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Comparison of Aloe Vera and Silver Sulfadiazine in the Treatment of Deep Second-Degree Burn in Dogs

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Abstract: Burn injury is a major cause of death and disability worldwide. Healing of burn wounds still remains a challenge to modern medicine. The aim of the present study was to evaluate the efficacy of Aloe vera (AV) gel in the treatment of deep second-degree burn wounds and compare its results with those of silver sulfadiazine (SSD) in dogs. A standard deep second-degree burn wound was produced, five dogs, each dog has three groups, AV gel, SSD 1% cream and control (no topical therapy at all). The efficacy of treatment was assessed based on the healing percentage of the wound, time to complete wound healing and the degree of inflammation and exudation. Wound contraction was higher in the AV group than both SSD and the control group. It was significantly higher in the AV group than the control group on days 18, 21 and 24, 27 while significantly higher than the SSD group on days 21 and 24. The mean times for wound complete closure were 22.9 ± 2.56 and 25.7 ± 2.31 days for AV and SSD, respectively, being significantly shorter for AV. Clinically, inflammatory reaction and exudation were less in AV group than the SSD group and control group.Conclusion. Using topical AV will accelerate the burn wound healing process in comparison with both the control and SSD groups and can be used as an adjunctive or alternative agent in the future.

Key words: Aloe Vera · SSD · Burn · Dog

INTRODUCTION

In veterinary medicine, the burn wounds were seen commonly with pet animals. The majority of thermal injury in dogs and cats was relatively occurring in the home. Burns can be caused by a variety of household items, including electrical equipment, chemicals and thermal (heat) [1,2].

Burn injuries are one of the most complex and painful physical injuries to treat and manage with high health care cost [3]. A domestic mediation in wound healing, preventing infection and reduction of scar tissue as well as availability is still an important challenge. To date, silver sulfadiazine (SSD) 1% cream is the most commonly used local treatment for burns in humans and animals [1,3]. Its popularity stems from the fact that prior studies have demonstrated the ability of SSD to reduce bacterial contamination. However, it has a tendency to adhere to the wound surface and requires frequent dressing changes that would traumatize new epithelized surface and delayed wound healing. Additionally, it has been suggested that SSD cream itself may delay healing [4,5]. Several adverse reactions and side effects have been reported, such as resistance to SSD, renal toxicity and leukopenia, thus confirming that this topical cream should not be used for long periods on extensive wounds [5,6]. Finding more efficient agents with fewer side effects for treatment of burns has always been a concern for researchers.

For many years the effect of herbal medicine on burn wound has been noted. Herbal products seem to possess moderate efficacy with no or less toxicity and are less expensive as compared with synthetic drugs [7]. Aloe vera (AV) plant has been used to treat wounds and burns for centuries. This plant has drawn immense attention in the recent past due to its numerous properties attributed by its unique compositional features [8]. Previous studies have demonstrated that AV, have anti-inflammatory and

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burn-healing properties [9-11]. Moreover, clinical studies in human beings have shown that AV has an efficacy superior to that of SSD to treat burn injuries [3,8]. Although burn wound healing is one of the major indications of AV gel use in several animal and clinical studies [7,8,11-15], no study has compared the efficacy of this gel with SSD in the treatment of burns in dogs. The purpose of this study was to determine the healing effect of AV on a second degree burn wounds in comparison to the SSD in a dog model.

MATERIALS AND METHODS

Chemicals and Drugs: Aloe vera gel (lyophilized powder), (Air Green Co. Lid. Fukui, Japan), Silver Sulfadiazine 1% topical cream (El-Nasr Pharmaceutical. Chemicals Co. Cairo, Egypt).

Animals: Five healthy male mixed breed dogs, 13-15-month-old, weighing 10-14 kg were used for this experiment. All dogs were handled according to the ethical principles for animal experiments of the international council for animal protection.

Creation of Skin Burn Wounds: General anesthesia was performed with 0.2% ketamine HCl by intravenous drip method after premedication with xylazine (5 mg/kg). Each dog was then placed in the prone position and prepared for aseptic surgery.

Equal sets of standardized deep, second-degree burn wound was created with a hot iron plate (diameter: 2×2 cm) at an identical temperature (warmed 5 minutes within a water bath at 100°C and placed for 20 seconds on the animal back with an equal pressure) (Fig. 1. A.). The 30 burn skin wounds of the five dogs were randomly assigned in three groups (10 wounds each), Each dog had six burn skin wounds, 2 wounds in the AV gel group (60 mg dissolved in 1 ml normal saline), 2 wounds in the SSD group (SSD cream) and 2 wounds in the control group (untreated group). After removal of necrotized tissues, all wounds were covered with a non-adherent occlusive bandage. The bandage was changed every 3 days and AV gel and SSD cream were reapplied every 3 days. Scabs that covered the wound were gently removed, to allow the assessment of the wound.

The primary outcome criterion was the percentage wound healing. For assessment of wound healing, digital photography was taken every 3 days. The photographs are then assessed by software Image j and the percentage of healing was determined as follows: Percent of wound healing = [initial wound area – unhealed wound area / initial wound area] × 100. The secondary outcome criterion was the time period between the infliction of the burns to complete wound closure and it was performed visually every 3 days.

The clinical course of skin lesions by burns was evaluated for 27 consecutive days based on the following aspects: redness, swelling, crust, bleeding, secretion, granulation tissue. The intensity of clinical signs was scored (0-3) as 0: absent, 1: mild, 2: moderate, 3: strong.

Data were collected, analyzed and reported as mean and standard deviation (Mean±S.D.). Statistical comparisons between groups were carried out by using SPSS software (Version 16.0, Chicago, IL, USA). One-way ANOVA followed by Tukey's post test were used to analyze the data. $P \leq 0.05$ was considered as statistically significant.

RESULTS

Burn wound model at 100°C for 20 sec. produced uniform deep second-degree burn on the skin of dogs (data not shown). On day 6 post-burn, after debridement of necrotic tissue had been performed, the wound size was stated as 100% and wound size on other days calculated compared to the 6th day (Fig. 1). After day 6 post-burn, wounds were initiated to promote healthy granulation tissue in both AV and SSD groups with a degree more than that of the control group.

Wound contraction was higher in the AV group than both SSD and the control group, but no significant differences observations in healing were made between the groups before 15 days of the wound induction. AV group was significantly higher than the control group on days 18, 21 and 24 (Fig. 2), 27 ($P < 0.05$), while significantly higher than the SSD group on days 21 and 24 (Fig. 2) ($P < 0.05$). The wound size percent at 6, 9, 12, 15, 18, 21, 24 and 27 days after burn injury are shown in Fig. 3.

The mean times for wound complete closure were 22.9 ± 2.56 and 25.7 ± 2.31 days for AV and SSD, respectively, being significantly shorter for AV ($P < 0.005$).

Clinically, inflammatory reaction and exudation were less in AV group than SSD and control group but not significantly. Also, there were no adverse outcomes (such as infection) noted in any of the groups.

Fig. 1: Location of burn-wounds on the back of the dog on the day of starting this experiment (A). On day 6 post-burn, appearance of burns before (B) and after (C) debridement of necrotic tissue had been performed.

Fig. 2: Visualization of burned wounds from Aloe vera (A), silver sulfadiazine (B) and control (C) groups on day 24 post-burn.

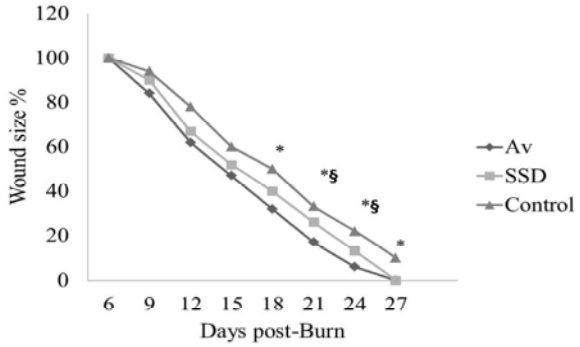

Fig. 3: Comparison of wound burn sizes in the Aloe vera (AV), silver sulfadiazine (SSD) and control groups. The wound size was defined as 100% on day 6 post-burn and then calculated and compared with day 6 thereafter.

DISCUSSION

Burn is one of the most widespread injuries in the world. The pathophysiology and histopathology of thermal burns in animals is very similar to that in humans [16]. Burns are classified by the depth of injury: first-degree burns involve only the most superficial layers of the epidermis; second-degree burns involve the entire epidermis and can be superficial or deep; third-degree burns are characterized by loss of the epidermal and dermal components; and fourth-degree burns involve all the skin and underlying muscle, bone and ligaments [17]. SSD cream is the most widely used topical treatment for burn injury in larger and smaller animals [1,18]. The antimicrobial efficacy of SSD is probably the main reason for the usage of this agent. Although SSD is considered a gold standard for treatment of burn injuries, prolonged application of this agent may result in a longer hospitalization [4, 19], indicating the need for a better burn dressing.

Aloe vera has been used for many centuries for its curative and therapeutic properties [20]. Aloe vera contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids [12] Reported pharmacological actions of AV include anti-inflammatory, antibacterial, antioxidant, antiviral and antifungal actions, as well as producing hypoglycemic effects [21,22]. Several studies emphasize the anti-inflammatory properties of aloe vera [9-11,23-25] also the present study showed a decrease of inflammation and exudation following AV treatment more than SSD and control but not significantly.

The anti-inflammatory effects of AV can contribute to resolving the inflammatory process induced by burn injury [13].

AV is known to have multiple beneficial effects on wound healing. Evidence from animal studies has highlighted the possible effects of AV in wound and burn healing [8,10,15,26,27]. Assessment of wound size was employed for evaluating efficacy of AV gel in the treatment of burn injuries in dogs. Our results indicated that AV is able to accelerate the rate of wound healing and shortens the time of healing, compared with those treated with SSD in burned dogs. Similar results were reported after first and second degree burn wound in rats and human [8,11,14] Moreover, our previous studies on the effect of AV on diffrents wound models indicated that AV accelerate wound healing [26,27]. Also, the results of our studies involving clinical cases in dogs and horses (data were not shown) would indicate that the application of AV accelerated wound healing.

The mechanism of AV lies in how it acts on cell proliferation of the dermal component [3]. Glycoprotein fraction is the major component of AV involved in its wound healing effect through cell proliferation and migration. This fraction promoted growth of both dermal fibroblasts and keratinocytes [28]. Our previous *in vivo* studies showed that AV accelerates cell proliferation in the full-thickness skin wound by increasing fibroblast proliferation and angiogenesis and epithelization, Moreover, AV increased growth factor production like transforming growth factor beta-1, basic fibroblast growth factor and vascular endothelial growth factor, which it is thought that was responsible for the healing process [26,27].

One of the main limitations of this study is the histological examination to support our findings. Further studies were required to understand the mechanism underlining the effect of AV on wound healing after burn in dogs.

CONCLUSION

This finding shows that treatment with AV has anti-inflammatory and healing effects in deep second degree burn in dogs more than that of SSD. AV can be used as an adjunctive or alternative agent in wound healing therapies in the future. However, further studies are certainly needed to shed more light on the healing mechanism of AV.

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REFERANCES

1. Pavletic, M.M. and N.J. Trout, 2006. Bullet, bite and burn wounds in dogs and cats. Vet. Clin. North Am. Small Anim. Pract., 36: 873-893.
2. Quist, E.M., M. Tanabe, J.E. Mansell and J.L. Edwards, 2012. A case series of thermal scald injuries in dogs exposed to hot water from garden hoses (garden hose scalding syndrome). Vet. Dermatol., 23: 162-166.
3. Khorasani, G., S.J. Hosseinimehr, M. Azadbakht, A. Zamani and M.R. Mahdavi, 2009, Aloe versus silver sulfadiazine creams for second-degree burns: a randomized controlled study. Surg. Today, 39: 587-591.
4. Cho Lee, A.R., H. Leem, J. Lee and K.C. Park, 2005. Reversal of silver sulfadiazine-impaired wound healing by epidermal growth factor. Biomaterials, 26: 4670-4676.
5. Atiyeh, B.S., M. Costagliola, S.N. Hayek and S.A. Dibo, 2007. Effect of silver on burn wound infection control and healing: review of the literature. Burns, 33: 139-148.
6. Hosseinimehr, S.J., G. Khorasani, M. Azadbakht, P. Zamani, M. Ghasemi and A. Ahmadi, 2010. Effect of aloe cream versus silver sulfadiazine for healing burn wounds in rats. Acta. Dermatovenerol. Croat. 18: 2-7.
7. Bedi, M.K. and P.D. Shenefelt, 2002. Herbal therapy in dermatology. Arch. Dermatol., 138: 232-242.
8. Maenthaisong, R., N. Chaiyakunapruk, S. Niruntraporn and C. Kongkaew, 2007. The efficacy of aloe vera used for burn wound healing: A systematic review. Burns, 33: 713-718.
9. Visuthikosol, V., B. Chowchuen, Y. Sukwanarat, S. Sriurairatana and V. Boonpucknavig, 1995. Effect of aloe vera gel to healing of burn wound a clinical and histologic study. J. Med. Assoc. Thai., 78: 403-409.
10. Chithra, P., G.B. Sajithlal and G. Chandrakasan, 1998. Influence of aloe vera on the healing of dermal wounds in diabetic rats. J. Ethnopharmacol., 59: 195-201.

11. Shahzad, M.N. and N. Ahmed, 2013. Effectiveness of Aloe Vera gel compared with 1% silver sulphadiazine cream as burn wound dressing in second degree burns. J. Pak. Med. Assoc., 63: 225-230.
12. Atherton, P., 1998. Aloe vera: magic or medicine? Nurs Stand., 12: 49-52.
13. Duansak, D., J. Somboonwong and S. Patumraj, 2003. Effects of Aloe vera on leukocyte adhesion and TNF-alpha and IL-6 levels in burn wounded rats. Clin. Hemorheol. Microcirc., 29: 239-246.
14. Cuttle, L ., M. Kempf, O. Kravchuk, N. George, P.Y. Liu, H.E. Chang, J. Mill, X.Q. Wang and R.M. Kimble, 2008. The efficacy of Aloe vera, tea tree oil and saliva as first aid treatment for partial thickness burn injuries. Burns, 34: 1176-1182.
15. Akhoondinasab, M.R., A. Khodarahmi, M. Akhoondinasab, M. Saberi and M. Iranpour, 2014. Assessing effect of three herbal medicines in second and third degree burns in rats and comparison with silver sulfadiazine ointment. Burns. http://dx.doi.org/10.1016/j.burns.2014.04.001.
16. Geiser, D.R. and R.D. Walker, 1984. Management of thermal injuries in large animals. Vet. Clin. North. Am. Large Anim. Pract., 6: 91-105.
17. Orgill, D.P., 2009. Excision and skin grafting of thermal burns. N. Engl. J. Med., 360: 893-901.
18. Hanson, R.R., 2005. Management of burn injuries in the horse. Vet. Clin. North. Am. Equine Pract., 21: 105-123.
19. Stern, H.S., 1989. Silver sulphadiazine and the healing of partial thickness burns: a prospective clinical trial. Br. J. Plast. Surg., 42: 581-585.
20. Reynolds, T. and A.C. Dweck, 1999. Aloe vera leaf gel: a review update. J. Ethnopharmacol., 68: 3-37.
21. Vogler, B.K. and E. Ernst, 1999. Aloe vera: a systematic review of its clinical effectiveness. Br. J. Gen. Pract., 49: 823-828.
22. Joseph, B. and S.J. Raj, 2010. Pharmacognostic and phytochemical properties of aloe vera Linn-an overview. Int. J. Pharma. Sci. Rev. Res., 3: 134-138.
23. Davis, R.H., M.G. Leitner and J.M. Russo, 1987. Topical anti-inflammatory activity of Aloe vera as measured by ear swelling. J. Am. Podiatr. Med. Assoc., 77: 610-612.
24. Davis, R.H., J.J. Donato, G.M. Hartman and R.C. Haas, 1994. Anti-inflammatory and wound healing activity of a growth substance in Aloe vera. J. Am. Podiatr. Med. Assoc., 84: 77-81.
25. Vazquez, B., G. Avila, D. Segura and B. Escalante, 1996. Antiinflammatory activity of extracts from Aloe vera gel. J. Ethnopharmacol., 55: 69-75.
26. Atiba, A., M. Nishimura, S. Kakinuma, T. Hiraoka, M. Goryo, Y. Shimada, H. Ueno and Y. Uzuka, 2011. Aloe vera oral administration accelerates acute radiation-delayed wound healing by stimulating transforming growth factor-beta and fibroblast growth factor production. Am. J. Surg., 201: 809-818.
27. Atiba, A., H. Ueno and Y. Uzuka, 2011. The effect of aloe vera oral administration on cutaneous wound healing in type 2 diabetic rats. J. Vet. Med. Sci., 73: 583-589.
28. Choi, S. and M.H. Chung, 2003. A review on the relationship between aloe vera components and their biologic effects. Seminars in Integrative Medicine, 1: 53-62.