Journal of Animal and Veterinary Advances 6 (2): 168-170, 2007
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Use of Gauze Soaked in 0.25% Formalin on Full Thickness Skin Wounds in Rabbits

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Abstract: The effects of 0.25% formalin on wound healing were investigated and compared to commonly used 10% povidone iodine and 0.9% sodium chloride treatment. Three full-thickness skin defects, 3,14 cm in diameter, were created ON dorsal aspects of 12 rabbits. Wound surfaces were macroscopically examinated from the points of exudation, beginning of the contraction, granulation tissue and epithelization during the postoperative period. Biopsy specimens which were collected on the 4th, 8th, 12th and 16th Postoperative Days (POD) were evaluated for histopathological changes. Specimens were evaluated according to several histopathologic parameters, such as the thickness of scar tissue, the density of vascular proliferation and the degree of inflammatory cell infiltration. SPSS 11.0 for windows was used for statistical analyses. Thickness of scar tissue was significantly changed between the treatments of 0.25% formalin and 0.9% sodium chloride ($p<0.05$), while the wound treatment with 10% povidone iodine and 0.9% sodium chloride created similar results ($p>0.05$). The density of vascular proliferation between study groups was significantly different only on POD 4 and 16 ($p<0.05$). The degree of inflammatory cell infiltration was similar in all groups ($p>0.05$), but a significant difference between the 10% povidone iodine and 0.9% sodium chloride treatments on PODs 12 as an exception ($p<0.05$). In conclusion, daily topical 0.25% formalin application to full-thickness skin defects in rabbit accelerated wound healing. Other adventages of formalin are ease of application and the low cost.

Key words: Formalin, rabbit, wound, infiltration, proliferation

INTRODUCTION

Clinicians have used numerous strategies to combat wound infections including topical and systemic administration of antibiotics and various antiseptic agents, many wound healing materials consisting of medications, chemical and physical agents, nutrients and biomoleculs in various experimantal and clinical on human and laboratory animals with different degrees of success (Selçukbiricik *et al*., 2004; Kilic *et al*., 2002).

The ideal result in wound healing is rapid regeneration, leading to the perfect restoration of form and function. There are two stages as major components of wound healing in the early phase. The first stage is the inflammatory stage and the second one is the new tissue formation (Selçukbiricik *et al*., 2004). That may result in certain undesirable complications including keloid formation with a poor final cosmetic appearance and a fragile epithelial layer. Therefore, the treatment methods that enhance wound healing and minimize related complications are desirable (Kilic *et al*., 2002).

Formaldehyde is used as such in aqueous solution (37-40% solution is called formalin) as a disinfectant and preservative in many applications. Formalin is cheap and effective and posseses a broad spectrum. It is used as a disinfectant, which has bactericidal, sporicidal and virucidal properties. However it is moderately irritant for the skin and mucosal membrane (Aslanbey, 2002; Kaya *et al*., 2002).

Povidone iodine 10% solution has a broad range of antimicrobial activity that lasts for 4 to 6 hours following application. Povidone iodine is inactivated by organic material and blood. Dermal hypersensitivity is associated with the use of povidone iodine in humans and small animals (Aslanbey, 2002).

In this study, we have investigated efficacy of 0,25% formalin solution on healing wound standing on the clinical and histopathologic parameters comparing with povidone iodine 10% solution and 0.9% sodium chloride.

MATERIALS AND METHODS

Six male and six female rabbits weighing about 2500±200 g. were taken for the study. The dorsal aspects (backs) of rabbits were clipped and prepared for aseptic surgery. All rabbits were anesthetized with i.m. administration of 10 mg kg^{-1} xylazine hydrochloride (Rompun, Bayer) and 50 mg kg^{-1} ketamine hydrochloride

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(Ketanes, Albe). On dorsal aspect of each animal, two cranially and one caudally located full-thickness skin wounds in 3,14 cm diameter were created using a template prepared from an X-ray film.

Following incision different wounds of each animal were treated with 0.25% formalin (3 mL of 40% formalin to 497 mL of normal saline), 10% povidon iodine and 0,9% sodium chloride as the control respectively. Then the wounds were closed with sterile gauze and fixed with circular adhesive bands. The animals had free access to water and standart laboratory pellet and were housed individually to prevent them from tampering with the others' wounds. The dressing were changed every day until complete wound healing. During the postoperative period, all rabbits were checked daily for general health condition, bandage slippage and other unspecified abnormalities. Macroscopically wounds were examinated and exudation, the beginning of the wound contraction to mark the beginning of healing, granulation tissue and the first day of epithelization were noted regularly.

Skin samples from all three incision sites for histologic examination were collected from each animal on postoperative days (PODs) 4, 8, 12 and 16. The biopsy specimens were fixated in 10% formalin solution and were placed into ototechnicon for routine tissue processing. They were embedded in parafin blocks, cut into 4 μm thickness slices and stained with Hemetoxylin-Eosin for routine light microscopic evaluation. The processed specimens were evaluated according to several histopathologic parameters, such as the thickness of scar tissue, the density of vascular proliferation and the degree of inflammatory cell infiltration. Thickness of scar tissue was expressed as ìm, the density of vascular proliferation and the degree of inflammatory cell infiltration was scored as follows: 0 = normal, 1 = light increase 2 = mild increase, 3 = marked increase. According to number of inflammatory cells in the wounded tissue per 40x magnification field, the increase was considered as light (3-10 cells), mild (11-30 cells) or marked (>30 cells).

SPSS 11.0 for Windows was used for all statistical analysis (Samsar and Akin, 2003). Comparison of the changes in the thicknesses of scar tissue analysed via variance analysis and Tukey test. Nonparametric values (vascular proliferation, the degree of inflammatory cell infiltration) were analysed by Kruskal Wallis and Mann-Whitney U test.

RESULTS

All rabbits survived until the end of study with no sign of pain or discomfort. During healing, all wound boundaries became progressively shapeless. All control wound surfaces were covered by a thin gelatinous exudate (POD 4). After removal of this exudate, an ongoing healthy granulation and epithelization was determinated underneath. Macroscopically, the wounds treated with 0.9% sodium chloride and 10% povidon iodine appeared to have marked fibrinous exudate and crust formation which led adherence to the gauze. Therefore, they required greater tearing force for removal of the dressing. On the other hand, 0.25% formalin gauze-applied wounds showed less adherence and a lesser degree exudate. The expansion process (to POD 4) was followed by the contraction process (to PODs 6-8). The contraction in 0.25% formalin gauze-applied wounds (to PODs 16) became more visible than other wounds. The granulation tissues on all wounds were noted on PODs 3-5, while epithelization was seen on PODs 6-8. The epithelization was completed on POD 16 on 0.25% formalin and 10% povidone iodine gauze-applied wounds, whereas it wasn't completed on 0.9% sodium chloride gauze-applied wounds and ulceration in central wounds was seen.

The thickness of scar tissue in different postoperative days showed statistical differences between 0.25% formalin and 0.9% sodium chloride groups ($p<0.05$). Such a difference could not be shown between 10% povidone iodine and 0.9% sodium chloride groups ($p>0.05$). The graphical expression of the change of scar thickness in study groups according time is presented in Fig. 1.

The density of vascular proliferation progression was significantly different PODs 4 and 16 between 0.25% formalin groups. Such a relation was not found in other days.

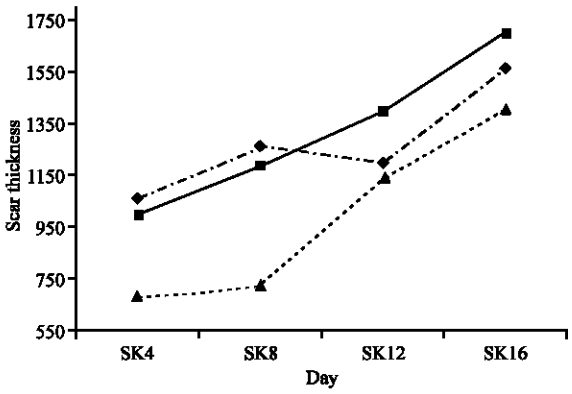

Fig. 1: The change of the thicknesses of scar tissue related to solutions used. (μM). ▲ = 0.25% Formalin, ◆ = 10% Povidon Iodine and ■ = 0.9% Sodium Chloride

Table 1: According to days, the thickness of scar tissue as average between groups (μM)

Groups		4. Days	8. Days	12. Days	16. Days
0.25% Formalin	Mean	676.6667	720.0000	1133.3333	1406.6667
	Std. Deviation	170.09801	98.48858	292.97326	126.62280
10% Povidon iodine	Mean	1060.0000	1260.0000	1196.6667	1558.3333
	Std. Deviation	144.22205	52.91503	257.35838	282.59217
0.9% Sodium chloride	Mean	996.6667	1183.3333	1399.0000	1706.6667
	Std. Deviation	181.75075	104.08330	35.67913	110.15141

The degree of inflammatory cell infiltration was similar in all groups almost all postoperative period ($p>0.05$) except on POD 12 between the 10% povidone iodine and 0.9% sodium chloride groups ($p<0.05$).

DISCUSSION

Some authors (Nair *et al*., 1991) conflicted to the use of antiseptics in open wounds, moreover some others (Anonymous, 2004) claimed that antiseptics might disorder epithelization layer and disturb progressive vascular proliferation. In our study we did not observe any adverse effects of antiseptics on the thickness of scar tissue, the density of vascular proliferation and the degree of inflammatory cell infiltration in full thickness skin wounds. Such a conclusion was reported before by Niedher and Schopf (1986) that antiseptics had not resulted any undesirable effects on granulation tissue formation in open wounds.

Formalin is moderately irritant for the skin and mucosal membrane (Kaya *et al*., 2002). However, in this study, we did not observe any irritant effects of 0.25% formalin or any abnormal process including keloid formations, poor final cosmetic appearance or the formation of fragile epithelial layer during progression of wound healing. Absence of irritant effects or other undesirable results could be related with the prefered concentration of formalin in this study.

As a result, 0.25% formalin application to full-thickness skin defects in rabbits accelerated wound healing (Table 1). Thus, we conclude from this study that, 0.25% formalin as an antiseptic not only improves the outcome of wounds but it's also, easy, safe and economical.

REFERENCES

Anonymous, 2004. SPSS 11.0 SPSS for window release.

Aslanbey, D., 2002. Veteriner Genel Operasyon Bilgisi. Medipress Matbacilik Yayincilik Ltd. Malatya, pp: 5-6.

Kaya, S., I. Pirinçci and A. Bilgili, 2002. Antiseptik ve Dezanfektanlar. Veteriner Hekimliginde Farmakoloji. Cilt 2. Baski Medisan Yayinevi Ankara, 3: 630-632.

Kiliç, S., N. Timurkan, S. Ünsaldi, C. Günay, Ö. Istek and B. Yilmaz, 2002. Comparison of the effects of some wound healing materials on full thickness skin wounds in rabbits. Turk. J. Vet. Anim. Sci., 26: 263-272.

Nair, R.G., A.N. Supe and A.B. Samsi, 1991. Formalin (% 0.25) as topical anti-microbial agent in burns. J. Postgraudate Med., 37: 1-4.

Niedher, R. and E. Schopf, 1986. Inhibition of wound healing by antiseptics. Br. J. Dermatol., 115(suppl 31): 41-44.

Norman, D., 2003. The used of povidone-iodine in superficial partial-thickness burns. Br. J. Nurs., 12: 30-36.

Samsar, E. and F. Akin, 2003. Genel Cerrahi. 11-12. Medipress Matbacilik Yayincilik Ltd. Malatya.

Selçukbiricik, H., N. Şindak, A. Hayat, H. Eraslan, S. Ganidagli and G. Tursun, 2004. Efficacy of tissupor wound pad on wound healing in rabbits., YYÜ. Vet. Fak. Derg., 15: 37-40

Yavuzer, R., O. Latifoglu, S. Ayhan, N. Edali, B. Çelik and K. Atabay, 1997. Enhanced wound healing using collagenase in guine pig. Gazi Med. J., 8: 110-113.