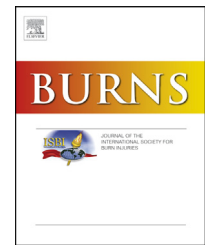


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Resuscitation using less fluid has no negative impact on hydration status in children with moderate sized scalds: a prospective single-centre UK study

Linda Hollén^{a,b}, Karen Coy^b, Andrew Day^c, Amber Young^{b,*}

^a Centre for Child and Adolescent Health, School of Social and Community Medicine, University of Bristol, Oakfield House, Oakfield Grove, Bristol BS8 2BN, United Kingdom

^b The Scar Free Foundation Centre for Children's Burns Research, Bristol Royal Hospital for Children, University Hospitals Bristol NHS Foundation Trust, BS2 8BJ, United Kingdom

^c Department of Clinical Biochemistry, Bristol Royal Infirmary, Marlborough Street, Bristol, BS2 8HW, United Kingdom

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ABSTRACT

Background: After a burn, optimal fluid resuscitation is critical for positive patient outcome. Although national guidelines advocate using resuscitation fluids of 4mL per kg body weight and percent body surface area (%BSA) for paediatric burns of >10% BSA, evidence in adults suggest that such volumes lead to over-resuscitation and related complications. Our aim was to investigate whether children managed with biosynthetic dressings (Biobrane™) and reduced fluid volumes remain well hydrated, as determined by clinical and laboratory parameters.

Methods: At a single UK Burn Centre, children with scalds of 10-19%BSA managed with Biobrane were given 80% maintenance fluids and no formal burn resuscitation (permissive hypovolaemia [PH] group). Urine output (UO), serum sodium, urea, and creatinine were used as 24h markers of hydration and concentrations compared to those in a patient cohort treated within the same centre when traditional resuscitation was used (TR group).

Results: Serum sodium concentrations and UO in the PH group were similar to those in the TR group (median sodium: PH=136, TR=136, P=1.00; median UO: PH=1.5, TR=1.8, P=0.25). Urea concentrations were lower and creatinine concentrations higher in the TR group compared to the PH group (median urea: PH=3.2, TR=2.3, P=0.04; median creatinine: PH=21, TR=30, P<0.001). A higher proportion of TR patients than PH patients fell outside the reference ranges for urea (61% vs. 23%; P=0.04) and creatinine (44% vs. 8%; P=0.03).

Conclusion: Based on markers of hydration, children with moderate-sized scalds managed with Biobrane can be safely managed with less fluid.

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Abbreviations: BSA, body surface area; UO, urine output; PH, permissive hypovolaemia; TR, traditional resuscitation; IQR, inter quartile range; SWCBC, The South West Children's Burns Centre; IV, intravenous.

* Corresponding author.

E-mail addresses: linda.hollen@bristol.ac.uk (L. Hollén), karen.coy@uhbristol.nhs.uk (K. Coy), Andrew.Day@uhbristol.nhs.uk (A. Day), amber.young1@nhs.net (A. Young).

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1. Introduction

Treating burned patients with appropriate and timely fluid resuscitation early after injury is critical to positive outcome and survival [1-6]. Under-resuscitation is known to lead to poor clinical outcome due to organ hypo-perfusion [7] and the possibility of burn depth conversion [8,9]. Over-resuscitation, or fluid overload, has been shown to increase the likelihood of complications such as respiratory compromise, sepsis, multi-organ failure and death, due to fluid accumulation, oedema formation and compartment syndrome [4,10,11]. It can also lead to deepening of the burn wound, resulting in longer healing times and potentially scarring [8].

Although national guidelines state that children who have sustained a burn of more than 10% of body surface area (BSA) should receive traditional fluid resuscitation according to the Parkland formula at 4mL/kg/%BSA [12], a growing body of evidence in adult patients shows that such volumes lead to over-resuscitation and high-risk complications [4,13-16]. Some centres have therefore adopted an alternative method, permissive hypovolaemic resuscitation, using decreased fluid volumes aiming to simply maintain organ perfusion [17]. However, as evidence supporting the effectiveness and safety of such a regimen in paediatric burns patients is currently limited, many places in the UK still opt to follow the traditional Parkland formula [18].

Prior to 2007, The South West Children's Burns Centre (SWCBC) used a resuscitation regimen based on the Parkland formula, which recommended starting resuscitation at 10% BSA but with an initial reduced rate of 3mL/kg/%BSA and 100% maintenance fluid (hereafter referred to as traditional regimen [TR]). All fluid administered was Hartmann's solution. In January 2007, following a local audit of outcomes including hyponatraemia, the SWCBC changed to a permissive hypovolaemic fluid resuscitation regimen. Children with partial thickness scalds who had biosynthetic dressings (Biobrane™) applied were resuscitated starting at a BSA of >15% and a rate of 2mL/kg/%BSA with 80% maintenance fluid. Published research from this centre has shown that using the 2mL/kg/%BSA regimen resulted in the use of 41% less fluid than used across other England and Wales services and resulted in improved outcomes; hospital length of stay per %BSA was significantly shortened and fewer patients underwent skin grafts than those treated before 2007 [18]. In 2011, following good results and with agreement from the local paediatric management team and burns team, the protocol was further adjusted and the burn size at which to start resuscitation was increased from >15% and >19% BSA. Using this new regimen, patients with scalds of 10-19% BSA were not formally

resuscitated and given 80% maintenance fluid alone (hereafter referred to as the permissive hypovolaemic [PH] group).

Although emerging evidence from the centre has shown promising results using reduced fluids, we have not formally shown whether children managed with less fluid remain adequately hydrated in the first 24h, during which time fluid loss is greatest and the risk of complications highest [19]. The aim of this study was to provide evidence that a permissive hypovolaemic regimen can provide adequate hydration and is safe in children with moderately sized scalds, as demonstrated by laboratory serum and urine markers of fluid status.

2. Methods

2.1. Patients

All children aged between six months and 15 completed years with a partial thickness scald of between 10-19% BSA managed with Biobrane and admitted to the SWCBC between April 2011 and Dec 2014 were included. Inclusion and exclusion criteria are shown in Table 1. Ethical and local Research and Innovation permissions were gained prior to study start. Funding was provided by the North Bristol NHS Trust Small Grant scheme.

2.2. Clinical management

Clinical management followed the South West burns fluid resuscitation protocol as agreed in 2011 (Fig. 1). Children were transferred as soon as possible after referral to the SWCBC, and remained 'nil by mouth' and on 80% intravenous maintenance fluids until a formal theatre assessment or assessment under oral sedation had been conducted. If the clinician caring for the child in the referring hospital considered that the child required fluid resuscitation then a bolus of 10mls/kg of 0.9% saline were given and the child reassessed. After arrival at the SWCBC, children were transferred to theatre within 24h (median [IQR]: 7h [3.5-11]) and Biobrane applied under general anaesthesia according to standard practice. Once the child returned to the ward after being assessed in theatre or under sedation as having an injury of between 10-19% TBSA, the parents, and child if age appropriate, were approached for consent. No family declined study participation.

2.3. Sampling

Blood samples to measure baseline levels of serum urea, creatinine and other electrolytes were collected in theatre. Back on the ward, children received routine post-operative

Table 1 – Inclusion and exclusion criteria for study participants.

	Inclusion criteria	Exclusion criteria
Size	All 10-19% BSA scalds assessed at SWCBC by burn surgery consultant in theatre	Scalds <10% or >19% BSA
Type of burn	Partial thickness scalds only	Flame, chemical and electrical burns, full thickness scalds or burns
Dressing application	Scalds receiving Biobrane™ within 24h	Any scald not receiving Biobrane™ within 24h
Age	All children between 6 months and 15 completed years	Children younger than 6 months or 16 years or older

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