Entry Level Clinical Nutrition Part XVII

Insulin – part II: Carbohydate:protein imbalances and the refeeding syndrome

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60 MINUTES

60 Minutes – Sunday, April 1, 2012

Is sugar toxic?

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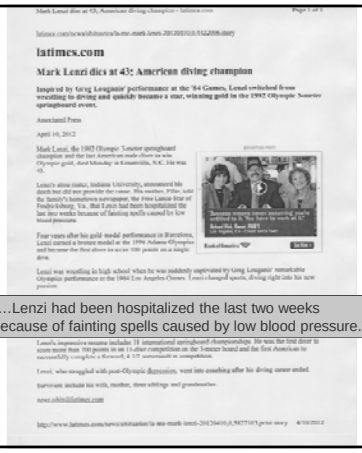

latimes.com

Mark Lenzi dies at 43; American diving champion

Inspired by Greg Louganis' performance at the '84 Games, Lenzi switched from wrestling to diving and quickly became a star, winning gold in the 1992 Olympic 3-meter springboard event.

Associated Press

April 10, 2012

"…Lenzi had been hospitalized the last two weeks because of fainting spells caused by low blood pressure."

3

Tuesday, April 10, 2012

OBITUARIES

James E. Bodmer Jr., engineer, scuba diver

Dead at 50

S. Hadley trainer dies

Dead at 57

"On a personal note, James participated in the Rustman Triathlon in 1989 and 1990. He was an avid scuba diver and photographer and was a past president of the ROI-Namur Dolphin's Club. James also hiked the Appalachian Trail with his father every year."

"'He was a body builder,'" Scammons said. 'He had run marathons. He was just really in good shape. For him to pass so suddenly is really a shock."

John F. McNulty Jr., hard worker

4

For Unsurpassed Absorption

Citracal offers a full line of products to help provide the calcium your body needs

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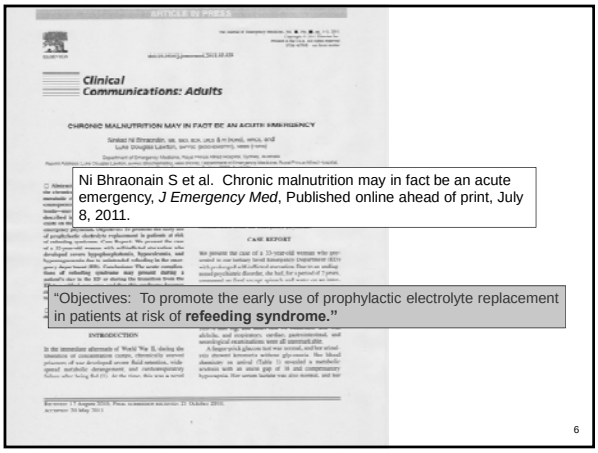

Clinical Communications: Adults

CHRONIC MALNUTRITION MAY IN FACT BE AN ACUTE EMERGENCY

Ni Bhraonain S et al. Chronic malnutrition may in fact be an acute emergency, *J Emergency Med*, Published online ahead of print, July 8, 2011.

"Objectives: To promote the early use of prophylactic electrolyte replacement in patients at risk of **refeeding syndrome."**

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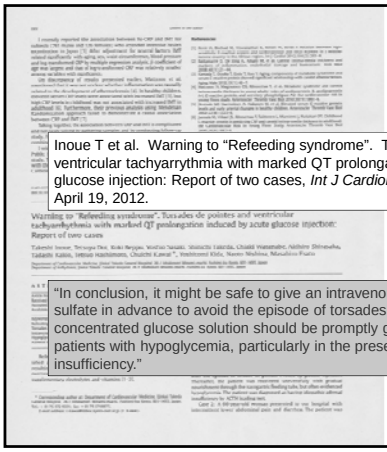

Inoue T et al. Warning to “Refeeding syndrome”. Torsades de pointes and ventricular tachyarrythmia with marked QT prolongation induced by acute glucose injection: Report of two cases, *Int J Cardiol*, Vol. 156, No. 2, pp. 222-4, April 19, 2012.

“In conclusion, it might be safe to give an intravenous infusion of magnesium sulfate in advance to avoid the episode of torsades de pointes when highly concentrated glucose solution should be promptly given intravenously in patients with hypoglycemia, particularly in the presence of adrenal insufficiency.”

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Could classic “carb loading” in certain susceptible athletes be contributing to torsades de pointes?

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Quality of life issues are the major concerns more than ever now.

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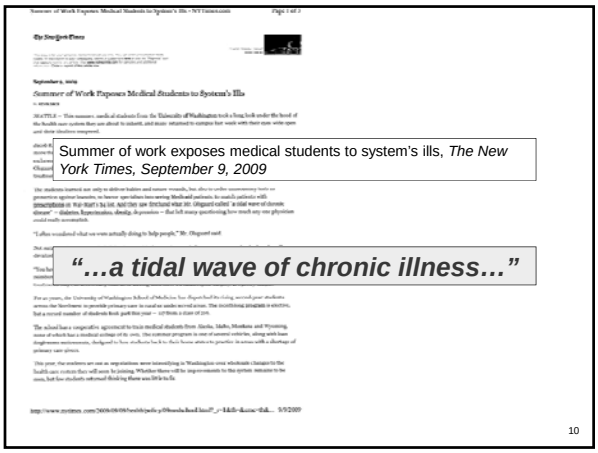
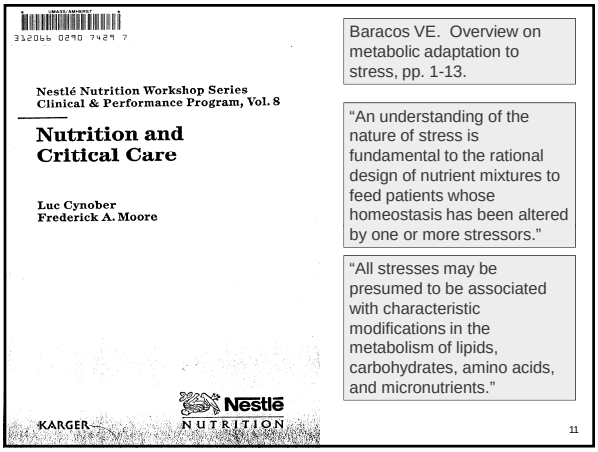


Summer of Work Exposes Medical Students to System's Ills

Summer of work exposes medical students to system's ills, *The New York Times, September 9, 2009*

"…a tidal wave of chronic illness…"

10



Nestlé Nutrition Workshop Series
Clinical & Performance Program, Vol. 8

Nutrition and Critical Care

Luc Cynober
Frederick A. Moore

KARGER

Nestlé NUTRITION

Baracos VE. Overview on metabolic adaptation to stress, pp. 1-13.

"An understanding of the nature of stress is fundamental to the rational design of nutrient mixtures to feed patients whose homeostasis has been altered by one or more stressors."

"All stresses may be presumed to be associated with characteristic modifications in the metabolism of lipids, carbohydrates, amino acids, and micronutrients."

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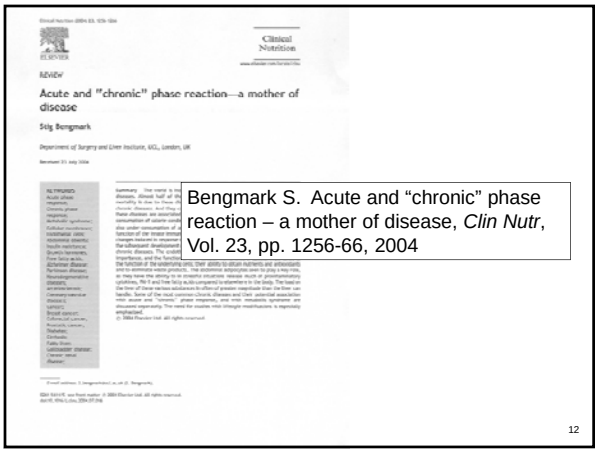


Clinical Nutrition

REVIEW

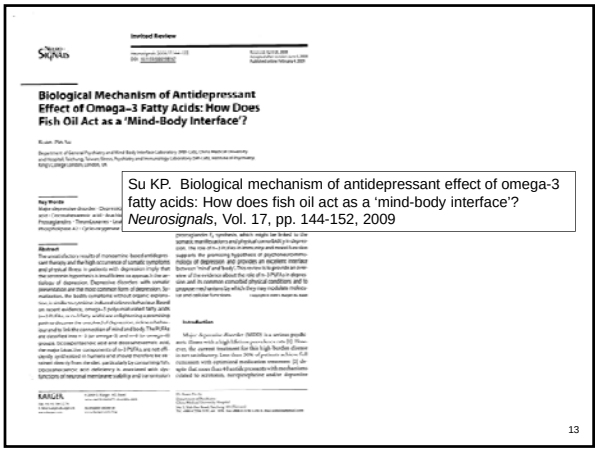
Acute and "chronic" phase reaction—a mother of disease

Stig Bengmark

Department of Surgery and Liver Institute, UCL, London, UK

Bengmark S. Acute and "chronic" phase reaction – a mother of disease, *Clin Nutr*, Vol. 23, pp. 1256-66, 2004

12



Biological Mechanism of Antidepressant Effect of Omega-3 Fatty Acids: How Does Fish Oil Act as a 'Mind-Body Interface'?

Su KP. Biological mechanism of antidepressant effect of omega-3 fatty acids: How does fish oil act as a 'mind-body interface'? *Neurosignals*, Vol. 17, pp. 144-152, 2009

13

Table 1. Overlapping of symptoms of acute sickness behaviour associated with IFN-α therapy and the somatic symptoms in MDD

Symptoms	Prevalence in IFN-α therapy[a], %	Prevalence in MDD[b], %
Fatigue/asthenia	39–90	73
Headache	27–67	33[e]
Gastrointestinal symptoms	50[c, 1]	34–47[f]
Psychomotor slowing	40[c]	59–65[f]
Insomnia	20–39[d]	63
Irritability	35[d]	50
Arthralgia	9–36	31[e]
Musculoskeletal pain	26–32	62–80[g, 2]
Abdominal pain	15–20	21[c]
Anorexia	13–19	40
Anxiety	13–18[d]	57
Poor concentration	14[d]	51

[a] [46], unless otherwise specified; [b] [99], unless otherwise specified; [c] [100]; [d] [101]; [e] [102]; [f] [103], [g] [104].
[1] Nausea, vomiting, bowel problems.
[2] Result from depressed inpatient population.

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Key metabolic imbalances seen with the acute phase response

- Metabolic acidosis
- Loss of lean body mass (sarcopenia)
- Insulin resistance
- Inflamm-aging (Increased innate immunity and decreased adaptive immunity)
- Suboptimal caloric intake and carbohydrate:protein ratio (Refeeding syndrome)
- Gastrointestinal dysfunction/gut atrophy
- Deficiencies of key micronutrients such as zinc, selenium, and vitamin D

15

Underlying hypotheses of Entry Level Clinical Nutrition:

- Chief complaints in chronically ill patients are not diseases but responses that have gone on too long (Allostatic load).
- The metabolic imbalances that combine to form this response have been well defined by critical care nutritionists.

16

Entry Level Clinical Nutrition:

A new model of functional medicine that incorporates allostatic load and the “chronic” acute phase response

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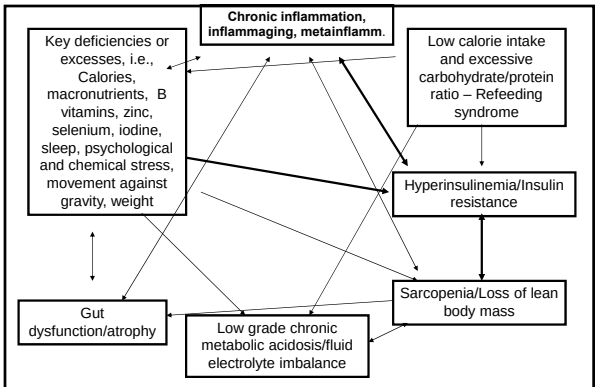

THE CREATION OF THE EXCESSIVE CATABOLIC PHYSIOLOGY “RESPONSE”

18

Is reactive hypoglycemia a mild form of refeeding syndrome?

19

What is reactive hypoglycemia?

20

According to Maria Collazo-Clavel, MD from the Mayo Clinic Website

- **"Reactive hypoglycemia (or alimentary hypoglycemia) is low blood sugar that occurs after a meal — usually one to three hours after eating."**
- **"Low blood sugar (hypoglycemia) usually occurs while fasting."**
- **"Signs and symptoms of reactive hypoglycemia may include hunger, weakness, shakiness, sleepiness, lightheadedness, anxiety and confusion."**

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Dr. Collazo-Cavell's recommendations

- **"Avoid or limit sugary foods, especially on an empty stomach."**
- **"Be sure to eat food if you're consuming alcohol and avoid using sugary soft drinks as mixers."**

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Refeeding syndrome

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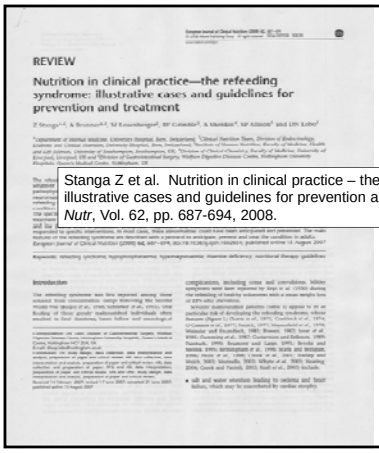

REVIEW

Nutrition in clinical practice—the refeeding syndrome: illustrative cases and guidelines for prevention and treatment

Stanga Z et al. Nutrition in clinical practice – the refeeding syndrome: illustrative cases and guidelines for prevention and treatment, *Eur J Clin Nutr*, Vol. 62, pp. 687-694, 2008.

24

- “The refeeding syndrome was first reported among those released from concentration camps following the Second World War.”
- “Oral feeding of these grossly malnourished individuals often resulted in fatal diarrhea, heart failure and neurological complications, including coma and convulsions.”
- “Milder symptoms were later reported by *Keys et al.* during the refeeding of healthy volunteers with a mean weight loss of 23% after starvation.”

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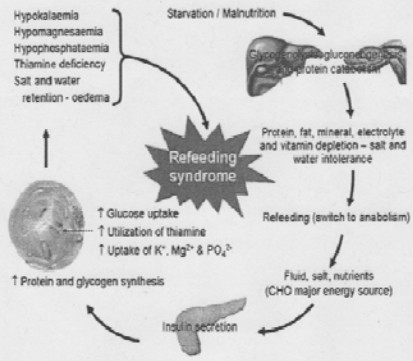

Figure 1 Pathogenesis and features of the refeeding syndrome.

Asian Journal of Clinical Nutrition

Table 1 Some groups of malnourished patients at particular risk of developing the refeeding syndrome

Unintentional weight loss
- Loss of >5% of body weight in 1 month
- Loss of >7.5% of body weight in 3 months
- Loss of >10% of body weight in 6 months

Low nutrient intake
- Patients starved for >7 days
- Prolonged hypocaloric feeding or fasting
- Chronic swallowing problems and other neurological disorders
- Anorexia nervosa
- Chronic alcoholism
- → Depression in the elderly
- → Patients with cancer
- Chronic infectious diseases (AIDS, tuberculosis)
- → During convalescence from catabolic illness
- Postoperative patients
- Diabetic hyperosmolar states
- → Morbid obesity with profound weight loss
- Homelessness, social deprivation
- → Idiosyncratic/eccentric diets
- Hunger strikers

Increased nutrient losses/decreased nutrient absorption
- → Significant vomiting and/or diarrhoea
- Dysfunction or inflammation of the gastrointestinal tract
- Chronic pancreatitis
- Chronic antacid users (these bind minerals)
- Chronic high-dose diuretic users
- After bariatric surgery

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Contributing factors to occurrence of refeeding syndrome

- “Common factors include the severity of the underlying malnutrition, overaggressive nutritional support in the early stages with adequate supplements of phosphate, thiamine, potassium and magnesium, and associated conditions that exacerbate micronutrient, electrolyte and mineral deficiencies, for example alcoholism, gastrointestinal disorders, and poor or eccentric diets.”

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Metabolic sequence

- “During starvation, phosphate and potassium are lost from the cell in proportion to the breakdown of glycogen and protein, potassium being the main intracellular cation balancing the negative charges on proteins.”

29

- “There is, therefore, no clinical deficiency of these electrolytes until catabolism is abruptly reversed and resynthesis of glycogen and protein begins, creating a sudden demand for inorganic phosphate for phosphorylation and adenosine triphosphate (ATP) synthesis and for potassium to balance the negative charges on protein and glycogen.”

30

- “Magnesium, being involved in ATP synthesis, is also taken up by the cells.”
- “Upon the introduction of carbohydrate, insulin is released into the blood stream and there is a shift of metabolism from fat to carbohydrate.”
- Acute thiamin deficiency may be precipitated, especially in patients suffering from chronic alcoholism, since diminished thiamine reserves are rapidly used up, as carbohydrate metabolism is accelerated.”

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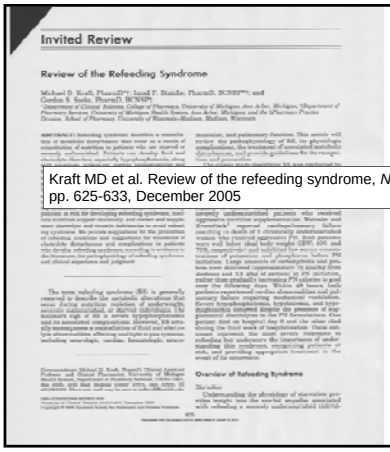

Invited Review

Review of the Refeeding Syndrome

Kraft MD et al. Review of the refeeding syndrome, *Nutr Clin Practice*, Vol. 20, pp. 625-633, December 2005

32

- **“Refeeding syndrome describes a constellation of metabolic disturbances that occur as a result of reinstitution of nutrition to patients who are starved or severely malnourished.”**
- **“Patients can develop fluid and electrolyte disorders, especially hypophosphatemia, along with neurologic, pulmonary, cardiac, neuromuscular, and hematologic complications.”**

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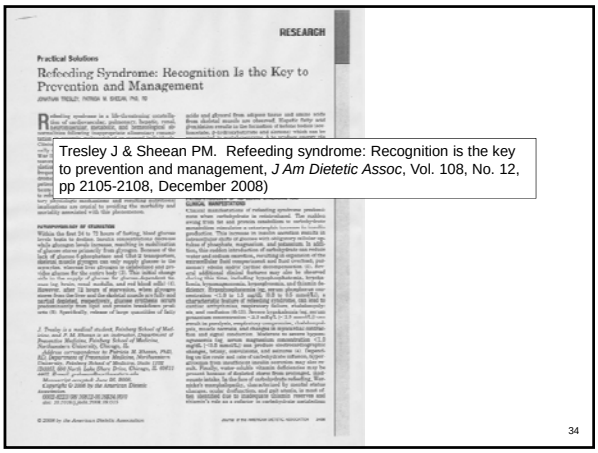

RESEARCH

Practical Solutions

Refeeding Syndrome: Recognition Is the Key to Prevention and Management

Tresley J & Sheean PM. Refeeding syndrome: Recognition is the key to prevention and management, *J Am Dietetic Assoc*, Vol. 108, No. 12, pp 2105-2108, December 2008)

34

- **"Today, anorexia nervosa is one of the more frequent clinical presentations at risk of refeeding syndrome; however, malnourished elderly patients, oncology patients receiving chemotherapy, and postoperative patients may also be at risk."**
- **"Recognizing individuals prone to refeeding syndrome and understanding the compensatory physiologic mechanisms and resulting nutritional implications are crucial to avoiding the morbidity and mortality associated with this phenomenon."**

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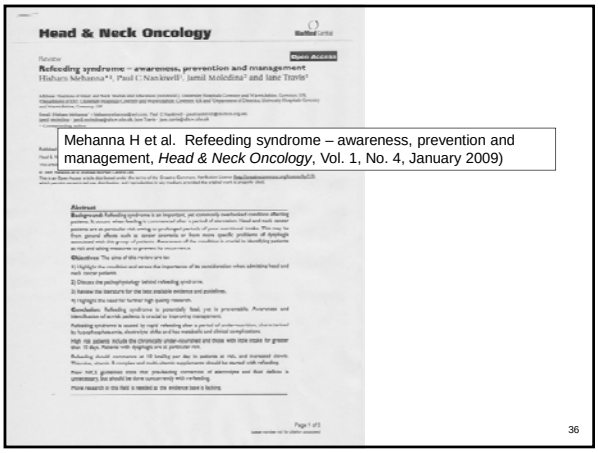

Head & Neck Oncology

Refeeding syndrome – awareness, prevention and management

Mehanna H et al. Refeeding syndrome – awareness, prevention and management, *Head & Neck Oncology*, Vol. 1, No. 4, January 2009)

36

- **"On refeeding, the absorbed glucose leads to increased blood glucose levels, which increase insulin and decrease glucagon secretion."**
- **"The net result of these changes is the synthesis of glycogen, fat and protein."**
- **"This anabolic state requires minerals such as phosphate and magnesium and cofactors such as thiamine."**
- **"Insulin stimulates absorption of potassium into the cells (via the Na-K ATPase symporter), with both magnesium and phosphate also taken up."**
- **"Water is drawn into the intracellular compartment by osmosis."**
- **"This decreases serum levels of phosphate, potassium and magnesium further, and results in the clinical features of refeeding syndrome."**

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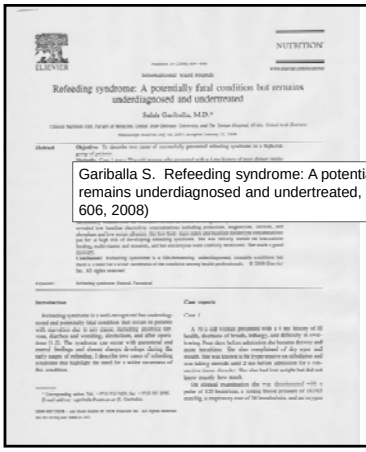
NUTRITION

Refeeding syndrome: A potentially fatal condition but remains underdiagnosed and undertreated

Salah Gariballa, M.D.*

Gariballa S. Refeeding syndrome: A potentially fatal condition but remains underdiagnosed and undertreated, *Nutrition*, Vol. 24, pp. 604-606, 2008)

38

- **"When patients start to refeed after a period of starvation, a sudden shift from fat to carbohydrate occurs."**
- **"A glucose load stimulates insulin release, causing increased cellular uptake of glucose, phosphate, potassium, magnesium, and water and protein synthesis."**
- **"This cellular uptake of phosphate, potassium, and magnesium results in a dramatic decrease of concentrations."**
- **"Decreased levels of such important minerals can lead to altered myocardial function, cardiac arrhythmias, hemolytic anemia, liver dysfunction, neuromuscular abnormalities, acute respiratory failure, gastrointestinal and renal disorders, and death."**

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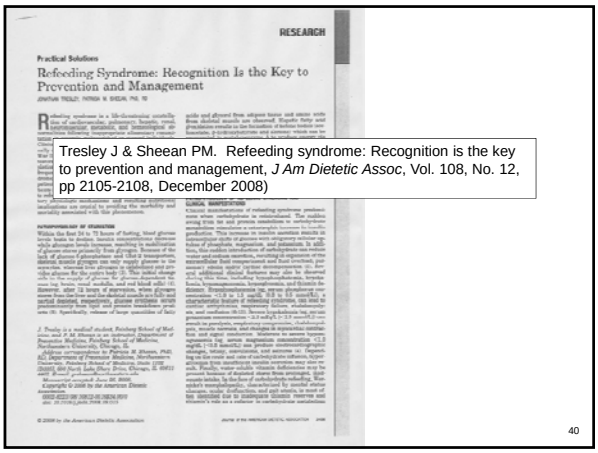

RESEARCH

Practical Solutions

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Tresley J & Sheean PM. Refeeding syndrome: Recognition is the key to prevention and management, *J Am Dietetic Assoc*, Vol. 108, No. 12, pp 2105-2108, December 2008)

40

- **"Clinical manifestations of refeeding syndrome predominate when carbohydrate is reintroduced."**
- **"The sudden swing from fat and protein catabolism to carbohydrate metabolism stimulates a catastrophic increase in insulin production."**
- **"This increase in insulin secretion results in intracellular shifts of glucose with obligatory cellular uptakes of phosphate, magnesium, and potassium."**

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- **"In addition, this sudden introduction of carbohydrate can reduce water and sodium excretion, resulting in expansion of the extracellular fluid compartment and fluid overload, pulmonary edema and/or cardiac decompensation."**
- **"Several additional clinical features may also be observed during this time, including hypophosphatemia, hypokalemia, hypomagnesemia, hyperglycemia, and thiamin deficiency."**

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- **"…water soluble vitamin deficiencies may be present because of depleted stores from prolonged, inadequate intake."**
- **"In the face of carbohydrate refeeding, Wernicke's encephalopathy, characterized by mental status changes, ocular dysfunction, and gait ataxia, is most often identified due to inadequate thiamin reserves and thiamin's role as a cofactor in carbohydrate metabolism."**

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- **"…after 72 hours of starvation, when glycogen stores from the liver and the skeletal muscle are fully and partially depleted, respectively, glucose synthesis occurs predominantly from lipid and protein breakdown products."**
- **"Specifically, release of large quantities of fatty acids and glycerol from adipose tissue and amino acids from skeletal muscle are observed."**
- **"Hepatic fatty acid β-oxidation results in the formation of ketone bodies (acetoacetate, β-hydroxybutyrate, and acetone) which can be reconverted to acetyl-coenzyme A to produce energy via the Krebs cycle."**

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- **"Energy in the form of glucose is also synthesized from endogenous glycerol, the gluconeogenic amino acids (primarily alanine and glutamine) and lactate and pyruvate produced by glycolysis via the Cori cycle."**
- **"Overall, this adaptation to altered sources of energy can result in profound fat and muscle wasting, in addition to total body depletion of electrolytes, magnesium, potassium, and phosphate."**

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- **“Optimal treatment generally includes a conservative approach to nutritional repletion, although no one technique has been reported to be superior. The clinical mantra of ‘start low and go slow’ has been advocated.”**

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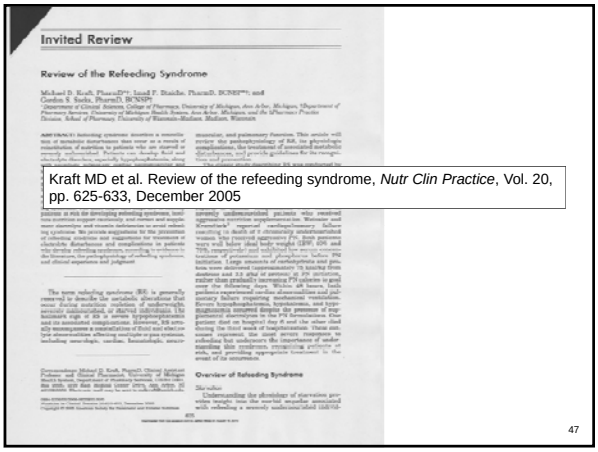

Invited Review

Review of the Refeeding Syndrome

Kraft MD et al. Review of the refeeding syndrome, *Nutr Clin Practice*, Vol. 20, pp. 625-633, December 2005

47

- **“If a patient manifests signs and symptoms of refeeding syndrome, nutrition support should be started with great caution.”**
- **“All electrolyte abnormalities should be adequately treated and supplemental electrolytes provided in the nutrition formulation above what was previously provided when refeeding syndrome symptoms developed.”**
- **“Multivitamins should also be supplemented…”**

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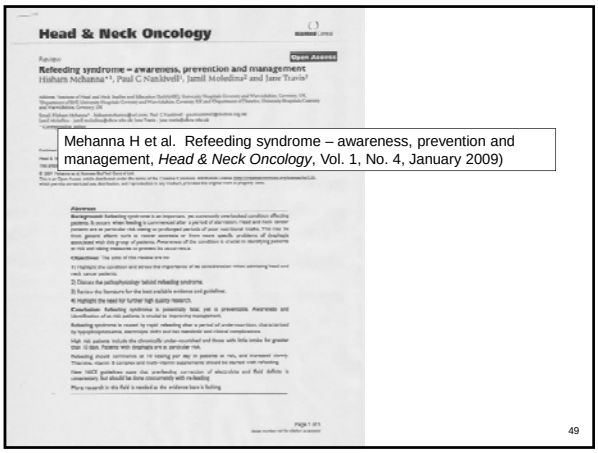
Head & Neck Oncology

Open Access

Refeeding syndrome – awareness, prevention and management

Hisham Mehanna*[1], Paul C Nankivell[1], Jamil Moledina[2] and Jane Travis[1]

Mehanna H et al. Refeeding syndrome – awareness, prevention and management, *Head & Neck Oncology*, Vol. 1, No. 4, January 2009)

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"Vitamin replacement should be started right away, in particular thiamine…"

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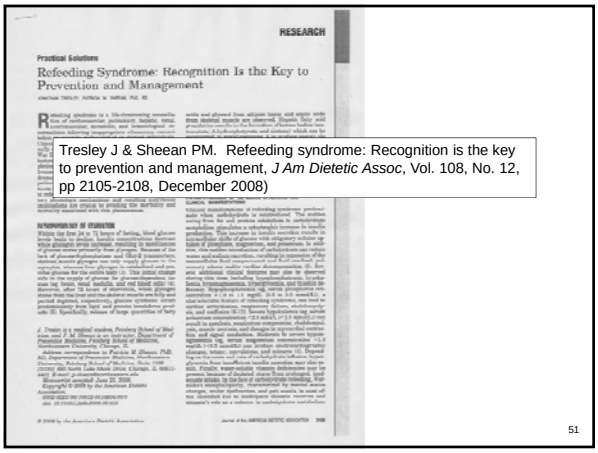
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51

- **"Currently, it is advised to begin feeding at 20 kcal/kg/day or about half of estimated needs with 1.0 to 1.5 g/kg/day protein and careful attention to correction of electrolyte abnormalities."**
- **"A low sodium diet and fluid restriction of 1L/day may also help to prevent fluid overload. To detect fluid overload, daily weights, heart rate, and rhythm should be monitored."**
- **"Once electrolytes are stable, it is appropriate to advance feeding by 200 to 300 kcal every 2 to 3 days, pending stable blood electrolytes."**
- **"However, weight gain of more than 2 to 3 lb/week is indicative of fluid retention and all of these clinical guidelines must be tailored to the individual case."**

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Thank you!!

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