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EFFICACY OF NANOCRYSTALLINE SILVER DRESSINGS IN THE MANAGEMENT OF SECOND DEGREE SCALD BURNS IN CHILDREN: A PROSPECTIVE COMPARATIVE STUDY

Surgery

Dr Sanjay Maurya Command Hospital(SC), Pune-411040

ABSTRACT

Background: Management of paediatric burns is challenging and is associated with morbidity and mortality. Most common cause of paediatric burns is the scald injury. Traditionally these burns have been managed with topical application of 1% Silver Sulphadiazine which requires frequent dressing changes and can have side effects on children. Nanocrystalline silver dressings are newer generation of dressings which release sustained silver thereby obviating these disadvantages of silver sulphadiazine. This study aims to compare the efficacy of nanocrystalline silver dressings over traditional silver sulphadiazine.

Materials & Methods: 28 children with 2nd degree scald burn injury were included in the study. 15 were managed with nanocrystalline silver dressings and 13 with silver sulphadiazine. Outcomes measured were frequency of dressing, wound healing time, length of hospitalisation. Secondary outcomes measured were wound infection rates and surgical intervention. Statistical analysis was done using student t-Test.

Results: The nanocrystalline silver dressings were associated with decreased wound healing time, reduced frequency of dressings and length of hospitalisation. Wound infection rates and surgical intervention were less in the nanocrystalline silver dressings.

Conclusions: The nanocrystalline silver dressings have an advantage over silver sulphadiazine. We recommend its use in paediatric scald burn injury.

KEYWORDS

Paediatric burns, nanocrystalline silver dressings, silver sulphadiazine

INTRODUCTION:

Paediatric burns are an important cause of childhood morbidity, often resulting in scarring, disfigurement, loss of function and severe burns may result in death. Children who survive the burn injury, have severe physical and psychological effects due to the resultant scarring, contractures and deformity[1]. Most burns occur in children at homes and are preventable[2,3]. Scalds are the commonest form of burn injury in children, as 79% of children with burns have scald injury[4]. Majority of these scalds are caused by bath water as a consequence of "reach & pull of variety of hot fluid containers[5]. The basic principles in the management of scalds in children remain the same which include estimation of correct burns total body surface area (TBSA), control of infection and pain, prevent heat and body fluid loss and adequate resuscitation. The conventional care of 2nd degree scalds is by regular dressings with topical antimicrobial agents most commonly used is 1% Silver Sulfadiazine (SSD) However, this form of dressing is associated with disadvantages which includes pain during dressings, loss of body fluid, heat loss and risk of wound infection. The agent itself can have side effects in form of bone marrow toxicity, hepatic and renal impairment[6]. Newer dressings use nanotechnology to provide sustained release of silver which helps in wound healing and infection control. The aim of this study was to compare the efficacy of NCS with SSD in terms of wound healing, length of hospitalisation and dressing changes in second degree scald burns in children. The colonisation with microorganisms and need for surgical intervention was also compared in the groups.

MATERIALS & METHODS

The study was carried out at a tertiary care centre which has a burn unit. A total of 28 children who presented with second degree scalds were included in the study. The children were randomly allotted the NCS and the SSD group.15 patients were managed with NCS dressings and 13 were managed with SSD. All children with second degree scalds who presented at the Burn unit within 48 hours of injury were included in the study. Exclusion criteria included third degree burns, delayed presentation or burn wound infection. Burn injury was assessed as per standard protocol which included estimation of TBSA using Lund & Browder charts, Broad spectrum antibiotics were started at the time of admission and later changed as per culture & sensitivity. The burn wounds were dressed with NCS dressings after de-roofing of blisters and through cleaning with saline. The NCS was moistened with sterile water and applied to the burn wound, with minimal overlap onto unburnt skin. The dressings were secured with absorbent rolls and bandages. The SSD was applied topically and secured with absorbent dressings (Figure 1) with regular dressing changes.

Figure 1: Second degree scalds (A-C: SSD application and Healing at 15 days)

Children were monitored periodically with respect to wound healing and signs of wound infection and septicaemia. Wound swab culture was undertaken on admission and during dressing changes. Wound was inspected on day 5 following application of nanocrystalline silver dressings and thereafter again after 5 days. Antibiotics were stopped once the child was afebrile and showed no signs of local or systemic infection. Dressings were changed whenever it was soaked with exudate. Dressings which were found adherent to burnt surface were not changed and allowed to fall off spontaneously following wound healing (Figure 2).

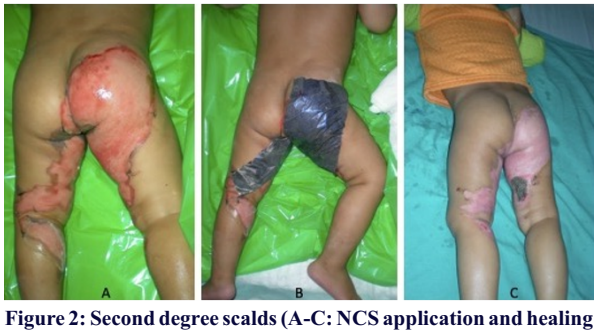

Figure 2: Second degree scalds (A-C: NCS application and healing at 10 days

Primary outcome measured were frequency of dressing change and wound healing time and length of hospitalisation. Secondary outcomes measured were surface colonisation with microorganisms and surgical intervention. Statistical analysis was done using Microsoft Excel using Student t-Test.

RESULTS:

28 children with scald injury were included in the study. 13 were

treated with SSD and 15 patients were treated with NCS dressings and. All children had second degree scalds and none showed evidence of wound infection when the treatment was started. Demographic profile and the mean age of patients is given in Table 1. There was no statistical difference between the mean age, gender and TBSA between the two groups and hence the demographic profile was well matched.

The wound healing time was compared between the two groups. The healing time significant less time (p=0.04) in the NCS group (12.73±2.31) as compared to the SSD group (14.80±2.88). The frequency of dressing changes was found to be higher in the SSD group (7.08±1.61) as compared to NCS group (3.20±1.05) and this was found to be statistically highly significant (p<0.001). The mean length of hospitalisation with the SSD group was 18.46±2.3 and 14.80 ± 4.51 in the NCS group which was statistically significant (p=0.02). The primary outcomes are depicted in Table 2.

The secondary outcomes measured were surface colonisation with microorganisms and need for surgical intervention. The colonisation was positive in 3 cases (23.07%)of SSD group and 1(6.6%) case showed culture positivity in the NCS group. Therefore, the colonisation rate was 3.4 times in SSD group. Two cases in SSD group (15.3%) required surgical intervention while all wounds in the NCS group healed with primary intention. The secondary outcomes are highlighted in Table 3.

Table 1: Demographic Profile

Parameter	SSD(n=13)	NCS (n=15)	P value(t -Test)
Age(Mean)	3.77±1.74	3.93± 2.12	0.82
Sex Male: Female	7:6	9:6	0.18
TBSA	19.53±7.96	17.2±5.0	0.32

Table 2: Measured Outcomes

Outcomes	SSD (n= 13)	NCS (n = 15)	P value(t- test)
Dressings Changes	7.08±1.61	3.2±1.05	<0.001
Wound Healing Time (Days)	14.80±2.88	12.73±2.31	0.04
Length of Hospitalisation(Days)	18.46±2.83	14.80±4.51	0.02

Table 3: Secondary outcomes

Parameter		SSD	NCS	Percentage
Surface colonisation	Positive	3	1	23.07/6.6
	Negative	10	14	
Surgical Intervention	Positive	2	0	15.3/0
	Negative	11	15	

DISCUSSION:

Despite numerous advances in the dressing material used in burn care, SSD remains the gold standard in the treatment of burn wounds[7] . SSD reduces the bacterial load and inhibits colonisation of burn wounds with Gram positive & Gram negative bacteria[8,9]. The antimicrobial action however is 6-12 hours and hence require frequent dressing changes. These dressings are painful and repeated exposure of the burn wounds makes the child prone for cross contamination, which can lead to increase in depth of burn wounds and the resulting consequences[10,11]. Advances in the silver delivery system to the wound in form of nanotechnology has markedly improved the outcomes in wound management. This technology is helpful in preventing bacterial infection and improves re- epithelisation of burn wounds. Numerous studies have shown this inherent advantage of NCS over SSD[12,13]. The prolonged and sustained antimicrobial action allows this dressing to remain for a longer time and thus reduces the frequency of dressings changes. Cuttle et al found that NCS was required to be changed every 3-4 days as compared to labour intensive periodic dressings with SSD and with reduced pain[14]. Other studies have also reported less frequent dressing changes with the NCS[15]. Our study shows similar results with significant less dressing changes with NCS 3.2 ±1.05 as compared to SSD 7.08±1.61, which is a major advantage as this reduces the pain and child irritability. Objective criteria to evaluate this parameter exists in children as young as three years [16], but this was not evaluated in our study as we found children extremely irritable and uncooperative following dressings. Varas et el have evaluated pain in dressings for adults and reported less pain with dressings changes with NCS than SSD dressings[17].

The use of NCS results in a shorter duration of hospital stay, fewer surgical intervention and reduced infection rates as compared to SSD[18]. The duration of hospitalisation has significant impact on the outcome of patient. It reduces the cross infection and its resultant complication. In fact, the major advantage of NCS is that many children with medium size burns can be treated at home which reduces the hospitalisation costs[19]. In this study all patients were admitted and managed until all wounds had healed in both the groups. The mean hospital stay for NCS group was 14.80±4.57 and SSD was18.46±2.83 and this difference was found to be statistically significant. This finding is similar to others studies conducted by various authors[20,21].

Healing time is reported to be reduced with NCS dressings when compared to SSD. Huang et al evaluated 166 wounds in 98 burn patients comparing the clinical efficacy of NCS dressings (Acticoat™) and Silver Sulfadiazine. Mean healing time was 12.42±5.40 days for NCS and 15.79±5.60 days for SSD[22]. In our study the mean healing time was 12.73±2.31 days with NCS dressings and 14.80±2.88 days with SSD. This was found to be statistically significant. Reduced healing time can be attributed to reduction in frequency of dressings and faster re-epithelisation rate with NCS [23].

The burn wound infection is a major cause of morbidity and mortality. A metaanalysis conducted by Nherera et al showed the incidence of infection of 13% with NCS and 39% with SSD[17]. This high figure could be attributed to the fact that majority of studies included burns of all degrees. The incidence of infection in our study was 23.07% with SSD and 6.60%. Frequent dressings can introduce infection when the asepsis is breached and often traumatize the delicate regenerating epithelium. Nosocomial infection often complicates a scald injury. This makes the wound full thickness requiring split skin grafting. NCS is hence advantageous in this regards. Cuttle et al reported a lower skin graft rate in patients with NCS than SSD (15.4% vs 25.6%)[14]. In our study the incidence of split skin grafting was 15.38 % with SSD group and 0% with NCS. This was due to the fact that all scalds with NCS dressings healed without secondary infection even though the depth of scald injury was same in both groups. This fact is important as split skin grafting produces additional scaring in children which is distressing for the child and the parents.

Limitations of study: This study demonstrates the efficacy of NCS over SSD but small sample size is its limitation. More studies will demonstrate the clinical efficacy and compare the two dressing materials.

Conclusions: NCS have shown better outcomes than SSD and are now being increasingly used in the management of Paediatric Burns. Though expensive as compared to SSD, overall cost effectiveness is well compensated when the parameter highlighted in this study are analysed. We recommend its use in children with scald burn injury.

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