

Eat Less to Treat Cancer? Researchers at USC Find Benefit to Fasting in Mice

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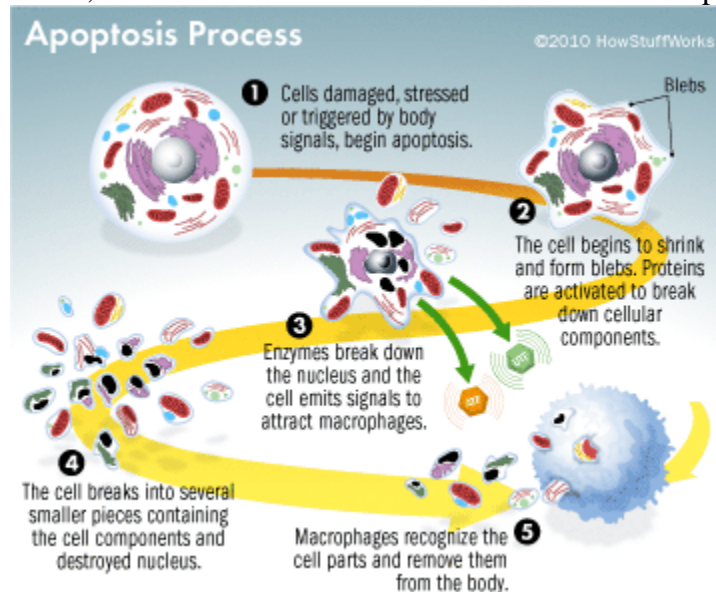
It was the second leading cause of mortality in the United States in 2011, responsible for 573,855 deaths last year. Annually, it costs the economy \$227 billion in direct medical costs and lost productivity. In the next five years, cancer will surpass heart disease to become the number one killer of Americans, and despite major advances in diagnosis and treatment, few true cures have been found. Those treatments that are available can be miserable, invasive procedures combined with extremely toxic chemicals that ravage the patients' already weakened bodies. But what if cancer could be treated by something as simple as eating less? Researchers at USC Davis School of Gerontology in partnership with the USC Norris Comprehensive Cancer Center published just such a study last month in *Science Translational Medicine*.

Chemotherapy versus Fasting in Mice

The study, headed by senior author Dr. Valter Longo of USC Davis School of Gerontology, found that five of the eight cancer types examined in mice responded to fasting alone. Fasting appears not only to slow the growth and spread of the cancerous cells, but to act as a protective force for the still-healthy cells that are often damaged by

chemotherapy. Adding cycles of short, severe fasting to a chemotherapy treatment increased the drugs' effectiveness against melanoma, glioma in the nervous system, human ovarian cancer and breast cancer. In mouse models of neuroblastoma, a cancer of the brain that most often affects young children, combining fasting and chemotherapy resulted in long-term cancer-free survival that was not found with either treatment when used alone. In fact, the combined treatment condition cured 20% of the mice with metastasized, or widespread, neuroblastoma, and 40% of mice with a more limited spread of the same cancer. None of the mice who were treated with only chemotherapy survived.

Dr. Longo has begun to look at the reasons for the astonishing effect of fasting on the growth of cancer cells. Evidence showed that fasting alone did not completely eliminate the cancerous tumors as chemotherapy could, but did cause the tumors to shrink. Dr. Longo alongside researchers at the National Institute of Aging suggested that fasting causes healthy cells to go into a state of slowed production and division, a bit like hibernation. Cancerous cells, on the other hand, try to compensate by making more proteins so as to continue to grow and divide. This compensation creates cellular stress caused by free radicals, which leads to a form of cellular death called apoptosis.



Essentially, in an effort to continue to divide by making up for proteins missing from the blood stream due to fasting, these cancerous cells are committing cellular suicide. Cancer cells are particularly prone to this reaction because of the mutations that made them cancerous in the first place. These mutations have allowed the cells to divide far more than they would be capable of normally, but have also decreased their ability to adapt. Dr. Longo suggests that more effective cancer treatments may need to focus not on killing the cancer cells specifically but in creating extreme environments like fasting that the cells cannot respond to. Normal cells could manage these conditions with ease, making the treatments far less damaging to healthy tissue than chemotherapy.

Will Fasting Work in Humans?

Long term clinical trials are the only way to test fasting as an effective treatment in humans. Just such a trial has recently been completed at USC Norris Comparative Cancer Center by Dr. Tanya Dorff and Dr. David Quinn, in collaboration with Dr. Longo. The first phase trial tested only whether short-term fasting is safe for patients. Once the results have been assessed from this trial and approval has been gained for further testing, researchers can then begin to assess whether fasting is effective in humans. Evidence from patients who chose to fast on their own suggests that chemotherapy may have fewer negative side effects in patients who tried fasting cycles. Fasting, however, may not be safe for everyone, including patients with diabetes and those who have already lost a lot of weight due to their disease, and may make some activities, like driving a car, more dangerous. Nevertheless, fasting represents a potential arena for further research into the treatment of a set of diseases whose damaging effect on our society is only growing. With the potential for a treatment that may not cause the extreme side-effects common with chemotherapy and with the fasting therapy's apparent effectiveness in mice, researchers are beginning to take a very serious look at fasting as a potential treatment for cancer.