Dynamic Chiropractic

CHIROPRACTIC (GENERAL)

Getting to Ketosis - An Anti-Inflammatory State

David Seaman, DC, MS, DABCN

When I previously thought about ketones, my mind went to ketoacidosis and uncontrolled diabetes. How about ketones in the urine? Diabetes would have been the correct answer if we were taking a test. So, I was basically conditioned to think of ketones as being mostly bad.

Health care practitioners are not typically trained to embrace ketosis as a desirable state; we are trained to the think of the extreme – the extreme case. We got this in biochemistry classes and the clinical classes back in the 1980s, and this continues today. This view of ketones needs to change.

In recent years, three excellent clinical studies have been published that utilized what the authors called a Spanish ketogenic Mediterranean diet.[1-3] The diet consisted of olive oil, moderate red wine, green vegetables and salads, fish as the primary protein, as well as lean meat, fowl, eggs, shellfish and cheese. (Nuts are also acceptable, although they were not included in these studies.) Notice that absolutely no sugar, flour, whole grains, or legumes were consumed. Fruit was also not included.

The application of this diet for 12 weeks led to weight loss and the resolution of metabolic syndrome and non-alcoholic fatty liver disease, demonstrating that a ketogenic diet is highly anti-inflammatory.

Ketosis vs. Ketoacidosis

Because the average American diet contains hundreds of grams of carbohydrate, this diet cannot lead to ketosis and fasting blood sugar levels range from 80-120 mg/dl, depending on the degree to which refined carbohydrates are consumed. Ketone body levels will be .1 mm/l. The fasting blood glucose of a diabetic patient in ketoacidosis will be >300 mg/dl and ketones will be >25 mm/l.

In contrast, the Spanish ketogenic diet described above will lead to fasting glucose levels that range from 65-80 mg/dl and ketone bodies at 7-8 mm/l,[4] which is an anti-inflammatory state.

To get into ketosis, the diet must contain less than 50 grams of carbohydrate per day. This means that less the 200 calories per day will come from carbohydrate. Thus, fruit is typically not permitted on this diet, even though fruit is a healthy food. It is possible, but more of a challenge.

On a practical level, the average person will not get to ketosis unless motivated. This does not mean patients should give up hope. Just because getting into ketosis takes effort and commitment does not mean one should live on bread if they do not get into ketosis. Instead, the goal can be to eat less than 100 grams of carbohydrate per day. This will not create ketosis, but is certainly a healthy, anti-inflammatory level.

For a humorous example of how to eat less than 100 grams of carbohydrate per day, watch the movie "Fathead." The writer, director and subject wanted to debunk the "Supersize Me" myth that obesity is the outcome if you eat at fast-food restaurants. He ate only at fast-food restaurants and consumed less than 100 grams of carbohydrate per day – and he lost weight.[5]

Who Should Be on a Ketogenic Diet?

Strong evidence suggests the ketogenic diet is excellent for weight reduction and is associated with a reduction in appetite.[4] This is extremely important for the overweight population, which generally has a strong appetite due to multiple metabolic abnormalities that enhance hunger. I recently wrote a review article on this topic, published in the *Journal of Chiropractic Humanities*.[6]

Strong evidence also indicates that ketogenic diets are the appropriate diet for patients with diabetes, heart disease and epilepsy. Emerging evidence supports a ketogenic diet for use in patients with acne, headache, neurotrauma, Alzheimer's and Parkinson's disease, sleep disorders, autism, multiple sclerosis, cancer, and polycystic ovarian syndrome.[4] Patients in pain may also do well to be on a ketogenic diet.[7-8] Ketosis is clearly a desirable anti-inflammatory state.

The Ketogenic Diet Works Like a Statin

We have been conditioned to think that eating fats will make us fat and raise cholesterol; however, this is not accurate. Forty percent of the average American's diet consists of refined carbohydrate. The excess carbohydrates are converted into pyruvate, then to acetyl-CoA and then into HMG-CoA. Cholesterol is formed when HMG-CoA is converted into cholesterol by the enzyme HMG-CoA reductase. Why is this important to know? Because statins lower cholesterol by blocking HMG-CoA reductase.

So, a quick summary. People have been scared away from fat, which leads to the excessive consumption of carbohydrate that is converted into cholesterol. What makes matters worse is that a high-carbohydrate diet leads to the overproduction of insulin, and insulin stimulates HMG-CoA reductase. The outcome is that a high-carbohydrate diet and its associated hyperinsulinemia equals hypercholesterolemia for life,4 which means many people are put on statins for life.

But there is another more healthy option. By eating less than 50 grams of carbohydrate, there would naturally be an increase in fat and protein consumption. But the increase in fat is not converted into cholesterol. Interestingly, as with sugar, fats are converted by the liver into acetyl CoA and then HMG-CoA; however, HMG-CoA reductase is not turned on, as insulin is no longer being stimulated by carbohydrates. Instead, HMG-CoA lyase is turned on, which leads to ketone body production, which then feeds the brain and skeletal muscles.[4]

Skeletal Muscle Loves Ketones

If it were not for ketone body synthesis, the body would catabolize skeletal muscle to generate glucose. Thus, ketone body production preserves lean muscle mass.[9] Additionally, the body generates more energy from ketone bodies compared with glucose. While 100 g of glucose generates 8.7 kg of ATP, ketone bodies generate 9.4-10.5 kg of ATP.[10]

And while ketone bodies improve energy production, they simultaneously reduce oxidative stress, which is very beneficial, as an excess production of free radicals is implicated as a promoter of most chronic inflammatory diseases.

What Should We Do?

I think we should get into ketosis or at least eat less than 100 grams of carbohydrate per day. If one stays in ketosis, fasting blood glucose levels will be around 80 mg/dl or less. At less than 100

grams of carbohydrate per day, it is likely that fasting glucose will be below 90 mg/dl. Two-hour postprandial glucose levels will be well below 140 mg/dl, which is the cutoff level for the metabolic syndrome.

My suggestion would be to get a glucometer and test glucose levels upon arising after an overnight fast of at least eight hours and also check two hours after eating. If ketosis is the goal, ketone test strips can be used to identify when ketosis has been achieved.

In addition, several basic supplements are anti-inflammatory and are beneficial for blood sugar control, such as magnesium, vitamin D, omega-3 fatty acids, chromium, lipoic acid, ginger, turmeric and garlic.

References

1. Pérez-Guisado J, et al. Spanish ketogenic Mediterranean diet: a healthy cardiovascular diet for weight loss. *Nutr J*, 2008;7:30.
2. Pérez-Guisado J. A pilot study of the Spanish ketogenic Mediterranean diet: an effective therapy for the metabolic syndrome. *J Med Food*, 2011;14(7-8):681-7.
3. Pérez-Guisado J, Muñoz-Serrano A. The effect of the Spanish ketogenic Mediterranean diet on nonalcoholic fatty liver disease: a pilot study. *J Med Food*, 2011;14(7-8):677-80.
4. Paoli A, Rubini A, Volek JS, Grimaldi KA. Beyond weight loss: a review of the therapeutic uses of very-low-carbohydrate (ketogenic) diets. *Eur J Clin Nutr*, 2013;67:789-96.
5. "Fathead" (the movie). www.fathead-movie.com/index.php/about/
6. Seaman DR. Weight gain as a consequence of living a modern lifestyle: a discussion of barriers to effective weight control and how to overcome them. *J Chiro Humanities*. Published online Oct. 24, 2013 (full text available).
7. Ruskin DN, Kawamura M, Masino SA. Reduced pain and inflammation in juvenile and adult rats fed a ketogenic diet. *PLoS One*, 2009;4(12):e8349.
8. Ruskin DN, Masino SA. The nervous system and metabolic dysregulation: emerging evidence converges on ketogenic diet therapy. *Front Neurosci*, 2012;6:33.
9. Manninen AH. Metabolic effects of the very-low-carbohydrate diets: misunderstood "villains" of human metabolism. *J Int Soc Sports Nutr*, 2004;1(2):7-11.
10. Veech RL, Chance B, Kashiwaya Y, Lardy Ha, Cahill GF. Ketone bodies, potential therapeutic uses. *IUBMB Life*, 2001;51(4):241-7.

FEBRUARY 2014