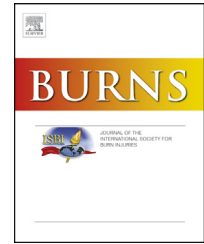


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Toxic shock syndrome in paediatric thermal injuries: A case series and systematic literature review

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ABSTRACT

Background: Toxic shock syndrome (TSS) is a rare, but potentially life-threatening complication of thermal injuries in children. The study objective was to systematically review the literature on paediatric TSS after burns or scalds, and describe our experience with this condition in Switzerland.

Methods: All tertiary paediatric healthcare centres managing burns and scalds in Switzerland were inquired. A systematic literature review was performed using EMBASE (1947–2016), MEDLINE (1946–2016), Web of Science (1900–2016) and Google Scholar in October 2016. Data on patient characteristics, symptoms, laboratory parameters, management and outcome were extracted from paper and electronic patient charts. Descriptive statistics were performed. **Results:** The literature review revealed 25 articles describing 59 cases observed in 10 countries (UK, USA, Hungary, Austria, Sweden, Denmark, Israel, Japan, Spain, Switzerland) from 1985 to 2016. The patient age ranged from 8 months to 8 years at the time point of TSS-diagnosis. The injured total body surface area ranged from <1% to 41%. Forty-one patients suffered from scalds, 6 from burns and in 12 cases the type of injury was not specified. The TSS-diagnosis was made 1–7 days after thermal injury. Nineteen children underwent admission to the Intensive Care Unit. Six children died from TSS. In Switzerland, we identified 11 consecutive cases between 07/2001 and 06/2011 (median age 15 months, range 9 months–14 years; 9 male, 2 female; 3 burns, 8 scalds; 7% median total body surface area (TBSA), range 2–30%). Diagnosis of TSS was made on day 5 after injury in median (range 3–34 days). Eight of eleven patients received intensive care. Survivors (10/11) suffered no long-term sequelae besides scars. One 13-month old boy died 3 days after a 7%-TBSA scald.

Conclusions: Toxic shock syndrome is an important complication of paediatric burns in Switzerland and several other countries world-wide. Diagnosis and management remain challenging. Awareness among treating clinicians is crucial for a favourable outcome.

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1. Introduction

Toxic shock syndrome (TSS) in previously healthy children has first been described by Todd et al. in 1978 [1]. Seven years after the first paediatric TSS-report, TSS was observed in seven children with thermal injuries [2]. Besides these occurrences, TSS has mainly been observed in menstruating women using superabsorbent tampons [3]. Today TSS in burns is typically associated with children aged 1–4 years two days after suffering from a small burn [4]. The toxin-mediated disease represents the most common cause of death in the paediatric population with small thermal injuries [4]. While diagnosis remains challenging, mortality from TSS is completely preventable by early diagnosis and aggressive treatment [4].

The diagnosis of TSS in paediatric burns is made clinically, but is challenging due to non-specific clinical signs and the disease's ability to mimic other childhood illnesses [4]. A child with sudden deterioration after a minor thermal injury should be worked-up for TSS and a high level of suspicion should be maintained. Diagnostic criteria have been published to facilitate diagnosis [5,6]. The generic diagnostic criteria proposed by the Centers for Disease Control and Prevention (CDC) have been abbreviated and revised to make them more applicable to the paediatric burn population by Cole et al. in 1990 [5,6]: fever $\geq 39^{\circ}\text{C}$, rash, diarrhoea \pm vomiting, irritability and lymphopenia. Three of the 5 abbreviated, age-specific and disease-specific criteria are required for TSS-diagnosis [6]. Toxin testing is rarely useful in the acute setting as the results typically take several days to weeks to return [7]. Once TSS is suspected, treatment has to be initiated quickly due to the rapid progression of the disease. The management typically consists of four main routes: first, resuscitation and stabilization; second, inspection and cleaning of the burn wound; third, anti-staphylococcal and anti-streptococcal antibiotics; fourth, passive immunity against staphylococcal toxic shock syndrome toxin-1 (TSST-1) with fresh frozen plasma (FFP) or intravenous immunoglobulin (IVIG) [4].

Awareness of TSS in paediatric thermal injuries has been perceived as increasing among healthcare professionals. While there are multiple reports from the United Kingdom on TSS in paediatric burns, other countries explicitly report the absence of this condition in their country [8]. This uneven geographical distribution and small number of TSS-cases in paediatric burns makes continuous reporting of case series crucial to increase knowledge and evidence on this condition. An individual case of TSS in a paediatric burn has been reported in Switzerland recently [26]. However, a systematic evaluation of paediatric TSS-cases after thermal injuries in Switzerland and in the medical literature has not been performed to date.

The objective of this study was to describe clinical presentation, management and outcome of children, who suffered from TSS after a thermal injury in Switzerland, and to systematically review the literature and pool the published paediatric cases of TSS after burns.

2. Methods

2.1. Systematic literature review

In October 2016 EMBASE (1947–2016), MEDLINE (1946–2016) and the Web of Science (1900–2016) were searched for eligible articles reporting paediatric cases of TSS after thermal injury. In addition, Google Scholar was searched for case series and case reports published in the grey literature. The references from included articles were reviewed as well. The following search terms were used: pediatric, paediatric, child, toddler, neonate, newborn, burn, scald, thermal injury, frostbite, chilblains, trench foot, frostnip, toxic shock syndrome.

Reports were screened for inclusion based on title, key words and abstract review. Final inclusion was based on full-text assessment. Inclusion criteria were individually reported cases of TSS after a thermal injury in children from zero to eighteen years of age. Data extraction was performed by one author (LG) and included study parameters (year of publication; country; sample size); patient characteristics (age; gender; injured TBSA; type of injury) and diagnostic criteria for TSS such as symptoms (symptom start; fever; rash; desquamation; hypotension; vomiting; diarrhoea; central nervous system manifestations) and laboratory parameters (lymphopenia; blood cultures; wound swabs). Surgical management (dressing type; surgical intervention); primary and secondary treatment (dressing type; systemic and topical antibiotics; FFP; IVIG); and outcome (survival; irreversible damage) were recorded as well. The yearly number of reported patients and published articles were quantified. No language restriction was adopted. One article was in Japanese so the English abstract was used to extract the data [23]. The PRISMA guidelines for systematic literature reviews were followed and a PRISMA flow chart diagram was prepared (Fig. 1).

2.2. Case series

In a first step, all intensive care units (ICU) of hospitals managing paediatric burns in Switzerland were contacted by mail. The average yearly number of paediatric burns and the number of observed TSS in children with small to moderate thermal injuries were elucidated with a short questionnaire.

None of the 7 contacted paediatric ICUs of hospitals managing paediatric burns recalled a TSS-case at the time point of the survey. Months after the questionnaire was sent out, one TSS-case in a child suffering from a scald was reported to us. Since the case was not managed at our institution and reported with a significant delay, it was not included in our case series.

In a second step, consecutive paediatric patients (aged 0–16 years) with burns or scalds who developed TSS and were treated at the Burns Center of the University Children's Hospital Zurich, between July 2001 and June 2011 were identified and included in the current case series. Patients treated for burns or scalds were identified using two administrative databases (logbook of the burns centre, institutional administrative database). Data on patient characteristics (age, gender, injured total body surface area (TBSA), type of injury, admission type and duration), symptoms (start

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