Cutting calories could limit muscle wasting in later years

September 16 2008

Chemical concoctions can smooth over wrinkles and hide those pesky grays, but what about the signs of aging that aren't so easy to fix, such as losing muscle mass? Cutting calories early could help, say University of Florida researchers who studied the phenomenon in rats.

A restricted-calorie diet, when started in early adulthood, seems to stymie a mitochondrial mishap that may contribute to muscle loss in aging adults, the researchers reported recently in the journal *PLoS One.*

In rats, the scientists found pockets of excess iron in muscle cell mitochondria, the tiny power plants found in every cell. The excess iron affects the chemistry inside the mitochondria, sparking the formation of harmful free radicals that can lead a mitochondrion straight to the emergency exit, said Christiaan Leeuwenburgh, Ph.D., a UF professor of aging in the UF College of Medicine and the Institute on Aging. Leeuwenburgh was the senior author of the study and of a related report published online this month in *Aging Cell* that details the damage done by excess iron in mitochondria.

"We become less efficient at an old age and we need to understand why this is," Leeuwenburgh said. "One thing, maybe, is the accumulation of redox-active metals in cells. If the mitochondria become unhappy or are ready to kick the bucket, they have proteins in the inner and outer membranes that they can open up and commit suicide. They're tricky beasts."

The suicidal mitochondria can damage the rest of the muscle cell, leading to cell death and perhaps to muscle wasting, a big problem for adults as they reach their mid-70s, Leeuwenburgh added.

"Muscle is critical for your overall well-being," Leeuwenburgh said. "As you walk, muscle functions partly as a pump to keep your blood going. Muscle is an incredible source of reserves."

The researchers found increasing amounts of iron in the muscle cells of aging rats fed a typical unrestricted diet. The older the rats got, the more iron accumulated in the mitochondria and the more damage was done to its RNA and DNA. Rats of the same ages that were kept on a calorie-restricted diet — about 60 percent of the food typically ingested — seemed to maintain more normal iron levels in mitochondria, the researchers reported.

"The novel thing here is that iron is accumulating in places it does not normally accumulate," said Mitch Knutson, Ph.D., a UF assistant professor of food science and human nutrition and a study co-author. "Such iron accumulation in muscle was quite unexpected. This may be of concern because more people are genetically predisposed to developing iron overload than we originally thought."

The problem occurs when metals such as iron accumulate in the mitochondria and react with oxygen. Iron can change the chemical structure of oxygen, triggering its metamorphosis into a free radical, an unstable atom that can upset the delicate balance inside the mitochondria. The result? Leeuwenburgh describes it sort of like internal rust.

"Not all free radicals are harmful," Leeuwenburgh said. "To just use antioxidants to neutralize all free radicals is a huge misconception because some radicals are helpful. You just need to try and target very

specific free radicals that form in specific parts of the body."

Researchers don't know exactly what causes iron to accumulate in mitochondria in aging animals, but a breakdown in how iron is transported through cells could be one reason why, Leeuwenburgh said. Understanding how caloric restriction limits the problem in rats could help researchers better understand how to combat it, he added.

Russell T. Hepple, Ph.D., an associate professor of kinesiology and medicine at the University of Calgary in Canada, said the findings are another step forward in linking iron to muscle cell death, but there are more questions researchers must answer.

"They've shown that apoptosis (cell death) goes up in aging muscle but where does that happen?" Hepple asked. "There are more than muscle cells in muscle. (For example) in older adults there are inflammatory cells."

Source: University of Florida