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In Vitro Study of Bacterial Growth Inhibition in Concentrated

Sugar Solutions: Microbiological Basis for the Use of Sugar in Treating Infected Wounds

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The use of sugar for the treatment of infected wounds was investigated in *in vitro* experiments with bacteria pathogenic to humans, such as *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*. Studies showed that solutions of appropriate sugar concentration incubated at pH 7.0 and 35°C were lethal to the bacterial species studied. On the basis of these results, it is proposed that an important function of sugar in the treatment of infected wounds is to create an environment of low water activity (a_w), which inhibits or stresses bacterial growth.

Various naturally occurring substances have been used in wound treatment throughout history. Among them, sugar (sucrose), honey (main constituents are glucose, fructose, and maltose), and molasses (main constituents are sucrose and glucose) are the most common. However, it is still uncertain how sugar acts on wounds, as recently reviewed by Forrest (9, 10).

In 1976, Herszage and Montenegro of Buenos Aires began treating wounds with ordinary sugar because of the complicated evolution (despite conventional therapy) and critical condition of two in-patients with postsurgical necrotic cellulitis.

Sugar was used simply on the basis of existing folk therapy. In view of the success obtained, they began using sugar systematically for the treatment of infected wounds. Ordinary granulated sugar (purchased in the supermarket) was used since it was found not to contain any foreign substance with antibacterial properties; the sugar was not mixed with any antiseptic or any other substance with proven or supposed antibacterial action; and antibiotics were not used concurrently. The procedure consisted of (i) wide opening of the wound; (ii) drying of tissues with gauze; and (iii) filling the wound with as much sugar as possible, taking care to fill every cavity, and adding more sugar periodically. Herszage et al. (12) reported 120 cases with infected wounds and other superficial lesions which were treated with sugar with a cure rate of 99.2%. The time for cure varied between 9 days and 17 weeks; however, it was usual for odor and secretion to diminish within 24 h and to disappear after 72 to 96 h of treatment. This report, however, was only a short summary of their findings and did not include hundreds of photographs showing the evolution of cases treated. The patients varied between 3 months and 94 years in age and included 50 females and 70 males, of whom 6 were diabetics.

In most cases treated with sugar, it was observed that wounds were healed without debridement of necrotic tissues or any other surgical procedure except for a complete opening of the wound. After 5 or 7 days, it was possible to remove the necrotic tissue with forceps as if it were a piece of dressing; this process occurred even in wounds contaminated with fecal material.

Diabetic patients showed the same response as others, even in the presence of hyperglycemia.

Glossy protecting covering formed in the wounds, and the resulting cicatrices were unusually resistant. The pH values of all wounds treated with sugar ranged from 6.8 to 7.4. Photo-graphs showing the evolution of wound healing in a representative case treated with sugar are shown in Fig. 1 and 2. For the sake of brevity, only one case is shown here. The work of Herzage et al. (12) was not a controlled study since the dramatic improvement resulting from this treatment initially prevented them, for ethical reasons, from undertaking a randomized controlled study. In spite of this, the accumulated evidence strongly suggests that sugar played a role in the treatment of infected wounds.

We are proposing that an important function of sugar in the treatment of infected wounds is to create an environment of low water activity (a_w) which inhibits or stresses bacterial growth. A low a_w also means high osmotic pressure (π) since both are thermodynamically related ac-766