Effect of Ascorbic Acid on Interleukin-2 Secretion By T Lymphocytes in Whole Blood Cultures

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Abstract

The effect of vitamin C on T lymphocyte function is not clear. In-vivo supplementation of vitamin C is found to have a stimulatory effect on T cells while studies in which ascorbic acid was added to T cell cultures show an inhibition of cell function. The study aims to investigate the effect of ascorbic acid on interleukin-2 secretion by T cells in whole blood cultures which better resembles the physiological environment than pure T cell cultures. It was found that ascorbic acid, when added to whole blood cultures at a very high concentration of 1 mM, inhibits interleukin-2 secretion by T cells (p<0.05). However at lower concentrations of 0.25 mM and 0.5 mM significant inhibition was not seen which is contrary to earlier reports in pure T cell cultures. Hence it can be concluded that ascorbic acid inhibits T cell function in-vitro at high concentrations but the effect is relatively less in whole blood cultures compared to pure T cell cultures.

Introduction

Vitamin C is known to have wound healing, immune enhancing and anticarcinogenic effects (1). Though vitamin C is known to have beneficial effects on the immune system, its effect of on T cell function is not very clear. Ascorbic acid is found to have stimulatory effects on T cell function when supplemented in-vivo. In-vivo supplementation of ascorbic acid was found to increase the lymphoproliferative capacity on stimulation by mitogens in guinea pigs (2) and in aged women (3). In another study it was found ascorbic acid supplementation in humans with weekly increasing doses augmented the lymphoproliferative capacity on mitogenic stimulation in all doses tested (4). However, studies in which ascorbic acid was added to cell cultures show an inhibition of T cell function. Viability of purified human T cells was found to decrease and interleukin-2 synthesis inhibited when cells were maintained in culture with ascorbic acid (5). Though pure T cell cultures are a good model to study T lymphocyte function in isolation, they may not replicate the events that happen in the in-vivo environment. Ascorbic acid is a well-known antioxidant (6) but it has been shown that pharmacological concentrations of ascorbic acid generates ascorbate radical and hydrogen peroxide in the extracellular fluid but not in blood (7). Another study reports that ascorbic acid caused production of hydrogen peroxide in the culture medium but not in blood (8). The absence of hydrogen peroxide production in whole blood is probably due to the presence of antioxidant enzymes in the whole blood but not in the medium. Whole blood culture may replicate the in vivo environment in a better way...
the supernatants were aliquoted and frozen. The concentration of IL-2 was measured using a ELISA kit (BD biosciences). Five independent experiments were conducted and all samples were duplicated.

Statistical analysis

The data is expressed as mean±SD. The IL-2 secretion in the control and cultures with different concentrations of ascorbic acid were compared by one way ANOVA and Tukey’s post hoc analysis using SPSS software version 17. p<0.05 was considered significant.

Results

Significant inhibition of IL-2 secretion by T cells in whole blood cultures was found at the highest concentration of ascorbic acid tested (1 mM) (p<0.05). Ascorbic acid did not inhibit IL-2 secretion by T cells at low concentrations (0.125 mM). At higher concentrations of 0.25 mM and 0.5 mM a decrease in IL-2 secretion is seen but it is not found to be significant.

Discussion

The purpose of the present study was to determine

![Graph: Ascorbic acid caused significant inhibition of IL-2 secretion by T cells at high concentration (1 mM) in whole blood cultures. *p<0.05]
Ascorbic Acid and T Cell Function

In the present study ascorbic acid was found to cause significant inhibition of IL-2 secretion at the highest concentration (1 mM). In a previous study vitamin C was found decrease viability, proliferation and cytokine secretion significantly at high concentrations (0.25-0.5 mM) when added to T cell cultures while no change was seen at low concentrations (10). Present study does not show a significant decrease in IL-2 secretion at concentrations of 0.25 mM and 0.5 mM. The results of the present study indicate that ascorbic acid does have an inhibitory effect on T cell function in vitro when present at high concentrations. However the inhibitory effect in whole blood cultures is relatively less when compared to pure T cell cultures. This could be due to the presence of antioxidant enzymes in red blood cells that neutralize the cytotoxic free radicals produced by the oxidation of ascorbic acid. As the concentration of ascorbic acid in culture increases the free radical generation probably overwhelms the antioxidant defense, hence inhibition of cell function occurs.

**Conclusion**

The results of the present study suggest that ascorbic acid inhibits T cell function at high concentrations in vitro but the inhibition appears to be less in whole blood cultures compared to pure T cell cultures.

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**References**