Intravenous Vitamin C

Key Features

» Intravenous vitamin C administration in studies has shown significant reductions of complaints induced by cancer and chemoradiotherapy, in particular: nausea, loss of appetite, fatigue, depression, sleep disorders, dizziness and blood count disorders*

» Ascorbic acid (vitamin C) is selectively cytotoxic to cancer cells*

» The blood levels necessary to kill cancer cells are only achievable through intravenous administration, not through oral dosing*

* Studies of intravenous vitamin C have shown it to be remarkably safe*

*These statements have not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease.
ABSTRACT: BACKGROUND: An inflammatory component is present in the microenvironment of most neoplastic tissues. Inflammation and elevated C-reactive protein (CRP) are associated with poor prognosis and decreased survival in many types of cancer. Vitamin C has been suggested as having both a preventative and therapeutic role in a number of pathologies when administered at much higher-than-recommended dietary allowance levels. Since in vitro studies demonstrated inhibition of pro-inflammatory pathways by millimolar concentrations of vitamin C, we decided to analyze the effects of high dose IVC therapy in suppression of inflammation in cancer patients. METHODS: 45 patients with prostate cancer, breast cancer, bladder cancer, pancreatic cancer, lung cancer, thyroid cancer, skin cancer and B-cell lymphoma were treated at the Riordan Clinic by high doses of vitamin C (7.5 g -50 g) after standard treatments by conventional methods. CRP and tumor markers were measured in serum or heparin-plasma as a routine analysis. In addition, serum samples were collected before and after the IVCs for the cytokine kit tests. RESULTS: According to our data positive response to treatment, which was demonstrated by measurements of C-reactive protein, was found in 75% of patients and progression of the inflammation in 25% of patients. IVC treatments on all aggressive stage cancer patients showed the poor response of treatment. There was correlation between tumor markers (PSA, CEA, CA27.29 and CA15-3) and changes in the levels of C-reactive protein. Our test of the effect of IVC on pro-inflammatory cytokines demonstrated that inflammation cytokines IL-1alpha, IL-2, IL-8, TNF-alpha, chemokine eotaxin and CRP were reduced significantly after treatments. CONCLUSIONS: The high dose intravenous ascorbic acid therapy affects C-reactive protein levels and pro-inflammation cytokines in cancer patients. In our study, we found that modulation of inflammation by IVC correlated with decreases in tumor marker levels. In summary, our data support the hypothesis that high dose intravenous ascorbate treatments may reduce inflammation in cancer patients. Our results suggest that further investigations into the use of IVC to reduce inflammation in diseases where inflammation is relevant are warranted.

Ascorbic acid and its salts (AA) are preferentially toxic to tumor cells in vitro and in vivo. Given in high enough doses to maintain plasma concentrations above levels that have been shown to be toxic to tumor cells in vitro, AA has the potential to selectively kill tumor cells in a manner similar to other tumor cytotoxic chemotherapeutic agents. Most studies of AA and cancer to date have not utilized high enough doses of AA to maintain tumor cytotoxic plasma concentrations of AA. Data are presented which demonstrate the ability to sustain plasma levels of AA in humans above levels which are toxic to tumor cells in vitro and suggests the feasibility of using AA as a cytotoxic chemotherapeutic agent.


AIM: The aim of the study was to evaluate under praxis conditions the safety and efficacy of intravenous (i.v.) vitamin C administration in the first postoperative year of women with breast cancer. PATIENTS AND METHODS: Epidemiological multicentre cohort study, including 15 gynaecologists and general practitioners representatively distributed in Germany. Data from 125 breast cancer patients in UICC stages IIa to IIIb were selected for the study. A total of 53 of these patients were treated with i.v. vitamin C (supplied as Pascorbin(R) 7.5 g) additional to standard tumour therapy for at least 4 weeks (study group) and 72 without this additional therapy (control group). Main outcome measures were efficacy in regard to outcome and severity of disease- or therapy-induced complaints during adjuvant chemo- and radiotherapy and aftercare. RESULTS: Comparison of control and study groups revealed that i.v. vitamin C administration resulted in a significant reduction of complaints induced by the disease and
chemo-/radiotherapy, in particular of nausea, loss of appetite, fatigue, depression, sleep disorders, dizziness and haemorrhagic diathesis. After adjustment for age and baseline conditions (intensity score before adjuvant therapy, chemotherapy, radiotherapy), the overall intensity score of symptoms during adjuvant therapy and aftercare was nearly twice as high in the control group compared to the study group. No side-effects of the i.v. vitamin C administration were documented.

**DISCUSSION:** Oxidative stress and vitamin C deficiency play an important role in the etiology of adverse effects of guideline-based adjuvant chemo-/radiotherapy. Restoring antioxidative capacity by complementary i.v. vitamin C administration helps to prevent or reduce disease-, or therapy-induced complaints in breast cancer patients. **CONCLUSION:** Complementary treatment of breast cancer patients with i.v. vitamin C was shown to be a well tolerated optimization of standard tumour-destructive therapies, reducing quality of life-related side-effects.


The antioxidant perhaps most widely used in complementary oncology is vitamin C, particularly by intravenous injection. In light of the recent clinical pharmacokinetic findings, the in vitro evidence of anti-tumour mechanisms and some well-documented cases of advanced cancers the role of high-dose intravenous vitamin C therapy in cancer treatment should be reassessed. High dose intravenous vitamin C therapy may have benefits in patients with advanced cancers, and cancers with poor prognosis and limited therapeutic options, but further clinical studies regarding the safety and efficacy of this therapy are necessary, especially in Germany.


There is a strong advocacy movement for large doses of vitamin C. Some authors argue that the biological half-life for vitamin C at high plasma levels is about 30 minutes, but these reports are the subject of some controversy. NIH researchers
established the current RDA based upon tests conducted 12 hours (24 half lives) after consumption. The dynamic flow model refutes the current low-dose recommendations for dietary intakes and links Pauling’s mega-dose suggestions with other reported effects of massive doses of ascorbate for the treatment of disease. Although, a couple of controlled clinical studies conducted at The Mayo Clinic did not support a significant benefit for terminal cancer patients after 10 grams of once-a-day oral vitamin C, other clinical trials have demonstrated that ascorbate may indeed be effective against tumors when administered intravenously. Recent studies confirmed that plasma vitamin C concentrations vary substantially with the route of administration. Only by intravenous administration, the necessary ascorbate levels to kill cancer cells are reached in both plasma and urine. Because the efficacy of vitamin C treatment cannot be judged from clinical trials that use only oral dosing, the role of vitamin C in cancer treatment should be reevaluated. One limitation of current studies is that pharmacokinetic data at high intravenous doses of vitamin C are sparse, particularly in cancer patients. This fact needs prompt attention to understand the significance of intravenous vitamin C administration. This review describes the current state-of-the-art in oral and intravenous vitamin C pharmacokinetics. In addition, the governmental recommendations of dose and frequency of vitamin C intake will also be addressed.


To the Editor: For more than 30 years, the medical profession has had lingering questions about the efficacy of vitamin C in cancer therapy. Initial clinical reports and early preclinical studies indicated that vitamin C administered intravenously may have potential anticancer benefits. Yet, few definitive clinical reports supporting this finding have been published. Thus, in October 2006, Cancer Treatment Centers of America (CTCA) initiated a US Food and Drug Administration–approved phase study of intravenous vitamin C for patients with solid tumors who have exhausted all other
available treatments. The investigators include an osteopathic internist (C.M.S.), a medical oncologist (R.D.L.), and a clinical epidemiologist (C.G.L.).

High doses (30 g/m2 to 130 g/m2) of vitamin C are used to achieve blood levels greater than the 20 mM that have been reported to be cytotoxic to tumor cells grown in hollow fibers. Neil H. Riordan, PA-C, and colleagues, reported that vitamin C infusions of 60 g resulted in brief blood level elevations to 24 mM. Blood levels are only elevated 0.2 mM when vitamin C is given orally. In the CTCA study, the first cohort of 3 patients is being treated with 30 g/m2—approximately 50 g for an average-sized individual—vitamin C infusions on 4 consecutive days per week for a period of 4 weeks.

Doses of vitamin C will be increased incrementally in future cohorts until the maximum tolerated dose is reached. Our goal is to have six dose escalations involving 18 patients. We are attempting to determine the safety, tolerability, optimum therapeutic dose, and pharmacokinetic profile of intravenous vitamin C, in addition to evaluating patient quality of life during treatment. We will also assess patients’ tumor burden for preliminary indications of intravenous vitamin C anticancer activity. Information from this study may provide the basis for a phase 2 trial of intravenous vitamin C.

The phase 1 clinical trial is open for accrual. As of February, 3 patients in the first cohort had completed their 4-week series of vitamin C infusions. One of these patients, whose disease was in stable condition, wanted to continue the vitamin C infusions and is currently on a continuation protocol. We are actively recruiting the second cohort of 6 patients. The current study should resolve some critical unanswered questions about the efficacy of vitamin C in cancer care.


Early clinical studies showed that high-dose vitamin C, given by intravenous and oral routes, may improve symptoms.
and prolong life in patients with terminal cancer. Double-blind placebo-controlled studies of oral vitamin C therapy showed no benefit. Recent evidence shows that oral administration of the maximum tolerated dose of vitamin C (18 g/d) produces peak plasma concentrations of only 220 micromol/L, whereas intravenous administration of the same dose produces plasma concentrations about 25-fold higher. Larger doses (50-100 g) given intravenously may result in plasma concentrations of about 14,000 micromol/L. At concentrations above 1000 micromol/L, vitamin C is toxic to some cancer cells but not to normal cells in vitro. We found 3 well-documented cases of advanced cancers, confirmed by histopathologic review, where patients had unexpectedly long survival times after receiving high-dose intravenous vitamin C therapy. We examined clinical details of each case in accordance with National Cancer Institute (NCI) Best Case Series guidelines. Tumour pathology was verified by pathologists at the NCI who were unaware of diagnosis or treatment. In light of recent clinical pharmacokinetic findings and in vitro evidence of anti-tumour mechanisms, these case reports indicate that the role of high-dose intravenous vitamin C therapy in cancer treatment should be reassessed.


Case studies suggest that vitamin C, given intravenously at doses of 10-100 grams/day can improve patient well being and in some cases, reduce tumor size. While ascorbate is generally considered safe, clinical data on high intravenous doses is limited. Twenty-four late stage terminal cancer patients were given continuous infusions of 150 to 710 mg/kg/day for up to eight weeks. Blood chemistry and blood count profiles were obtained at roughly one-week intervals while patient health, adverse events and tumor progression were monitored. The majority of patients were vitamin C deficient prior to treatment. Intravenous infusions increased plasma ascorbate concentrations to a mean of 1.1 mM. The most common adverse events reported were nausea, edema, and dry mouth or skin; and these were generally minor. Two Grade 3 adverse events ‘possibly related’ to the agent were reported: one patient with a history of renal calculi developed a kidney stone after thirteen days of treatment and another
patient experienced hypokalemia after six weeks of treatment. White blood cell counts were stable while hemoglobin and hematocrit levels dropped slightly during treatment, consistent with trends observed prior to therapy. Blood creatinine, BUN, glucose, and uric acid concentrations decreased or remained stable during therapy, suggesting that ascorbate infusions did not adversely affect renal function. One patient had stable disease and continued the treatment for forty-eight weeks. These data suggest that intravenous vitamin C therapy for cancer is relatively safe, provided the patient does not have a history of kidney stone formation.


A series of seven cases are presented in which intravenous vitamin C has been used as antineoplastic agent in the treatment of different types of cancers. The cancers cases reviewed are the following: Renal cell carcinoma (2), Colorectal cancer (1), Pancreatic cancer (1), Non-Hodgkin’s lymphoma (2) and breast cancer (1). Toxic reactions were not observed at these high doses of intravenous Vitamin C. All patients were pre-screened for Glucose 6--phosphate dehydrogenase deficiency before administering intravenous Vitamin C in order to prevent hemolysis.