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The use of a non-medicated dressing for superficial-partial thickness burns in children: a case series and review

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Abstract

Background: Cutimed® Sorbact® is a dressing marketed as having antimicrobial properties and easy application without the threat of antibiotic resistance and difficult accessibility. There is little evidence on the clinical outcomes of the use of Cutimed® Sorbact® in adults and currently no evidence of use of Cutimed® Sorbact® on superficial-partial thickness burn injuries in children.

Objective: To summarise the clinical outcome of burn wounds in children with superficial-partial thickness burns in which Cutimed® Sorbact® was used.

Method: An observational case series was conducted in Edendale Hospital, Pietermaritzburg, South Africa over the course of four weeks. Patients where included if they were aged < 10 years and had a $\leqslant 15\%$ superficial-partial burn. The primary outcome measure was time to 95% re-epithelialisation. Secondary outcome measures included wound complications, adverse healing and number of dressing changes.

Results: Ten patients (five girls, five boys; age range = 11 months–8 years) were included in this case series. All participants had a type VI Fitzpatrick skin type and 80% of burns were hot water burns. Of all patients treated with Cutimed® Sorbact®, 50% healed within seven days, 70% within 14 days and 100% within 21 days. There was only one wound complication noted in this study and there was no adverse healing in any burn wounds. The mean number of dressing changes was 1.4 (range = 1–2) and length of hospital stay was in the range of 0–11 days (mean = 5.1 days).

Conclusion: Cutimed® Sorbact® is a safe, useful and cost-effective dressing that should be used as an alternative for superficial-partial burns in children.

Keywords
Cutimed® Sorbact®, superficial-partial burn, children, anti-microbial, cost-effective, observational study

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Lay Summary

Cutimed® Sorbact® is a dressing used for burns that has unconventional ways to fight bacteria. This allows the dressing to work without becoming resistant to antibiotics and it is also easy to apply. In order to find out how well this dressing works in children, a study was performed in a South African hospital, Edendale, over four weeks. The main aim of the study was to find out how long the wounds took to heal when Cutimed® Sorbact® was put on a burn in children aged < 10 years. The study found that 50% of children's burns healed within seven days and 100% healed within 21 days. There was one complication that was resolved and children stayed in hospital for an average of five days. Therefore, Cutimed® Sorbact® is a safe and cost-effective dressing that should be considered as an alternative for burns in children.

Introduction

Established dressings in different categories of burn wounds have been extensively studied but there is a lack of knowledge on newer innovations. Burn wounds are primarily assessed using two components: total body surface area (TBSA) and wound depth. Burn wound depth ranges from superficial-partial thickness (SPT) to full thickness (FT), where the epidermis, dermis and sometimes underlying structures are destroyed. Superficial-partial burns, which tend to blister and cause pain, are common particularly in children, and are typically caused by a scald.[1] A clinical diagnosis of a SPT burn is made when a pink moist and shiny surface, with brisk capillary refill times/blanching is observed. In such cases, the epidermis is breached with limited damage to the basal epithelial layer of cells, leaving behind 'islands' of living epidermis to re-epithelialise the wound. Healing of SPT burns usually occurs within 14 days but must occur by day 21 or they are converted to deep dermal and require skin grafting.[2] Other variables such as infection and patient co-morbidities, as well as this burn wound conversion and time taken to heal, have significant implications on scar formation.[3]

The basic principles of burn wound management are ultimately designed to limit scar formation. These dictate that dressings should be utilised on all occasions with the exception of very superficial burns. The ideal burn wound dressing is one that should maintain wound temperature and moisture, allow for respiration, epithelial migration and the exclusion of environmental bacteria while minimising pain and expediting healing.[4]

Current options for dressing a SPT burn include antimicrobial and non-antimicrobial dressings. Anti-microbial dressings usually come in a medium impregnated with bactericidal chemicals that reduce bacterial load and colonisation. These chemicals include, but are not limited to, silver, iodine, chlorhexidine and polyhexadine.[5] The most commonly used antimicrobial dressing for SPT burns is a topical 1% silver sulfadiazine cream (SSD).[5] It possesses antimicrobial properties against a range of gram-positive and gram-negative bacteria; however, it is also associated with delayed wound healing due to its toxic effect on regenerating keratinocytes.[6] More recently the use of non-antimicrobial skin substitutes, such as Biobrane®, have been implemented for SPT burns. This collection of materials mimics the function of skin by replacing the dermis or epidermis or both. Skin substitutes have increased in popularity as the literature suggests that they reduce symptom severity, lead to quicker times to heal and require fewer dressing changes than SSD.[5] Nevertheless, the main caveat with these dressings is their high cost. Although they are beneficial, it is not plausible for centres with a low socioeconomic status and a high number of patients with burns to sustain their everyday use. Therefore, it is necessary to explore and describe dressings that can also be effective in SPT burns at a lower cost.

Cutimed® Sorbact® is a wound dressing that utilises the hydrophobic interactions between the fatty acid dialkyl carbamoyl chloride (DACC) and bacteria. Such bacteria become physically bound to the fibres of the DACC-coated dressing and are removed when the dressing is removed. This effect is therefore limited to bacteria in contact with the dressing. The 'antibacterial' mechanism of this dressing is beneficial as it reduces the need for chemically active antimicrobial agents, thereby reducing the risk of bacterial resistance and cytotoxic prophylaxis.[7] Further stated advantages of Cutimed® Sorbact® include

no contraindications and no cytotoxicity or allergy inducing substrates. It is effective against all wound pathogens including methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococcus without inducing resistant strains, and also blocks endotoxin release.[8] The frequency of dressing changes when using Cutimed® Sorbact® is dependent on the amount of exudate present and can be in the range of 1–3 days. It therefore exhibits a universal appeal both in the acute and chronic care of wound management.

The evidence base for the management of paediatric SPT burns is limited as quantifying the efficacy of wound management and classifying burns accurately without compromising patient safety is difficult. Despite the fact that Cutimed® Sorbact® has not been investigated in the context of SPT burns specifically, the most recent systematic review investigating DACC-coated dressings in the management and prevention of wound infection concluded that despite a current lack of evidence these dressings demonstrate potential to prevent and treat infection without adverse effects.[7]

An initial investigation in the use of Cutimed® Sorbact® in paediatric SPT burn management will provide valuable information to help clinicians better assess the suitability of this dressing for burn injuries. Such evidence will provide a steppingstone for further research to explore a dressing that tackles antimicrobial resistance and current challenges to cost-effective patient care.

This paper describes our use of Cutimed® Sorbact® in the management of paediatric SPT burns.

This case series has been reported as per the PROCESS guidelines.

Method

Ethical approval

This study was registered at the Research Registry (4471) and conducted in line with the declaration of Helsinki. Following ethical approval of this study by the Biomedical Research Ethics Committee, South Africa (Ref no. BCA106/14, 12/07/16) and Edendale Hospital, South Africa (05/07/17).

Study design

This study is an observational case series carried out in a single centre from 5 July 2017 to 1 August 2017. It will aim to describe the use of superficial partial burns in consecutive cases.

Study setting

Participants in this study were patients at Edendale Hospital, Pietermaritzburg, South Africa. Children who presented in the emergency department were screened by the surgical registrar and consultant for eligibility to this study. Selected patients were then chosen for inclusion in this study by one burns consultant and followed up for 7–21 days.

Patient population

Written consent for all pictures is routinely taken on admission to the burns service. Patients aged < 10 years, with $< 15\%$ TBSA superficial-partial burns were included in this study. Only those who did not consent or presented with an infected burn wound were excluded. All patients who met the inclusion criteria in the recruitment time period were included in this study.

The depth and surface area of the burn injury was determined by a consultant or senior registrar. De-identified patient data were recorded. Primary outcome included: (1) time to re-epithelialisation. Secondary outcomes included: (1) wound complications; and (2) dressing changes.

Intervention considerations

Dressings were applied under a ketamine sedation protocol, as is also used for other dressings. When applied to the face, provision was made for the eyes, nose and mouth. Gauze was most commonly used as a secondary dressing, but foam can also be used. No staples are needed and, where possible, Cutimed® Sorbact® was held in place with a tubular net. Once applied, Cutimed® Sorbact® was checked for adherence (usually in the third day) and the outer layer of the dressing was checked daily for wetness. The natural history of Cutimed® Sorbact® on a SPT burn wound is as follows: the initial exudate will wet the dressing, then evaporate; the Cutimed® Sorbact® then forms a crust over the wound that is firmly adherent. Premature removal will cause trauma by disturbing the new epithelial cells, leading to bleeding. It is our experience to leave the Sorbact® crust in place if dry. Epithelialisation occurs and in 10–14 days the Cutimed® Sorbact® peels off. If after the first few days no dry crust is present, the dressing is removed in order to allow for re-evaluation of the wound. Two patients initially included in this study were re-evaluated after their dressing remained wet and consequently were not included

in our final results due to a visual and clinical examination that suggested they did not have an SPT burn. Removal of the dressing was attempted after 7–10 days. If it peeled off easily, it was removed; however, if it remained firmly adherent it was left in place till the next clinic review (once weekly) and then removed. Premature removal results in removal of the new epithelium and leaves a new wound. This can be dressed with Cutimed® Sorbact® again and reviewed in one week. Nevertheless, this did not occur in this study. On occasions, a thin scab or flaking of skin was seen on removal of the Cutimed® Sorbact® dressing. This was easily washed off with warm water and soap. Sunscreen and aqueous cream were then prescribed.

Ointment or SSD should not be used first as this prevents the hydrophobicity of the Cutimed® Sorbact® from binding to the bacterial cell wall. Furthermore, antimicrobial creams also reduce the efficacy of Cutimed® Sorbact®.

It is not local practice to swab acute burn wounds. Results are typically received in 7–10 days precluding its usefulness. Thorough wound cleaning and use of topical antimicrobial dressings are used empirically.

Results

Participants

Ten participants were eligible for inclusion in this study (Table 1). There were no changes made to the method of intervention in any cases. Cutimed® Sorbact® was not routinely used in Edendale Hospital, South Africa and is a novel treatment for SPT burns internationally. The age range of patients was 11 months–8 years (mean age = 2.49 years) and TBSA was in the range of 4%–14% (mean = 8%). Of the 10 cases reported, five were boys and five were girls. Three of the 10 patients took > 14 but < 21 days to reach 95% re-epithelialisation. The other 70% of patients healed within 14 days (mode = 7 days). The length of hospital stay (mean = 5.1 days) correlated with the time taken to re-epithelialisation and the mean number of dressing changes was 1.4 (range = 1–2).

Outcomes and follow-up

Adherence to Cutimed® Sorbact® in hospital was checked every day during a morning ward round by a consultant and the principle investigator. Clinical assessment of the burn was carried out by a senior burn surgeon. Burns were assessed before treatment (Figures 1 and 2) and followed up for two weeks. Due to the financial and logistical difficulties of contacting patients and requesting further follow up, longer follow-up periods were not possible.

Wound or systemic complications were initially managed by a consultant who then directed more medical staff in treating them. Patients that had areas of deep dermal (DD) burns had these areas grafted after the SPT burn had healed. One patient in this case series developed 3–4 temperature spikes 36 h after admission and was successfully treated with broad-spectrum antibiotics. Their burn wound microscopy culture and sensitivity (MCS) was negative before the administration of any antibiotics and there were no clinical signs of infection associated with the burn. Although it is unlikely that the burn wound is the source of infection, this cannot be ruled out as wound MCS was not routinely carried out on admission. Another patient developed a urinary tract infection after admission and this also resolved after a course of antibiotics. Although many burn centres may treat SPT burns as outpatients, limiting inpatient associated morbidity, this is difficult in a centre and cohort such as ours due to lack of follow-up and the inability of patients or carers to look after themselves and maintain adequate sanitation at home. Finally, no early signs of adverse healing were observed but due to the short follow-up in this study, it is not possible to comment on future dyspigmentation and scarring.

Discussion

This is the first study investigating the outcome of superficial partial burns after the use of Cutimed® Sorbact®. It is also the first study to describe the effects of this dressing in children. In this prospective case series of 10 burns patients, SPT burns demonstrated promising outcomes when Cutimed® Sorbact® was used. Of SPT burns in this population, 70% healed within 14 days and 40% healed within seven days with no observed wound complications. While the burn injury pervades across all demographics, the mechanism of injury varies in prevalence between groups. This study examined the paediatric population alone (mean age = 2.49 years), a group in which scalds in particular are most frequently seen.[1] This is evidenced by the majority (n = 8) of burns in this study and thus reflects an important aspect of the paediatric burns population. Nevertheless, all children in this case

Table 1. Study participant data.

	1	2	3	4	5	6	7	8	9	10
Age (years)	8	4	11 months	2	2	1	1	2	2	2
Sex	M	M	M	M	F	F	F	F	F	M
TBSA (%)	8	5	14	12	4	4	10	7	10	6
Fitzpatrick skin type	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI
Hospital stay length (days)	2	2	3	11	1	0	10	7	6	9
Burn location	Face	Face	Face/torso	Torso/R arm	Chest	Chest and jaw	Face and chest	Back and chest	Face and thigh	Back and thigh
First dressing date	10 Jul 2017	10 Jul 2017	17 Jul 2017	14 Jul 2017	17 Jul 2017	17 Jul 2017	18 Jul 2017	17 Jul 2017	18 Jul 2017	19 Jul 2017
Dressing changes	2	2	1	2	1	Unknown	1	1	1 face, 2 thigh	1
Co-morbidities	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Time to ED (hours)	7	7	11	7–14	8	3	< 24	< 24	< 24	96
Complications	Nil	Nil	Fever, suspected chest infection	Nil	1% DD	Centrally deep dermal	UTI resolved with ABx	Nil	Nil	Nil
Burn mechanism	Flame	Flame	Hot water	Hot water	Hot water	Hot water	Hot water	Hot water	Hot water	Hot water
Depth	SP	SP	SP	SP	SP	SP	SP	SP	SP	SP
Seven-day assessment (% healed)	95	95	95	< 40 (15)	45 (15)	60 (17)	95 (10)	95 (7)	95(6)	95 (13)

Abx, antibiotics; DD, deep dermal; ED, emergency department; SP, superficial partial; TBSA, total body surface area; UTI, urinary tract infection.

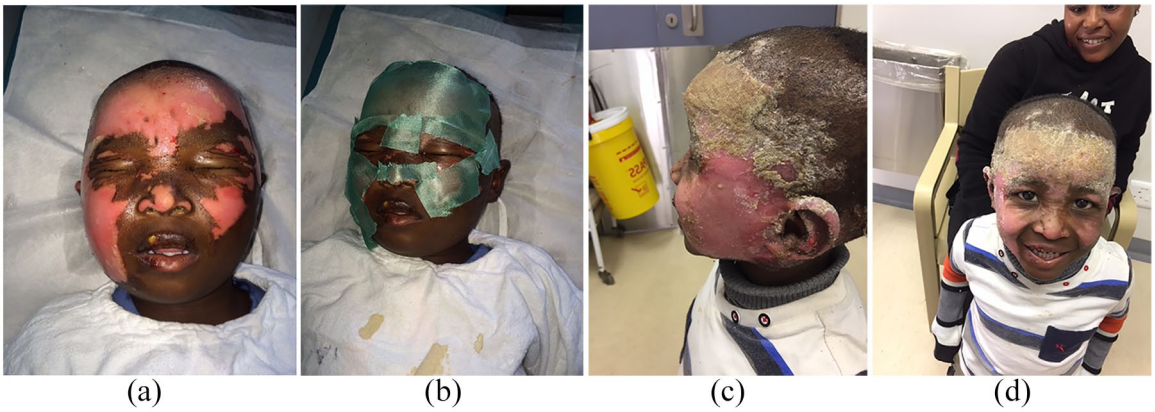

Figure 1. Patient 1: Example of burn site before dressing (a), dressing on burn site (b) and wound at seven-day assessment (c, d). (c, d) Wounds that are healing after the Cutimed® Sorbact® dressing has been removed.

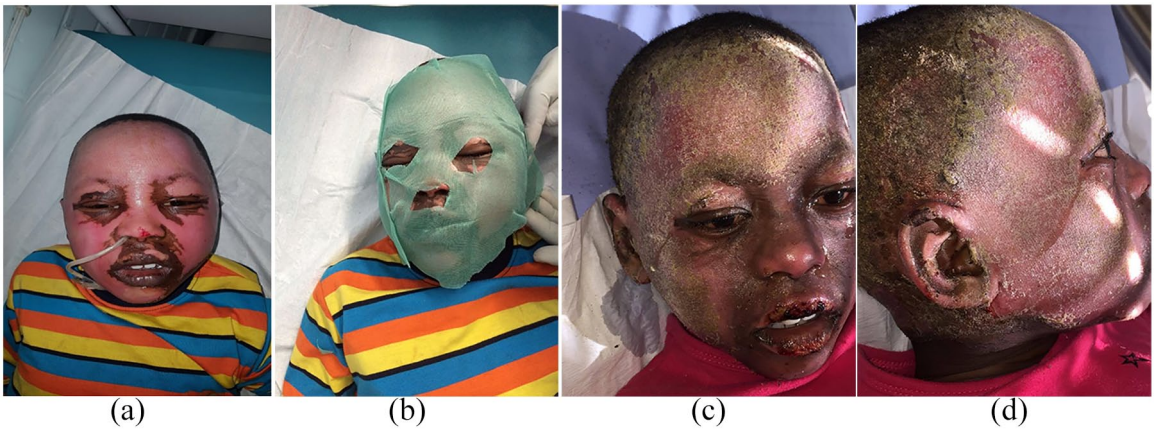

Figure 2. Patient 1: Example of burn site before dressing (a), dressing on burn site (b) and wound at three-day assessment (c, d). (c, d) Wounds that are healing after the Cutimed® Sorbact® dressing has been removed.

series were Black African (Fitzpatrick skin type VI); therefore, physiological differences in response to scalds and healing from burn wounds should also be considered when translating this research.[9] Furthermore, although the mechanism of burn was consistent across this group, the location varied, giving insight into the relative effectiveness of Cutimed® Sorbact® across a range of anatomical sites.

The mean 'time to re-epithelialisation' seen in this cohort is approximately 10.4 days which is slightly higher in comparison to skin substitutes, such as Biobrane®.[5] Biobrane® is composed of a bilaminate biosynthetic material that contains porcine collagen and also acts without antimicrobial additives. It is one of the more common dressings used internationally as it substantially reduces infection and is better at promoting healing than other commonly used dressings such as beta glucan collagen matrix (BGC) and Mepilex.[10] Nevertheless, the application and removal of Biobrane® for children is complex and can be problematic in areas such as the face and neck, requiring stapling or suturing to the surrounding tissue.[11] On the other hand, Cutimed® Sorbact® only requires a two-step application process, as described above, which causes minimal distress to patients and is easily managed by careful ketamine dosing.

Moreover, the main factor that limits the use of Biobrane®, particularly in lower socioeconomic areas such as Edendale Hospital, is its cost (Table 2). Due to the large variation in the cost per pack from different suppliers, the price of Biobrane® is more easily comparable to Cutimed® Sorbact® using a cost per area inch. The largest dressing size offers a considerably lower average price per area inch (£0.33) in comparison to its smaller counterparts (£0.46); therefore, the purchase of larger dressings is recommended as it is both

Table 2. Price of Cutimed® Sorbact® compared with price of Biobrane® among three leading industry suppliers.

	Cutimed® Sorbact®	Biobrane®	Bactigras®	Xeroform®
Dressing size (cm)	7 × 9 (pack of 5)	25 × 38 (pack of 5)	10 × 10 (pack of 10)	5 × 9 (pack of 50)
Suppliers	Williams Medical Supplies Ltd.	Emble Health Pharmacy	Safety First Aid Group Ltd	Health Products For You Ltd.
	Medisave UK Ltd.	Downtown Pharmacy	MedTree Ltd.	Vitality Medical Ltd.
	EasyMeds Healthcare Ltd.	Xpress Lane Pharmacy	Care From Nature Ltd.	
Average cost per inch^2	£0.46	£1.33	£0.07	£0.02

cost-effective and practical as they can be cut to size depending on the wound. In addition to this cost, Biobrane® usually requires more senior staff or doctors to apply the dressing and more than two dressing changes are usually required.[5] In this case series using Cutimed® Sorbact®, the mean number of dressing changes needed was 1.4 (max = 2, SD = 0.53). When taking into consideration the various costs for both dressings, Cutimed® Sorbact® appears to be a more affordable alternative. It is worth noting that the entirely synthetic nature of DACC used in Cutimed® Sorbact® makes the product universally accessible, while the porcine constituent of Biobrane® limits its use in those of certain religious denominations.

Cells shaded in grey represent average costs.

Other dressings used in Edendale for SPT burns include Bactigras® and Xeroform® (Table 2). These dressings are cheap to purchase and therefore offer some benefit in resource-poor countries and government hospitals such as Edendale. Although Cutimed® Sorbact® is more expensive to purchase, its effectiveness against all bacteria without inducing resistance, ease of use and lack of cytotoxicity or allergy inducing substrates in previous studies demonstrate benefits that may make it an affordable alternative for SPTburns.[7,12,13] Nevertheless, further study is needed in order to determine if these advantages are also applicable to SPT burns in children.

Although Cutimed® Sorbact® has not been previously studied for superficial partial burns in the paediatric population, its efficacy was recently demonstrated in the donor site wound after a split-skin thickness graft in children aged < 16 years.[14] This prospective randomised control trial that included three popular and commonly used dressings showed that Cutimed® Sorbact® was not statistically significantly different in time to re-epithelialisation, pain and itch scores. The time to re-epithelialisation in Farroha et al.'s study[14] was 10 days, similar to that seen in this study. Research directly comparing Biobrane® and Cutimed® Sorbact® would be useful in further establishing their relative importance in the treatment of SPT burns.

Strengths and limitations

While the benefits of Cutimed® Sorbact® are highlighted when used in the paediatric population, this study is limited in its ability to ascertain the dressing's utility in non-black African adults with partial thickness burns. The accelerated wound healing seen in children and altered response to burns in other skin types may exaggerate the capacity of Cutimed® Sorbact® to facilitate re-epithelisation, thus overestimating the efficacy of the product. To truly ascertain whether confounding is present, further investigation in adult cohorts is necessary.

Edendale Hospital is a government hospital, which has limited resources and is geographically placed in a low-income area. This placed a few limitations on this study, namely an inability to follow up patients for long periods of time, an inability to assess wound care after discharge, and lack of objective and complete data via note keeping.

Nevertheless, the primary outcome of this study, time to re-epithelialisation, was difficult to measure accurately and was most likely overestimated as patients were not able to be seen on the exact day their wound had healed. To limit this bias, measurements recorded in this study were observed by two researchers and checked in the patient notes.

Moreover, definitive statements regarding the use and benefits of Cutimed® Sorbact® cannot be made due to the small sample size and study design. This study does provide useful insights into the Cutimed® Sorbact® dressing;

nevertheless, a prospective study with a larger number of patients that compares Sorbact® against standard practice is needed to provide more conclusive data.

Conclusions

Cutimed® Sorbact® is a safe, practical and affordable dressing in the paediatric population that produces good cosmetic results for patients with little psychological and physiological distress. This dressing should be considered as another option for SPT burns in this population.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

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