Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/burns

Partial-thickness scalds in children: A comparison of different treatment strategies

E. de Graaf [a], M.E. van Baar [b,*], M.G.A. Baartmans [c], S.M.H.J. Scholten-Jaegers [e], M.K. Nieuwenhuis [d], J. Eshuis [e], J. Hiddingh [e], G.I.J.M. Beerthuizen [e], C.H. van der Vlies [f], The Dutch Burn Repository group, Martini Hospital and Maasstad Hospital [1]

[a] Erasmus Medical Centre, Erasmus University of Rotterdam, Rotterdam, The Netherlands
[b] Association of Dutch Burn Centers, Maasstad Hospital, Rotterdam, The Netherlands
[c] Department of Pediatrics, Maasstad Hospital, Rotterdam, The Netherlands
[d] Association of Dutch Burn Centers, Martini Hospital, Groningen, The Netherlands
[e] Department of Surgery, Burn Center, Martini Hospital, Groningen, The Netherlands
[f] Department of Surgery, Burn Center, Maasstad Hospital, Rotterdam, The Netherlands

ARTICLE INFO

Article history:
Accepted 18 October 2016

Keywords:
Hydrofiber
Silver sulfadiazine
Cerium nitrate-silver sulfadiazine
Partial-thickness burns
Scalds

ABSTRACT

Aim: The aim of this study was to compare the clinical outcomes of different treatment strategies for children with partial-thickness scalds at two burn centers. At the first burn center, these burns were treated with a hydrofiber dressing (Aquacel®, Convatec, Inc.®, Princeton, NJ, USA) or silver sulfadiazine (SSD, Flammazine®, Sinclair IS Pharma, London, UK Pharmaceuticals), while at the second burn center, cerium nitrate-silver sulfadiazine (CN-SSD, Flammacerium®, Sinclair IS Pharma, London, UK Pharmaceuticals) was used.

Methods: A two-center retrospective study was conducted of children admitted between January 2009 and December 2013 for partial-thickness scalds up to 10% TBSA who were treated primarily with a hydrofiber dressing or silver sulfadiazine (Burn Center Rotterdam) vs. cerium nitrate-silver sulfadiazine (Burn Center Groningen). The Dutch Burn Repository R3 and the electronic medical records of the study population were used for data extraction. The primary outcome was the time to wound healing. The secondary outcomes were the length of hospital stay, wound infection, and surgical treatment.

Results: The time to wound healing differed between the groups (HR=1.46, 95%CI 1.17–1.82); the shortest time to wound healing was observed in the patients treated with CN-SSD (median 13 days), compared with 15 days for the patients treated with hydrofiber and 16 days for the patients treated with SSD ($p<0.01$). The length of stay was significantly shorter for the hydrofiber patients (medians: hydrofiber 3 days, SSD 10 days and CN-SSD 7 days; $p<0.01$), but their outpatient treatment period was significantly longer (medians: hydrofiber 12 days, SSD 6 and CN-SSD 4 days; $p<0.01$). The proportion of surgeries and the mean time to surgery was similar between the burn centers.

Conclusions: This study compared different burn centers' treatment strategies for children with partial-thickness scalds and found a shorter time to wound healing in the CN-SSD

* *Corresponding author*: Burn Center, Maasstad Hospital, P.O. Box 9100, 3007 AC Rotterdam, The Netherlands. Fax: +31 10 291 3135.
E-mail address: baarm@maasstadziekenhuis.nl (M.E. van Baar).

[1] The Dutch Burn Repository group of Martini Hospital and Maasstad Hospital consists of: (a) Burn Center Rotterdam: A. van Es, J. Dokter, C.H. van der Vlies; (b) Burn Center Groningen: G.I.J.M. Beerthuizen, J. Eshuis, J. Hiddingh, S.M.H.J. Scholten-Jaegers; (c) Association of Dutch Burn Centers: M.E. van Baar, E. Middelkoop, M.K. Nieuwenhuis, A. Novin, M. Novin.

http://dx.doi.org/10.1016/j.burns.2016.10.009

group. Patients treated with hydrofiber had a shorter clinical period in comparison with the SSD and CN-SSD patients. The results of CN-SSD are promising and warrant further study. A prospective study is needed to gain full insight into the merits and drawbacks of the treatment strategies. This will allow clinicians to make full use of the strengths of particular treatments to benefit specific patients.

1. Introduction

Burns are the fifth most common cause of non-fatal childhood injuries [1]. Scalds are the main cause of burns in young children (USA: 60–67%, Nl: 84%) [2,3]. The majority of these children (aged 0–4 years) have burns smaller than 10% of their total body surface area (TBSA) [2,4]. For children between five and seventeen years, the distribution of burn causes is equal to that of adults: 60% flame, 20% scalds and 20% other causes [3].

The depth of a burn determines the treatment modality used. For partial-thickness or mixed partial-thickness and subdermal burns, different wound treatments are available. The cornerstones of burn treatment are preserving the remaining epithelium, preventing infection and creating an optimal wound-healing environment in the most comfortable way [5–7]. Preventing infection is important because infected wounds have a poor healing potential. In cases of wound infection, the prescription of therapeutic antibiotics is indicated [8]. Scalds are often of mixed depth. Mixed partial-thickness and partial-thickness burns are usually treated conservatively while awaiting spontaneous healing. Non-healing or poorly healing wounds can be operated on at a later stage [9].

Although scalds are quite common in children, there is no gold standard for treatment [7,10]. The treatment protocols for partial-thickness scalds of up to 10% of the TBSA in children vary from one burn center to another. At one burn center in the Netherlands, initial treatment usually consists of applying a hydrofiber dressing (Aquacel® Convatec, Inc., Princeton, NJ, USA). For some body areas, hydrofiber dressings are less appropriate. In such cases, silver sulfadiazine (SSD: Flammazine® Sinclair IS Pharma, London, UK) is the usual alternative treatment used at this burn center. Another burn center initially treats all of these scalds with cerium nitrate-silver sulfadiazine (CN-SSD: Flammacerium®, Sinclair IS Pharma, London, UK) [11].

These three treatments have different mechanisms of action. Hydrofiber dressings create a moist, stable wound-healing environment. Evidence from the late 1980s shows that such an environment provides better wound healing than a dry environment [12]. SSD, on the other hand, has a broad antibacterial spectrum that leads to fewer wound infections and sepsis cases. However, the silver particles also have cytotoxic effects on keratinocytes, which is unfavorable for wound healing in partial-thickness burns [13]. CN-SSD is an advanced version of SSD. Adding cerium nitrate to SSD both neutralizes the cytotoxic effects of the silver particles and limits local infection, inflammation and systemic immunosuppression [14].

To date, no comparative study of the use of hydrofiber or SSD vs. CN-SSD has been performed. The aim of this study was to examine the differences between the treatment strategies in terms of the treatment processes and clinical outcomes of children with partial-thickness scalds. The primary outcome was the time to wound healing. The secondary outcomes were the length of stay, the proportions of wound colonization, wound infection, and surgical treatment.

2. Methods

2.1. Study design

A two-center retrospective cohort study was performed. The participating burn centers were the Maasstad Hospital in Rotterdam (primary treatment: hydrofiber dressing (Aquacel®), alternative treatment: SSD (Flammazine®)) and the Martini Hospital in Groningen (primary treatment: CN-SSD (Flammacerium®)).

2.2. Participants

Children from zero to sixteen years of age with (mixed) partial-thickness scalds (e.g., those resulting from hot water, soup or oil) affecting up to 10% of their TBSA who were treated primarily with either a hydrofiber dressing, SSD or CN-SSD were considered eligible for this study. The participants had to be inpatients who were admitted to the burn center in either Groningen or Rotterdam between January 2009 and December 2013. Patients who met these criteria were included in the study. Patients who did not receive primary treatment with hydrofiber dressings, SSD or CN-SSD and those who left to continue treatment elsewhere were excluded.

2.3. Standard treatment strategies

Children with (mixed) partial-thickness scalds with a limited surface area (approximately up to 10% TBSA) were treated according to the following standard protocols.

2.3.1. Hydrofiber

After debridement, the first layer of hydrofiber is applied. This first layer remains on the wound for 14 days. Additional layers may be applied if the dressing slides and/or becomes saturated because of the amount of exudate. In case of awaiting laser Doppler Imaging 48-h after burn, which assesses the healing potential of the burns, low-adherent silicone wound dressings (Mepitel®, Mölnlycke Health Care, Dunstable, Bedfordshire, UK) or low-adherent lipidocolloid