Wound Management Using Sugar*

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Granulated sugar provides an excellent topical dressing for treating open wounds, especially those wounds that are contaminated. Advantages of using sugar include its rapid antibacterial action, enhanced tissue formation and epithelialization, and accelerated wound healing; it is also readily available and inexpensive.

The use of finely powdered sugar to clean wounds was first reported by Scultetus in 1679, but the mechanism of action was not elucidated until the twentieth century. Many recent reports show excellent results with the use of granulated (table) sugar to treat contaminated wounds.[1–9] Granulated sugar is currently used worldwide to treat human patients with contaminated wounds or infected body cavities, but the cleansing and healing properties of granulated sugar are not widely known in veterinary medicine. For many years, surgeons at the Ontario Veterinary College (OVC), Guelph, Ontario, Canada, have used granulated sugar to treat contaminated wounds in cats and dogs. Animals with these types of wounds often have associated problems, such as pain, shock, or sepsis, and these conditions must be treated appropriately prior to or during wound management.

Sugar therapy is suitable for treating patients with degloving injuries caused by motor vehicle accidents; infected surgical wounds; necrotizing fasciitis due to *Escherichia coli, Pseudomonas aeruginosa, Streptococcus canis*, and other organisms; decubitus ulcers; self mutilation; burns; and other skin defects that require a healthy granulating bed to heal. No adverse effects have been reported with the use of sugar.

HEALING PROPERTIES OF SUGAR

Scientific support for treatment of wounds using granulated sugar is based on the low water content (or high osmolality) that sugar creates in a wound.[1] In addition, because the high osmolarity of sugar draws lymph into a wound, dissolved nutrients within the lymph provide nutrition for regenerating tissue.[10] The water requirements for microorganisms (and all other forms of life) can be defined in terms of water activity (a_w) of substrate.[1] Every microorganism has a limiting a_w below which it cannot grow.[2] When the aqueous solution in the organism's environment is concentrated by the addition of solutes (e.g., sucrose), the effects on microbial growth are mainly due to the change in a_w. The minimum a_w for most bacterial pathogens (e.g., *E. coli, Pseudomonas, Klebsiella, Corynebacterium, Clostridium perfringens*, and other clostridia and streptococcal species) is 0.91 or more but is 0.86 for *Staphylococcus aureus*. All bacterial growth was inhibited at an a_w of 0.858 (195 g sugar/100 ml water). When compared with a test medium of brain–heart infusion in which the a_w was 0.993 (which supported rapid bacterial growth), the medium was adjusted to an a_w of 0.858 by adding sugar, which caused complete inhibition of growth.[1] This action has been produced in the clinical setting. When a wound is filled with sugar, the sugar dissolves in the tissue fluid, creating an environment of low a_w, which inhibits bacterial growth. As the concentrated sugar solution causes migration of water and lymph out of the tissues and into the sugar solution, the solution becomes diluted, thereby raising the a_w. Therefore, in order to retain an environment of low a_w, large amounts of granulated sugar should be used on wounds. Dressings should be changed once or twice per day initially to maintain the antibacterial a_w, especially when treating large wounds (see box on page 7). As the infection and edema become controlled, bandage changes can be reduced to once daily or every other day.

Other mechanisms associated with the wound cleansing and healing properties of sugar (which are similar to those of honey) include decreased inflammatory edema, attraction of macrophages to further cleanse the wound, accelerated sloughing of devitalized tissue, provision of a local cellular energy source, and formation of a protective layer of protein on the wound and a healthy granulation bed.[3] Sugar also has a deodorizing action, whereby the infecting bacteria utilize the sugar instead of the amino acids, resulting in the production of lactic acid rather than malodorous compounds.[10]

*Excerpted from Mathews KA, Binnington AG: Wound management using sugar. *Compend Contin Educ Pract Vet* 24(1):41–50, 2002.

USE OF A SUGAR PASTE

Human patients have reported that the wound management procedure using sugar therapy is not painful, especially when compared with gauze packing (which is painful).[3,6] Occasionally, some human patients complain of a burning sensation when dry sugar is placed into a cavity; therefore, a sugar paste, which is not associated with pain, can be useful for infusion into such cavities as decubitus ulcers or abscesses. The paste can be made from 400 g castor sugar, 600 g icing sugar, 480 ml glycerin BP, and 7.5 ml hydrogen peroxide 3% BP (100 vol). Hydrogen peroxide should be combined with the glycerin and stirred; the sugars should then be added and the ingredients mixed in a blender. This paste can then be "squirted" into deep cavities.[4] A similar sugar paste[5] used on wounds has been shown to reduce water available and inhibit bacterial growth; however, granulation tissue is still allowed to form and epithelialization takes place at a rate similar to that for wounds that are kept moist and covered with OpSite® plastic film (Smith & Nephew).[5]

GUIDELINES FOR THE TREATMENT OF WOUNDS WITH SUGAR

Case Selection

- Crush injuries
- Thermal burns with skin slough
- Extensive deep tissue infection
- Grossly contaminated wounds following mechanical debridement
- Wound bed preparation for skin grafting
- Wounds in which tissue viability is questionable

Guidelines for Use

- Lavage and debride wound or surgically excised area of concern. Frequently, in road injuries, the area is lavaged with copious amounts of body temperature tap water and not debrided. The sugar will debride the area of devitalized tissue.
- Use an excess of sugar (pour to approximately 1 cm thickness).
- Change bandage once or twice daily initially. Frequency varies with size of wound and production of exudates. Bandages should be changed if strike through occurs. (As a guide, when granulated sugar is still present in the wound, less frequent bandage changes are recommended.)
- Lavage wound at each bandage change with body temperature tap water. Sterile saline may be used as a substitute for tap water but is more expensive and has no benefit. Sterile saline delivered with a 60-ml syringe and 18-gauge needle may be used to lavage crevices that are difficult to access.
- Pat the area dry with a sterile cotton towel before reapplying the sugar.
- Monitor the patient's hydration status and serum protein level during high fluid losses.
- Treat the wound until all pockets and undermined tissue are closed.
- When the debridement is complete, a healthy granulation bed is present, and epithelialization has begun, stop sugar therapy and switch to Furacin ointment.

CLINICAL STUDIES USING SUGAR THERAPY

One study[6] reported that packing cavity wounds (e.g., infected, malodorous decubitus ulcers) with a thick sugar paste cleared the foul odor and debrided the necrotic tissue after several days. Granulated sugar or sugar paste can be instilled into deep wounds or cavities instead of packing them with ribbon gauze and antiseptics, which delays healing and can be very painful to remove. In addition, gauze becomes enmeshed with the developing granulation tissue, which is then torn away when the dressing is removed.[6] In human patients, it is recommended that when a healthy granulation bed has formed, the sugar paste should be replaced with an alginate, hydrogel, or hydrocolloid dressing because application of the sugar paste may cause bleeding.[6] Bleeding has not been a problem at the OVC when using granulated sugar to treat animals. When healthy granulation tissue has formed, most wounds are surgically closed using various techniques based on wound size and location. Otherwise, epithelialization is allowed to continue until secondary healing has ccurred. This may be accomplished with the application of nonadhesive bandages.

Traumatic wounds, diabetic ulcers, peritonitis, and thoracic cavity lesions have been treated using sugar. A study by Trouillet and colleagues[7] illustrates the efficacy of using sugar to treat major wounds. Granulated sugar was used to treat 19 critically ill adult humans with open mediastinitis after cardiac surgery; 11 patients were treated immediately with sugar, and 8 patients were treated with sugar after irrigation with povidone–iodine and physiologic saline was unsuccessful. Eighteen wounds were contaminated with *Staphylococcus, Streptococcus, Enterobacter, E. coli, Klebsiella, Pseudomonas*, or *Serratia*. The mediastinum was packed with about 150 to 400 ml sterile granulated sugar (obtained from the supermarket); additional sugar was added every 3 to 4 hours to keep the cavity full. Dressings were changed twice daily, at which time the wounds were irrigated using physiologic

saline mixed with povidone–iodine. Debridement occurred at each dressing change. Almost complete debridement of the wound and rapid formation of granulation tissue occurred in all patients after 5 to 9 days of treatment; only three patients required surgical debridement, and none developed hyperglycemia. Because sugar is a complex molecule, it cannot be directly absorbed from the wound.[3]

In another report,[8] sugar paste was used to heal liver abscesses and infected chest cavities without development of hyperglycemia. A case study that compared the healing properties of granulated sugar to conventional methods of chlorhexidine wound lavage and subsequent packing with gauze in postoperative wound infections was carried out on nine human patients (age range, 4 months to 32 years) and two older patients (65 and 80 years old).[9] In this study, healthy granulation tissue formed earlier in the wounds treated with sugar and the wounds were less painful than those treated using conventional methods.

FIGURE 1

Surgical wound being treated with granulated sugar. The sugar layer should be at least 1 cm thick and completely fill the wound.

DRESSING TECHNIQUE USING SUGAR

When using sugar, the old adage "more is better" holds true. Various types of injuries, burns, and infected or necrotic wounds are all managed using a similar technique. Grossly contaminated wounds are lavaged initially with body temperature tap water using a kitchen-type spray nozzle over a grate to allow drainage. Although not all wounds require irrigation, irrigation of wounds with tap water under pressure may be a reasonable alternative to saline irrigation.[11] Large breed dogs may require up to 50 L of lavage fluid to irrigate large, dirty-infected wounds. After the wound is irrigated, it should be patted almost dry with sterile towels. Resection of necrotic tissue or debridement of a traumatic or surgical wound should be performed prior to the application of sugar. When superficial contamination of wounds occurs in an otherwise healthy animal, systemic antibiotics are frequently avoided and topical treatment with sugar alone is used.

Granulated sugar is poured into the wound (the layer should be at least 1 cm thick) and should fill all pockets and undermined areas (Figure 1). The wound must be filled because the osmolarity within the wound area must remain high in order for bacterial killing to occur. Sterile absorbent towels can be used as a primary bandage layer for large dogs, and sterile lap sponges can be used for cats and small dogs. A large amount of absorbent material is required to absorb the fluid. A secondary bandage layer should be added to hold the absorbent material in place. This should be covered with an adhesive tertiary layer. Because edema fluid is mobilized due to the hygroscopic nature of sugar, a plastic bag or plastic kitchen wrap can be used to further cover the bandage to prevent seepage during the first few days. For wounds that are difficult to bandage, kitchen wrap may be used until gross contamination is cleared, which usually takes a day. The sugar is diluted rapidly when wounds (especially large ones) are initially infected and edematous, and thus bandages should be changed and sugar replaced at least twice daily to maintain a high osmolarity. Bandage changes can be reduced to daily or alternating days as granulation tissue forms. Moderately infected wounds are usually clean in 2 to 4 days; large, severely infected wounds may require 5 days or longer. In distal limb injuries, once-daily bandage changes are adequate in most cases.

A guideline to when bandage changes are required is the presence or absence of granulated sugar in the wound. The lack of or presence of only small amounts of sugar indicates that frequent changes are needed, whereas the presence of a good covering of granular sugar indicates that the change interval can be lengthened. Bandages should be changed any time strike through occurs. After removal of the covering material at the appropriate bandage change interval, the wound should be gently lavaged with body temperature tap water (using a shower head) and patted almost dry, and an excess of sugar should be applied again.

Analgesics are frequently necessary during the first few days of

bandage changes. As the granulation tissue starts to develop, many patients no longer need analgesics to facilitate routine bandage changes. A pale, healthy granulation bed begins to form in 2 days. As the bandages are changed, the viability of the tissue will become evident. At this time, sharp dissection of devitalized tissue can be performed (often without analgesics). During the period of heavy exudation (caused by the osmotic draw of the sugar), the hydration status and protein levels of animals with large wounds should be monitored frequently. The duration of sugar therapy depends on the wound. Sugar treatment has been used from 4 days to 21 days in cats and dogs at the OVC. Once a healthy granulation bed has formed, infection is eliminated, and all pockets have closed, sugar is no longer needed. The wounds can be surgically closed if adequate skin is available, or skin grafting techniques may be used. Alternatively, the wound can be covered with a Furacin ointment using a nonadherent primary layer to encourage epithelialization and secondary healing. Granulation tissue will cover bony surfaces; however, this may take weeks to months for complete coverage.

Following the use of sugar treatment, the resultant wound scar has been reported to be more resistant and supple.[9]

When *Pseudomonas* species are present, the minimal a_w necessary for multiplication of strains of this bacteria is reported to be higher than that for other bacteria that commonly infect wounds, indicating that *Pseudomonas* are more susceptible to the high osmolarity of sugar.[12] In our experience, superficial *Pseudomonas* infections are rapidly eliminated with the use of sugar.

CONCLUSION

Sugar is an excellent topical dressing for treating open (especially contaminated) wounds. The advantages of using sugar as a dressing include its rapid antibacterial action, enhanced granulation tissue formation and epithelialization, accelerated wound healing, decreased cost, and ready availability.

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