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A cure for miracles

In this issue we publish, in the tolerant space of The Left Atrium, some reflections on miracles (page 382). One of these, an anecdotal account of a spontaneous remission of mitral valve disease, had a rough ride in our editorial offices, where we are inclined to doubt any attribution of a cure to divine intervention. Yet in the popular language of medicine the word "miracle" is used readily enough. We use it when we speak of scientific breakthroughs, impressive new treatments and unexpected observations. Whether the genuine article really exists, it is the apparently miraculous finding that provides the keenest impetus to science.

The unsteady reputation of vitamin C is a case in point. Vitamin C was certainly one of Europe's first alternative therapies: Dutch sailors knew in the 16th century that eating citrus fruits prevented scurvy, even though it wasn't until the 1920s that the active principle was identified. Aside from the determination of a recommended daily allowance (based on the amount needed for an antiscorbutic effect), vitamin C was ignored until Linus Pauling developed an end-of-career (and perhaps terminal) passion about the health effects of this small molecule.¹ He convinced Scottish general surgeon Ewan Cameron and colleagues to try giving high doses of vitamin C intravenously to patients with inoperable malignancies. Cameron reported on 50 patients, albeit in an obscure journal,² and showed that in many cases the tumours appeared to go into remission.

Because of the controversy fuelled by these findings, clinical trials of vitamin C were done. They showed no benefit. Pauling was not satisfied, especially as the trials used much smaller doses of vitamin C and administered it orally. He asked the US National Cancer Institute to review 25 cases in which Pauling claimed there was evidence of

complete cancer remissions in the course of high-dose intravenous vitamin C therapy. After careful deliberation, the panel concluded in 1991 that in each and every case there were alternative explanations for the observed remissions. Spontaneous remissions were possible and, besides, there were no control subjects. Most important, vitamin C as chemotherapy was, well, implausible. There was no known biochemical pathway whereby vitamin C could kill cancer cells. Pauling's passion expired with the report and, ultimately, with his death in 1994.

In the past decade, however, interest in vitamin C has been revitalized with a new understanding of its biochemistry. Ascorbic acid, an antioxidant, is now known to be a specific electron donor for 8 enzymes, and it may have more biologic functions than just preventing scurvy. In this issue, Sebastian J. Padayatty and Mark Levine review these developments and argue that subclinical vitamin C deficiency may be more common than we think (page 353).

On page 351 L. John Hoffer argues that it is also time to re-evaluate vitamin C's possible usefulness in managing cancer. Pointing out errors in the design of the randomized trials of vitamin C therapy published in the 1970s, Hoffer argues that although there are other possible explanations we cannot rule out high-dose intravenous vitamin C as the cause of the remissions in Cameron's patients. Such a thing is no longer implausible. As science advances, so does the potential for a miracle. — *CMAJ*

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