



CASE REPORT

# High Dose IV Vitamin C and Metastatic Breast Cancer: A Case Report

Author(s): Michael J. Gonzalez, DSc, NMD, PhD, FACN<sup>1</sup>; Miguel J. Berdiel, MD<sup>2</sup>; Amanda V. Cintrón, BS<sup>3</sup>

<sup>1</sup>University of Puerto Rico, Medical Sciences Campus, School of Public Health; <sup>2</sup>Berdiel Clinic, Ponce, PR; <sup>3</sup>Comprehensive Cancer Center, San Juan, PR.

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## Abstract

Breast cancer is the most common cancer in females in the United States, and is the second cause of cancer-related deaths among females, after lung cancer. In Puerto Rico breast cancer is the second leading cause of death in females. This is a case of a 52-year-old patient with a diagnosis of metastatic breast adenocarcinoma. The patient arrived in our clinic after having difficulty with her chemotherapeutic regime. Positive outcomes were obtained after three months of treatment with high doses of intravenous vitamin C infusions. Studies with high dose vitamin C have shown cytotoxic and anti-metastatic activity on various cancer types mainly by its action as a pro-oxidant agent. Based on the outcomes obtained in this clinical case, we recommend continuing studying the role of intravenous infusion of high dose vitamin C, as an adjuvant treatment for breast cancer.

## Introduction

Metastatic breast cancer (MBC) is also referred to as advanced breast cancer, secondary tumors, or stage four breast cancer, is a stage of breast cancer where the disease has spread to distant sites beyond the axillary lymph nodes. There is no cure for metastatic breast cancer. Nearly 30% of women initially diagnosed with breast cancer will eventually develop recurrent advanced or metastatic disease (Hayat, Howlader, Reichman, & Edwards, 2006). Long-term survival is very rare with only 2% of patients surviving more than 20 years after the initial diagnosis of MBC. Metastatic breast cancer cells frequently differ from the primary breast cancer in properties such as receptor status. The cells have often developed resistance to several lines of previous treatment and have acquired special properties that permit them to metastasize to distant sites. Distant metastases are the cause of about 90% of deaths due to breast

cancer (Fouad et al., 2005). Treatment of metastatic breast cancer depends on location of the metastatic tumors and includes surgery, radiation, chemotherapy, biological, and hormonal therapy. Here, we present a case of a 52-year-old woman who was diagnosed with MBC seven years after the initial diagnosis of stage one, estrogen receptor (ER)-positive BC.

There are many studies where intravenous Vitamin C has been very effective in treating various types of cancer (Riordan, Riordan, & Casciari, 2000; Jackson, Riordan, Hunninghake, & Riordan, 1995; Padayatty, et al., 2006; Duconge et al., 2007; Gonzalez, Miranda-Massari, Duconge, & Berdiel, 2015; Gonzalez et al., 2005; Riordan, Jackson, & Schultz, 1990; Gonzalez, & Miranda-Massari, 2014). Studies have shown that post intravenous vitamin C plasma at levels of 350 to 400 mg/dL have been very toxic to human cancer cells. Vitamin C also increases collagen production and enhances the immune system activity. It has been demonstrated that high dose intravenous vitamin C has given many cancer patients the opportunity to improve their quality of life (Riordan, Riordan, & Casciari, 2000; Jackson, Riordan, Hunninghake, & Riordan, 1995; Padayatty, et al., 2006; Duconge et al., 2007; Riordan, Jackson, & Schultz, 1990).

### Case Presentation

The patient is a 52-year-old woman (non-smoker) who was diagnosed with ER-positive, progesterone receptor (PR)-positive, T2N0M0 stage 1 (Tumor, Node, Metastasis) BC at the age of 45. She underwent right-sided modified radical mastectomy (MRM) and received no further adjuvant treatment including chemotherapy, radiotherapy, or antiestrogen therapy. She had right breast reconstruction surgery with a silicone implant three years later. Her medical history showed no medical condition previous to cancer. She had been asymptomatic and physical examination was normal until she presented with a small lump on her right breast lower out quadrant. The examination showed a right-sided pleural effusion with multiple sub-centimeter pulmonary nodules and a pleural biopsy confirmed metastatic disease consistent with a breast primary (ER-/PR-positive). Her disease was stable on tamoxifen and anastrozole (Arimidex; AstraZeneca Pharmaceuticals) for six years (three years treatment for each). Six years after the initial diagnosis of her BC, she presented with new liver masses. A biopsy showed adenocarcinoma in liver parenchyma, consistent with metastatic breast carcinoma, ductal type, low nuclear grade, Nottingham histologic grade 1 (4/9 score). Tumor markers alkaline phosphatase (ALP), Carcinoembryonic antigen (CEA) and Carcinoma Antigen 15-3 (CA 15-3) were all high (750 IU/L, 25 ng/mL, 517 U/mL, respectively). The tumor cells were positive for ER and negative for Human Epidermal growth factor Receptor 2 (HER2) by immunohistochemistry. Her pulmonary and bone metastasis remained stable. Therefore, she was started on palliative chemotherapy with single-agent capecitabine (Xeloda, Bristol-Myers Squibb Company; 1500 mg, Per Os (PO), orally) daily, divided into two doses. The treatment was discontinued after the second cycle upon patient's request owing to grade two hand and foot syndrome.

At this time she decided to try a high dose intravenous vitamin C protocol. The patient started the intravenous vitamin C treatment after a Glucose 6 Phosphate Dehydrogenase (G6PD) test to assure no adverse red blood cell reaction will occur to the high dose vitamin C. She initially received three different doses of vitamin C the first week. The first dose was 25 g of vitamin C (sodium ascorbate) in 250cc Ringer's lactated solution during one hour infusion. The second infusion was 50 g of vitamin C in 500 cc of Ringer's lactated solution over a period of 1.5 hr. The third infusion was 75 g of vitamin C in 1,000 mL of Ringer's lactated solution over a period of 2 hrs. A maximum of 75 g of vitamin C in 1,000 mL Ringer's lactated solution was given three times a week over a period of 6 months. No other treatment was given during intravenous (IV) vitamin C therapy.

The patient showed improvement after receiving high dose IV vitamin C infusions for three months by decreasing tumor marker levels Alkaline Phosphatase (ALP), CarcinoEmbryonic Antigen (CEA) and Cancer Antigen 15-3 (CA 15-3) (140 IU/L, 7.0 ng/mL, 30 U/mL, respectively). A whole body Positron emission tomography-computed tomography (PET/CT) study was performed after six months of IV vitamin C therapy. The liver appeared enlarge with diffuse FluoroDeoxyGlucose (FDG) activity. No focal areas of abnormal FDG uptake were noted within the hepatic parenchyma. The spleen, adrenal glands and visualized pancreatic portions demonstrate no area of abdominal FDG uptake. According to the PET/CT impression "no hypermetabolic foci to suggest F-18 FDG avid active neoplastic process or metastatic disease at present time." In relation to bone and lung, a resolution of metastasis was observed suggesting remission of the disease. No adverse side effects were reported by the patient during and after the intravenous vitamin C treatment. At this moment, the patient is still alive and enjoying activities of daily living.

## Discussion

A vast number of publications confirm that vitamin C (ascorbic acid, AA) possess many therapeutic benefits for cancer patients as improving the quality of life, reducing pain, increasing energy, increasing appetite, and reducing complications of the disease, among other benefits (Gonzalez & Miranda- Massari, 2014). High doses of intravenous vitamin C have demonstrated promising results in the treatment of different types of cancer in every stage. Some studies in vitro show that high doses of vitamin C produce hydrogen peroxide, which is very toxic to tumor cells which lack the necessary enzymes (catalase and glutathione peroxidase) to metabolize it (Riordan, Riordan & Casciari, 2000). Also Padayatty et al., (2006) suggested that a high plasma concentration of vitamin C (14, 000  $\mu$  mol/L) acts as a powerful pro-oxidative agent for the formation of hydrogen peroxide in extracellular fluid which is very toxic to the cancer cells. One of the greatest advantages of vitamin C is its similar molecular structure with glucose. Normally, cancer cells have an increased requirement for glucose, and therefore there is an increase in glucose transporters in cancer cell membranes. This action enhances and favors the entrance of vitamin C into the cancer cell and facilitates the action of ascorbate as a selective, nontoxic chemotherapeutic agent that slows tumor growth (Gonzalez et al., 2005).

This treatment has given the opportunity to many patients to increase their survival time and their quality of life. It also provides an alternative to those patients whom cannot withstand a chemotherapeutic regime. There are case reports describing patients with lung cancer, who began to receive high doses of IV vitamin C, living up to 10 years after diagnosis (Riordan, Riordan, & Casciari, 2000). On the other hand, there is a case report of a patient diagnosed with adenocarcinoma of his right kidney with metastatic lesions in the liver and lung, received IV vitamin C treatment and after 15 months of initial therapy the patient had no signs of progressive cancer and remained cancer free for 14 years (Riordan, Jackson, & Schultz, 1990). There are studies that show that vitamin C acts as a potential chemotherapeutic agent (Riordan, Riordan, & Casciari, 2000; Jackson et al., 1995; Padayatty, et al., 2006; Duconge et al., 2007; Gonzalez, et al., 2015; Gonzalez et al., 2005; Riordan, Jackson, & Schultz, 1990; Gonzalez, & Miranda- Massari, 2014). Compared with some chemotherapeutic drugs that cause many severe adverse side effects, vitamin C provides positive side benefits such as enhancing immune function and increasing collagen production and energy (Gonzalez et al., 2015; Gonzalez et al., 2005; Gonzalez, & Miranda- Massari, 2014). It has been reported that a vitamin C plasma level above 400 mg/dL is toxic to tumor cells (Duconge et al., 2007). This concentration of vitamin C can be achieved in humans utilizing IV vitamin C infusions periodically (every other day, 3x a week).

## Conclusion

Over the years, more and more studies have been published that confirms the effectiveness of Vitamin C as a non-toxic chemotherapeutic agent. Our case supports that high dose intravenous vitamin C can be used effectively as an adjuvant therapy in the management of patients with breast cancer with improvement in the quality of life and disease outcomes. Based on the presented clinical case and the positive outcomes obtained, we recommend to continue studying the role of intravenous infusion of high dose vitamin C as a possible adjuvant treatment for cancer in any stage.

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