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Vitamin C pharmacokinetics: implications for oral and intravenous use.

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Abstract

BACKGROUND: Vitamin C at high concentrations is toxic to cancer cells in vitro. Early clinical studies of vitamin C in patients with terminal cancer suggested clinical benefit, but 2 double-blind, placebo-controlled trials showed none. However, these studies used different routes of administration.

OBJECTIVE: To determine whether plasma vitamin C concentrations vary substantially with the route of administration.

DESIGN: Dose concentration studies and pharmacokinetic modeling.

SETTING: Academic medical center.

PARTICIPANTS: 17 healthy hospitalized volunteers.

MEASUREMENTS: Vitamin C plasma and urine concentrations were measured after administration of oral and intravenous doses at a dose range of 0.015 to 1.25 g, and plasma concentrations were calculated for a dose range of 1 to 100 g.

RESULTS: Peak plasma vitamin C concentrations were higher after administration of intravenous doses than after administration of oral doses ($P < 0.001$), and the difference increased according to dose. Vitamin C at a dose of 1.25 g administered orally produced mean (+/-sd) peak plasma concentrations of 134.8 +/- 20.6 micromol/L compared with 885 +/- 201.2 micromol/L for intravenous administration. For the maximum tolerated oral dose of 3 g every 4 hours, pharmacokinetic modeling predicted peak plasma vitamin C concentrations of 220 micromol/L and 13 400 micromol/L for a 50-g intravenous dose. Peak predicted urine concentrations of vitamin C from intravenous administration were 140-fold higher than those from maximum oral doses.

LIMITATIONS: Patient data are not available to confirm pharmacokinetic modeling at high doses and in patients with cancer.

CONCLUSIONS: Oral vitamin C produces plasma concentrations that are tightly controlled. Only intravenous administration of vitamin C produces high plasma and urine concentrations that might have antitumor activity. Because 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.

Comment in

Summaries for patients. How vitamin C is administered affects how much reaches the bloodstream and may affect the results of studies of its potential effect on cancer. [Ann Intern Med. 2004]

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