, Andrea K Garber, et al.

Starvation and Refeeding

- Purpose:
  - To examine weight change and clinical outcomes in hospitalized adolescents with Anorexia Nervosa on a recommended refeeding protocol.

Starvation and Refeeding

- Background
  - Weight gain during hospitalization should be maximized.
  - Higher weight at discharge predicts weight restoration at 1 year.
  - Patients with AN are hypometabolic during starvation, hypermetabolic with refeeding.

Starvation and Refeeding

- Background
  - Energy requirements per kilogram in AN are far higher than in normal weight persons.
  - Complex set of factors are responsible for these needs including increased resting energy expenditure, increased thermic effect of feeding and psychological factors.
Starvation and Refeeding

- **Methods**
  - Criteria for admission per SAHM:
    - heart rate <50bpm
    - temperature <36.0 C.
    - orthostasis
  - Age 9-20 years, diagnosis of AN per the DSM 4, total of 35 participants

**Inpatient Refeeding Protocol**
- 3 meals and 3 snacks
- Starting diets around 1200kcal
- Calories advanced 200kcal every other day
- Vitamin and mineral supplements (calcium carbonate, zinc, adult MVI)
- Daily weights, vital signs, strict I's O's
- Lab measures: urine SG, Na, BUN, serum albumin, daily; Phos twice daily

Starvation and Refeeding

- **Results and Discussion**
  - *weight gain* - almost 2.5kg/17 days
  - *80%* significant early weight loss, weight gain not observed until day 8
  - *weight loss during first 3 days was similar to the total fluid lost*
  - *none of the subjects developed refeeding syndrome*
  - *calories went from 1205kcal to 2668kcal at discharge*
  - *higher calories at baseline predicted faster weight gain*

**Rapid Weight Restoration** (Anzai, Hackert)
- Avoid underfeeding
- Use nutrient dense foods
- May need 70-100kcal/kg/day
- Distribute foods over multiple sessions
- Goal of 4-7lbs per week inpatient
- Shorter hospital stay, earlier entry into effective psychotherapy

Starvation and Refeeding

- **Rapid Weight Restoration**
  - Stage 1 - “cognitive awakening”
    - 55%-60% total energy as carbs, fuel for the brain
    - 15% protein, 25%-30% lipids
    - clinically more alert, better thought function, less painful GI function
    - 3-4 days
Starvation and Refeeding

- **Rapid Weight Restoration**

  Stage 3 - “oil the gears”
  
  - Increase in lipid ratio to 30%-35%
  - Individualize protein/carb ratio
  - Combat inflammation during the healing process
  - Omega-3 fatty acids

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Starvation and Refeeding

- **Rapid Weight Restoration**

  Stage 4 - “moving forward”
  
  - 50% carbohydrate, 20% protein, 30% lipids
  - Psychotherapy success increases

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### Starvation and Refeeding

<table>
<thead>
<tr>
<th>Patient/Age</th>
<th>Admit Weight (BMI)</th>
<th>Discharge Weight (BMI)</th>
<th>Calories</th>
<th>Electrolyte problems</th>
<th>Length Of Stay</th>
</tr>
</thead>
<tbody>
<tr>
<td>J.O.</td>
<td>48.5kg (17)</td>
<td>53.3kg (18.5)</td>
<td>1600kcal-3400kcal (part NGT)</td>
<td>No</td>
<td>19 days</td>
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<td>A.C.</td>
<td>47kg (14.8)</td>
<td>53.5kg (16)</td>
<td>1400kcal-2900kcal</td>
<td>No</td>
<td>16 days</td>
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<tr>
<td>S.K.</td>
<td>23.5kg (10.5)</td>
<td>32kg (14.4)</td>
<td>1000kcal-2600kcal (part NGT)</td>
<td>No</td>
<td>40 days</td>
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<tr>
<td>M.O.</td>
<td>44kg (14)</td>
<td>47kg (15)</td>
<td>1400kcal-3000kcal</td>
<td>No</td>
<td>35 days</td>
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