

## Intravenous Vitamin C Therapy with Cancer Patients

Cancer patients are more likely to suffer from vitamin C deficiency due to some of the effects of cancer and the treatments that are typically introduced throughout the course of the disease. Cancer tends to increase inflammation and infection, and treatments include radiation, chemotherapy, and surgery. Some studies also indicate that cancer patients have a lower oral consumption of vitamin C. All of these factors result in an increased likelihood for vitamin C deficiency.

Vitamin C has been used in the supportive treatment of cancer patients for decades with some degree of controversy. Low plasma vitamin C concentrations have been found to be linked to shorter survival and a lower quality of life in cancer patients. Many studies show an improvement in symptoms and quality of life with the introduction of vitamin C through intravenous delivery. The controversy stems from a lack of quality studies to demonstrate both effectiveness in decreasing cancer treatment side effects while not interfering with the ultimate goal of chemotherapy.

## Background

Vitamin C, or ascorbate acid, is an essential nutrient for the biosynthesis of collagen, L-carnitine, and neurotransmitters. Vitamin C also increases absorption of dietary iron sources. It helps metabolize tyrosine and maximizes the hormones cholecystokinin, oxytocin, vasopressin, and alpha-melanotropin. It is necessary to maintain normal levels of vitamin C in humans to prevent deficiency and disease.

Current recommended daily allowance (RDA) for vitamin C is 60 mg/d. That is twice the amount needed to prevent deficiency as well as the amount needed before excess is excreted in the urine. The RDA accounts for absorption, loss of the vitamin during food prep, and depletion. The new proposed RDA is 200 mg/d and that is still too low for people suffering from an illness. Humans are unable to synthesize vitamin C, so it is very important that it is prevalent in the diet or with supplementation, especially for those who are sick.

Oral intake of vitamin C during periods of illness has been linked to a quicker recovery. One study showed that 1,000 mg of vitamin C for 6 hours and then 3 times per day thereafter were shown to have a significant reduction in viral and bacterial infection symptoms.

Ascorbate is a vitamin that is water-soluble and derived from glucose. It is transported via circulation. This means that vitamin C is easily acquired and transported but it is not stored in large quantities. Humans store between 300 mg and 2 g of vitamin C and rely on dietary intake to maintain normal levels. During sickness, vitamin C is utilized more quickly, so those individuals are more prone to deficiency.

The purpose of introducing vitamin C during cancer treatment originates from the physiology of the nutrient in the body. Ascorbate primarily acts as an antioxidant. Vitamin C places stress on cancer cells when it is present in concentrations of 1 mM or above. The result is cell cycle arrest, decreased ATP levels, compromised mitochondrial function, suppression of antioxidant gene expression, and cell death.

## Vitamin C Deficiency

Vitamin C deficiency occurs more frequently in patients with chronic disease, depression, with those who are hospitalized, post-op, and smokers. Cancer patients in advanced stages show lower levels of vitamin C than those early in the onset of disease. Scurvy occurs within 1-3

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