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Pediatric First-Degree Burn Management With Honey and 1% Silver Sulfadiazine (Ag-SD): Comparison and Contrast

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Abstract

Background

The cardinal area of managing fire wounds is guided by adequately evaluating the burn-induced lesion's profundity and size. Superficial second-degree burns are often treated through daily reinstating with fresh sterile bandaging with appropriate topical antimicrobials to allow rapid spontaneous epithelialization. Around the world, a wide variety of substances are used to treat these wounds, from honey to synthetic biological dressings.

Objective

This study intended to determine honey's therapeutic potential compared with 1% silver sulfadiazine (Ag-SD) in arsenal-caused contusion medicament fulfillment.

Methods

A total of 70 cases were evaluated in this research work after fulfilling the required selection criteria during the study period of January 2014 to December 2014 and January 2017 to December 2017. Purposive selection criteria were adopted in the study to select research patients. The patients in Group-1 (n = 35) relied on honey as medication, while patients in Group-2 (n = 35) relied on 1% Ag-SD.

Results

In Group-1, exudation (68.4%) and sloughing (82.9%) were substantially reduced by Days 3 and 5 of therapeutic intervention, respectively. However, in Group-2, a reduction of exudation (17.1%) and sloughing (22.9%) occurred after Days 3 and 5 of treatment, respectively. Completion of the epithelialization process was observed among Group-1 and Group-2 cases. It was detected after Days 7 and 10 of treatment at 36.3% and 77% (Group-1) and 27% and 67% (Group-2), respectively. Around 3 ml of 1% honey was required per body surface area per dressing in Group-1. On the other hand, in Group-2, 2 gm Ag-SD was needed per body surface area per dressing.

Conclusion

Patients treated with honey found better clinical outcomes in managing superficial partial-thickness burns.

Categories: Pediatric Surgery, Infectious Disease, Trauma
Keywords: bangladesh, postburn contracture, scar, cooking fire, hot water, honey, silver sulphadiazine, wound healing, children, burn

Introduction

A burn is a heat-induced acute trauma [1]. It is often brought by chemical, electrical, friction, or radiation, physical, and chemical (organic or inorganic) agents [2]. Burn injury uniformly involves local and systemic adverse impacts on any living creature, including humans, with short- and long-term consequences [3,4]. Severe burns have been observed to upset cardio-vascular physiology resulting in hypovolemic and distributive shock [1]. It also involves the immune and metabolic systems and causes disastrous inflammatory retaliation to catalyze diversiform organ failure and promote sepsis [1,5,6]. Burn causes not only bodily damage but also causes physical limitation, with promotes cosmetic issues. Nevertheless, it also damages psychological and emotional well-being, impairing the patient's future quality of life [4,7,8]. Thermal burn wounds are common among pediatric cases and a significant cause of childhood trauma [9-11]. Burn management frequently needs multidisciplinary care [12,13]. It often causes fatal outcomes, especially among children, everlasting indelible defacement, mutilation, and anatomical and physiological malfunction [4, 14-17].

Categories of burn

Skin is the largest organ system of our body, and its weight is 16%, which is about one-seventh of total body weight [18-20]. Skin acts as a shielding fence, managing evaporation, controlling temperature, expelling waste products, and carrying sensations such as pain, touch, temperature, and pressure [21]. Burns encompass a range of intensity of injury determined by the profundity of the maim and the quantity or percentage of the burn of the whole body [22]. Burn has been categorized as superficial (first degree), partial thickness (second degree), and total thickness (third degree), involving just the epidermal layer of the skin, damaging to deeper structures within the skin, and all layers of the skin, respectively [23-25]. It has been reported that burns have the possibility to damage structures beneath the skin and deeper tissues. Thereafter, this clinical condition is called total thickness burn, which can entangle more inner tissues (fourth degree) [21]. Similarly, superficial or first-degree burns only include the epidermal layer of skin [26,27]. Partial thickness burns are often defined when 10% of the total body surface area (TBSA) is affected and commonly affect people aged 10-50 years [22]. A third-degree burn indicates a full-thickness epidermis and dermis, affecting over 15% of the TBSA [22].

Burn-related morbidity and mortality

It has been estimated that 180,000 patients have fatal outcomes globally every year due to burns [28]. Additionally, there is high-rate morbidity, prolonged hospital stays, and management of burn involves financial burden over healthcare. The treatment of burns increases substantial impediments to the healthcare system at the public and community levels around the globe, especially among low-income countries [29]. The number of global deaths due to burning was recorded as 120,000-265,000 per year, most importantly of which occurred in low- and middle-income countries (LMICs) [30,31]. Multiple studies have reported that the overall mortality rate in Bangladesh is 2-2.2 per 100,000 people per year [25,26]. The fatal clinical outcome has been more among female victims [31,32]. Additionally, burn-related injuries in Egypt, Colombia, Pakistan, and Bangladesh give rise to 18% of permanent disorders and special needs [33]. In low-income countries, children below 5 to 6 years are at maximum risk of burn-related trauma as they have thinner skin [34,35]. Flame and scald burns remain the primary contributors to burn injuries among infants, children, and adolescents [36-38]. Subsequently, burns are the most prevalent and calamitous type of wound that requires surgical management. Nevertheless, this global public health issue has been reported to be preventable [25,39-42].

Burn and infection

One study reported that the infection is a typical stumbling block in the therapeutic intervention of post-burn wounds [43]. *Providencia rettgeri* is a gram-negative bacillus. *P. rettgeri* is an atypical pathogenic microbe that hardly ever causes wound infections. *P. rettgeri* often infect burn wound and causes substantial morbidities. Furthermore, drug resistance towards *P. rettgeri* further complicates burn infection. Additionally, antimicrobial resistance raises treatment difficulty, especially in low-budget healthcare settings [43]. Additionally, one more study revealed that 75% of fatal outcomes result from sepsis from a burn-wound infection [44]. Resistance microbes infect burn wounds, causing sepsis, often hindering the therapeutic process [45]. Consequently, worldwide infection of burn wounds endures the principal mainspring of high-level morbidity and mortality [1]. Multiple studies also revealed that the death rate is as high as 51% [14,46-48]. One Cochrane study reported that 75% of burn cases died from life-threatening microbial infection after a preliminary emergency procedure [49]. Most dermatological burns are minor and treated with domiciliary care [50, 51]. Minor skin burns are often managed at home with cold water and several over-the-counter burn creams and gels [52].

Burn and hospitalization

Patients with burns in either pediatric or adult cases require urgent hospitalization when affected areas cover 5-10% and 10-20% of TBSA, respectively [52]. Additionally, burns involving hands, feet, neck, face, airway, and perineum demand hospital care [52,53]. Furthermore, burn cases with diabetes, immunosuppressed circumstances, and of extreme age, either pediatric or geriatricindividuals require high-profile medical care [54-58].

Modalities of burn infection control

Commonly used antimicrobials in burns management include neosporin, polymyxin B, mafenide acetate, mupirocin, bacitracin, nystatin, nitrofurazone, etc. [59-62]. Additionally, silver derivative compounds are also utilized in burn infection management. Those compounds include Ag-SD, flammacerium, silver amniotic membrane, silver nitrate, acticoat 7, silver foams, aquacel-Ag, and silvercel [62-65]. Furthermore, iodine-based compounds have also been used in cadexomer iodine, povidone-iodine, repithel, liposomal iodine, and Iocide [62,66,67]. Several antimicrobial peptides, such as histone H1.2, ceragenins, demegel, defensins, cecropin B, rBPI, etc. have been reported to have beneficial effects regarding burn infection control [62,68,69]. It has been observed that multiple synthetic and herbal compounds have also been used in burn-related infection management. Those include papaya, honey, bicomponent triton tri-n-butyl phosphate (BCTP) nanoemulsion, acidified nitrite, chlorhexidine, mitogen-activated protein kinase (p38 MAPK) inhibitor, 1-ethyl-6-fluoro-1,4-dihydro-4-oxo-7(1-piperazinyl)-quinoline-carboxylic acid (FPQC), moist exposed burn ointment (MEBO), probiotics, lactobacillus, phage therapy, super oxidized water, essential oils [62,70-76].

Critical issues of burn treatment

A censorious segment of burn wound medical intervention is correcting fluid and electrolyte imbalance, nutritional intervention, organ support, wound care, and overall resuscitation [29,77-79]. Additionally, burn wound management requires rapid healing with minimum scarring [25,80-83]. Multiple procedures are advocated for therapeutic intervention of burn wounds [84-86]. Open or exposed, semi-closed, or complete bandaging burn wound procedure, with or without antibiotics, has been often practiced in many developing countries [87-89]. Burn patients are usually kept strictly under the mosquito net in ambulatory and hospitalized cases in many LMICs to prevent maggots' formation [90,91]. The open approach line-up with desiccating up the burnt area in the earliest possible time, restoring the site, and rejuvenating beneath the withered crust [92]. Burn patients had a high possibility of developing infections. Thereby, infection control and management remain as centerpiece of therapeutic intervention [93,94]. Additionally, these patients required encouraging or fostering skin tissue reconstruction (epithelialization) activity [95]. Several modalities regarding infection control among burn cases have been practiced around the globe [96].

Silver sulfadiazine (Ag-SD) in burn infection control

It has been reported that long-standing burn patients often had fatal outcomes, including death (42-65%) because of infection [97-101]. Ag-SD is a pharmaceutical product often prescribed to stave off, control, and treat infectious disorders in burn lesions. It is a heavy metal dermatological medication with antimicrobial effects [59,102,103]. Ag-SD has been considered the gold standard for therapeutic intervention regarding infection control of burn wounds for topical, second- and third-degree burns [62,104,105]. Ag-SD (1%) topical formulation has been reported to possess potentially good efficacy with an admirable low adverse profile for superficial and partial thickness burn [106-108]. Ag-SD has been considered a potent antimicrobial medication and appraised as a conventional or typical strategy for burn-affected individuals [109]. Nonetheless, one meta-analysis revealed that new dressings for burn treatment containing silver or without silver have better efficacy than Ag-SD regarding wound alleviation. Additionally, dressings that do not contain silver had a lower possibility of developing an infection than with Ag-SD. Moreover, statistically significant disagreement was observed between Ag-SD and new silver materials containing dressings associated with averting infection [110]. The efficacy of Ag-SD regarding burn wound healing is solely dependent on its antimicrobial properties; thereby, Ag-SD has been utilized for decades [111, 112]. Multiple studies reported that several microbial agents resist Ag-SD [62,104,113].

Role of honey in the management of burn

Globally, multiple natural substances, traditionally used as medication, especially honey, have been used to aggrandize burn-induced trauma alleviating, especially for about 8,000 years [114-118]. Burn dressings containing honey minimize pain, decontaminate, disinfect burn lesions, and expedite the restorative and beneficial process [113,119]. It has been reported that honey's valuable contributions to burn are its anti-inflammatory, antioxidant, and anti-microbial properties that ensure the success of skin grafting and wound mitigating process [117,120, 121]. Honey comprises various subcategories of carbohydrates, lipids, amino acids, proteins, vitamins, and minerals that are predominant in burn-trauma curative effect and minimizes further injury throughout the dressing process [122]. Vitamin C, monophenolics, flavonoids, and polyphenolics like watery and lipotropic anti-oxidants are commonly available in honey. Additionally, aqueous and blacker honey contains more antioxidants, consequently, acts as an ideal natural oxidants antagonist [123-126]. Many research papers have postulated several mechanisms regarding honey's anti-inflammatory effect. Those are suppression of synthesis of nitric oxide and complement, impediment of macrophage activity, curbing and squashing of reactive oxygen species (ROS) by phagocytes, minimizing free radical formation reducing oxidative stress, and availability of apalbumina-1 in honey because this chemical moiety secreted by the honeybees. Apalbumina-1 is known to possess an immunostimulatory effect [127-130]. Antimicrobial properties of honey have been explained as it contains high sugar, which causes the osmotic effect. Thereby preventing the growth of microbes in the wound and enhancing the healing process [131-133]. Another study reported that honey produces antimicrobial effects through the enzymatic production of hydrogen peroxide. Although some medicinal honey shows an antimicrobial effect, even hydrogen peroxide activity is blocked [117,134]. However, honey's medicinal properties differ in the country of origin, type of plant, and bees [135]. Besides honey's antimicrobial effects, it has an antioxidant effect that neutralizes free radical formation inflammatory response because of burn [114,136]. Additionally, honey's hygroscopic effect, high viscosity, acidic pH, and hydrogen peroxide content produce comprehensive favorable results in burns therapeutics and care [114,119]. Multiple studies reported that honey's hydrogen peroxide, also known as inhibin, is the principal component responsible for antimicrobial properties [135, 137]. The burn area required slightly wet burn surroundings for fast remedy. Honey effectively generates moist conditions and promotes ideal healing [114, 132]. Additionally, honey-induced damp conditions quickly reduce edema, and exudates, remove the infection, decreases inflammation, and freshen and sanitize burned wound area [132,138]. Furthermore, honey enhances the rapid re-epithelization process in burn-induced lesions called the epithelial-mesenchymal transition (EMT) and stimulates angiogenesis and the immune system [116,136,139-141].

Objective of the study

This study intended to assess the effectiveness of honey in comparison with 1% Ag-SD in burn wound management.

Materials And Methods

Study details

Study Design and Sample Selection

This was a prospective comparative study conducted in the burn and reconstructive surgery unit of Dhaka Shishu Hospital, Dhaka, Bangladesh. The age range was 12-60 months.

Study Period, Sampling Method, and Sample Size

From January 2014 to December 2014 and January 2017 to December 2017, totaling two years. 70 patients were incorporated into this study after fulfilling the all-inclusive required criteria. Purposive sampling was adopted for the current research. It is because the availability of pediatric study samples was extremely low. Purposive sampling, recognized as judgmental, selective, or subjective sampling, is a pattern of non-probability sampling in that investigators trust their self-acumen while picking out subjects of the inhabitants to participate in their research.

Inclusion and Exclusion Criteria

Inclusion criteria: Patients with superficial partial thickness burn; burn covering 5-20% of TBSA; written informed consent was obtained from their parents.

Exclusion criteria: Patients with burns involving the face, hands, feet, genitalia, perineum, and major joints with burn-wound infection; delayed arrival to hospital (more than 24 hours); patients with known allergies to honey or Ag-SD; patients with other systemic illnesses, e.g., protein energy malnutrition (PEM) and cerebral palsy.

Procedure of Data Collection, Data Analysis, and Interpretation

The TBSA entangled in burn calculated through rules of nine [142-144]. Total samples were divided into two groups. Dressings for patients in Group-1 and Group-2 were conducted with pure, undiluted, and unprocessed honey and 1% Ag-SD, respectively. The honey utilized was of multi-floral origin. It was obtained from home garden of the principal researcher. Grouping was determined through a lottery among parents. General management was the same in both groups. Study variables were recorded on the third, fifth, seventh, tenth, and fourteenth day of treatment. Patients of both groups followed the same discharge criteria, and weekly follow-ups were done for up to four weeks. Infection rate, pathogenic microbes involved, and details were detailed in the result section.

Data were collected, compiled, and statistical analysis was conducted by SPSS software version 20 [IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.]. The findings of the study were presented by frequency and percentage in tables. Means and standard deviations for continuous variables and frequency distributions for categorical variables were used to describe the characteristics of the total sample. To estimate the p-value, the non-parametric Mann-Whitney U test was used for non-normalize data, an independent sample t-test was used for normalized data, and a Chi-square test was applied for dichotomous variables. A p-value of <0.05 was considered significant.

Ethical Approval

This study obtained ethical approval from the Institutional Review Board (IRB) of the Dhaka Shishu Hospital, Dhaka-1000, Bangladesh (Reference No. BICH-ERC-9/2/2017, June 19, 2017). The study participants' parents (as participants were minors) were Informed in detail regarding the study plan and future publication. Only those participants who gave written informed consent from a valid guardian were included in this research.

Statistical Analysis Plan

Demographic data were furnished as mean±SD or median with interquartile range (IQR) or number with percent in parenthesis. To assess the association between demographic features and treatment group, a non-parametric Mann-Whitney U test for non-normalize data, an independent sample t-test for normalized data, and a Chi-square test was applied for dichotomous observation. The logistic regression model was used to estimate the treatment effects on the slough's presence and the slough's reduction on Days 3, 5, and 7. We also used a multivariate regression model to evaluate the mean difference in the completion of epithelialization between the treatment group. All the regression model was adjusted by age, sex, weight, cause of burn (hot water and cooking-related burn), duration of burn injury, and surface area. For statistical analysis, we used STAT-15, and a graphical presentation was performed by Graph Pad Prism 8.3. All the statistical significance was considered with $p < 0.05$.

Results

In total, 70 participants, 35 in Group-1 and another 35 in Group-2, were enrolled to see the effectiveness of pediatric first-degree burn management. Burn patients' photographs are illustrated in Figures *1* and 2 on the admission of Groups I and II, respectively. The median age with the IQR was 24 (14, 40) in Group-1 and 19 (12, 60) months in Group-2. In Group-2, 21 (60%) were girls, whereas in Group-2, 15 (42.9%) were girls. Most of the study population (85.71%) were below 5 years. The median body weight of the studied participants was 10 kg in both groups. None of the observations showed any statistical significance ($p > 0.05$) in the baseline (Table *1*). Figures *3* and 4 illustrate the treatment progress on Day 3 of Group-1 and Group-2, respectively. Similarly, Figures *5* and 6 pictorially denote the treatment progress on Day 7 among Group-1 and Group-2, respectively. Figures *7* and 8 display treatment progress on Day 10 in Group-1 and Group-2, respectively.

FIGURE 1: Photo depicting a patient in Group-1 on admission

The photograph has been taken by Md. Moniruzzaman.

FIGURE 2: Photo depicting a patient in Group-2 on admission

The photograph has been taken by Md. Moniruzzaman.

	Group-1 (n=35)	Group-2 (n=35)	p-value
Age in months, median (IQR)	24 (14, 40)	19 (12, 60)	0.972
Sex			
Boys	14 (40.0%)	20 (57.1%)	0.151
Girls	21 (60.0%)	15 (42.9%)	
Weight in kg, median (IQR)	10.0 (8.70, 14.0)	10.0 (9.0, 15.5)	0.292
Cause of burn			
Hot water	21 (60.0%)	23 (65.7%)	0.621
Cooking related burn	14 (40.0%)	12 (34.3%)	
Duration of burn injury	3.66±1.85	3.66±1.85	0.999
Total surface area of burns (%)	10.3±2.65	11.2±2.87	0.158

TABLE 1: Socio-demographic features of the study participants

Data were presented as median with IQR or number with percent in parenthesis. To estimate the p-value, the non-parametric Mann-Whitney U test was used for non-normalized data, an independent sample t-test was used for normalized data, and a Chi-square test was applied for dichotomous variables.

IQR: Interquartile range

FIGURE 3: Photo depicting the patient in Group-1 on Day 3 of treatment

The photograph has been taken by Md. Moniruzzaman.

FIGURE 4: Photo depicting the patient in Group-2 on Day 3 of treatment

The photograph has been taken byMd. Moniruzzaman.

FIGURE 5: Photo depicting the patient in Group-1 on Day 7 of treatment

The photograph has been taken by Md. Moniruzzaman.

FIGURE 6: Photo depicting the patient in Group-2 on Day 7 of treatment

The photograph has been taken by Md. Moniruzzaman.

FIGURE 7: Photo depicting the patient in Group-1 on Day 10 of treatment

The photograph has been taken by Md. Moniruzzaman.

FIGURE 8: Photo depicting the patient in Group-2 on Day 10 of treatment

The photograph has been taken by Md. Moniruzzaman.

Infection details

In Group-1 and Group-2, 14.3% and 22.9% of participants developed wound infections. Pearson's Chi-square test found no statistical differences between the two groups regarding wound infection ($p > 0.05$). In Group-1, most (60%) of the wound infection was caused by *Staphylococcus aureus*. Other organisms were *Escherichia coli* (20.0%) and *Pseudomonas aeruginosa* (20.0%). In Group-2, half (50.0%) of the wound infection was caused by *S. aureus*. Other organisms were *E. coli* (12.5%) and *P. aeruginosa* (37.5%).

Multivariate logistic regression found that the odds ratio (OR) of the reduction of slough in Group-1 was 5.46 times (95% CI: 1.05, 37.9; $p = 0.040$) and 39.8 times (95% CI: 5.88, 269.5) higher at Days 3 and 5 compared to Group-2. This study observed that both groups were 100% slough was abolished at Day 7 (see Table 2 and Figure 9).

	Present	Absence	p-value[1]	OR (95% CI)	p-value[2]
Slough on day 3					
Group I	27 (77.1%)	8 (22.9%)	0.040	5.46 (1.05, 37.9)	0.049
Group II	33 (94.3%)	2 (5.71%)		Ref.	
Slough at day 5					
Group I	6 (17.1%)	29 (82.9%)	<0.001	39.8 (5.88, 269.5)	<0.001
Group II	27 (77.1%)	8 (22.9%)		Ref.	
Slough on day 7					
Group I	0	35 (100%)	-	-	-
Group II	0	35 (100%)		Ref.	

TABLE 2: Association of treatment effects on the presence of slough at Days 3, 5, and 7

[1] Non-parametric Chi-square test was used to estimate the p-value; [2] Multivariate logistic regression model was used to calculate the p-value. The model was adjusted by age, sex, weight, cause of burn (hot water and cooking-related burn), duration of burn injury, and surface area.

OR: Odds ratio

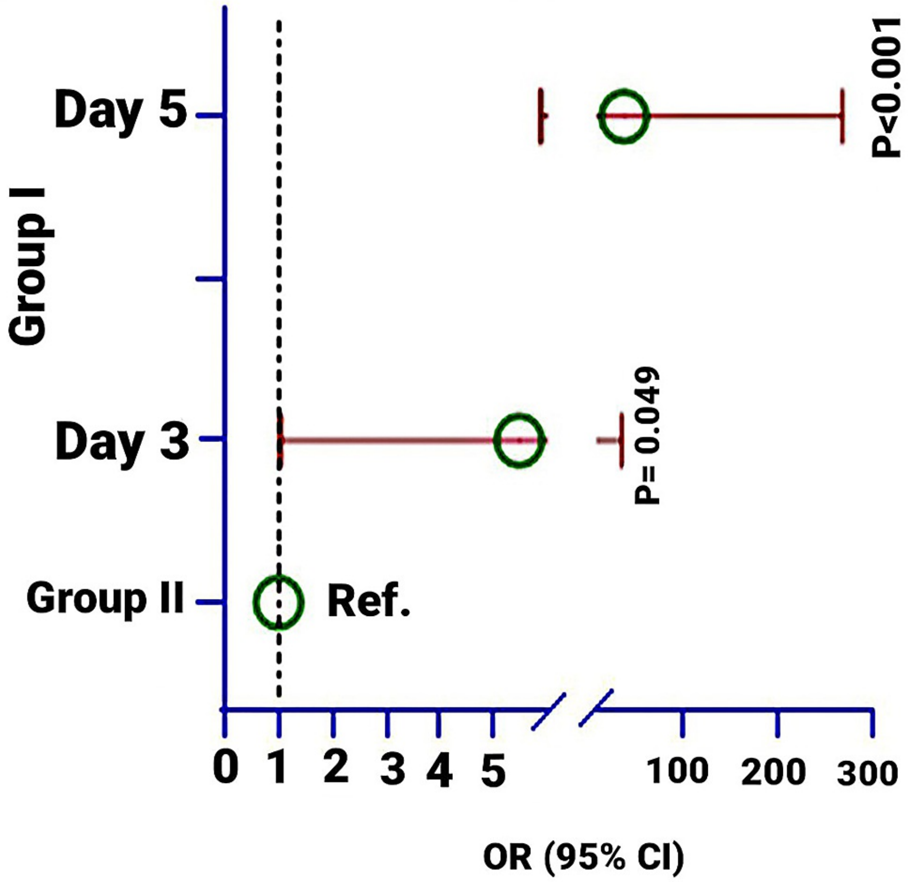

FIGURE 9: Odds of reduction of the slough at Days 3, 5, and 7 in Group-1 compared to Group-2. The multivariate logistic regression model was used to estimate the p-value. The model was adjusted by age, sex, weight, cause of burn (hot water and cooking-related burn), duration of burn injury, and surface area.

The figure has been created by Md. Ahsanul Haq.

The multivariate logistic regression model was used to estimate the p-value. The model was adjusted by age, sex, weight, cause of burn (hot water and cooking-related burn), duration of burn injury, and surface area. Reduction of exudate showed a significant OR in Group-1 compared to Group-2 on Days 3 (Figure 6) and 5 and which was 13.8 times (95% CI: 3.63, 52.2; p < 0.001) and 35.2 times (95% CI: 25.2, 45.2; p < 0.001) higher in Group-1 compared to Group-2. On Day 7, both groups reduced 100% exudate (see Table 3 and Figure 10).

	Present	Absence	p-value[1]	OR (95% CI)	p-value[2]
Exudate on Day 3					
Group-1	11(31.4%)	24 (68.6%)	<0.001	13.8 (3.63, 52.2)	<0.001
Group-2	29(82.9%)	6 (17.1%)		Ref.	
Exudate at Day 5					
Group-1	0	35 (100%)	<0.001	35.2 (25.2, 45.2)	<0.001
Group-2	21(60.0%)	14 (40.0%)		Ref.	
Exudate at Day 7					
Group-1	0	35 (100%)	-	-	-
Group-2	0	35 (100%)		Ref.	

TABLE 3: Association of treatment effects on the presence of exudate at Days 3, 5, and 7 in Group-1 compared to Group-2.

[1] Non-parametric Chi-square test was used to estimate the p-value; [2] Multivariate logistic regression model was used to calculate the p-value. The model was adjusted by age, sex, weight, cause of burn (hot water and cooking-related burn), duration of burn injury, and surface area.

OR: Odds ratio

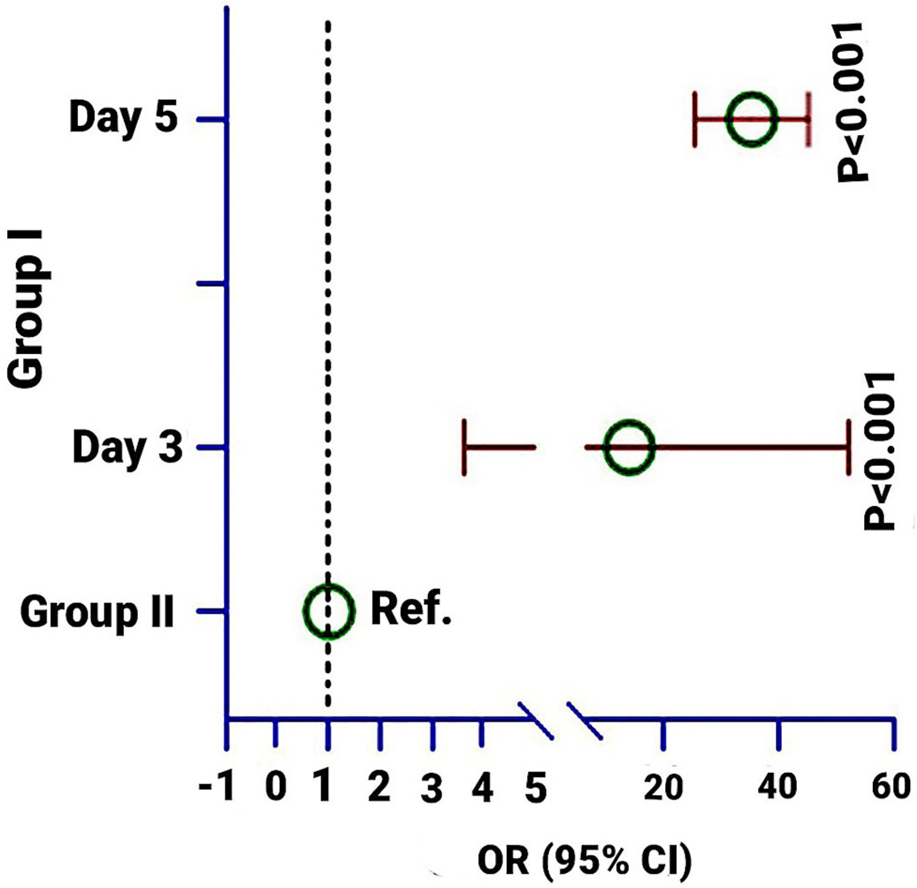

FIGURE 10: Odds of reduction of exudate at Days 3, 5, and 7 in Group-1 compared to Group-2. The multivariate regression model was used to estimate the p-value. The regression model was adjusted by age, sex, weight, cause of burn (hot water and cooking-related burn), duration of burn injury, and surface area.

The figure has been created by Md. Ahsanul Haq.

Completion of epithelialization in Group-1 decreased by 11.3% compared to Group-2 (p < 0.001, 95% CI: -14.8, -7.79) on Day 7. Whereas completion of epithelialization in Group-1 increased by 9.29% (p = 0.006, 95% CI: 2.78, 15.8) on Day 10. An older person has a relatively lower completion of epithelialization by 0.15% (p = 0.027, 95% CI: -0.28, -0.02). A similar lower count was noted on Day 14 by 10% (p = 0.012, 95% CI: -0.17, -0.02) (Table 4).

	Unadjusted		Adjusted	
	β-Coff (95% CI)	p-value	β-Coff (95% CI)	p-value
At day 7				
Group II	Ref.		Ref.	
Group I	-9.09 (-13.6, -4.58)	<0.001	-11.3 (-14.8, -7.79)	<0.001
At day 10				
Group II	Ref.		Ref.	
Group I	9.28 (2.91, 15.7)	0.005	9.29 (2.78, 15.8)	0.006
Age	-	-	-0.15 (-0.28, -0.02)	0.027
At day 14				
Group II	Ref.		Ref.	
Group I	2.71 (-0.91, 6.34)	0.140	2.57 (-1.13, 6.27)	0.170
Age			-0.10 (-0.17, -0.02)	0.012

TABLE 4: Mean difference of completion of epithelialization at Days 7, 10, and 14 in Group-1 compared to Group-2.

The multivariate regression model was used to estimate the p-value. The regression model was adjusted by age, sex, weight, cause of burn (hot water and cooking-related burn), duration of burn injury, and surface area.

Duration of hospitalization showed no significant difference and thus was not reported here. β-Coff (95% CI: -0.26(-1.38, 0.86), p = 0.642, but elderly age children left the hospital earlier by 0.04 days (β=0.04, 95% CI: 0.02, 0.06, p = 0.001). In the overall group, elderly children had a higher probability of leaving the hospital early.

Discussion

Burns remain the fourth typical cause of injury among the pediatric population, often demanding multidisciplinary medical care [145-147]. It has been observed that increased morbidities and mortalities occur, principally among LMICs, because of burns [147-149]. Microbial infection, followed by sepsis, is among the highest contributing features in burn-related impermanence and fatal clinical outcome [150, 151]. Burn patients quickly develop fluid and electrolyte imbalances that often cause fatality. Proper and adequate fluid and electrolyte correction saves pediatric and adult lives [152-155].

This study population's age range was 6 to 120 months. Earlier, one Bangladeshi study reported that the highest rate of burn cases was among 1-4 years and 3.5-fold higher than among teenagers (15-17 years) [156]. Another study reported that the range of these burn cases was 0-14 years [157]. Our findings were in line with earlier studies [156, 158]. There were no statistically significant differences observed among pediatric burn cases regarding sex. Our results were similar to an earlier study conducted in the USA and Italy [158,159]. Nevertheless, one study at Linköping University Hospital of Sweden reported that more males (70%) were burned cases than females [160]. While conducting logistic regression analysis, one recent Malawian study reported no statistically significant difference regarding the fatal outcome in the odds when compared between sex (OR 1.12, 95% CI: 0.82-1.52, p = 0.5) [161]. The current study participants of childhood burn patients' median weight was 10 kg. Most of our cases were burned through hot water and associated with cooking. Our findings were similar to an earlier study of the USA extracting data from the "Electronic Injury Surveillance System Database" from 2000-2016 [162]. Another study conducted in Ghana reported that most pediatric burns were caused by open-fire cooking utilizing wood, manure, garbage, etc. [163]. To reach the nearest hospital and the treatment process at home, pediatric burn cases at home require over three hours in Bangladesh. Two US studies revealed that the median time from commencing burn to transport to the burn care hospital was 6.26 (range: 0.5-96 hours) and 7.2 hours (range: 1.6-48) [164,165]. Nonetheless, one more study reported that from Central Malawi to Kamuzu Central Hospital was within eight hours [166]. It seems transportation in our study was lower than in earlier studies. It has been reported that a prolonged time to reach the hospital enhances morbidities and mortalities [167,168]. This study found that the TBSA (%) was 10.3 to 11.2. It has been reported that most pediatric burns are of accidental origin and often lead to death [11,35]. Less than 10% of TBSA are considered minor among childhood cases [169]. Nevertheless, a substantial proportion of pediatric burns involve over 15% TBSA, which remains as dominant cause of the commencement of the systemic inflammatory response syndrome (SIRS) [170]. SIRS usually shows unfocused symptoms and is often instigated by a pernicious stressor, such as trauma, inflammation, ischemia, infection, and/or various offending agents alone or in combination. Thereby showing an over-elaborated immune response [171].

This study revealed that childhood burn exudate and slough statistically significantly eliminated earlier among cases were treated with honey when compared with the 1% Ag-SD-treated group through multivariate logistic regression model analysis was applied. Multiple studies reported that honey dressings were more effective in sterilizing and fostering medicinal and curative approaches to manage superficial and partial thickness burn wounds than Ag-SD [138,172-174].

Study Group-2 (1% Ag-SD) shows a statistically significantly improved epithelization process than the honey-treated group by Day 7. Multiple studies reported that honey shows better efficacy regarding re-epithelialization [173,175,176]. The current study revealed that the reverse situation was observed on Day 10, as honey treated shows a much better epithelization process when compared with Ag-SD-treated group. Nevertheless, one Indonesian study revealed no statistically significant differences between the honey and Ag-SD-treated group regarding re-epithelization on Day 10 [177]. However, one Indian study revealed that the honey-treated group showed at least two weeks earlier healing than the Ag-SD group [178]. Baghel et al. reported that burn wound disinfects and heals faster when treated with honey than Ag-SD. Compared to 1% Ag-SD, honey stopped hypertrophic disfigurement and post-burn tightening and narrowing, and reduced the requirement of debridement regardless of hospitalization time [179]. The superficial and partial-thickness burns' re-epithelialization and the healing process were significant with high speed when burn-wound treated with honey than 1% Ag-SD (13·47±4·06 Vs. 15·62±4·40 days, respectively: $p < 0.0001$) [173]. Additionally, older childhood burn cases' re-epithelialization process was slower than relatively younger children in the current study. It has been reported that disregarding the cause of burn wounds; elderly victims manifest a slow-moving healing process with enhanced complications. With the aging process reduced thereby, the immune system promotes infections, the healing process is slowed down, and develops various complications [180-182]. Although, no statistically significant variance was observed between the honey and Ag-SD-treated group regarding hospital stay. However, another study reported that honey-treated cases took at least 3 days less than 1% Ag-SD to heal entirely and be released from the hospital [173]. One more study revealed that honey substantially reduced infection by day 5 and pain. Thereby minimizing hospital stay among burn cases [120,183].

Limitations of this research

This study sample size was small. If it were more extensive, the results would be more accurate. Researchers have time and financial constraints. These are significant obstacles to conducting this research more widely.

Conclusions

The present study manifests better clinical outcomes regarding burn traumas dressed by honey than in Ag-SD. It increases the rate of healing. It also improves overall patient compliance and significantly reduces the cost of dressing which is a crucial factor in burn wound management. So, for good analgesic effect, a minimum rate of hypertrophic scar and post-burn contracture, less expensive and economically feasible for LMICs, and wide accessibility make honey an exemplary dressing agent for treating burns. Further studies regarding this issue involving large-scale study samples and multicenter research are advocated. Thereby, study results can be generalized all over the country.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Institutional Review Board (IRB) of the Dhaka Shishu Hospital, Dhaka, Bangladesh issued approval BICH-ERC-9/2/2017, June 19, 2017. This study obtained required ethical approval from the above-mentioned IRB, Dhaka, Bangladesh. The study participants were informed in detail regarding the study plan and future publication with photographs. Only those participants who gave written informed consent from a valid guardian were included in this research. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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