

Article 4 – Fatigue Part Two; Energy Production.

In the previous article on fatigue I discussed the role of the blood in maintaining good energy levels and the factors required to build healthy blood cells. This article will look at *where* the action happens as far as energy production goes.

Every cell in your body has little energy-producing factories in it called mitochondria which look a little like jelly beans with a maze inside them. The outside of the jelly bean and the walls of the maze are a type of membrane structure, and it is within these membranes that your body makes all of its energy. The number of mitochondria can range from one per cell to many thousand depending on what role the cell has. A heart muscle cell for example will have a greater need for energy because of its level of activity than say a skin cell. As a result, the number of mitochondria will be many times greater in the heart muscle cell than in the skin cell. If a cell feels it is not able to make enough energy to survive, more mitochondria can be created and sometimes mitochondria will grow, move, or combine with other mitochondria depending on the cell's energy needs.

The major things which determine how well your mitochondria work are:

- The quality of the membranes that make up the inside and outside of the mitochondria. The types of fats you eat contribute enormously to this, and membranes made with the wrong fats (saturated, trans fats or damaged fats) will be stiffer and less able to do their job. The most important fats for good membrane structure are the omega 3 essential fatty acids (omega 3 EFAs).
- The supply of raw ingredients - food, oxygen and the substances which allow the conversion of these into energy.
- The level of antioxidants available to the mitochondria which prevent damage to its membrane structures.
- A supply of amino acids (protein) which are used to make the enzymes which carry out the chemical reactions and to carry out any repair processes.
- The supply of water, as this is a large part of the fluid environment inside the mitochondria. This is one of the reasons why people feel so tired when they are dehydrated.

The inside of the mitochondria is filled with water and proteins called enzymes which have the job of taking food molecules and combining them with oxygen. The oxygen comes from the deliveries via the red blood cells and via the water, which is simply hydrogen and oxygen (H₂O). The mitochondria are the only place in the body where oxygen can be combined with food molecules to create a form of chemical energy called ATP (adenosine triphosphate) which can then be “burnt” and used to carry out all the functions which keep us alive. You could think of ATP as petrol for the body.

In order for the mitochondria to work properly and produce the "petrol", they require a supply of certain raw materials in addition to food molecules and oxygen. These include B₂, B₃, N-acetyl carnitine, alpha-lipoic acid, Co-enzyme Q₁₀, essential fatty acids, antioxidants such as vitamin E, and magnesium. All of these we must gain primarily from our food, with the exception of Co Q₁₀ which we can produce in small amounts for ourselves. N-acetyl carnitine, Co Q₁₀, essential fatty acids and alpha-lipoic acid are vital for mitochondrial function both in terms of creating the ATP and in protecting the mitochondria from damage. Damage to the mitochondria essentially translates into accelerated aging and fatigue.

Fish oils and oily fish such as sardines, salmon and mackerel are very valuable sources of the omega 3 EFAs because they are easily converted by the body to useful

substances which improve oxygen usage, induce mitochondrial growth and are vital for keeping the membranes of the mitochondria in good working order. Fish oils are more easily converted than flaxseed oil because they use one less enzyme system in the process, and are therefore the source that I tend to recommend. An inadequate intake of omega 3 EFAs will change the types of fats that are used to build the membranes, and this will result in unhealthy membrane formation which will then affect how well the reactions required to make energy are carried out.

The B vitamins are essential for the production of ATP, and succinctly put; no magnesium = no ATP, which basically amounts to a petrol shortage. The presence of magnesium is required for virtually all steps of energy production. Given that magnesium should be the fourth most common mineral in the body (after sodium, potassium and calcium) and that most people's diets are deficient in it, it is not surprising that tiredness is such a common problem in our society. New Zealand's soils are known to be low in magnesium; a fact addressed by many farmers who supplement this for their animals. However, it is not often recognized that we eat food grown in the same soil as the food our animals eat and that if they are short in it, then we will be too.

It is also worth noting that some medications actively deplete the body's magnesium, Co Q₁₀ and B vitamin levels, and that refined foods, prolonged stress or repeated strenuous exercise will do this to both magnesium and the B vitamins. Where certain medications, stress or strenuous exercise is a factor it is essential that the above nutrients be supplemented. I have found that the best results are gained by using a form of magnesium called magnesium diglycinate in conjunction with the other nutrients mentioned. (This is available through the dispensary at the clinic). If refined foods are a large part of your diet, the best thing you can do is minimize them and then supplement, as no amount of supplementation will compensate for a poor diet if unaddressed.

The best sources of antioxidants are the good old fruit and vegetables. As I mentioned last month, live blood screening is a very good way of checking how much cellular damage is occurring as it shows up very clearly as abnormally shaped blood cells. If there is a high level of these in a person's sample, it is an indication of the damage that will be going on elsewhere in the body, including in the mitochondria.

The best food sources of alpha-lipoic acid are spinach, broccoli, beef, brewers yeast, and heart or kidney meats. The best food sources of carnitine are protein foods such as chicken, fish, red meats and dairy. And where is Co Q₁₀ found? Our bodies are able to produce some of the Co Q₁₀ that we need and the rest is made from the foods we eat. The highest dietary sources of Co Q₁₀ come from - in descending order according to content - fresh sardines and mackerel, the heart, liver and meat of beef, lamb and pork along with eggs. There are plenty of vegetable sources of Co Q₁₀, the richest being spinach, then broccoli, wheat germ and whole grains (although the amount is significantly smaller than that found in meats). Also, it is important to note that to be considered viable sources of Co Q₁₀ these foods must be raw, fresh and unprocessed - no milling, canning, preserving, freezing, etc.... This poses an obvious problem when it comes to the meat side of things. We also produce less Co Q₁₀ as we age, so supplementation is often a very good option where fatigue is an issue.

If you would like more assistance with issues relating to fatigue you are welcome to contact us at The Self Heal Clinic in Greytown on 06 304-8177.