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Burn Wound Healing Potential of *Jatyadi* Formulations in Rats

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ABSTRACT

Initial treatment of burn wound aims at preventing infection and early wound healing. Whether traditionally used ayurvedic preparations are effective in burn injuries and can be used as alternatives to our conventional treatment is to be studied. The study was planned to compare the effect of silver sulfadiazine with two ayurvedic formulations (jatyadighrita and jatyadi tail), on experimentally induced burn injury in rats. Partial thickness burn wounds were inflicted upon four groups of seven rats each. Group I- Control (no treatment), Group II- Jatyadi-Ghrita, Group III- Jatyadi-tail & Group IV- Silver sulfadiazine ointment. All drugs were applied topically on the burn wounds for 21 days or till complete healing. The parameters observed were epithelization period and percentage of wound contraction. The results were analyzed using One-way ANOVA followed by Tukey's test. Epithelization was hastened in all drug treated groups. There was significant improvement in wound contraction in the Jatyadi-tail & Silver sulfadiazine treated groups as compared to control group. Results of Jatyadi tail were comparable to that of the standard treatment drug silver sulfadiazine. Jatyadi tail has burn wound healing potential comparable to silver sulfadiazine.

Keywords: burn wounds; jatyadighrita; jatyadi tail; wound healing

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INTRODUCTION

Burn injuries are one of the most devastating injuries encountered in medicine. Burn can be defined as tissue damage caused by a variety of agents such as heat, chemicals, electricity, sunlight, or nuclear radiation. Burn injuries can be accidental, suicidal and homicidal. Estimated annual burn incidence in India is 6-7 million/yr [1].

Depending upon the extent and severity of burns, the availability & accessibility to health care, the impact of burns varies from superficial burns and scalds to damage of internal body organs. Absence of facilities in district and peripheral hospitals, combined with traditional unscientific household practices and lack of safety systems result in high mortality and disability from burn injuries. Managing burns is important because they are common, painful and can result in disfiguring and disabling scarring, amputation of affected parts or death in severe cases. Most of the early treatment modalities include use of an appropriate dressing, particularly to reduce pain and to help prevent infection [2].

Wound healing is the process of repair that follows injury to the skin and other soft tissues. It involves a complex series of interactions between different cell types, cytokine mediators, and the extracellular matrix. Most burns only affect the skin. Various topical agents such as silver sulfadiazine, povidone iodine, framycetin, etc are used in burn wound patients. In ayurvedic practice, number of preparations is used to treat burn injuries. Jatyadi Ghrita, Madhu Ghrita, Jatyadi tail, Honey, Aloe vera are few of them which are traditionally popular for their use in wound healing [3-5]. Whether these medicines are effective in burn injuries and can be used as alternatives to our conventional treatment options is being studied.

Hence this study was planned to compare the effect of one of the standard treatment drug silver sulfadiazine with two ayurvedic formulations- jatyadighrita and jatyadi tail, on experimentally induced burn injury in rats.

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MATERIALS AND METHODS

Animals

Wistar rats of either sex weighing 150-200 gm were obtained from the Central Animal House of Bharati Vidyapeeth Deemed University Medical College, Pune; recognized by CPCSEA (Regd. No. 258). They were housed in separate cages with free access of rodent food and aquaguard water. In the animal house, 12hrs day and night cycle was maintained. The study was initiated after obtaining the approval of the Institutional Animal Ethics Committee (IAEC/BVDUMC/443/2012-2013)



Drugs

Jatyadi Ghrita (JG)- It is a ghee based formulation useful for wounds, painful ulcers, insect bite wounds, wounds caused by heat or fire and deep wounds by external application as per the classical texts of ayurveda. Jatyadi Ghrutham from Ashtavaidyan Thaikkatu Mooss Vaidyaratnam Oushadshala, Kerala, India was used. The textual reference taken is Ashtanga Hrudayam Uttarasthana 25/67.

Jatyadi Ghrita Ingredients: Jati –*Jasminum sambac*; Nimbapatra – neem leaves; Patolapatra-*Trichosanthes dioica*; Katuka – *Picrorrhiza kurroa*; Darvi – *Berberis aristata*, Nisha – *Curcuma longa*; Sariva – *Hemidesmus indica*; Manjishta – *Rubia cordifolia*; Abhaya – *Terminalia chebula*; Siktaka – Honey bee wax; Tuttha – Purified blue vitriol; Madhuka – *Glycyrrhiza glabra*; Naktahva – *Pongamia pinnata*; Sarpi – ghee; water.

The above combination is heated till herbal ghee is prepared.

Jatyadi tail (JT)- Traditional oil based formulation which as per the classical text in ayurveda acts as antiseptic, fungicidal and a good healer used in boils, cuts, wounds, burns, piles & fistula. Jatyadi Thailam of Arya Vaidya Pharmacy (Coimbatore) Limited, Kerala, India was used. The textual reference taken is Sharangdhara Samhita Madhyama Khanda 9/168-171.5.

Jatyadi Tel ingredients: Jati – *Myristica fragrans*; Nimba – Neem – *Azadirachta indica*; Patola – *Stereospermum suaveolens*; Naktamala – leaves of *Pongamia pinnata*; Sikta – Honey bee wax; Madhuka – Licorice – *Glycyrrhiza glabra*; Kushta – *Saussurea lappa*; Haridra – Turmeric – *Curcuma longa*; Daruharidra – *Berberis aristata*; Manjishta – *Rubia cordifolia*; Katurhini – *Picrorrhiza kurroa*; Padmaka – *Prunus pudum*; Lodhra – *Symplocos racemosa*; Abhaya – *Terminalia chebula*; Nilotpala - *Nymphaea stellata*; Tutthaka – Copper sulphate; Sariva – *Hemidesmus indicus*; Naktamala beeja – Seeds of *Pongamia pinnata*; Taila & Water.

Silver sulfadiazine- The preparation of 1% silver sulfadiazine cream (SSD) of Universal Twin Labs, Solan (H.P.) was used as standard drug.

Methodology

Partial thickness burn wound was inflicted, on all overnight starved rats under ketamine (50mg/kg/i.p) by pouring hot molten wax at 80°C into a metal cylinder of 300 mm² circular opening placed on shaven back of the rat [6]. Wound contraction was monitored by measuring wound area planimetrically, on the alternate days till the wounds completely healed. Time taken for full epithelization was measured by recording the days required for fall of scab leaving no raw wound behind. Apart from the drugs under investigation no local/systemic chemotherapeutic cover was provided to animals. The animals were randomly divided into 4 groups of 7 rats each. Group I did not receive any treatment and served as control. Group II, III & IV received topical treatment with Jatyadighrita (JG), Jatyadi-tail (JT) and Silver sulfadiazine

(SSD) respectively. All drugs were applied topically once a day by sterile gauze on the burn wounds for 21 days or till complete healing whichever were earlier.

Assessment of burn wound healing

Animals were inspected daily and the healing was assessed based on the physical parameters like epithelization period and wound contraction.

a) Epithelization period: It was monitored by noting the number of days required for the eschar to fall off from the burn wound surface without leaving a raw wound behind.

b) Wound contraction: It was assessed by noting the progressive changes in wound area planimetrically, excluding the day of the wounding. The sizes of the wounds were traced on a transparent paper every two days, throughout the monitoring period. The tracing was then superimposed on a 1 mm² graph sheet, from which the wound surface area was evaluated. The evaluated surface area was then employed to calculate the percentage of wound contraction, taking the initial size of the wound, as 100%, by using the following

$$\% \text{ of wound contraction} = \frac{\text{Initial wound size} - \text{specific day wound size}}{\text{Initial wound size}} \times 100$$

Statistical analysis-The results were analyzed using one-way ANOVA followed by Tukey's test.

RESULTS

Duration of epithelization of burn wound

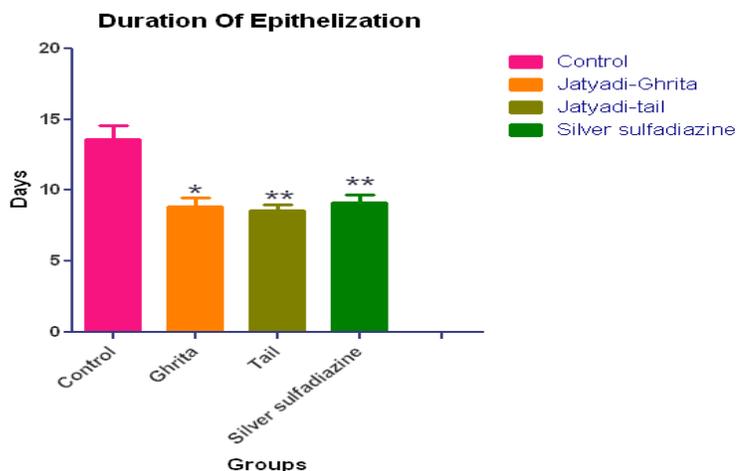


Figure 1: Duration of epithelization of burn wound in days

Values =Mean ± SEM, * p<0.05, ** p<0.01 in comparison to control

There was significant reduction in the duration of epithelization in all the drug treated groups. The results seen with JG were significant ($p < 0.05$) when compared to control. Reduction in the duration of epithelization with JT and SSD groups was highly significant ($p < 0.01$) when compared with control group. The Mean \pm SEM of the number of days required for epithelization is shown in the figure 1.

Percentage of wound contraction

The percentage of burn wound contraction increased in all drug treated groups from 4th day onwards. The percentage of burn wound contraction was significantly more in the JT and SSD groups on day 4, 8 while it was highly significant on day 12 in comparison to control group. The Mean \pm SEM values of the percentages of wound contraction of various treatment groups is given in the table1.

Table 1: Percentage of wound contraction after drug treatment on day 4, 8, 12 & 16

Group	Day 4	Day 8	Day 12	Day 16
Control	24.20 \pm 6.05	44.90 \pm 4.71	54.68 \pm 3.51	87.53 \pm 6.55
Jatyadighrita	30.81 \pm 6.32	49.09 \pm 8.45	77.86 \pm 7.40	92.18 \pm 5.22
Jatyadi tail	41.59 \pm 5.44*	58.20 \pm 4.95*	80.76 \pm 4.36**	96.65 \pm 0.86
Silver sulfadiazine	47.17 \pm 5.18*	63.87 \pm 3.46*	79.26 \pm 4.23**	93.86 \pm 4.58

Values =Mean \pm SEM, * $p < 0.05$, ** $p < 0.01$ in comparison to control

DISCUSSION

Healing of wounds starts from the moment of injury and can continue for varying periods of time depending on the extent of wounding. The process of wound healing can be broadly categorized into three phases: inflammatory phase, proliferative phase and remodeling phase. The objective in wound management is to heal the wound in the shortest time possible, with minimal pain, discomfort and scarring [7]. Improving the process of wound healing and tissue repair offers tremendous opportunities to enhance the quality of life for trauma and burn patients.

In the present study, silver sulfadiazine (SSD) significantly reduced the period of epithelization of the burn wound (9.1 \pm 1.5 days) in comparison with the control group (13.6 \pm 2.6 days). Both the ayurvedic drug formulations, Jatyadi Ghrita and Jatyadi Tail also significantly reduced the period of epithelization of the burn wound (8.8 \pm 1.6 & 8.8 \pm 1.1 days respectively) as compared to control group wounds. The results of reducing the period of epithelization of the burn wound were in accordance with that of standard treatment drug SSD.



The probable mode of action of the ayurvedic formulations is:

- Neem (*A. indica*)[8] , Haridra (*Curcuma longa*)[9], Daruharidra (*Berberis aristata*)[10] Abhaya (*Terminalia chebula*), Lodhra (*Symplocos racemosa*) [11] have antimicrobial activity
- Manjistha [12] , Sariva [13] , Karanja ingredients are having *vrnashodhana* (wound cleansing) property
- Naktahva (*Pongamia pinnata*)[14] and Abhaya (*Terminalia chebula*) have antioxidant and wound healing properties [15].
- Katuka (*Picrorrhiza kurroa*) improves re-epithelialization, neovascularization and migration of endothelial cells, dermal myofibroblasts and fibroblasts into the wound bed [16].
- Jati, Patola [17] and Sikta have *vrunaropana* (Wound healing) action
- Kushta (*Saussurea lappa*) has anti-inflammatory action [18]
- Madhuka (*Glycyrrhiza glabra*) has soothing and healing action on skin lesions topically
- *Nymphaea stellata* has astringent and antiseptic properties [19]
- Tuttha i.e. copper sulphate induces vascular endothelial growth factor (VEGF) expression in the wound [20].

The natural essential oils in the formula penetrate into cell membranes to enhance drug penetration for early & uncomplicated wound healing.

The study drugs, Jatyadi ghrita, tail & SSD also increased the percentage of burn wound contraction from 4th day of induction of burn wound as compared to control group.

Previous studies done with Jatyadi ghrita in *dushta vrana* (wound with foul smell, intense discharge, pain and long time for healing) [21] as dressing, for fissure-in-ano [22] and chronic wounds [23] have shown promising results in those respective models. But JG in this burn wound model has failed to show its significant efficacy. The use of JG can be tested for its adjuvant role in hastening burn wounds in further studies.

The results of burn wound healing seen only with JT & SSD were statistically significant on days 4, 8 and 12 when compared with control. Wound healing with JT is very promising and goes hand-in-hand with that of the standard drug silver sulfadiazine in this study.

The phytochemical evaluation of JT has revealed presence of flavonoids, essential oils, tannins, glycosides, steroids and alkaloids. Tannins & phytosterols promote the wound healing process with increased capillary formation & fibroblast proliferation enhancing the rate of epithelization [24]. Previous study done with JT in excision wound model has also shown promising results. Topical application of JT on excision wounds has caused significantly faster reduction in wound area as compared to the application of modern topical formulation (Neosporin) and untreated control wounds. Animals treated with JT showed significant increase in protein, hydroxyproline and hexosamine content in the granulation tissue when compared with the untreated controls [3].



Ingredients of JT have been studied extensively for their antimicrobial, anti-inflammatory and antiseptic activity which may be responsible for its efficacy in wound healing.

Thus in the present study, Jatyadi tail has shown comparable efficacy to standard treatment drug silver sulfadiazine in partial thickness burn wound healing. The results can be verified in clinical trials to approve the utility of Jatyadi tail as an effective option for treatment of burn wound injuries.

CONCLUSION

This study shows promising results of Jatyadi tail in partial thickness burn wound model and its comparable effectiveness to silver sulfadiazine in burn wound healing.

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