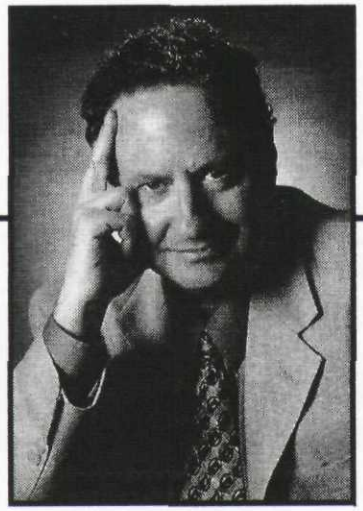

The War on Cancer

by Ralph W. Moss, PhD, Director, The Moss Reports

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Intravenous Vitamin C

Vitamin C is in the news again. A study carried out by a research team from the Harvard School of Public Health and published July 1 in the *New England Journal of Medicine* (Fawzi, WW, 2004) showed that a multivitamin supplement that included vitamin C significantly slowed the onset of AIDS and provided an "effective, low-cost means of delaying the initiation of antiretroviral therapy in HIV-infected women." The total cost of the treatment was estimated by the researchers to be about $15 per year. Here is yet another demonstration of the astonishing power of food supplements, particularly antioxidants such as vitamin C, to promote human health.

I am often asked whether or not vitamin C (ascorbic acid) is also an effective way of fighting cancer. I answer that while there is a growing body of scientific evidence to suggest that vitamin C is useful in the prevention of cancer, the jury is still out on its effectiveness as a cancer treatment. However, its low cost and astonishing lack of toxicity make it an extremely attractive candidate for further testing.

Representative of the investigations that are currently underway concerning vitamin C's role in the treatment of cancer is the work of Kedar N. Prasad, PhD, a professor of radiology at the University of Colorado Health Sciences Center, Denver. Prasad has demonstrated that vitamin C is capable of inhibiting the growth of cancer cells *in vitro*. He advocates giving vitamin C and other antioxidants to patients while they are undergoing conventional chemotherapy and radiation. (I draw on his work in my book *Antioxidants Against Cancer*.)

Prasad's theory is that normal cells require only a minute, precisely controlled amount of antioxidants in order to function. They reject any excess. But among other defects, malignant cells have lost the capacity to regulate their uptake of antioxidants such as vitamin C and E. Antioxidants can therefore accumulate in cancer tissue in levels that can lead to the breakdown and death of malignant cells (Prasad 2003).

The history of research into vitamin C as a cancer treatment is clouded with controversy. In the 1970s, a Scottish physician Ewan Cameron, MD, teamed up with Linus Pauling, PhD, to write a book, *Cancer and Vitamin C*, in which they extolled the usefulness of vitamin C as a treatment for cancer. (Pauling had previously published a book on vitamin C and the common cold.) *Cancer and Vitamin C* became a bestseller and this fueled public demand for investigation of the role of vitamin C in cancer treatment.

Pauling was a world-famous chemist, a two-time Nobel laureate, with great medical achievements to his record. But he was not a medical doctor, and this raised the ire of some medical critics such as the self-proclaimed "quackbuster" Victor Herbert, MD. However, the demand for a fair test of Pauling's thesis could not be ignored indefinitely, and in time doctors at the Mayo Clinic, Rochester, Minnesota, undertook a clinical trial that was supposed to replicate Drs. Cameron and Pauling's protocol.

In two often-cited papers, Charles Moertel, MD and his Mayo colleagues claimed that vitamin C had absolutely no beneficial effect when used in the treatment of patients with advanced cancer, regardless of whether or not they had received prior chemotherapy (Creagan 1979 and Moertel 1985). Dr. Moertel was called the "foremost professional demolition expert...of alternative cancer treatments" (Richards 1991). Moertel's negative comments on the topic included his assertion that evaluating alternative treatments was a "waste of time and money...a waste of patient hope" (Moertel 1989). His high-handed manner of testing vitamin C convinced proponents that they had been set up for inevitable defeat. But the damage had been done, and vitamin C was marginalized as a cancer treatment.

Tale of Two Trials

Is there a good scientific reason why vitamin C might have failed to show a beneficial effect in the Mayo Clinic trials while succeeding in the hands of its proponents? It now appears that there was. In the Mayo Clinic studies all patients received either vitamin C tablets or an inert sugar pill. What was widely overlooked at the time was that patients on the Cameron-Pauling protocol were given vitamin C not only orally but also via intravenous injection.

A few practitioners – most notably Abram Hoffer, MD of Victoria, British Columbia and Hugh Riordan, MD of the Center For the Improvement Of Human Functioning International in Wichita, Kansas – continue to use vitamin C intravenously at doses of up to 100 grams – almost 4 ounces – per day. In fact, using high-dose intravenous vitamin C has become a common procedure among CAM-oriented doctors, although it is ignored by orthodox medicine – witness the fact that in the decade since 1994 the number of presentations on intravenous vitamin C at the American Society of Clinical Oncology (ASCO) convention has been exactly zero.

New NIH Data

Could the route of administering vitamin C make a significant difference? Yes it could. New data shows that how one gives ascorbic acid has a big impact on the amount that actually becomes physiologically available. An April, 2004 study by scientists at the US National Institutes of Health (NIH) showed that much more vitamin C gets taken up when it is given via the intravenous route than when the vitamin is taken orally. The authors of the study include Sebastian J. Padayatty, MD of the Molecular and Clinical Nutrition Section at one of the NIH institutes, and his chief, Mark A. Levine, MD. Both are highly regarded figures in academic circles. Dr. Levine is a Harvard Medical School graduate who carried out the laboratory work that convinced the National Academy of Science to increase the recommended daily allowance (RDA) of vitamin C. (In 2000, the RDA for men was increased from 60 to 90 mg

daily, and for women the RDA was increased from 60 to 75 mg daily.)

In the Padayatty study, 17 healthy hospitalized volunteers were given either oral or intravenous doses of vitamin C, and blood plasma levels were calculated for a dose range of 1 to 100 grams. The authors reported that "peak plasma vitamin C concentrations were higher after administration of intravenous doses than after administration of oral doses...and the difference increased according to dose."

In fact, the blood concentration of Vitamin C when given intravenously was 6.6 times greater than when the same amount was given orally. However, this hardly tells the full story. The maximum tolerated doses also differed significantly according to whether the vitamin C was administered orally or intravenously. The maximum tolerated oral dose was calculated to be three grams every four hours, but when the vitamin C was given intravenously the researchers found they could give a 50 gram dose in the same period. Furthermore, plasma concentrations up to 60 times greater could be achieved using the intravenous route.

These NIH scientists observed that oral vitamin C "produces plasma concentrations that are tightly controlled.... Only intravenous administration of vitamin C produces high plasma and urine concentrations that might have antitumor activity." They conclude that "the efficacy of vitamin C treatment cannot be judged from clinical trials that use only oral dosing," as the Mayo Clinic studies most conspicuously did, and that "the role of vitamin C in cancer treatment should be reevaluated" (Padayatti 2004). Coming from such prestigious government scientists, publishing in the *Annals of Internal Medicine*, I believe this is a convincing (albeit belated) refutation of the poorly designed Mayo Clinic studies.

It is never easy to arrange clinical trials, especially of an agent that has long been in the public domain and from whose sale no super-profits can be expected. The way the drug approval system works in the United States virtually requires the enthusiastic support of sponsors with deep pockets (which almost invariably means a pharmaceutical company) in order to see a new drug through the long, involved and expensive process of drug approval. No non-toxic, readily available agent has ever been approved by the Food and Drug Administration for the treatment of cancer. Vitamin C at retail sells for around five cents per gram. The cost of even 100 grams prepared for intravenous use is still very inexpensive compared to patented chemotherapy. I therefore don't think you will find many drug companies lining up to test and market such a readily available agent. And so the question of what vitamin C can do for patients – so fascinating and promising – has remained in limbo.

However, things may be about to change. At a meeting of the American College for the Advancement of Medicine (ACAM) in April, 2003, Jeanne A. Drisko, MD, announced just such a clinical trial at her institution, the University of Kansas Medical Center. Luckily, the Cancer Treatment Research Foundation (CTRF) stepped forward to fund the Kansas City clinical trial. A randomized controlled trial, with Dr. Drisko as principal investigator, is now underway at the University of Kansas Medical Center, evaluating the safety and efficacy of antioxidants when added to chemotherapy in newly diagnosed ovarian cancer (Drisko 2003).

In a recent letter, Dr. Drisko wrote: "This is a randomized study in newly diagnosed ovarian cancer (Stage III or IV). The study subjects are randomized to receive either first-line chemotherapy or first-line chemotherapy along with high-dose antioxidants. The antioxidants are given both orally and intravenously. If randomized to the antioxidant arm, patients receive daily oral vitamins A, C, E and carotenoids, and intravenous (IV) vitamin C 2 times per week for 12 months. We tailor the dose of the IV vitamin C to their plasma vitamin C level – we try to get...the neoplastic cell kill dose, using Dr. Hugh Riordan's protocol.

"At this plasma level, vitamin C is chemotoxic to the cancer cells and appears to be non-toxic to healthy cells. But we are following white cell and platelet counts and other markers for possible toxicity from the vitamin C. Most patients need between 75 and 100 grams infused to get to that plasma level. We can assure concerned oncologists that it preliminarily does not appear that the high-dose antioxidants are interfering with the chemotherapy at this time.

"In ovarian cancer," she continued, "the patients are usually treated with chemotherapy during the first 5 to 6 months (6 cycles of carboplatin and paclitaxel) so they are getting an additional 6 to 7 months of antioxidants past the chemo. This study is conducted under the oversight of the FDA with an Investigative Drug (IND) number and has approval from the Human Subjects Committee (i.e., the institutional review board) of the University of Kansas Medical Center. So far, we have 14 patients enrolled and are hoping to recruit 40. We have had 2 dropouts: One because she refused to adhere to the treatment requirements and started smoking, and one because she was chemotherapy resistant to all chemotherapy by drug assays" (Drisko 2004).

This trial is a very encouraging development. Dr. Drisko is a person with credibility in both orthodox and CAM circles. She is thus in an ideal position to do a study that will be not only rigorous but entirely believable in its conclusions.

As some readers know, I wrote the authorized biography (*Free Radical*) of Albert Szent-Gyorgyi, MD, PhD, who won the 1937 Nobel Prize for his discovery of vitamin C. In fact, it was he who named the vitamin ascorbic acid and first predicted its use in cancer. When Szent-Gyorgyi was on his deathbed, at the age of 93, Linus Pauling flew from California to Szent-Gyorgyi's home at Woods Hole, Massachusetts, to say goodbye. Holding his hand, Linus said wistfully, "You know, Albert, I always thought that someday we two would work together." Szent-Gyorgyi looked up and said, humorously, "Well, if not in this life, then maybe in the next." Pauling himself died a few years later, also at age 93. They were two of the greatest thinkers of the 20th century and it was one of the great privileges of my life to know them both. I like to think of the two of them smiling down at this latest development in the fascinating saga of this amazing chemical.

To find out more about the Kansas clinical trial of vitamin C, contact: Jeanne Drisko, MD, Associate Professor; Program Director, Program in Integrative Medicine; Functional Medicine and Complementary and Alternative Therapies; University of Kansas Medical Center, Kansas City, Kansas 66160 USA; 913-588-6208; jdrisko@kumc.edu.

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