

Comparison of hydro-fiber silver dressing and 1% silver sulfadiazine dressing for treatment of pediatric burns

Abdul Rehman Rashid^{1*}, Khadija-Tul-Kubra¹ and Ayesha Latif²

¹Department of Pediatric Surgery, Recep Tayyip Erdogan Hospital, Muzaffargarh, Pakistan

²Department of General Surgery, Mayo Hospital, King Edward Medical University, Lahore, Pakistan

Abstract: Burn is a debilitating and devastating emergency with many physical and psychological sequelae. Essential steps in burn wound management include cleansing/wound debridement, application of topical antimicrobial and dressing of affected body areas. Objective of this study is comparison in effectiveness of Hydro-fiber Silver dressing and 1% silver sulfadiazine dressing in management of pediatric burn patients in terms of wound healing. After ethical approval, 264 patients were enrolled and divided into two groups. Patients were managed with hydro-fiber silver dressing in group A and 1% silver sulfadiazine dressing in group B. An experienced pediatric surgeon examined the wounds for re epithelialization and efficacy was labeled after 15 days. Out of 264 enrolled patients 148(56.06%) were males and 116(43.94%) were females. Mean age of patients was 3.73 ± 2.34 years. Type of burn was Scald in 215(81.4%) patients and flame in 49(18.6%). Depth of burn was 2nd degree in 185(70.08%) patients and 3rd degree in 79(29.92%) patients. Mean TBSA was $19.93 \pm 9.62\%$. In group A the efficacy was achieved in 91(68.9%) patients whereas in group B the efficacy was achieved in 73(55.3%) patients (p -value<0.05). Hydro-fiber Silver dressing is significantly more efficacious as compared to 1% silver sulfadiazine dressing for treatment of pediatric burn.

Keywords: Burn, pediatric, hydro-fiber silver dressing, 1% silver sulfadiazine dressing, efficacy.

INTRODUCTION

Burns are tissue injuries resulting from excessive heat, cold or radiation exposure, and chemical or electrical contact. Management of pain and distress during wound care procedures is a significant challenge in children with burn injuries (Kumar *et al.*, 2022). Along with major burns (those involving more than 15% of TBSA & initiation of SIRS) minor burns (less than 10% of TBSA) also cause significant morbidity and mortality in pediatric population (Williams and Lee, 2021). Every year about 250000 children suffer from burn injury in USA, with 100000 having scald injury from hot liquids (Lagziel *et al.*, 2023). In Pakistan national emergency department 403 patients were reported with burn injuries in a period of four months, with 48.9% of patients below 19 years of age and incidence was two times more in males as compared to females (Siddiqui *et al.*, 2015). Initially critical care issues are managed in pediatric burn patients then attention is directed to management of burn wounds. Essential steps in burn wound management include cleansing/wound debridement, application of topical antimicrobial and dressing of affected body areas (Mizgan *et al.*, 2022). Characteristics of an ideal dressing for burn wound management would include maintenance of aseptic moist environment around wound, prevention from wound site infection and minimal pain while changing the dressing. In pediatric population dressings impregnated with silver are used more commonly than 1% Silver Sulfadiazine cream for burn wound management (Jaipuria, 2020).

For management of burn wounds silver dressings are considered to be gold standard but in literature few high level clinical trial have been conducted to determine their relative effectiveness and best clinical outcomes (Levin *et al.*, 2022). Therefore in pediatric population it is imperious to find a dressing with ideal characteristics for burn wound healing (Oliveira *et al.*, 2022). Literature showed that hydro-fiber silver dressing is more effective than silver sulfadiazine dressing for management of pediatric burns but controversial evidence has been found in literature regarding efficacy of both dressings (Wu *et al.*, 2023). In routine we apply 1% silver sulfadiazine dressing. Hydro-fiber silver dressing is relatively less costly and more efficacious. This may be due to lack of local study in our set up and in literature as well. The rationale of our study is to figure out the effectiveness of hydro-fiber silver dressing and to implement results of this study in local population to replace the 1% silver sulfadiazine by hydro-fiber silver dressing for pediatric burns. This study will help to improve our practice and local guidelines regarding management of pediatric burn.

MATERIALS AND METHODS

After obtaining approval from hospital ethical review board (IRB #368/RC/KEMU), 264 patients who fulfilled the inclusion criteria were enrolled for study from pediatric surgical emergency, Mayo Hospital, Lahore. Informed consent was taken then demographics (including patient name, age, sex, time since burn, type of burn, and weight of patient) were recorded. Randomization of patients was done in two groups by allocating computer generated number. In group A,

*Corresponding author: e-mail: arr154@yahoo.com.

Hydro-fiber Silver dressing was applied at presentation after wound washing under sedation. Similarly In group B, 1% Silver Sulfadiazine was applied after wound washing and dressing was done with sterile dry gauze. These dressings were covered by dry dressing/gauze. In group A Hydro-fiber Silver dressing was changed every third day. Similarly In group B, the application and removal of 1% Silver Sulfadiazine and dry gauze dressing was done every third day. Swabs for wound culture and sensitivity were taken twice weekly. An experienced pediatric surgeon examined the wounds for re epithelialization and efficacy was labeled after 15 days (Caruso *et al.*, 2006a).

STATISTICAL ANALYSIS

Data analysis was done using SPSS version 22. Quantitative variables like age duration of burn and depth of burn was presented as mean \pm SD. Qualitative variables like gender, site of burn, type of burn and efficacy was presented as frequency and percentage. Both groups were compared for efficacy by using chi-square test. P value \leq 0.05 was taken as significant. Data was stratified for age, gender, type of burn; depth of burn, site of burn and duration of burn. Post-stratification, chi-square test was applied to compare efficacy in both groups for each strata with p-value \leq 0.05 being taken as significant.

RESULTS

Out of 264 pediatric burn patients enrolled in study from pediatric surgical emergency, 148(56.06%) were male and 116(43.94%) were females. There were 78(59.1%) males and 54(40.9%) females in group A, whereas there were 70(53.0%) male and 62(47.0%) females in group B. Mean age of patients was 3.73 ± 2.34 years (range 1year to 13 years). Mean hemoglobin (Hb) level of the patients was 11.54 ± 10.94 g/dl. In group A mean Hb was 11.45 ± 10.95 g/dl, while in group B it was 11.63 ± 10.97 g/dl. (p-value = 0.893). The Mean weight of patients was 12.48 ± 5.17 kg. It was 12.32 ± 5.17 kg in group A and 12.64 ± 5.19 kg in group B (p-value=0.610).

Burn type was Scald in 215(81.4%) patients and flame burn in 49(18.6%) patients. In group A 107(81.1%) patients had scald burn and 25(18.9%) patients had flame burn whereas in group B 108(81.8%) patients had scald burn and 24(18.2%) patients had flame burn. The depth of burn was 2nd degree in 185(70.08%) patients and 3rd degree in 79(29.92%) patients. In group A 94 (71.2%) patients had 2nd degree burn and 38(28.8%) patients had 3rd degree burn, whereas in group B 91(68.9%) patients had 2nd degree burn and 41(31.1%) patients had 3rd degree burn. The mean percentage of total burnt surface area (TBSA) was 19.93 ± 9.62 % (Minimum was 6% and maximum was 50%). In group A mean TBSA was 19.06 ± 9.37 whereas in group B mean TBSA 20.80 ± 9.83 .

The p-value >0.05 so the difference is statistically insignificant.

Out of 264 patients, the efficacy was achieved in 164(62.12%) patients. In group A the efficacy was achieved in 91(68.9%) patients whereas in group B the efficacy was achieved in 73(55.3%) patients. A statistically significant difference is present i.e. p-value=0.022 (table1). In patients having age \leq 5 years: in group A the efficacy was achieved in 80(74.1%) patients while in group B the efficacy was achieved in 57(57%) patients (p-value=0.009). Similarly In patients having age >5 years: in group A the efficacy was achieved in 11(45.8%) patients while in group B the efficacy was achieved in 16(50%) patients (p-value=0.757) (table2). In male patients efficacy was achieved in 58(74.4%) patients in group A and 39(55.7%) patients in group B (p-value=0.017). Similarly in female patients, efficacy was achieved in 33(61.1%) patients in group A and 34(54.8%) patients in group B (p-value=0.495) (table3). In patients with scald burn efficacy was achieved in 79(73.8%) patients in group A and 61(56.5%) patients in group B (p-value=0.008). Similarly In patients having flame burn efficacy was achieved in 12(48.0%) patients in group A and 12(50%) patients in group B (p-value=0.0889) (table4). In patients with 2nd degree burn efficacy was achieved in 87(92.6%) patients in group A and 73(80.2%) patients in group B (p-value=0.014). Similarly In patients with 3rd degree burn efficacy was achieved in 4(10.5%) patients in group A, while in group B the efficacy was achieved in 0(0%) patients (p-value=0.033) (table5).

DISCUSSION

This randomized control trial study was conducted at Department of Pediatric Surgery, Mayo Hospital Lahore to compare the efficacy of Hydro-fiber silver dressing and 1% Silver Sulfadiazine dressing in management of pediatric burns. Wound dressings are primary tool in care of burn patients. Dressings made up of different materials like hydrogels, hydrocolloids, collagen, alginates, and hyaluronic acid are in use, but at present no universally accepted gold standard dressing for burn wound is present (Rani Raju *et al.*, 2022). There is evidence of silver being used in management of burn wound for past centuries but increasing use of dressings impregnated with silver has been observed in last two decades (Haidari *et al.*, 2020). In literature incidence of burn injury is highest among children of age 1 to 6 years (Lin *et al.*, 2005) , in our study mean age of patients is 3.73 years.

Burn injuries are more common in males than females (Saeman *et al.*, 2016), similarly in this study 148 (56.06%) patients were male. Studies have shown that scald burn is major cause of pediatric burn as compared to non-scald burn with incidence of 75.6, in this study scald burn were found in 215 (81.4%) patients (Lam *et al.*, 2021).

Table 1: Comparison of efficacy between study groups

		Study Groups		Total	p-value
		Group A	Group B		
Efficacy Achieved	Yes	91 68.9%	73 55.3%	164 62.1%	0.022
	No	41 31.1%	59 44.7%	100 37.9%	
Total		132 100.0%	132 100.0%	264 100.0%	

Table 2: Comparison of efficacy stratified by age groups

Age (years)	Efficacy Achieved	Study Groups		Total	p-value
		Group A	Group B		
≤5	Yes	80 74.1%	57 57.0%	137 65.9%	0.009
	No	28 25.9%	43 43.0%	71 34.1%	
>5	Yes	11 45.8%	16 50.0%	27 48.2%	0.757
	No	13 54.2%	16 50.0%	29 51.8%	

Table 3: Comparison of efficacy stratified by gender

Gender	Efficacy Achieved	Study Groups		Total	p-value
		Group A	Group B		
Male	Yes	58 74.4%	39 55.7%	97 65.5%	0.017
	No	20 25.6%	31 44.3%	51 34.5%	
Female	Yes	33 61.1%	34 54.8%	67 57.8%	0.495
	No	21 38.9%	28 45.2%	49 42.2%	

Table 4: Comparison of efficacy stratified by mechanism of burn

Mechanism of Burn	Efficacy Achieved	Study Groups		Total	p-value
		Group A	Group B		
Scaled	Yes	79 73.8%	61 56.5%	140 65.1%	0.008
	No	28 26.2%	47 43.5%	75 34.9%	
Flame	Yes	12 48.0%	12 50.0%	24 49.0%	0.889
	No	13 52.0%	12 50.0%	25 51.0%	

Table 5: Comparison of efficacy stratified by depth of burn

Depth of burn	Efficacy achieved	Study groups		Total	p-value
		Group A	Group B		
2 nd degree	Yes	87 92.6%	73 80.2%	160 86.5%	0.014
	No	7 7.4%	18 19.8%	25 13.5%	
3 rd Degree	Yes	4 10.5%	0 0.0%	4 5.1%	0.033
	No	34	41	75	

In this study 2nd degree depth of burn was noted in 185 (70.08%) patients whereas the 3rd degree depth of burn was found in 79 (29.92%) patients. The efficacy was achieved in 164 (62.12%) patients. In Hydro-fiber silver dressing group the efficacy was achieved in 91(68.9%) patients whereas in silver sulfadiazine dressing group the efficacy was achieved in 73 (55.3%) patients. This difference is statistically significant. i.e. p-value=0.022.

One trial found that with 1% Silver sulfadiazine (C₁₀H₉AgN₄O₂S) dressing, skin grafting was required in about 37% of children and in 63% cases efficacy was achieved (as no grafting done) while with Hydro-fiber silver dressing 23% children required grafting while 77% showed efficacy (no grafting) (Cuttle *et al.*, 2007). A study done by SC Saba *et al.* have demonstrated the effectiveness of hydro-fiber silver dressing in management of partial thickness burns in children over routine dressing, with significant reduction in time for wound re-epithelialization (10.3 vs. 16.3 days) (Saba *et al.*, 2009). Another study showed that with 1% Silver sulfadiazine, 32% of children required skin grafting and in 68% cases efficacy was achieved while with hydro-fiber silver dressing 16% children required skin grafting and 84% showed efficacy of the treatment (p = 0.32) (Muangman *et al.*, 2006). A prospective RCT done by Muangman *et al.* (2010) demonstrated effectiveness of silver containing hydro-fiber dressing over 1% silver Sulfadiazine for the treatment of partial thickness burns. In their study time to wound closure was significantly shorter in the hydro-fiber silver dressing-treated group as compared to silver sulfadiazine (10 ± 3 versus 13.7± 4 days, P<0.02). The author concluded that hydro-fiber silver dressing is more efficacious for partial thickness burn wound treatment as it promotes wound healing and decreases patient discomfort by lowering pain scores, frequency of dressing changes and overall reduction in treatment cost.

In a comparative study, Caruso *et al.* (2006a) found that wound re epithelialization is higher with hydro-fiber silver dressing as compared with 1% silver sulfadiazine. In addition fewer dressing changes and decreased pain and anxiety associated with dressing changes, less burning and stinging during wear, were observed with hydro-fiber silver dressing. Yarboro *et al.* (2013) concluded in their study that hydro-fiber silver dressing results in decreased pain and reduce the number of treatments required for wound re epithelialization in superficial-partial thickness burns. The reported decreased cost of burn treatment by reducing the frequency of dressing change and decreased length of hospital stay with use of hydro-fiber silver dressing (Amer *et al.*, 2021). Nedeljka Glavan *et al* (Glavan and Jonjić, 2015) presented in their study findings that from the beginning of treatment, wound dressing with Hydro-fiber silver was performed on an outpatient basis and without antibiotic

therapy. The wounds healed within 4-8 weeks. In another study cost effectiveness of hydro-fiber silver dressing was demonstrated per burn healed, by estimated lower treatment cost and increased rate of wound re epithelialization as compared with silver sulfadiazine. 1,409.06 dollars for hydro-fiber Silver dressing and 1,967.95 dollars for silver sulfadiazine (Caruso *et al.*, 2006b; da Silva Oliveira Merola *et al.*, 2022).

CONCLUSION

This study concluded that the hydro fiber silver dressing is significantly more efficacious as compared to silver sulfadiazine dressing for treatment of pediatric burns.

REFERENCES

- Amer Y, Bridges C and Marathe K (2021). Epidemiology, pathophysiology, and management strategies of neonatal wound care. *NeoReviews*, **22**: e452-e460.
- Caruso DM, Foster KN, Blome-Eberwein SA, Twomey JA, Herndon DN, Luteran A, Silverstein P, Antimarino JR and Bauer GJ (2006a). Randomized clinical study of Hydrofiber dressing with silver or silver sulfadiazine in the management of partial-thickness burns. *J. Burn Care Res.*, **27**: 298-309.
- Caruso DM, Foster KN, Blome-Eberwein SA, Twomey JA, Herndon DN, Luteran A, Silverstein P, Antimarino JR and Bauer GJ (2006b). Randomized clinical study of Hydrofiber dressing with silver or silver sulfadiazine in the management of partial-thickness burns. *J. Burn Care Res.*, **27**: 298-309.
- Cuttle L, Naidu S, Mill J, Hoskins W, Das K and Kimble RM (2007). A retrospective cohort study of Acticoat™ versus Silvazine™ in a paediatric population. *Burns*, **33**: 701-707.
- DA Silva Oliveira Merola LN, Sampaio GA, Vinaud MC, Coutinho EL and De Souza Lino Junior R (2022). How effective are commercialized products used in the treatment of superficial partial-thickness burn injuries? – Systematic Review with Meta-analysis. *medRxiv*, 2022.11.14.22282317.
- Glavan N and Jonjić N (2015). Efficacy of hydrofiber silver dressing in the treatment of posttraumatic skin wounds in children. *Wounds*, **27**: 239-243.
- Haidari H, Garg S, Vasilev K, Kopecki Z and Cowin AJ (2020). Silver-based wound dressings: Current issues and future developments for treating bacterial infections. *Wound Pract. Res.*, **28**: 173-180.
- Jaipuriar A (2020). Comparative study in effectiveness of topical povidone iodine with silver sulfadiazine ointment and only silver sulfadiazine ointment in the management of burns. Coimbatore Medical College, Coimbatore, India.
- Kumar R, Keshamma E, Kumari B, Kumar A, Kumar V, Janjua D and Billah AM (2022). Burn injury management, pathophysiology and its future

- prospectives. *Int. J. Res. Appl. Sci. Biotechnol.*, **1**: 78-89.
- Lagziel T, Lopez CD, Khoo KH, Cox CA, Garcia AV, Cooney CM, Yang R, Caffrey JA, Hultman CS and Redett RJ (2023). Public perception of household risks for pediatric burn injuries and assessment of management readiness. *Burns*, **49**: 1305-1310.
- Lam NN, Hung NT, Duc NM and Luong NV (2021). Epidemiology and risk factors for death of pediatric burns in a developing country. an experience from the national burn hospital. *Ann. Burn. Fire Disasters*, **34**: 213-217.
- Levin NJ, Erben Y, Li Y, Brigham TJ and Bruce AJ (2022). A systematic review and meta-analysis comparing burn healing outcomes between silver sulfadiazine and *Aloe vera*. *Cureus*, **14**: e30815.
- Lin TM, Wang KH, Lai CS and Lin SD (2005). Epidemiology of pediatric burn in southern Taiwan. *Burns*, **31**: 182-187.
- Mizgan GE, Kousar S, Khan IA, Perwasha P, Gul H, Aslam I, Abbas A and Ul-Ain Q (2022). Evaluation of anti-clotting and thrombolytic potential of the aqueous-methanolic extract of *Jasminum sambac*. *Pak. J. Pharm. Sci.*, **35**: 1747-1754.
- Muangman P, Chuntrasakul C, Silthram S, Suvanchote S, Benjathanung R, Kittidacha S and Rueksomtawin S (2006). Comparison of efficacy of 1% silver sulfadiazine and Acticoat™ for treatment of partial-thickness burn wounds. *J. Med. Assoc. Thailand*, **89**: 953.
- Muangman P, Pundee C, Opananon S and Muangman S (2010). A prospective, randomized trial of silver containing hydrofiber dressing versus 1% silver sulfadiazine for the treatment of partial thickness burns. *Int. Wound J.*, **7**: 271-276.
- Oliveira A, Simões S, Ascenso A and Reis CP (2022). Therapeutic advances in wound healing. *J. Dermatolog. Treat.*, **33**: 2-22.
- Rani RN, Silina E, Stupin V, Manturova N, Chidambaram SB and Achar RR (2022). Multifunctional and smart wound dressings - A review on recent research advancements in skin regenerative medicine. *Pharmaceutics*, **14**: 1574.
- Saba SC, Tsai R and Glat P (2009). Clinical evaluation comparing the efficacy of Aquacel® Ag Hydrofiber® dressing versus petrolatum gauze with antibiotic ointment in partial-thickness burns in a pediatric burn center. *J. Burn Care Res.*, **30**: 380-385.
- Saeman MR, Hodgman EI, Burris A, Wolf SE, Arnoldo BD, Kowalske KJ and Phelan HA (2016). Epidemiology and outcomes of pediatric burns over 35 years at Parkland Hospital. *Burns*, **42**: 202-208.
- Siddiqui E, Zia N, Feroze A, Awan S, Ali A, Razzak J, Hyder AA and Latif A (2015). Burn injury characteristics: Findings from Pakistan National Emergency Department Surveillance Study. *BMC Emerg. Med.*, **15**(Suppl 2): S5.
- Williams FN and Lee JO (2021). Pediatric Burn Infection. *Surg. Infect. (Larchmt)*, **22**: 54-57.
- Wu JJ, Zhang F, Liu J, Yao HJ and Wang Y (2023). Effect of silver-containing hydrofiber dressing on burn wound healing: A meta-analysis and systematic review. *J. Cosmet. Dermatol.*, **22**: 1685-1691.
- Yarboro DD (2013). A comparative study of the dressings silver sulfadiazine and Aquacel Ag in the management of superficial partial-thickness burns. *Adv. Skin Wound Care*, **26**: 259-262.