Serum Calcium, Phosphorus, and Magnesium Level During Prolong Hunger Strike

Shrestha SL,* Dahal P**
*Associate Professor Department of Medicine, **Associate Professor. Department of Plastic Surgery, NAMS, Bir Hospital.

ABSTRACT

INTRODUCTION: The conscious decision to refuse food or fluids to achieve a goal or set of demands. Fasting is a method of protesting injustice. From the medical view, in the first 3 days, the body is still using energy from glucose. After that, the liver starts processing body fat, in a process called ketosis. After 3 weeks the body enters a starvation mode. At this point the body “mines” the muscles and vital organs for energy, and loss of bone marrow becomes life-threatening. This was the case of a hunger striker who was admitted in the Bir Hospital. This study was undertaken to see the pattern of changes in calcium, phosphorus and magnesium in prolong hunger strike.

METHOD: The striker was on prolong fasting about 329 days. The study was carried out during the period of 2070/4/32 to 2071 6/6 until declared death. The level of calcium, phosphorus and magnesium were collected, evaluated, and analyzed by using SPSS 16.

RESULT: The data were collected and mean value were calculated as 1 day, 30 days, 90 days, 130 days, 150 days, 210 days, 220 days, 270 days and 320 days. There was a slight decrease in calcium and phosphorus level without change in the level of Magnesium.

CONCLUSION: There was changes in Calcium, Phosphorus but there is no changes in Magnesium in the prolong hunger strike but needs further evaluation and study.

KEY WORDS: Hunger strike, Calcium, Phosphorus and Magnesium

INTRODUCTION

The definition of a hunger strike varies from institution to institution, but one of the most widely accepted definitions is the absence of food intake for 3 consecutive days (typically 9 meals). A broader and more useful definition of a hunger strike is the following: “an action in which person or group of persons, with decision-making capacity, refuses to ingest vital nourishment until another party accedes to a specific demand.”

Abnormalities of calcium, phosphorus and magnesium homeostasis are common, and collectively are called disorders of mineral metabolism. Normal homeostatic regulation maintains serum levels, intracellular levels, and optimal mineral content in bone. This regulation occurs at three major target organs, the intestine, kidney and bone, principally via the complex integration of two hormones, parathyroid hormone and vitamin D. An understanding of normal physiology is necessary to accurately diagnose and treat disorders of mineral.

Physiology of Human Starvation (Fasting): Physiological changes begin several days after fasting. Early in the fast, the body uses stores of glycogen in the liver and muscles. The brain normally mainly uses glucose for cellular metabolism but can substitute a fat or...
fat-derived product, ketone bodies, for glucose as an alternative fuel. With prolonged fasting, ketone bodies, specifically hydroxybutyrate and acetoacetate, substitute for glucose oxidation in the brain and spare gluconeogenesis by the liver, and thus preserve body protein.\textsuperscript{3} Fatty acids (from adipose tissue) are broken down into ketones, causing ketosis, which begins 2 to 3 days after fasting and suppresses hunger. Glycogen stores are exhausted by approximately day 3 and the substrate for gluconeogenesis is shifted to amino acids, gradually using up muscle (including heart muscle).\textsuperscript{4,5} The adaptation by the brain to use ketone bodies as an energy source permits weeks of starvation to be extended to months, with the total duration of life depending on the initial body protein and particularly fat stores. Thus, the human brain derives energy from storage fat, permitting survival in normal-weight persons for up to 2 to 2.5 months and in obese persons for many months to even 1 year.\textsuperscript{3} The 250 mL of water produced daily by metabolism during starvation may even be adequate for covering water needs if the individual minimizes evaporative water loss in moderately warm and humid temperature zones and by decreasing activity. This minimizes the need for much water intake because water excretion diminishes with decreased urea production and reduced salt intake. With the loss of one-third of body protein, however, starvation becomes incompatible with survival. Small amounts of glucose (as little as 75 g of carbohydrate) can reduce the urinary nitrogen losses by half, which preserves muscle mass.\textsuperscript{4,6} Death can occur by several mechanisms, notably intractable ventricular dysrhythmias or uncommonly, lactic acidosis from sepsis secondary to immune system dysfunction leading to small bowel obstruction and multiple organ failure.

Time from starvation to Serious medical problems begin at a weight loss of approximately 18% of initial body weight in individuals who continue fasting.\textsuperscript{7} Starvation is life threatening when more than 30% of the original body weight is lost. The fasting hunger striker progresses through phases of symptoms. Sometime after a short period of euphoria and well-being, the hunger striker will begin to experience symptoms of weakness and dizziness, which can be disabling. Abdominal pain is common. Because both hunger and thirst mechanisms are lost, volume depletion occurs.\textsuperscript{7}

Serum calcium levels are tightly controlled within a narrow range, usually 8.5–10.5 mg/dL (2.1–2.5 mmol/L). However, the serum calcium level is a poor reflection of overall total body calcium, as serum levels are only 0.1–0.2% of extracellular calcium, which in turn is only 1% of total body calcium. The remainder of total body calcium is stored in bone. Ionized calcium, generally 40% of total serum calcium level is physiologically active, while the non-ionized calcium is bound to albumin or anions such as citrate, bicarbonate and phosphorus.

Phosphorus is critical for numerous normal physiologic functions including skeletal development, mineral metabolism, energy transfer through mitochondrial metabolism, cell membrane phospholipid content and function, cell signaling, and even platelet aggregation. Because of its importance, normal homeostasis maintains serum concentrations between 2.5 to 4.5 mg/dL.

The normal homoeostasis for magnesium is less studied but there has been recent increased interest. Magnesium is critical for normal ATP (adenosine triphosphate) function and glucose metabolism and therefore has widespread cellular effects. Magnesium is also important in cellular cytoskeleton contraction and at the myoneural junction, and therefore can alter skeletal and cardiac muscle function. Magnesium is the second most abundant intracellular cation, with 67% of total body stores found in bone, 31% intracellular, and only 2% in the extracellular (measurable space). Normal serum levels are 1.5 - 2.5 meq/L, and approximately 30% is bound to albumin. Similar to the other divalent mineral ions, less than 1% of the total body magnesium is in the extracellular space (and therefore measurable) and thus levels do not accurately reflect total body stores.\textsuperscript{8}

**METHOD**

This is the retrospective study of a hunger striker who was on prolong fasting about 329 days. The study was carried out in the Bir Hospital in medical department, during the period of 2070/4/32 to 2071/6/6 until declared death. The level of calcium, phosphorus and magnesium were collected, evaluated and analyzed by using SPSS 16.

During hunger strike, after 45 days of fasting, TPN was continued twice weekly. Thereafter 15 days...
of continuing TPN, he agreed to oral food. He was then started on oral feeding after 50 days of fasting for one month. Because of ongoing political issues not resolved, he stayed in hospital for next 30 days. After 30 days of starting feeding he restarted fasting again because of his demand was not fulfilled. This time he refused enteral, Parenteral feeding and even refused intravenous fluids. After 15 days of fasting, intravenous fluids was started. He was on intravenous fluids with vitamins supplementation. During this entire period his general condition ill looking with rundown of health and cachexia and sarcopenia. His BMI was 16.1 kg/m2. After 40 days of refeeding total parenteral nutrition was started and continued twice weekly. Total Parenteral nutrition and intravenous fluids and vitamins and minerals supplementation were continued throughout with regular evaluation of blood parameters.

RESULT

The data were collected and mean value were calculated as 1 day,30 days,90 days,130 days,150 days,190 days, 210 days,210 days, 270 days and 320 days. There was a slight decrease in calcium and phosphorus level without change in the level of Magnesium.

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DISCUSSION

Azizi F and Rasoul HA showed in their study that there is slight decrease in serum calcium level occurred by the 10th day and serum phosphorus levels did not change significantly during Ramadan. In studies of prolong continuous fasting, serum phosphorus is normal, serum calcium may be normal or deceased, and there occur a significant increase in urinary excretion of both calcium and phosphorus. However, there is a decline rather than a rise in calcium excretion on the first day of the fasting. The cause of the slight decrease in serum calcium during Ramadan is not clear and requires studies of urinary excretion of calcium and measurement of serum parathormone and vitamin metabolites.

Serum calcium does not show any remarkable decrease during the vitamin B-free period. The convulsions in tetany are accompanied by an increased drop in the serum calcium. Therefore it may be assumed that the convulsions observed in the final stage of vitamin B deficiency must be of different origin. In this study, it is observed that there is slight decrease in the level of calcium and phosphorus without any changes in normal level of magnesium. As the patient had got TPN and was accepted to be on oral feeding. In the later stage of his fasting, it was found normal level of calcium, phosphorus and magnesium.

In the study of kalk W.J and felix E.R., in 1993 depression and abdominal pains were the predominant Symptoms. In 6 lean subjects with complete data the expected initial period of rapid weight loss was not observed. Before hospitalization, most subjects became dehydrated from inadequate fluid intake and an apparent absence of thirst. Serum creatinine concentrations were a better indication of dehydration than serum urea levels. Mild hyponatraemia was found in one-third of patients. The clinical assessment of dehydration may, however, be difficult and depends upon the measurements of
serum concentrations of urea and creatinine. During dehydration serum concentrations of urea rise in the face of normal creatinine levels and increase in creatinine indicates renal tubular damage as a result of reduced kidney perfusion. Urea synthesis falls during prolonged starvation. In the first week of fasting there is a fall in total body water, associated with a marked early natriuresis. These sodium losses, combined with a degree of dehydration and only water intake, may have been sufficient to explain the hyponaeremia observed in one-third of patients. Comparable hyponaeremia has been reponed in one apparently well-hydrated subject on total fasting. The present data points to the need for sodium supplements to prevent hyponaeremia during fasting. On the basis of published reports it seems that an intake of sodium chloride of about 15 mmol/day (eg. 1 - 1.5 g, one-quarter to half a teaspoon per day) is likely to prevent hyponaeremia without inducing clinically important hypokalaemia.

Anemia is quite common among individuals who undergo prolonged fasting and is most often a microcytic, hypochromic anemia secondary to iron loss. Other common laboratory findings include leukocytosis, elevated liver transaminases, hypophosphatemia, elevated creatinine kinase, hypokalemia, and mild hypoglycemia. Starvation-related ketonuria is a common early finding.

CONCLUSION: There was changes in Calcium, Phosphorus but there is no changes Magnesium in the prolong hunger strike but needs further evaluation and study.

REFERENCES