

## Novel Insights from Clinical Practice

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# Use of Skin Substitute Dressings in the Treatment of Staphylococcal Scalded Skin Syndrome in Neonates and Young Infants

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## Established Facts

- No adhesive wound dressings for neonates with SSSS.

## Novel Insights

- Skin therapy with adhesive skin substitutes in neonates.
- Practical guidelines for treatment of neonates with severe SSSS.

## Key Words

Infants, neonates · Staphylococcal infections · Staphylococcal scalded skin syndrome · Skin substitutes · Guidelines

## Abstract

**Background:** Staphylococcal scalded skin syndrome (SSSS) is a rare toxin-mediated skin disease caused by *Staphylococcus aureus* and seen in infants and children younger than 5 years. **Objectives:** The supportive role of skin substitutes in SSSS is stressed as a new and relatively unknown method. **Methods:** Retrospective observational case-series study, in neonates and young infants diagnosed with SSSS. **Results:** Seven infants with SSSS, treatment with antibiotics, skin sub-

stitutes, strict pain relief strategy and prognosis were described. One of them was severely affected and deceased. **Conclusion:** This study describes 7 infants with SSSS and stresses the important role of skin substitutes as Omiderm<sup>®</sup> and Suprathel<sup>®</sup> as valuable adjuvant treatment modality.

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## Introduction

Staphylococcal scalded skin syndrome (SSSS) is a toxin-mediated skin disease caused by *Staphylococcus aureus* and usually seen in neonates and children younger than 5 years. It is rarely seen in adults. *S. aureus* produces exfoliative toxins which destroy the desmosomes in the

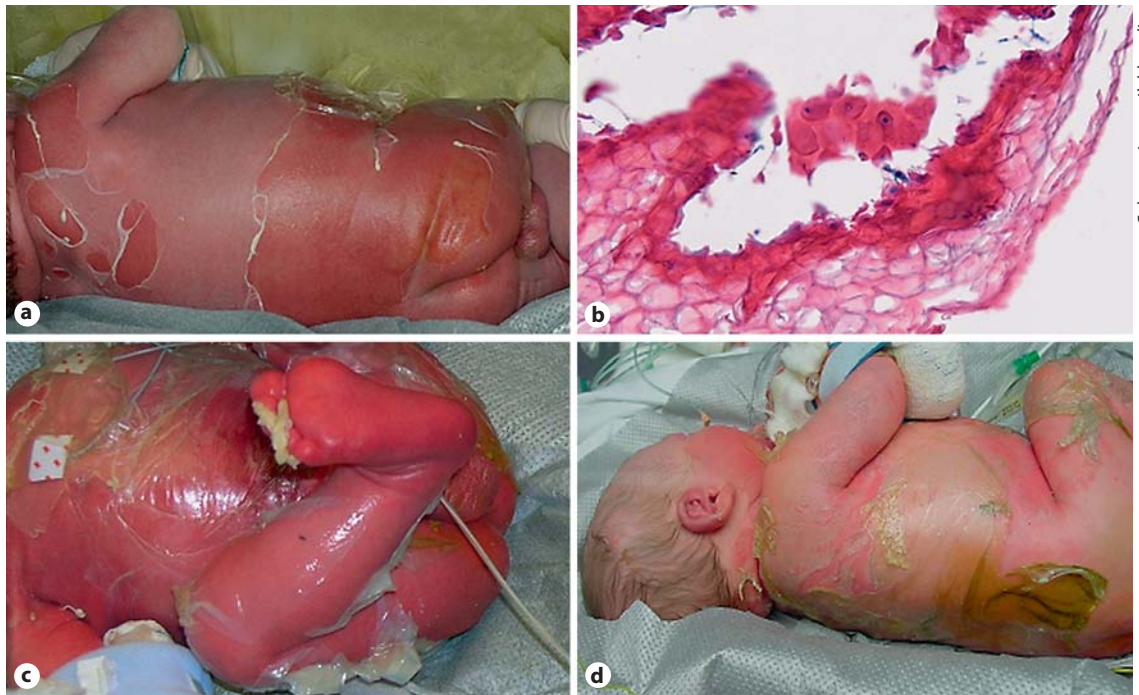
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**Fig. 1.** **a** Scald appearance with blisters and erythema of the trunk. **b** Acantholytic cells in the subcorneal region. **c** Abdomen and legs covered with Omiderm®. **d** Omiderm® treatment after 4 days.

stratum granulosum of the skin. Clinically, there are superficial blisters without mucosal lesions [1, 2].

SSSS usually presents with sore throat and purulent conjunctivitis as the source of infection. In neonates, the umbilical cord is often the source of infection. Within 48 h the patient develops fever, malaise and extremely tender erythematous areas on the face, neck, axilla and perineum (fig. 1a). Flaccid bullae develop within the erythematous areas and the Nikolsky's sign is positive [2]. The bullae generally affect the bending sides of the extremities and large areas of the skin may be affected. Bullae enlarge and rupture easily to reveal a moist erythematous base, which gives rise to the scalded appearance. The diagnosis of SSSS is clinically and by histopathological examination of a sample from the roof of a blister (fig. 1b).

Healing occurs without scarring. SSSS usually resolves within 7 days but management may be very challenging and complicated including repeated and daily use of sedatives and analgesics for skin treatment [4–7]. Adhesive wound dressings are not recommended for SSSS, but are practical solutions for skin substitution in burns [8, 9]. In this communication, we introduce the treatment of 7 infants with SSSS treated with adhesive skin substitutes such as Omiderm® or Suprathel®.

## Method

We collected retrospective data of children younger than 1 year of age admitted to the hospital with SSSS over a period of 4 years (2004–2008). Data were collected in two medical centers, Erasmus MC-Sophia Children's Hospital and Burn Centre Maastadziekenhuis, Rotterdam, The Netherlands. Age, gender, total affected area, culture results, histopathology, time of intensive care treatment, amount of analgesics and sedatives, skin treatment, and length of stay were evaluated.

## Results

In table 1a patient data are summarized. Patient 5 has been published before [10]. Four neonates and 3 infants were analyzed. All patients were infected with *S. aureus* and needed intensive care support. All patients required opioid infusion (morphine) and all received paracetamol (acetaminophen). Three patients were sedated with midazolam. Six patients were treated with Omiderm and/or Suprathel; 5 patients were discharged within 1 week. One patient (No. 4) died after severe *Pseudomonas aeruginosa* sepsis, another patient (No. 1) needed special care for his prematurity after recovering from SSSS.

**Table 1a.** Summary of patient data

	Patient						
	1	2	3	4*	5	6	7
Age	3 days	7 months	6 days	18 days	6 days	5 months	11 months
Gender	male	male	male	male	male	female	male
Total affected area, %	70	20	70	70	90	30	40
Source of infection	umbilical	airway	umbilical	umbilical	umbilical	nose	no source
Histopathology: roof of blister	+	+	+	+	–	–	–
Skin therapy: Omiderm®	+	+	+ <sup>†</sup>	–	+	+	+
Highest dose of morphine, µg/kg/h	15	20	20	20	40	10	20
Intensive care, days	3	3	4	4	6	4	3

Seven cases with SSSS. \* Deceased. <sup>†</sup> Also treated with Suprathel®. Case 5 published before [11].

**Table 1b.** Summary of diagnosis and treatment

<i>Diagnosis</i>	
Clinical picture	Age younger than 5 years Source of infection: umbilical, conjunctivitis, perioral infection Erythema with blistering Progression within hours/day
Histopathology	Roof of blister
Culture	Skin, umbilical and nose ( <i>S. aureus</i> )
<i>Treatment</i>	
Environment	Sterile undersheets (non-sticky) Control of humidity and temperature Isolate patient, control contamination of other patients
Antibiotics	Neonates: sepsis therapy with aminoglycosides ( <i>Staphylococcus</i> , <i>Pseudomonas</i> ) Flucloxacillin
Control fluid balance	Maintenance fluid Extra fluid based on formula (35 + % damage skin) × BSA (m <sup>2</sup> ) = ml/h Covering skin
Analgesia and sedation	Acetaminophen Opiates Midazolam
Skin care	Covering with skin substitutes (Omiderm, Suprathel) Minimal handling No application of antibiotic ointments

## Discussion

SSSS is a potential life-threatening disease especially in the first month of life. Differential diagnosis can be difficult in the prodromal phase with erythroderma [12]. When blistering is the presenting symptom, SSSS should be differentiated from bullous impetigo, epidermolysis bullosa, mastocytosis, pemphigus and other congenital bullous disorders such as bullous ichthyosis and toxic epidermal necrolysis (TEN). TEN is extremely rare in in-

fancy and caused by necrosis of the epidermis, whereas SSSS is caused by acantholysis [13–15]. In TEN the oral mucosa is always involved, whereas it is spared in SSSS. A skin biopsy for histological examination is not necessary, the roof of the blisters shows acantholytic cells in SSSS. The Tzanck smear is also an easy method to illustrate acantholysis [16]. Determining the exfoliative toxin produced by the *S. aureus* can be helpful in epidemiological studies during outbreaks on neonatal wards but is not necessary for the diagnosis SSSS [17]. To prevent out-

breaks of SSSS on neonatal wards it is necessary to isolate the patient and during outbreaks it is also necessary to treat healthcare workers or parents with mupirocin to eradicate nasal carriage of *S. aureus* and prevent contamination of other patients [17].

Recently, Blyth et al. [3] described the diagnosis and treatment in 4 older children with SSSS. Skin treatment consists of silver sulfadiazine creams and daily dressings change under anesthesia on the unit with sedation. Antibiotic or antiseptic ointments should also not be applied on large areas of the skin because of systemic toxicity by absorption of antibiotics, especially in neonates or infants [5, 7]. Therefore, treatment is required with skin substitutes that are applied only. We introduced a new skin treatment for SSSS with Omiderm in a case report in 2006 [11]. After that period, we treated 6 patients with SSSS and used Omiderm, in 1 case added with Suprathel (case 3). Others reported the use of Omiderm protecting the skin of low birth weight infants or in aplasia cutis congenita [18, 19].

A case report emphasizes the use of Suprathel in the treatment of an infant with TEN [20]. Recently, Mueller et al. [21] reported an infant with SSSS who was successfully treated with Suprathel. Greenwood et al. [22] described the use of Mepitel® in SSSS patients. The major disadvantages of the use of Mepitel are that it is not transparent which renders it impossible to evaluate the skin and daily changing of the covering bandages are required.

Omiderm and Suprathel must be left on the skin because both skin substitutes are synthetic and there is no need to change the dressing (fig. 1c). The dressings will gradually peel off on their own (fig. 1d). Suprathel is also biodegradable (see Appendix). In older children we also prefer treatment with skin substitutes to improve pain relief and fluid control.

The proposed treatment requires hospitalization, as intravenous antibiotics are generally necessary to eradicate the source of staphylococcal infection or colonization. However, antibiotics do not influence the progression of the 'skin' manifestations of SSSS. Affected skin and blisters were in most cases sterile in classical SSSS by definition, but exceptions are reported [23]. The toxins will be neutralized by antibodies and are eliminated in the urine [1, 8]. Generally, sepsis therapy will be chosen for neonates, which also covers infections with *P. aeruginosa*. Case 4 was not treated with skin substitutes and deceased, unfortunately due to *P. aeruginosa* sepsis. This case stresses the indication of early use of broad-spectrum antibiotics to prevent *P. aeruginosa* sepsis.

After determining the *S. aureus*, a penicillinase-resistant, anti-staphylococcal antibiotic such as flucloxacillin is preferred. Depending on the response to treatment, oral antibiotics can be substituted within several days. The use of pooled human immunoglobulin or fresh-frozen plasma in SSSS has been reported [3], but has not been investigated in randomized controlled trials [24]. The use of corticosteroids is contraindicated [4]. In general, patients with SSSS have extreme pain as did our patients. Not only touch but even a draught can cause pain. Neonates may become irritated but may also present with hypotonia and lethargic states due to extreme pain. Therefore, it is important to cover the wounds with an adhesive skin substitute.

We acknowledge the limitation of our study as no control group was used. Our first experience with Omiderm was positive and has shown that the use of Omiderm and Suprathel has an analgesic effect. These dressings should be applied as soon as possible on the exfoliated skin. In addition, pain relief is necessary. Paracetamol in combination with opiates is required. In our patients we administered paracetamol and intravenous morphine (1 case needed dosages up to 40 µg/kg/h) and in 3 cases we also added low-dose midazolam (0.1 mg/kg/h). NSAIDs are contraindicated. Premature neonates with diminished renal function due to hypovolemia, immaturity or use of NSAIDs are prone to SSSS due to limited renal elimination clearance of exfoliative toxins [1, 8].

In most cases, we initially started with a fluid bolus when the circulation is threatened by hypovolemia. Many referring specialists calculate the fluid needed on the basis of burns resuscitation formulas (Parkland formula). However, patients with SSSS are not similar to burn patients who have extensive dermal necrosis and capillary leakage. The amount of fluid administered using the Parkland formula is too much and there is a risk of fluid overload and hyponatremia [3]. In our patients, we used another formula that is used in burn care, after the initial resuscitation phase [25]. For children, we advise the maintenance requirements plus  $(35 + \text{TBSA} (\%)) \times (\text{BSA} / \text{m}^2) = \text{the amount of fluid in milliliters per hour}$ . There is a risk of hyponatremia and isotonic fluids such as saline (0.9% NaCl) should be used when substituting for fluid losses. In some cases the serum albumin or colloid osmotic pressure is low and human albumin or plasma expanders are necessary. To control body temperature, neonates are nursed in an incubator with high humidity. Children are sometimes nursed in burn units where air, humidity and ambient temperature are controlled. Enteral feeding is encouraged and should be started as soon

as possible. Our therapeutic approach is summarized in table 1b.

In conclusion, although the external signs of SSSS appear worse, infants generally recover well and healing is usually complete within 5–7 days after starting treatment. Skin substitutes and special care including appropriate fluids and analgesics are essential to achieve the best results.

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### Appendix. Characteristics of Omiderm® versus Suprathel®

Brand name	Omiderm	Suprathel
Generic name	water-vapour permeable polyurethane film	synthetic copolymer based on dl-lactic acid
Application time	once	once
Non-toxic	+	+
Flexibility	+	+
Elasticity	±	+
Sticky	–	+
Pain relief	+	+
Transparent	+	after attachment
Expensive	–	+