# Intravenously administered vitamin C as cancer therapy: three cases. Canadian Medical Association.

March 28, 2006 vol. 174 no. 7 937-942

### Abstract

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 μmol/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 μmol/L. At concentrations above 1000 μmol/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.

Conclusion:

The cases reported here are of tumours confirmed by histopathologic examination to have poor prognosis but that instead had long clinical remissions. Most previous case reports lacked independent pathologic confirmation of the tumour and did not follow the NCI Best Case Series guidelines, which makes their interpretation difficult. Recent findings show that only high-dose intravenous, but not oral, vitamin C therapy results in very high plasma vitamin C concentrations (e.g., 14 000 μmol/L). At these concentrations, the vitamin is toxic to some cancer cells, possibly because at these concentrations the vitamin is a pro-drug for hydrogen peroxide formation in extracellular fluid. Accumulated data confer some degree of biological and clinical plausibility to the notion that high-dose intravenous vitamin C therapy may have anti-tumour effects in certain cancers. When all available data are considered, further clinical study as to safety and efficacy of intravenous vitamin C is warranted.

1. [Sebastian J. Padayatty](http://www.cmaj.ca/search?author1=Sebastian+J.+Padayatty&sortspec=date&submit=Submit),
2. [Hugh D. Riordan](http://www.cmaj.ca/search?author1=Hugh+D.+Riordan&sortspec=date&submit=Submit),
3. [Stephen M. Hewitt](http://www.cmaj.ca/search?author1=Stephen+M.+Hewitt&sortspec=date&submit=Submit),
4. [Arie Katz](http://www.cmaj.ca/search?author1=Arie+Katz&sortspec=date&submit=Submit),
5. [L. John Hoffer](http://www.cmaj.ca/search?author1=L.+John+Hoffer&sortspec=date&submit=Submit),
6. [Mark Levine](http://www.cmaj.ca/search?author1=Mark+Levine&sortspec=date&submit=Submit)
7. **Correspondence to:**  
   Dr. Mark Levine, Molecular and Clinical Nutrition Section, Bldg. 10, Rm 4D52–MSC 1372, National Institutes of Health, Bethesda MD 20892–1372; [MarkL@mail.nih.gov](mailto:MarkL@mail.nih.gov)