Targeting the Endothelium: Vitamin C as an Adjunct to Resuscitation in Burns, Sepsis, and Trauma

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INTRODUCTION

Trauma, burns, and sepsis evoke a systemic inflammatory response that lead to increased permeability and fluid extravasation. A pivotal mechanism of inflammation is the generation of oxygen radicals and resultant endothelial injury. Vitamin C has the inherent ability as an oxygen scavenger. There is a growing body of data to support its role as an adjunct to mitigate the negative impact of inflammation on organ function.

OBJECTIVES

To review and describe the existing literature supporting the role of Vitamin C as an adjunct for resuscitation in inflammation related to burns, sepsis and hemorrhage.

DISCUSSION

Vitamin C is an electron donor whose function is to simply reduce molecules, including oxygen species. Hence its reputation as an anti-oxidant. It is an important cofactor in catecholamine, collagen, and peptide synthesis, and a “scavenger” of oxygen radicals in the endothelium. Ascorbate has been shown to lessen the morbidity associated with large volume resuscitation in burns, by moderating the inflammatory response and water retention. Thus, the morbidity associated with large volume resuscitation is limited. Consumption of ROS occurs via much needed co-factor production, as well as decreased cellular uptake is a key mechanism of Vitamin C in sepsis, which results in improving micro-vascular flow and end organ perfusion. Recently the results of a phase I safety trial for sepsis revealed, that patients receiving ascorbic acid had significant reductions in Sequential Organ Failure Assessment (SOFA) scores and inflammatory markers compared to the control group. Similar improvements in pressor requirements, vent days and risk of multi-organ failure were noted. Finally, in trauma, hemorrhagic shock is the leading cause of death in individuals between the ages of 5 and 44 and therapy has primarily been focused on controlling bleeding. The emerging role of Vitamin C in traumatic injury is limited primarily to animal studies and human studies for traumatic brain injury. The inflammatory mechanisms of traumatic hemorrhage are similar to burns and sepsis and there is a potential clinically beneficial role of using ascorbate in the acute resuscitation of traumatic injury.

CONCLUSIONS

Vitamin C’s role in minimizing the insult generated by oxygen radicals leads to a notable decrease in vascular permeability, resulting in increased vascular reactivity and more meaningful resuscitation. Studies in septic and burn patients, as well as numerous animal models have shown the overall improvement in hemodynamic parameters and decreased requirement of fluid resuscitation. There is promising early data for trauma resuscitation which may limit fluid requirements and preserve organ perfusion after hemorrhagic shock.

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