IV vitamin C and cancer

Are you considering high dose IV vitamin C as a cancer treatment? An analysis of the research.

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When I got a cold growing up or woke up with a stuffy nose, my parents would always bring me a glass of orange juice and tell me to take vitamin C. I continued this ritual in college to ward off getting sick during finals week. And whenever I was about to take a trip on a plane, I would always take Airborne, a vitamin cocktail which contained high doses of vitamin C. The reason why I and almost everyone I knew took vitamin C when we got sick was because we knew it would help us get rid of the cold.

The problem is, it doesn't.

Vitamin C (also known as ascorbate or ascorbic acid) is widely used by alternative medical practioners as an alternative treatment and you can even find it at your local grocery store. Many other supplements have carved their way into the market with similar claims. Like the previously mentioned dietary supplement called Airborne. Some of you may recall that it was created by a school teacher in the 90s and the product claimed to cure or prevent the common cold. But in 2006 the company was sued for tens of millions of dollars for false advertising as there was no scientific evidence to back up the companies claims. Airborne doesn't actually cure anything! And research finds that even vitamin C by itself does not treat or prevent the common cold either. As enticing as many of these products can be, they are mostly just good marketing. But how did this myth with vitamin C get started and what does it have to do with cancer?

This misinformation can largely be attributed to Linus Pauling, who was a genius chemist. He's the only scientist in history to be granted **two** solo Nobel prizes and was considered America's scientist celebrity if you will. So to say he was well respected and considered highly credible is an understatement. But in the 70s he became obsessed with living forever and he went vitamin crazy. He began claiming that massive doses of vitamin C cured the common cold, prolonged your life, and even cured cancer—he convinced everyone that vitamin C was like magic. He even believed that heart disease could be treated and cured only with vitamin C and lysine without the use of drugs or even surgery. And because he had a celebrity status nearly everyone trusted him. People thought if Linus Pauling was saying it, then it must be true.

In 1970, Pauling began taking 3,000 mg of vitamin C per day to prevent colds (which is much higher than is recommended to take). Becoming convinced and excited from his own personal experience, the same year he wrote his book Vitamin C and the Common Cold,where he

encouraged Americans to consume the same dose of vitamin C each day. Within a few months of his books publication vitamin C sales were soaring!

At the time we knew that vitamins were various micronutrients we only needed in tiny amounts that were essential for our bodies to function normally. Most of us get plenty in our diets, but we often hear getting more vitamins is even better. And that's what was beginning to be hypothesized about cancer then, that more might actually be protective against the disease.

Soon after Pauling's book was published, a Scottish surgeon named Ewan Cameron, also hypothesized that ascorbate could have anti-cancer action. In 1971 the two teamed up to study cancer patients taking high doses of the vitamin. Together the two wrote many technical papers and published the book Cancer and Vitamin C, which discussed their observations. Within no time vitamin C became popularized from Pauling's books, talks, and even more so when he formed his own institute in 1973, to conduct experiments in order to "prove his ideas". Then in the late 70s, Pauling and Cameron published two papers (here and here) where they reported that a majority of 100 terminal cancer patients who were treated with a mega dose of 10,000 mg vitamin C per day survived 3 to 4 times longer than patients who were not treated.

But in 1978 findings from research of Pauling's colleague, Author Robinson (a biochemist), found that vitamin C at doses recommended by Pauling might actually increase the rate of tumor growth in mice. Robinson was a prior student and long time associate of Pauling. He even helped to found the institute and became its first president. Robinson found that mice were contracting skin cancer almost twice as frequently as the control group. And only the doses that were nearly lethal had any protective effect.

When Robinson reported to Pauling, he was asked to resign from the institute and his data was destroyed. Pauling had sharp criticism of Robinson stating his research was inadequate and amateurish. But then Robinson responded by suing the institute. The suit was settled out of court in 1983 for ~$575,000. Over a decade later Robinson and a few of his colleagues summarized the results from his prior work, reporting that vitamin C in normal to high doses accelerated the growth of squamous cell carcinoma in these mice. Meanwhile, Pauling was still promoting that 75% of all cancer could be prevented or cured by vitamin C alone.

With so much controversy, these studies were re-evaluated in the early 80s and have since been heavily criticized for the lack of standardization of key factors as Pauling was not a clinician and had no experience using a clinical trial design. Scientists also found the patient groups that he was using were not comparable as the vitamin C group was less sick. His papers were also published in non-clinical journals. But given that he had won two Nobel Prizes, Pauling was a member of the National Academy of Sciences. This meant that he could contribute papers to Proceedings of the National Academy of Sciences (PNAS) journal as he saw fit and in essence he could pick his reviewers. Normally having this ability would not have been a huge problem because in order to be a member of the PNAS was so so incredibly difficult—only the most prestigious scientists were invited to join. This journal is still extremely prestigious and most of the papers selected are high quality. Submissions today however are much more rigorous as they no longer allow members to

automatically publish their own papers.

Scientific findings

With influence from Pauling and Cameron's prior studies, other scientists and organizations followed suit to investigate the topic further. Some studies used animal experiments and found that pharmacologic concentrations of ascorbate did kill a number of cancer cell types, while at the same time not harming normal cells, and also decreased tumor growth in mice. But humans are not mice and unfortunately we don't always have the same responses. Human cell studies and animal studies are often good models to start with. If positive results are found, then studies will usually progress to humans.

Eventually three different randomized trials, in humans, using the same dose of high-dose ascorbic acid (vitamin C) used by Pauling and Cameron to treat cancer were carried out by the Mayo Clinic. The first study was published in 1979 in the New England Journal of Medicine finding that vitamin C was no better than placebo and found no benefits of any kind from the vitamin C. Pauling was not pleased to say the least. Pauling could not tolerate data that went against his belief of the vitamin. He eventually wrote a letter to the editor and complained that most of the patients in the study had a prior history of cancer therapy claiming that this meant they were immunologically compromised. He believed that high-dose vitamin C somehow boosted the immune system and he believed that it was an unfair trial despite his own studies including patients that had received standard therapy of chemo, radiation, and surgery. He also stated that these conclusions were deliberate misrepresentation and fraud. Pauling also criticized the Mayo Clinics studies for having a short trial and felt the cancer patients needed to take the vitamin C for life. He also said that the studies used oral instead of IV vitamin C, despite this being the same protocol Pauling used in his original study. The results were publicly debated at length between Pauling and Moertel (the lead author of the Mayo Clinic studies), with accusations of misconduct and scientific incompetence by both scientists.

But then another randomized double blind study followed and they too failed to find benefit in cancer patients from high-dose oral vitamin C. The failure of many studies to demonstrate any benefit resulted in the medical establishment conclusion that vitamin C was not effective in treating cancer or colds. Vitamin C is known for its anti-oxidant activity, but it is only one antioxidant out of many. In vitro (research taking place in a test tube) evidence suggests that vitamin C functions as an antioxidant in low concentrations, but the opposite may be true in high doses. It may act as a pro-oxidant in high doses and the mechanism that is not fully understood. Taking too many vitamins can actually make you sick. This was demonstrated by two research studies that found there were adverse reactions with high-dose IV vitamin C, such as diarrhea and even renal (kidney) failure and the studies had to be discontinued.

Following the research failing to show that oral vitamin C had an anti-tumor effect, the research shifted to IV vitamin C (as Pauling and Cameron also studied this form of the vitamin). Some scientists said that the human body keeps a pretty tight control over the blood concentration of

vitamin C and that it was not possible to get to a concentration that Pauling was recommending through oral dosing alone. Many other studies investigating oral and IV ascorbic acid treatments have not found this therapy to be beneficial as a cancer treatment. One of the prior facilities I worked at (Cancer Treatment Centers of America) even conducted a study, but there were no substantial outcomes found as a cancer treatment. Even a more recent review of cancer patients receiving oral vitamin C doses has demonstrated no anti-cancer benefit and only recommends its use in clinical trials.

Overall, the current research findings, it's unlikely that vitamin C does have an anti-anti-tumor effect, but even if it did, it would likely be a tiny benefit. Now scientists are studying if it may boost the effectiveness of certain cancer therapies. So far some studies have shown that high-dose IV vitamin C may help improve quality of life and may decrease some cancer treatment side effects (here and here). Conversely, some clinical trials had to be stopped early as they found that patients were experiencing severe side effects from the vitamin C itself. And other studies are finding that high-dose vitamin C might actually interfere with some cancer treatments. Thus far there is still no strong evidence that vitamin C can cure cancer by itself and a recent review of the literature on IV vitamin C from 2015 finds the same even when used concurrently with chemotherapy.

Take home message

The concept of high-dose vitamin C treating diseases likely would not have been taken so seriously for such a long duration of time if Pauling were not such a well respected scientific figure. But many studies have shown that Pauling was very wrong and there are no medical bases for his claims. And in 1994 he actually died of cancer—the disease in which he claimed vitamins could cure.

Antioxidants, like vitamin C, can become pro-oxidants when administered in high doses and it's not a well understood mechanism. High doses may also interfere with chemotherapy or radiation therapy. Initial human studies had some promising results, but these studies were found to be flawed. Vitamin supplements unfortunately don't cure colds, don't prolong your life, and in some cases they have actually been found to be harmful (which I talked about briefly here). Alternative therapies certainly can have their appeal for many, but it's important to remember that alternative therapies are either therapies that have been disproven or have yet to be proven. And that is a gamble to your health. Medicine (which can be natural or synthetic) becomes medicine once rigorous testing demonstrates its effectiveness. I've also written extensively about the topic here. Certainly the choice is yours alone to make, but it's good to have all of the facts. Personally I recommended getting your vitamin C from food by eating lots of produce!

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