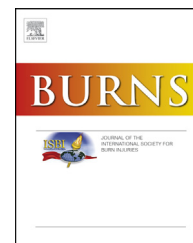


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Impact of reduced resuscitation fluid on outcomes of children with 10–20% body surface area scalds

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ABSTRACT

‘Permissive hypovolaemia’ fluid regimes in adult burn care are suggested to improve outcomes. Effects in paediatric burn care are less well understood.

In a retrospective audit, outcomes of children from the South West Children’s Burn Centre (SWCBC) less than 16 years of age with scalds of 10–20% burn surface area (BSA) managed with a reduced volume fluid resuscitation regime (post-2007) were compared to (a) an historical local protocol (pre-2007) and (b) current regimes in burn services across England and Wales (E&W). Outcomes included length of stay per percent burn surface area (LOS/%BSA), skin graft requirement and re-admission rates.

92 SWCBC patients and 475 patients treated in 15 other E&W burn services were included. Median LOS/%BSA for patients managed with the reduced fluid regime was 0.27 days: significantly less than pre-2007 and other E&W burn services (0.54 days, 0.50 days, $p < 0.001$). Skin grafting to achieve healing reduced post-2007 compared to pre-2007 and remains comparable with other E&W services. Re-admission rates were comparable between all groups.

A reduced fluid regime has significantly shortened LOS/%BSA without compromising burn depth as measured by skin grafting to achieve healing. A prospective trial comparing permissive hypovolaemia to current regimes for moderate paediatric scald injuries would help clarify.

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1. Introduction

International burn services are attempting to develop standardised clinical quality indicators to monitor outcomes [1]. The United Kingdom’s National Health Service (NHS) is also striving for a system of healthcare focused on measurable clinical outcomes [2]. The change from a process-driven NHS

system to one weighted towards clinical outcomes has evolved over the last three years in response to the 2010 Department of Health (DOH) White Paper, “Equity and Excellence: Liberating the NHS” which stressed that the effectiveness of the treatment and care provided to patients will be measured by clinical outcomes [2].

The development of appropriate clinical outcomes in burn care is an area of current controversy and has been highlighted

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as needing development in the United Kingdom *National Burn Care Review* (2001) and the National Burn Care Standards published by the British Burns Association [3,4]. Outcome measures need to be evidence-based, permit useful comparison, be clinically relevant, age-specific, consistently reliable, specific and sensitive enough to make comparisons and have an agreed definition [5]. The most commonly used indicators of clinical outcome in both adult and paediatric burn care are survival, time to return to pre-burn activity, length of hospital stay (LOS) per percent BSA (LOS/%BSA), need for secondary surgery and re-admission rates [6]. To date, there is no single, ratified outcome measure for moderate sized paediatric scald injuries as defined by a body surface area (BSA) of 10–20%.

Mortality in 10–20% BSA paediatric scald injuries is rare and therefore gives no indication of the quality of services provided to patients. Time taken to return to pre-burn activities often reflects the size of burn rather than the quality of care provided. There is a close correlation between LOS and extent of size of burn [7,8] and outcome in paediatric scalds can be better assessed by monitoring hospital LOS, with studies showing a link between improving quality of care and shortened LOS for similar burn sizes and depths [9].

The length of stay of patients sustaining burns depends on the size of the burn. Using LOS/%BSA as an outcome measure will correct for size of burn [10]. It does not, however, correct for burn depth, children who have delays in discharge due to other co-morbidities, child protection issues or social care delays. With these provisos however, LOS has been found to be linearly associated with %BSA for small and moderately sized burns. Despite advances in burn care, length of stay still remains consistent with the one day per percent model proposed by Dimick and Warden 20 years ago [11]. Although not a gold standard, use of one day per % BSA remains a helpful outcome target for burn care services assuming depth of burn and co-morbidity is standardised [12].

Adequate and timely fluid resuscitation is recognised as one of the most important therapeutic interventions in burn care [13]. Fluid is administered in order to prevent both burn shock and renal insufficiency (as a measure of vital organ perfusion). Over-resuscitation is common with conventional fluid resuscitation regimes and has been shown to increase complications such as respiratory compromise, sepsis, multi-organ failure (MOF) and death [14]. In adults, there is an emerging body of evidence confirming the risks of over-resuscitation and this has led to the development of the permissive hypovolaemic fluid resuscitation model [15]. Evidence supporting the effectiveness of permissive hypovolaemic resuscitation in children sustaining burns is currently lacking.

The South West Children's Burns Centre (SWCBC) uses the biosynthetic dressing Biobrane™ for the wound dressing management for partial thickness scalds. This biosynthetic dressing is effective in reducing fluid loss directly from the burn and has been demonstrated to reduce pain levels, healing time, inpatient stay and nursing requirements in the management of moderate to large area superficial and partial thickness depth burns [16].

Prior to January 2007, the SWCBC used a fluid resuscitation regime based on the traditional Parkland Formula. The protocol recommended starting fluid resuscitation at 10% BSA with an initial rate of 3 ml/kg/%BSA with 100%

maintenance fluid requirements and the application of biosynthetic dressings.

Since January 2007, in response to an on-going audit of complications of over-resuscitation in children with moderate partial thickness scald injuries, the SWCBC has changed to a permissive hypovolaemic fluid resuscitation regime. In children with moderate-sized partial thickness scalds, this protocol recommends starting fluid resuscitation at 15% BSA with a rate of 2 ml/kg/%BSA with 80% maintenance fluid requirements and the application of biosynthetic dressings.

Our aim is to investigate whether a permissive hypovolaemic fluid resuscitation regime has an affect on patient outcome in children sustaining scalds of 10–20%BSA. The primary outcome is defined by hospital LOS/%BSA. Secondary outcomes include skin graft rate, re-admission rate, renal impairment incidence, intensive care unit (ICU) admission, ventilator use and total length of stay.

We have also summarised the current fluid regimes used in other England and Wales burns services and compared outcomes of moderate sized scald injuries in these services to those from children treated at the SWCBC before and since 2007 in order to attempt to clarify the link between fluid management and outcome in these injuries.

2. Methods

It was deemed by the Local Research Ethics Committee that ethical permission was not required for this study.

The International Burns Injury Database (iBID) created in 1996, is a registry of data from all burn services in England and Wales (E&W) [17]. The iBID allows information on burn causation, clinical data, service data and quality of service to be collated and analysed.

Data was obtained from the iBID and local databases from 1st January 2004 to 31st December 2011 for children from the South West Children's Burns Centre.

Inclusion criteria used were age less than 16 years at time of injury, a scald (burn due to hot liquid) mechanism recorded, depth defined by senior surgeon at wound review as partial thickness and of surface area between 10% and 20% inclusive. Clinical notes for children managed at SWCBC were reviewed for the child's age and burn surface area as a % of the total body (%BSA) as documented in the initial operation note. The number of skin-graft procedures performed from the time of injury to the time of discharge was recorded, along with any admissions to the intensive care unit. Any evidence of renal dysfunction as defined by the paediatric modified RIFLE criteria (RIFLE) (estimated creatinine clearance reduction by 25% or urine output <0.5 ml/kg/h for 8 hours) at any point during the acute admission was also noted. As an indirect measure of the incidence of pulmonary oedema, the number of patients who received respiratory support was noted. Hospital admission and discharge dates were reviewed to calculate length of hospital stay. It was also recorded whether the patient was re-admitted at any point after discharge.

Anonymised demographic and outcome data for children fulfilling the same inclusion criteria was also obtained from the iBID database for all E&W burns services (excluding SWCBC) for the same time period.

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