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C-reactive protein response patterns after antibiotic treatment among children with scalds

Ingrid Steinvall [a,b,*], *Matilda Karlsson* [a,b], *Moustafa Elmasry* [a,b,c]

[a] *Department of Hand Surgery, Plastic Surgery, and Burns, Linköping University, Linköping, Sweden*
[b] *Department of Clinical and Experimental Medicine, Linköping University, Linköping, Sweden*
[c] *Plastic Surgery Unit, Surgery Department, Suez Canal University, Ismailia, Egypt*

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ABSTRACT

Background: Scalds are the most common cause of burns in children, yet there is little information available about the inflammatory response. The aim of the study was to investigate the response to treatment with antibiotics among scalded children by following the C-reactive protein (CRP) concentration, procalcitonin (PCT) concentration, and white blood cell count (WCC) during the first two weeks after injury.

Methods: All children with scalds who presented to the Burn Centre during 2010–2016 were included in this retrospective study. All measurements of CRP, PCT, and WCC from the first 14 days after injury were recorded, and each patient's maximum values during days 0–2, 3–7, and 8–14 were used for calculations. Multivariable regression for panel data was used to study the inflammatory response after antibiotic treatment.

Results: A total of 216 children were included. C-reactive protein was 45 mg/L ($p < 0.001$) higher in the group treated with antibiotics, and decreased with 8.8 mg/L per day over the studied time in this group, which was more than twice as fast as among the children who were not given antibiotics.

Conclusion: The CRP response, among children with minor scalds treated with antibiotics, shows an appreciable rise during the first week of injury that subsided rapidly during the second week.

1. Introduction

Scalds are the most common types of burn in children, both in developed and developing countries [1,2]. In Sweden they are one of the most common causes of accidents among children up to the age of 3 years and are associated with the longest duration of hospital stay [3], and considerable health care costs. Boys are more likely to be injured than girls, and similar figures have been reported worldwide [4–11]. The main causes involve pulling down receptacles from tables and benches, or overturning containers of hot water. Scalds are most common in the kitchen with at least one parent present, or in the bathroom from hot tap water [12–14].

Burned patients have a high rate of infections, and it is thought that all burns are colonised with bacteria at a certain stage [15]. Inflammatory markers are usually used serially to detect and follow injuries, to note the development of infection, and to assess the patient's response to any antibiotics given [16] (although opinions differ about their value in

* *Corresponding author at*: The Burn Centre, Linköping University Hospital, Linköping 58185, Sweden.
E-mail addresses: ingrid.steinvall@regionostergotland.se (I. Steinvall), matilda.karlsson@regionostergotland.se (M. Karlsson), moustafa.elmasry@liu.se (M. Elmasry).
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burn care [16–18]). Inflammatory markers are often investigated in severely burned patients with considerable systemic inflammatory responses [16,17]. However, we know of little information about the inflammatory responses after minor scalds in children.

The aim of the study was to investigate the response to treatment with antibiotics among scalded children by following the C-reactive protein (CRP) concentration, procalcitonin (PCT) concentration, and white blood cell count (WCC) during the first two weeks after injury.

2. Methods

We studied all patients with scalds between the ages of 0–18 years who were admitted to the Burn Centre in the 7-year period 2010–2016. The hospital's primary catchment area is 244000 inhabitants, although it is extended nationwide in terms of advanced care of burns, for which it shares the total population of 10 million people with the other national Burns Unit. Patients studied are therefore either local residents or referrals, and the severity of scalds varies accordingly. A total of 815 patients were admitted of whom 534 were adults and 65 were children with a burn type other than scalds.

Data were collected retrospectively from the medical records, and from prospectively-recorded burn-specific data entered in the local computerised burn registry [19]. Data retrieved included age, sex, cause of burn, day of injury, TBSA%, depth of burn, duration of stay in hospital, details of diagnosis and clinical management, plasma concentrations of CRP and PCT, WCC, antibiotic treatment given intravenous or oral (according to physician's decision), and duration of wound healing, which is defined as the time between the date of injury and the wound being declared healed by the attending surgeon and requiring no more care at the Burn Centre outpatient clinic.

The physician decision is based on the local criteria for prescribing antibiotics for scalded children at the Linköping Burn Centre in cooperation with Paediatric and Infection departments at Linköping University Hospital

- Rise of CRP level and fever exceeding 38°C where other sources of infection are excluded.
- Fever >48h after injury indicate ongoing burn wound infection.
- Visible clinical signs of local wound infection.

Indicators for sepsis among scalded children if 3 or more signs/symptoms of the following are present:

- Fever >39°C or hypothermia <36.5°C
- Tachycardia (>2 SD above age reference value)
- Tachypnea
- Thrombocytopenia (not applicable the first 3 days after burn injury)
- Hyperglycemia
- Gastrointestinal symptoms: feeding difficulties, distended abdomen, vomiting.

All children were admitted on the first or second day after injury, depending on the distance from the referring hospital to our centre. On admission the severity of the wound was examined by a burn surgeon, who took into account the appearance of the wound, capillary refill, and the sensory functions of injured areas, and these were recorded in detail on a Lund & Browder chart and entered into the registry. We treated a child with deep burns with porcine xenografts as biological dressings that were monitored frequently (two or three times a week) for up to two weeks, during which time the burn wound was examined and patients requiring surgical excision and skin grafts were operated on. The group of patients with clear superficial burns were covered with silicon dressings and they were examined twice weekly. The burn surgeon was responsible for the management of the wound, and a paediatrician took care of the general condition and nutritional state of each child. There was a specialised team of physiotherapists who were responsible for rehabilitation and physiotherapy, and follow up of the scar.

Blood for CRP (reference range <10 mg/L), PCT (reference range <0.5 μg/L), and WCC (upper reference value 16×10^9/L at <3 years, 15×10^9/L at 3–5 years of age, and 13×10^9/L at 6–16 years of age) was taken at regular intervals during the patient's time in the Burn Centre and all recordings from the day of injury until day 14 were recorded. Each patient's maximum values during days 0–2, 3–7, and 8–14 were used for the figures and unadjusted calculations while daily values were used for the multivariable regression for panel data.

The study was approved by the Regional Ethics Review Board. (No. 2013\341-31)

2.1. *Statistics*

Data are presented as median (10th–90th centiles), unless otherwise stated. The significance of the differences between timely variables was assessed using the Friedman ANOVA and the Wilcoxon matched pairs' post hoc test. Differences between two groups was analysed using the Mann–Whitney U, and the chi square, tests. Multivariable regression for panel data was used to analyse daily values of the inflammatory markers after start of treatment adjusted for TBSA%, age, and sex, and grouped by antibiotic treatment. Data were analysed with the help of STATA (STATA v12.0, Stata Corp. LP College Station, TX, USA). Probabilities of less than 0.05 were accepted as significant.

3. Results

We studied 216 children, of whom 127 were boys, mean (95% CI) age was 2.2 (1.9–2.6) years, mean (95% CI) duration of wound healing was 19 (18–21) days, and 48 required operation. The subgroup of children who were treated with antibiotics had bigger and deeper burns, longer time in hospital, longer healing time (Table 1), and higher maximum values of CRP and of WCC (Table 2). The treatment was started on median (10th–90th centiles) day 2 (1–5) after injury.

CRP concentration was initially raised in the study group. During the days 0–2 it was 33 (0–121) mg/L, rising to 39 (0–176) mg/L during the rest of the first week, which differed significantly from the lower value of 11 (0–75) mg/L during the second week (post hoc $p=0.004$ and $p<0.001$, respectively)

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